



**EAL CONSULT BUILDING SUSTAINABILITY SINCE 2008**

# **ENERGY & SUSTAINABILITY ASSESSMENT**

## **29 BEECH HILL**

### **PROPERTY ADDRESS**

29 Beech Hill  
Hadley Wood  
Enfield  
EN4 0JN

### **DATE**

September 2023

### **PREPARED BY**

EAL Consult

# CONTENTS

1. EXECUTIVE SUMMARY .....	3
2. METHODOLOGY .....	4
3. PLANNING POLICY CONTEXT.....	5
4. ENERGY STRATEGY.....	8
a. Baseline Model.....	8
b. Be 'Lean' – Demand Reduction.....	9
c. Be 'Clean' – Supply Energy Efficiently.....	10
d. Be 'Green' – Renewable Energy.....	12
e. Be 'Seen' – Monitoring Performance.....	13
5. SUSTAINABILITY STRATEGY.....	15
a. Sustainable Design .....	15
b. Overheating Strategy .....	15
c. Water Efficiency .....	16
d. Pollution: Light, Air and Noise.....	16
e. Waste Management .....	17
f. Flood Risk .....	17
g. Sustainable Procurement.....	17
h. Biodiversity and Green Infrastructure .....	17
6. CONCLUSION.....	18
7. APPENDIX.....	19

# 1. EXECUTIVE SUMMARY

## Site description

This Energy and Sustainability Assessment has been prepared to support the planning application for the creation of two new build semi-detached houses in Hadley Wood, Enfield.

## Strategy

The strategy highlights how the proposed development will promote sustainability through both design and operation and responds to the UK Planning and regulatory framework, National Planning Policy Framework 2021, the London Plan 2021 and Enfield Local planning policy, summarising how the relevant targets will be addressed and achieved.

## Energy Hierarchy

In accordance with the Energy Hierarchy detailed within The London Plan 2021, 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 **34.43%** 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 **48.2%** 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 **82.62%**

## Overheating

- Minimising adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.

## 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
- 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

## 2.METHODOLOGY

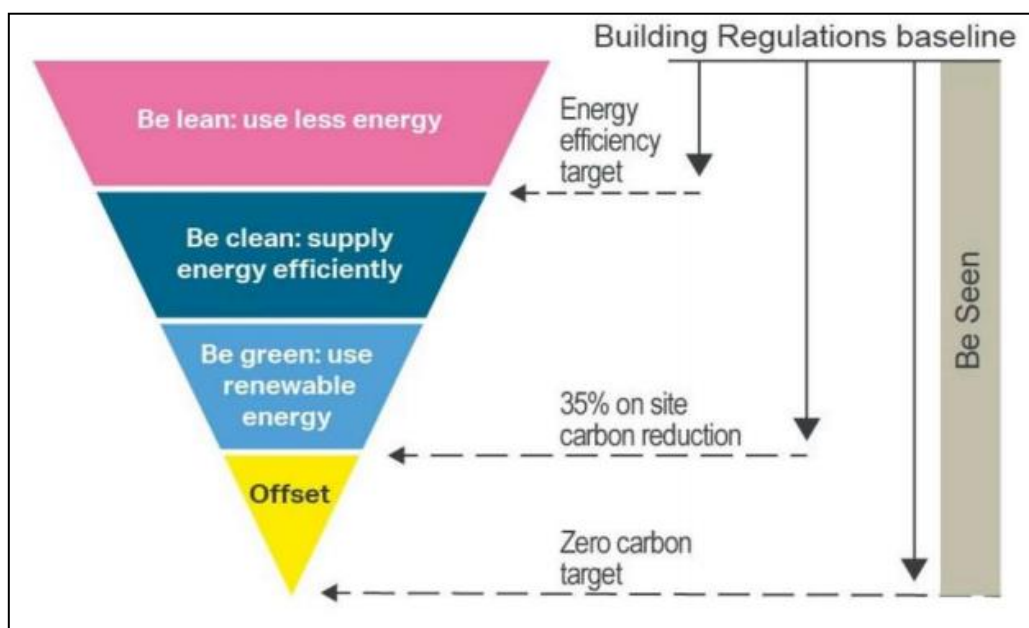
This energy assessment outlines the energy demand from the development together with the associated CO<sub>2</sub> emissions, using Building Regulations Part L 2021

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 CO<sub>2</sub> 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 has been used to determine the CO<sub>2</sub> emissions and energy requirements. It compares CO<sub>2</sub> 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) 2021

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.

### The London Plan 2021

#### Policy SI 2 Minimising Greenhouse Gas Emissions:

- A. Major development should be net zero-carbon. Proposals should make the fullest contribution to reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy: i) Be lean: use less energy and manage demand during operation, ii) Be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly, iii) Be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site, iiiii) Be seen: monitor, verify and report on energy performance
- B. Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.
- C. A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either: i) through a cash in lieu contribution to the borough's carbon offset fund, or i) off-site provided that an alternative proposal is identified, and delivery is certain.
- D. Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.

**Policy 5.3 Sustainable Design and Construction**

Major development proposals should meet minimum standards outlines in the supplementary guidance Sustainable Design and Construction SPG (2014), to consider the following principles:

- a. Minimising carbon dioxide emissions across the site, including the building and services (such as heating and cooling systems)
- b. Avoiding internal overheating and contributing to the urban heat island effect
- c. Efficient use of natural resources (including water), including making the most of natural systems both within and around buildings
- d. Minimising pollution (including noise, air and urban runoff)
- e. Minimising the generation of waste and maximising reuse or recycling
- f. Avoiding impacts from natural hazards (including flooding)
- g. Ensuring developments are comfortable and secure for users, including avoiding the creation of adverse local climatic conditions
- h. Securing sustainable procurement of materials, using local supplies where feasible, and
- i. Promoting and protecting biodiversity and green infrastructure.

**Enfield Draft Local Plan 2021****DRAFT STRATEGIC POLICY SP SE1 Responding to the climate emergency**

The Council will work with partners to:

1. use all planning tools available to meet the 2040 net zero carbon borough commitments set out in the Climate Action Plan1;
2. encourage innovative approaches to tackling climate change, reducing air pollution, managing flood risk and promoting sustainable infrastructure;
3. require high-quality and verifiable low energy development which maximises on-site renewable energy generation;
4. prioritise heat decarbonisation, with no new gas connections, ensuring all heating and hot water to be provided through low carbon sources;
5. ensure where appropriate development supports the expansion and decarbonisation of the Borough's heat network;
6. ensure development is designed for resilience in a changing climate, supporting future adaptability and mitigate the risk of overheating (including through considering the orientation of buildings and using trees for shading);
7. reduce flood risk (including through the use of Sustainable Drainage Systems), improve wastewater infrastructure in line with the Council's Infrastructure Delivery Plan;
8. require developments to embed design and operation that is aligned with sustainable waste management in operation, the minimisation of waste and the uplift of recycling targets; and
9. embed circular economy approach to building design and construction to reduce waste, support reuse and minimise embodied carbon, prioritising retrofit first.

**DRAFT POLICY DM SE2 Sustainable design and construction**

1. All development, including new developments, change of use, conversions and refurbishments, will be required to submit a sustainable design and construction statement. The statement should set out how sustainable design principles have been integrated into a design-led approach, including the consideration of the construction and operational phases of development. The statement should be proportionate to the nature and scale of development proposed with a sufficient level of detail to demonstrate that the relevant policy requirements have been satisfied.

**DRAFT POLICY DM SE4 Reducing energy demand**

- All developments (resulting in the creation of one or more dwellings or 500 sq.m. or more non-residential gross internal area (GIA), including new build, change of use, conversions and major refurbishments) should deliver a high level of energy efficiency, in alignment with 'Be Lean' stage of the energy hierarchy and demonstrate a space heating demand, to meet the targets set out in Table 4.2:

**Table 4.2: Space heating demand targets**

	<b>1st January 2023 (or Local Plan Adopted)</b>	<b>1st January 2025</b>	<b>1st January 2030</b>
All developments	30 kWh/m <sup>2</sup> /yr	20 kWh/m <sup>2</sup> /yr	15 kWh/m <sup>2</sup> /yr

- All developments (resulting in the creation of one or more dwellings or 500sqm or more non-residential GIA, including new build, change of use, conversions and major refurbishments) should meet the targets out set in Table 4.3:

**Table 4.3: Operational energy use targets**

	<b>1st January 2023 (or Local Plan Adopted)</b>	<b>1st January 2025</b>	<b>1st January 2030</b>
Domestic buildings	105 kWh/m <sup>2</sup> /yr	70 kWh/m <sup>2</sup> /yr	35 kWh/m <sup>2</sup> /yr
Non-domestic buildings	170 kWh/m <sup>2</sup> /yr	110 kWh/m <sup>2</sup> /yr	55 kWh/m <sup>2</sup> /yr

**DRAFT POLICY DM SE5 Greenhouse gas emissions and low carbon energy supply**

- All developments (resulting in the creation of one or more dwellings or 500sqm or more non-residential GIA, including new build, change of use, conversions and major refurbishments) are required to:
  - Provide an energy statement demonstrating how emissions savings have been maximised on site at each stage of the energy hierarchy.
  - Achieve carbon reduction, as far as possible on-site meeting minimum reductions as set out in the table below, or London Plan/subsequent national policy, whichever is higher

**Table 4.4: On-site carbon reduction targets**

	<b>Minimum on-site total reduction in CO2</b>	<b>Residual emissions carbon offset fund contribution</b>
Major residential development of ten or more dwellings (including new build, change of use, conversions and major refurbishments)	Net-zero with minimum 45% on-site reduction	Tiered offset
Minor new build residential development of one or more dwellings	45% minimum on-site reduction with	£1,500 flat fee per dwelling
Minor residential change of use and conversions resulting in the creation of one or more dwellings	35% minimum on-site reduction	£1,000 flat fee per dwelling
Non-residential development of 500sqm GIA or more (including new build, change of use and major refurbishments)	Net-zero with minimum 45% on-site reduction	Tiered offset

- All new developments (resulting in the creation of one or more dwellings or 500sqm or more non-residential GIA) are required to install low carbon heating and hot water, there should be no on-site combustion of fossil fuel. New developments should not be connected to the gas grid, except for in exceptional circumstances

## 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 carbon emissions and savings per unit.

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

	Regulated Carbon dioxide emissions (Tonnes CO <sub>2</sub> per annum)
<b>Baseline: Part L 2021 of the Building Regulations Compliant Development</b>	0.83
<b>After Energy Demand Reduction (Be Lean)</b>	0.54
<b>After Heat Network Connection (Be Clean)</b>	0.00
<b>After Renewables (Be Green)</b>	0.43

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

	Regulated Carbon dioxide savings	
	Tonnes CO <sub>2</sub> per annum	%
<b>Be Lean: Savings from Energy Demand Reduction</b>	0.29	34.43
<b>Be Clean: Savings from Heat Network</b>	0	0
<b>Be Green: Savings from Renewable Energy</b>	0.40	48.02
<b>Cumulative savings</b>	0.69	82.62

### a. Baseline Model

In accordance with London Plan Policy SI 2, 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 CO<sub>2</sub> emissions from the development.

The baseline model used for this project assumed that any heating and hot water supply would be provided by gas boilers 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

In accordance with London Plan Policy SI 2 the development must achieve at least a 10% improvement in energy efficiency on Building Regulations Part L 2021 baseline scenario.

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 **34.43%** reduction in annual regulated CO<sub>2</sub> 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 4. Energy Efficient Design Specification**

Element	Building Regulations 2021 Standard	Specification
Wall	0.18 W/m <sup>2</sup> k	0.12W/m <sup>2</sup> k
Ground Floor	0.13W/ m <sup>2</sup> k	0.14W/m <sup>2</sup> k
Roof	0.13 W/ m <sup>2</sup> k	0.11 W/ m <sup>2</sup> k
Glazing	1.4 W/ m <sup>2</sup> k	1.3 W/ m <sup>2</sup> k

**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

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

### c. Be 'Clean' - Supply Energy Efficiently

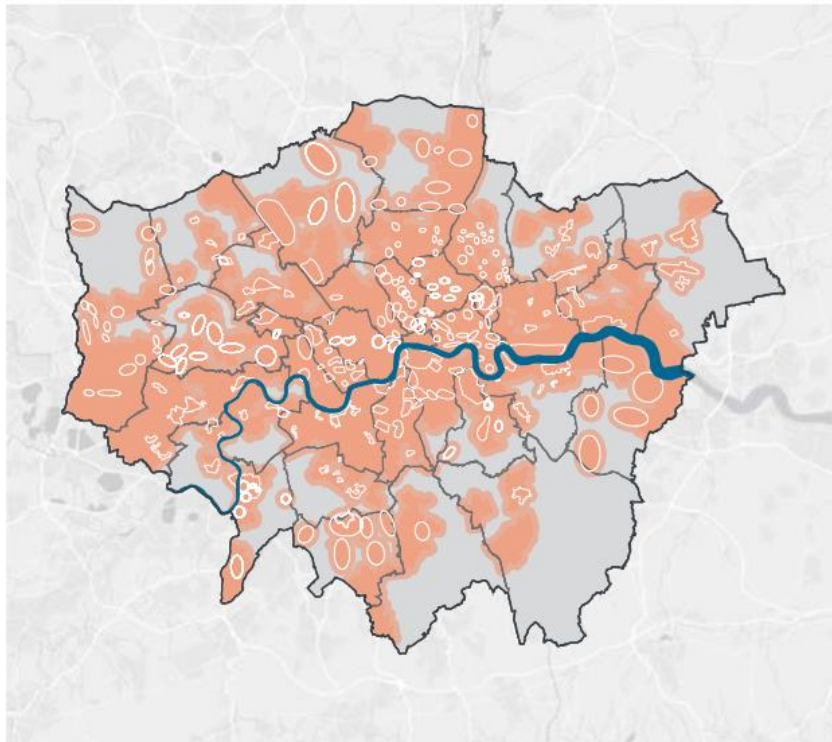
The Be Clean step of the energy hierarchy refers to the use of 'Clean energy supply'. This includes, but is not limited to, the use of Combined Heat and Power (CHP) and District Heat Networks. Policy SI 3 seeks for new development to promote the use of CHP and district heating.

#### Policy SI 1 Improving Air Quality

- A. Development Plans, through relevant strategic, site-specific and area-based policies, should seek opportunities to identify and deliver further improvements to air quality and should not reduce air quality benefits that result from the Mayor's or boroughs' activities to improve air quality.
- B. To tackle poor air quality, protect health and meet legal obligations the following criteria should be addressed:
  - 1. Development proposals should not:
    - a. lead to further deterioration of existing poor air quality
    - b. create any new areas that exceed air quality limits, or delay the date at which compliance will be achieved in areas that are currently in exceedance of legal limits
    - c. create unacceptable risk of high levels of exposure to poor air quality.
  - 2. In order to meet the requirements in Part 1, as a minimum:
    - a. development proposals must be at least Air Quality Neutral
    - b. development proposals should use design solutions to prevent or minimise increased exposure to existing air pollution and make provision to address local problems of air quality in preference to post-design or retro-fitted mitigation measures
    - c. development proposals in Air Quality Focus Areas or that are likely to be used by large numbers of people particularly vulnerable to poor air quality, such as children or older people should demonstrate that design measures have been used to minimise exposure.
- E. Development proposals should ensure that where emissions need to be reduced to meet the requirements of Air Quality Neutral or to make the impact of development on local air quality acceptable, this is done on-site. Where it can be demonstrated that emissions cannot be further reduced by on-site measures, off-site measures to improve local air quality may be acceptable, provided that equivalent air quality benefits can be demonstrated within the area affected by the development.

#### Policy SI 3 Energy Infrastructure

- A. Boroughs and developers should engage at an early stage with relevant energy companies and bodies to establish the future energy and infrastructure requirements arising from large-scale development proposals such as Opportunity Areas, Town Centres, other growth areas or clusters of significant new development.
- C. Development Plans should:
  - 1. identify the need for, and suitable sites for, any necessary energy infrastructure requirements including energy centres, energy storage and upgrades to existing infrastructure
  - 2. identify existing heating and cooling networks, identify proposed locations for future heating and cooling networks and identify opportunities for expanding and inter-connecting existing networks as well as establishing new networks.

**Figure 2: Heat Network Priority Areas****Heat Network Priority Areas**

- Heat Network Priority Areas
- Local Authority Heat Network Studies

Source: GLA  
Environment

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### **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 as identified in the London Plan.

### **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.

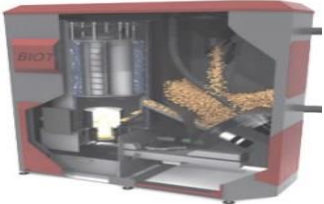

### **Site-wide communal system/network and design for district network connection**



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 5. Renewable Technologies Feasibility Table**

Technology	Pros	Cons
<p><b>Biomass Heating</b> A biomass system designed for wood pellets, which have a high-energy content, would fuel this development.</p> 	<ul style="list-style-type: none"> <li>• Less volume of storage</li> <li>• Less maintenance and produce considerably less ash residue</li> </ul>	<ul style="list-style-type: none"> <li>• Nox Emissions which may impacts</li> <li>• High Costs</li> <li>• Not suitable for the project</li> </ul>
<p><b>Ground Source Heat Pump</b> 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</p> 	<ul style="list-style-type: none"> <li>• Use all through the year</li> </ul>	<ul style="list-style-type: none"> <li>• High Costs</li> <li>• Not suitable for this project</li> </ul>
<p><b>Air Source Heat Pump</b> 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</p>	<ul style="list-style-type: none"> <li>• Can generate less CO<sub>2</sub> than conventional heating systems.</li> <li>• Cheaper</li> <li>• Provides heating and hot water</li> <li>• Less maintenance</li> <li>• Can be used as air-conditioning in the summer</li> </ul>	<ul style="list-style-type: none"> <li>• Needs electricity</li> <li>• Can be noisy</li> </ul>
<p><b>Wind Turbines</b> 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.</p>	<ul style="list-style-type: none"> <li>• Cheaper</li> <li>• Less CO<sub>2</sub></li> </ul>	<ul style="list-style-type: none"> <li>• Local wind speeds in the area is likely to be below the level generally required</li> </ul>

			<p>for investment in large wind turbines.</p> <ul style="list-style-type: none"> <li>• Noise and signal interference.</li> <li>• Detrimental aesthetic impact</li> </ul>
<p><b>Solar Photovoltaic Panels (PV)</b> 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.</p> 		<ul style="list-style-type: none"> <li>• Cheaper</li> <li>• Less CO<sub>2</sub></li> <li>• No input power in order to generate electricity.</li> </ul>	

**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 air source heat pump and solar photovoltaic panels is to be incorporated in the design because it achieves a CO<sub>2</sub> percentage reduction of **48.2%** contributing to an overall reduction of **82.62%** in carbon emissions.

**Table 6. Photovoltaic Panels**

System size	Degree	Orientation
2 kWp	30	South facing

**e. Be ‘Seen’ - Monitoring Performance**

In accordance with London Plan Policy Guidance ‘Be Seen’ Energy Monitoring 1.2, the following is suggested:

1.2.1 To truly achieve net zero-carbon buildings we need to have a better understanding of their actual operational energy performance. Although Part L calculations and Energy Performance Certificates (EPCs) give an indication of the theoretical performance of buildings, it is well established that there is a ‘performance gap’ between design theory and measured reality.

1.2.2 To address this gap the London Plan Policy SI 2 ‘Minimising greenhouse gas emissions’ introduces a fourth stage to the energy hierarchy; the ‘be seen’ stage, which requires monitoring and reporting of the actual operational energy performance of major developments for at least five years via the Mayor’s ‘be seen’ monitoring portal.

1.2.3 The ‘be seen’ policy establishes post-construction monitoring as good practice, enabling developers and building owners to better understand their buildings and identify methods for improving energy performance from the project inception stage and throughout the building’s lifetime.

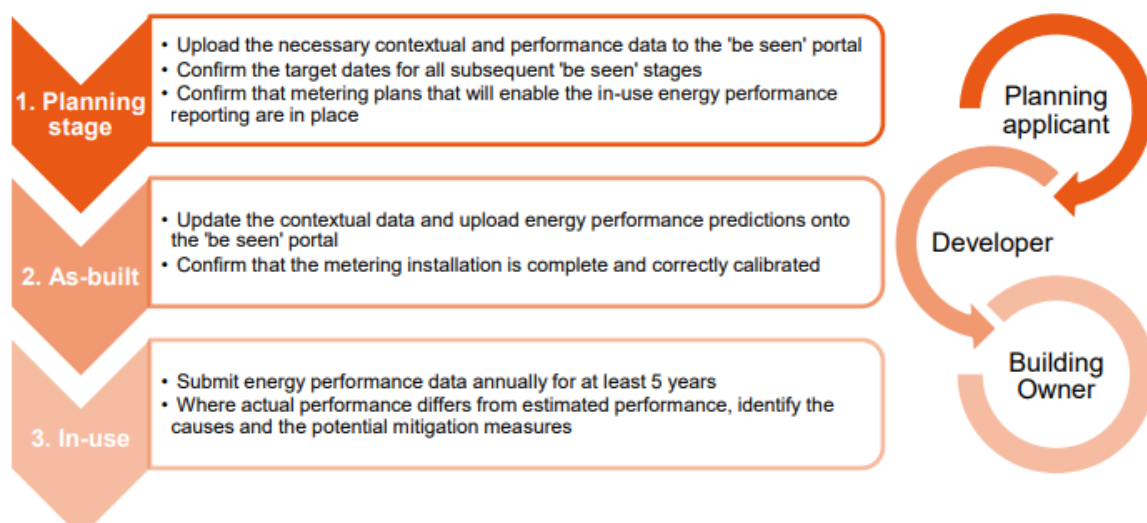
1.2.4 Ensuring that the actual energy and carbon performance of buildings is aligned with the estimated energy and carbon performance will also be a key factor in achieving a zero-carbon London.

1.2.5 The energy performance data that will be collected will provide an evidence base which could help inform future industry-wide benchmarks or performance ratings for major building typologies based on in-use performance

1.2.6 An effectively implemented post-construction monitoring regime can have a number of benefits including environmental (for example, carbon emissions reduction) and socio-economic (for example, reduced occupants’ bills, raised awareness around energy usage).

Figure 3 outlines the ‘be seen’ process through the reporting stages of a development

**Figure 3: ‘Be seen’ process and responsibilities**



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. The GLA spreadsheet informs the planning stage energy performance data including carbon offset. 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

London Plan Policy 5.3 Sustainable Design and Construction and Sustainable Design and Construction SPG (2014) to consider the following principles:

- a. Minimising carbon dioxide emissions across the site, including the building and services (such as heating and cooling systems)
- b. Avoiding internal overheating and contributing to the urban heat island effect
- c. Efficient use of natural resources (including water), including making the most of natural systems both within and around buildings
- d. Minimising pollution (including noise, air and urban runoff)
- e. Minimising the generation of waste and maximising reuse or recycling
- f. Avoiding impacts from natural hazards (including flooding)
- g. Ensuring developments are comfortable and secure for users, including avoiding the creation of adverse local climatic conditions
- h. Securing sustainable procurement of materials, using local supplies where feasible, and
- i. Promoting and protecting biodiversity and green infrastructure.

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 2021.

#### 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

#### Policy SI 4 Managing Heat Risk

- A. 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, reduced cold bridging and light coloured materials.

#### 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.

## 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 7. 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
		<b>104.99</b>

## 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 have been 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 would have been 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 were considered;
- Reusable packing solutions with key product manufacturers will be explored at the earliest opportunity. Solutions may include lets, bulk bags, steel stillages and returnable cable drums;

### Operational Waste

A space for reuse and recycling has been included for the residents exclusive use.

## f. Flood Risk

### 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 should 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 will incorporate measures to support and enhance the environment through consideration of the existing site, including measures to mitigate the impact of the development and enhance site biodiversity.

## 6. CONCLUSION

The development has been designed to exceed Part L building regulations requirements. In line with the national and local policies, regulated CO<sub>2</sub> emissions from the development will be reduced by **52.27%** from the notional emissions once energy efficiency measures and lean measures are taken into account.

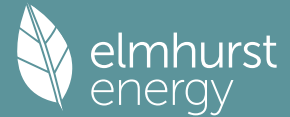
In order to achieve the required carbon emissions reduction, the report concludes and proposes the use of energy efficient measures outlined in the section 4 of this report.

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

### I. SAP Calculations

# Full SAP Calculation Printout



Property Reference	Poli		Issued on Date	18/09/2023	
Assessment Reference	Heatpump Baseline	Prop Type Ref			
Property	29 BEECH HILL, POLI, EN4 0JN				
SAP Rating	84 B	DER	3.05	TER	9.79
Environmental	97 A	% DER < TER			68.85
CO <sub>2</sub> Emissions (t/year)	0.74	DFEE	64.63	TFEE	46.49
Compliance Check	See BREL	% DFEE < TFEE			-39.02
% DPER < TPER	39.08	DPER	31.61	TPER	51.88
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 <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	113.3400 (1b)	x 2.9400 (2b)	= 333.2196 (1b) -
First floor	93.2700 (1c)	x 2.9500 (2c)	= 275.1465 (1c) -
Second floor	65.0900 (1d)	x 2.8600 (2d)	= 186.1574 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	271.7000		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 794.5235 (5)

## 2. Ventilation rate

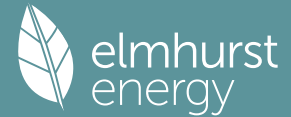
	m <sup>3</sup> per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	5 * 10 = 50.0000 (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) =	50.0000 / (5) = 0.0629 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.2129 (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) = 0.2129 (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	0.2715	0.2662	0.2608	0.2342	0.2289	0.2023	0.2023	0.1970	0.2129	0.2289	0.2395	0.2502 (22b)
Effective ac	0.5369	0.5354	0.5340	0.5274	0.5262	0.5205	0.5205	0.5194	0.5227	0.5262	0.5287	0.5313 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
FRONT (Uw = 1.60)			9.0200	1.5038	13.5639		(27)
SIDE (Uw = 2.20)			4.3200	2.0221	8.7353		(27)
REAR (Uw = 2.20)			6.0300	2.0221	12.1930		(27)
FRONT			2.8300	1.6000	4.5280		(26)
SIDE			12.4900	1.6000	19.9840		(26a)
REAR			18.8100	1.6000	30.0960		(26a)

# Full SAP Calculation Printout



SIDE			2.4800	1.5038	3.7293								(27a)
FLAT ROOF			3.5000	1.5038	5.2632								(27a)
UNDERGROUND			113.3400	0.2200	24.9348	110.0000	12467.4000						(28a)
EXTERNAL	191.7500	53.5000	138.2500	0.1800	24.8850	70.0000	9677.5000						(29a)
ROOF WALL	17.3200		17.3200	0.1500	2.5980	70.0000	1212.4000						(29a)
FLAT ROOF @GF	8.2100		8.2100	0.1600	1.3136	9.0000	73.8900						(30)
FLAT ROOF @SF	38.2100	3.5000	34.7100	0.1600	5.5536	9.0000	312.3900						(30)
PITCHED ROOF RU	37.0400		37.0400	0.1600	5.9264	9.0000	333.3600						(30)
PITCHED RAFTER	26.8800	2.4800	24.4000	0.1600	3.9040	9.0000	219.6000						(30)
Total net area of external elements Aum(A, m2)			432.7500										(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	167.2081								(33)
PARTY WALL			117.4600	0.0000	0.0000	180.0000	21142.8000						(32)
INTERNAL FLOOR @FF			93.2700			18.0000	1678.8600						(32d)
INTERNAL FLOOR @SF			65.0900			18.0000	1171.6200						(32d)
INTERNAL CEILING @GF			93.2700			9.0000	839.4300						(32e)
INTERNAL CEILING @FF			65.0900			9.0000	585.8100						(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 49715.0600 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 182.9778 (35)  
 Thermal bridges (Default value 0.200 \* total exposed area) 86.5500 (36)  
 Point Thermal bridges 0.0000 (36a) =  
 Total fabric heat loss (33) + (36) + (36a) = 253.7581 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(38)
Heat transfer coeff	140.7588	140.3836	140.0159	138.2884	137.9652	136.4607	136.4607	136.1821	137.0402	137.9652	138.6191	139.3026	(38)
Average = Sum(39)m / 12 =	394.5169	394.1417	393.7740	392.0465	391.7233	390.2188	390.2188	389.9402	390.7983	391.7233	392.3772	393.0607	(39)
													(39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(40)
HLP (average)	1.4520	1.4507	1.4493	1.4429	1.4417	1.4362	1.4362	1.4352	1.4383	1.4417	1.4442	1.4467	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	(40)

#### 4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0951 (42)

Hot water usage for mixer showers														(42a)
	76.1152	74.9713	73.3045	70.1153	67.7618	65.1371	63.6453	65.2995	67.1128	69.9309	73.1886	75.8236	(42a)	
Hot water usage for baths														(42b)
	32.8553	32.3673	31.6802	30.4132	29.4646	28.4126	27.8444	28.5267	29.2697	30.3953	31.6883	32.7442	(42b)	
Hot water usage for other uses														(42c)
	46.3273	44.6427	42.9581	41.2734	39.5888	37.9042	37.9042	39.5888	41.2734	42.9581	44.6427	46.3273	(42c)	
Average daily hot water use (litres/day)														(43)
														(43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(44)
	155.2978	151.9814	147.9428	141.8020	136.8152	131.4539	129.3939	133.4151	137.6560	143.2843	149.5196	154.8951	(44)
Energy conte	245.9537	216.4194	227.3825	194.1198	184.1795	161.6380	156.4907	165.1957	169.7436	194.4354	213.0181	242.5283	(45)
Energy content (annual)													(45)
													(45)
Distribution loss (46)m = 0.15 x (45)m													(46)
	36.8931	32.4629	34.1074	29.1180	27.6269	24.2457	23.4736	24.7794	25.4615	29.1653	31.9527	36.3792	(46)

Water storage loss:  
 Store volume 210.0000 (47)  
 a) If manufacturer declared loss factor is known (kWh/day):  
 Temperature factor from Table 2b 2.1000 (48)  
 Enter (49) or (54) in (55) 0.5400 (49)  
 Total storage loss 1.1340 (55)

Primary 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)
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													(62)
	304.3701	269.1826	285.7989	250.6518	242.5959	218.1700	214.9071	223.6121	226.2756	252.8518	269.5501	300.9447	(62)
WVHRS	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	304.3701	269.1826	285.7989	250.6518	242.5959	218.1700	214.9071	223.6121	226.2756	252.8518	269.5501	300.9447	(64)
													(64)

12Total per year (kWh/year) Total per year (kWh/year) = Sum(64)m = 3058.9107 (64)  
 Electric shower(s) 3059 (64)  

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
													(64a)

 Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)  
 Heat gains from water heating, kWh/month 127.3738 (65)  

	128.5127	114.1700	122.3378	109.7704	107.9728	98.9702	98.7663	101.6607	101.6653	111.3829	116.0541	127.3738	(65)
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#### 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5  

	254.4872	281.7536	254.4872	262.9701	254.4872	262.9701	254.4872	254.4872	262.9701	254.4872	262.9701	254.4872	(67)
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 Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

# Full SAP Calculation Printout



Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	434.9226	439.4358	428.0628	403.8511	373.2882	344.5634	325.3735	320.8604	332.2333	356.4450	387.0079	415.7327 (68)
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)	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056 (71)
Water heating gains (Table 5)	172.7322	169.8959	164.4325	152.4590	145.1247	137.4586	132.7504	136.6407	141.2019	149.7082	161.1863	171.2013 (72)
Total internal gains	931.5691	960.5124	916.4096	888.7073	842.3272	814.4192	782.0381	781.4153	805.8323	830.0674	880.5913	910.8483 (73)

## 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
South	9.0200	46.7521	0.5700	0.8000	0.7700	133.2617 (78)
East	4.3200	19.6403	0.5700	0.8000	0.7700	26.8120 (76)
North	6.0300	10.6334	0.5700	0.8000	0.7700	20.2622 (74)
East	2.4800	26.6072	0.5700	0.8000	1.0000	27.0806 (82)
North	3.5000	26.0000	0.5700	0.8000	1.0000	37.3464 (82)

Solar gains	244.7630	441.7352	662.6800	906.3120	1083.9075	1103.9065	1052.8766	917.7202	747.4709	504.6620	297.8733	206.3223 (83)
Total gains	1176.3320	1402.2476	1579.0896	1795.0193	1926.2347	1918.3257	1834.9147	1699.1355	1553.3032	1334.7294	1178.4647	1117.1706 (84)

## 7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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)												
tau	35.0042	35.0375	35.0702	35.2247	35.2538	35.3897	35.3897	35.4150	35.3373	35.2538	35.1951	35.1339
alpha	3.3336	3.3358	3.3380	3.3483	3.3503	3.3593	3.3593	3.3610	3.3558	3.3503	3.3463	3.3423
util living area	0.9974	0.9949	0.9901	0.9756	0.9406	0.8601	0.7444	0.7911	0.9268	0.9839	0.9953	0.9978 (86)
Living	18.4658	18.6826	19.0585	19.5968	20.1411	20.6021	20.8351	20.7889	20.4100	19.7052	18.9931	18.4284
Non living	16.7737	17.0517	17.5329	18.2201	18.8988	19.4380	19.6597	19.6276	19.2341	18.3632	17.4532	16.7282
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	19.7036	18.6826	19.0585	19.5968	20.1411	20.6021	20.8351	20.7889	20.4100	19.7052	18.9931	18.7881 (87)
Th 2	19.7237	19.7247	19.7257	19.7306	19.7315	19.7357	19.7357	19.7365	19.7341	19.7315	19.7296	19.7277 (88)
util rest of house	0.9966	0.9935	0.9870	0.9669	0.9150	0.7872	0.5981	0.6594	0.8831	0.9766	0.9938	0.9972 (89)
MIT 2	18.5476	17.0517	17.5329	18.2201	18.8988	19.4380	19.6597	19.6276	19.2341	18.3632	17.4532	17.2687 (90)
Living area fraction									fLA = Living area / (4) =			0.2939 (91)
MIT	18.8874	17.5311	17.9813	18.6247	19.2639	19.7802	20.0052	19.9689	19.5797	18.7576	17.9058	17.7153 (92)
Temperature adjustment												0.0000
adjusted MIT	18.8874	17.5311	17.9813	18.6247	19.2639	19.7802	20.0052	19.9689	19.5797	18.7576	17.9058	17.7153 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9960	0.9895	0.9804	0.9558	0.9023	0.7903	0.6347	0.6887	0.8758	0.9680	0.9900	0.9957 (94)
Useful gains	1171.6212	1387.4790	1548.0837	1715.7656	1738.0757	1516.1309	1164.6254	1170.1729	1360.4560	1292.0570	1166.6929	1112.3531 (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	5754.9714	4978.4310	4521.0454	3812.5445	2962.9612	2021.3925	1328.7762	1391.6602	2141.4754	3195.5372	4239.9546	5312.3324 (97)
Space heating kWh	3410.0126	2413.1198	2211.8835	1509.6808	911.3148	0.0000	0.0000	0.0000	0.0000	1416.1893	2212.7485	3124.7846 (98a)
Space heating requirement - total per year (kWh/year)												17209.7337
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	3410.0126	2413.1198	2211.8835	1509.6808	911.3148	0.0000	0.0000	0.0000	0.0000	1416.1893	2212.7485	3124.7846 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												17209.7337
Space heating per m <sup>2</sup>										(98c) / (4) =		63.3409 (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 %)												466.4147 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement												

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3410.0126	2413.1198	2211.8835	1509.6808	911.3148	0.0000	0.0000	0.0000	0.0000	1416.1893	2212.7485	3124.7846	(98)
Space heating efficiency (main heating system 1)												
466.4147	466.4147	466.4147	466.4147	466.4147	0.0000	0.0000	0.0000	0.0000	466.4147	466.4147	466.4147	(210)
Space heating fuel (main heating system)												
731.1117	517.3764	474.2310	323.6778	195.3872	0.0000	0.0000	0.0000	0.0000	303.6330	474.4165	669.9584	(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												
304.3701	269.1826	285.7989	250.6518	242.5959	218.1700	214.9071	223.6121	226.2756	252.8518	269.5501	300.9447	(64)
Efficiency of water heater (217)m												
307.9819	307.9819	307.9819	307.9819	307.9819	307.9819	307.9819	307.9819	307.9819	307.9819	307.9819	307.9819	(216)
Fuel for water heating, kWh/month												
98.8273	87.4021	92.7973	81.3853	78.7695	70.8386	69.7791	72.6056	73.4704	82.0996	87.5214	97.7151	(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												
103.5120	83.0412	74.7694	54.7793	42.3131	34.5702	38.5994	50.1730	65.1697	85.5062	96.5791	106.3890	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year												
Space heating fuel - main system 1											3689.7920	(211)
Space heating fuel - main system 2											0.0000	(213)
Space heating fuel - secondary											0.0000	(215)
Efficiency of water heater											307.9819	
Water heating fuel used											993.2113	(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)											835.4015	(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											5518.4048	(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	3689.7920	0.1541	568.7200 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	993.2113	0.1409	139.9770 (264)
Space and water heating			708.6970 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	835.4015	0.1443	120.5743 (268)
Total CO2, kg/year			829.2713 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.0500 (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	3689.7920	1.5706	5795.2018 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	993.2113	1.5211	1510.7972 (278)
Space and water heating			7305.9989 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	835.4015	1.5338	1281.3667 (282)
Total Primary energy kWh/year			8587.3657 (286)
Dwelling Primary energy Rate (DPER)			31.6100 (287)

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	113.3400 (1b)	x 2.9400 (2b)	= 333.2196 (1b) -
First floor	93.2700 (1c)	x 2.9500 (2c)	= 275.1465 (1c) -
Second floor	65.0900 (1d)	x 2.8600 (2d)	= 186.1574 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	271.7000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 794.5235 (5)

## 2. Ventilation rate

		m <sup>3</sup> 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) =	0.0503 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.3003	(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) =	0.3003 (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	0.3829	0.3754	0.3679	0.3304	0.3229	0.2853	0.2853	0.2778	0.3003	0.3229	0.3379	0.3529 (22b)
Effective ac	0.5733	0.5705	0.5677	0.5546	0.5521	0.5407	0.5407	0.5386	0.5451	0.5521	0.5571	0.5623 (25)

## 3. Heat losses and heat loss parameter

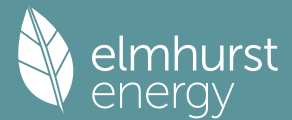
Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
TER Opaque door			2.8300	1.0000	2.8300		(26)
TER Semi-glazed door			31.3000	1.0000	31.3000		(26a)
TER Opening Type (Uw = 1.20)			19.3700	1.1450	22.1794		(27)
SIDE			2.4800	2.0221	5.0147		(27a)
FLAT ROOF			3.5000	2.0221	7.0772		(27a)
UNDERGROUND			113.3400	0.1300	14.7342		(28a)
EXTERNAL	191.7500	53.5000	138.2500	0.1800	24.8850		(29a)
ROOF WALL	17.3200		17.3200	0.1800	3.1176		(29a)
FLAT ROOF @GF	8.2100		8.2100	0.1100	0.9031		(30)
FLAT ROOF @SF	38.2100	3.5000	34.7100	0.1100	3.8181		(30)
PITCHED ROOF RU	37.0400		37.0400	0.1100	4.0744		(30)
PITCHED RAFTER	26.8800	2.4800	24.4000	0.1100	2.6840		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			432.7500				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	122.6177		(33)
PARTY WALL			117.4600	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							182.9778 (35)
Thermal bridges (User defined value 0.050 * total exposed area)							21.6375 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	144.2552 (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	150.3207	149.5742	148.8425	145.4056	144.7626	141.7692	141.7692	141.2148	142.9222	144.7626	146.0634	147.4234 (38)
Heat transfer coeff	294.5759	293.8294	293.0977	289.6608	289.0178	286.0244	286.0244	285.4700	287.1774	289.0178	290.3186	291.6786 (39)
Average = Sum(39)m / 12 =												289.6577



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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0842	1.0814	1.0788	1.0661	1.0637	1.0527	1.0527	1.0507	1.0570	1.0637	1.0685	1.0735 (40)
HLP (average)												1.0661
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.0951 (42)
Hot water usage for mixer showers	76.1152	74.9713	73.3045	70.1153	67.7618	65.1371	63.6453	65.2995	67.1128	69.9309	73.1886	75.8236 (42a)
Hot water usage for baths	32.8553	32.3673	31.6802	30.4132	29.4646	28.4126	27.8444	28.5267	29.2697	30.3953	31.6883	32.7442 (42b)
Hot water usage for other uses	46.3273	44.6427	42.9581	41.2734	39.5888	37.9042	37.9042	39.5888	41.2734	42.9581	44.6427	46.3273 (42c)
Average daily hot water use (litres/day)												142.7534 (43)
Daily hot water use	155.2978	151.9814	147.9428	141.8020	136.8152	131.4539	129.3939	133.4151	137.6560	143.2843	149.5196	154.8951 (44)
Energy content (annual)	245.9537	216.4194	227.3825	194.1198	184.1795	161.6380	156.4907	165.1957	169.7436	194.4354	213.0181	242.5283 (45)
Distribution loss (46)m = 0.15 x (45)m	36.8931	32.4629	34.1074	29.1180	27.6269	24.2457	23.4736	24.7794	25.4615	29.1653	31.9527	36.3792 (46)
Water storage loss:												210.0000 (47)
Store volume												1.7016 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.9188 (55)
Enter (49) or (54) in (55)												
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	297.7003	263.1583	279.1291	244.1972	235.9261	211.7153	208.2373	216.9423	219.8209	246.1820	263.0955	294.2749 (62)
WWHRS	-34.7967	-30.7745	-32.2253	-26.6838	-24.8683	-21.2800	-19.9466	-21.2112	-22.0171	-25.9558	-29.4047	-34.1523 (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	262.9036	232.3838	246.9038	217.5134	211.0577	190.4353	188.2907	195.7311	197.8038	220.2262	233.6907	260.1226 (64)
12Total per year (kWh/year)												2657.0628 (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	123.1769	109.3505	117.0020	104.6067	102.6370	93.8065	93.4304	96.3249	96.5016	106.0470	110.8904	122.0379 (65)

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

Metabolic gains (Table 5), Watts	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	254.4872	281.7536	254.4872	262.9701	254.4872	262.9701	254.4872	254.4872	262.9701	254.4872	262.9701	254.4872 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	434.9226	439.4358	428.0628	403.8511	373.2882	344.5634	325.3735	320.8604	332.2333	356.4450	387.0079	415.7327 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757 (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)	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056 (71)
Water heating gains (Table 5)	165.5603	162.7240	157.2607	145.2871	137.9529	130.2868	125.5785	129.4689	134.0300	142.5363	154.0144	164.0295 (72)
Total internal gains	927.3972	956.3405	912.2378	884.5354	838.1554	807.2474	774.8663	774.2435	798.6605	825.8956	876.4195	906.6764 (73)

## 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data or Table 6b	g	Specific FF or Table 6c	Access factor Table 6d	Gains W					
North	6.0300	10.6334	0.6300	0.7000	0.7700	19.5957 (74)						
East	4.3200	19.6403	0.6300	0.7000	0.7700	25.9300 (76)						
South	9.0200	46.7521	0.6300	0.7000	0.7700	128.8781 (78)						
North	3.5000	26.0000	0.6300	0.7000	1.0000	36.1179 (82)						
East	2.4800	26.6072	0.6300	0.7000	1.0000	26.1898 (82)						
Solar gains	236.7116	427.2045	640.8813	876.4991	1048.2526	1067.5937	1018.2425	887.5320	722.8830	488.0613	288.0749	199.5354 (83)

# Full SAP Calculation Printout



Total gains 1164.1088 1383.5450 1553.1191 1761.0345 1886.4080 1874.8411 1793.1088 1661.7755 1521.5435 1313.9569 1164.4943 1106.2118 (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	46.8801	46.9992	47.1165	47.6756	47.7816	48.2817	48.2817	48.3754	48.0878	47.7816	47.5675	47.3457	
alpha	4.1253	4.1333	4.1411	4.1784	4.1854	4.2188	4.2188	4.2250	4.2059	4.1854	4.1712	4.1564	
util living area	0.9980	0.9956	0.9901	0.9711	0.9194	0.7986	0.6461	0.7036	0.8977	0.9821	0.9960	0.9984	(86)
MIT	19.0897	19.2942	19.6194	20.0837	20.5129	20.8293	20.9488	20.9262	20.6850	20.1238	19.5327	19.0655	(87)
Th 2	20.0138	20.0160	20.0182	20.0286	20.0306	20.0396	20.0396	20.0413	20.0361	20.0306	20.0266	20.0225	(88)
util rest of house	0.9975	0.9944	0.9873	0.9621	0.8914	0.7265	0.5281	0.5902	0.8509	0.9750	0.9948	0.9980	(89)
MIT 2	17.7516	18.0148	18.4318	19.0267	19.5545	19.9123	20.0154	20.0027	19.7669	19.0837	18.3279	17.7263	(90)
Living area fraction									flA = Living area / (4) =				0.2939 (91)
MIT	18.1449	18.3909	18.7809	19.3374	19.8362	20.1818	20.2897	20.2742	20.0367	19.3894	18.6820	18.1199	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1449	18.3909	18.7809	19.3374	19.8362	20.1818	20.2897	20.2742	20.0367	19.3894	18.6820	18.1199	(93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9959	0.9916	0.9823	0.9535	0.8845	0.7385	0.5609	0.6203	0.8509	0.9684	0.9921	0.9967	(94)
Useful gains	1159.3825	1371.8764	1525.5706	1679.1882	1668.6130	1384.5961	1005.8405	1030.7872	1294.6714	1272.4165	1155.3238	1102.5885	(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	4078.3780	3964.0182	3599.5030	3023.3081	2351.5176	1596.5424	1055.3528	1105.9609	1704.8994	2540.2947	3362.4780	4060.1467	(97)
Space heating kWh	2171.7327	1741.9193	1543.0058	967.7663	508.0810	0.0000	0.0000	0.0000	0.0000	943.3013	1589.1510	2200.4233	(98a)
Space heating requirement - total per year (kWh/year)												11665.3807	
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	2171.7327	1741.9193	1543.0058	967.7663	508.0810	0.0000	0.0000	0.0000	0.0000	943.3013	1589.1510	2200.4233	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												11665.3807	
Space heating per m2												(98c) / (4) =	42.9348 (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	2171.7327	1741.9193	1543.0058	967.7663	508.0810	0.0000	0.0000	0.0000	0.0000	943.3013	1589.1510	2200.4233	(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)	2352.9065	1887.2365	1671.7289	1048.5009	550.4670	0.0000	0.0000	0.0000	0.0000	1021.9950	1721.7238	2383.9906	(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	262.9036	232.3838	246.9038	217.5134	211.0577	190.4353	188.2907	195.7311	197.8038	220.2262	233.6907	260.1226	(64)
Efficiency of water heater (217)m	87.7315	87.6366	87.4397	86.9994	85.9549	79.8000	79.8000	79.8000	79.8000	86.9440	87.5344	87.7537	(216)
Fuel for water heating, kWh/month	299.6683	265.1674	282.3705	250.0172	245.5448	238.6407	235.9532	245.2771	247.8744	253.2966	266.9703	296.4234	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	52.8774	42.4202	38.1947	27.9831	21.6149	17.6596	19.7179	25.6300	33.2909	43.6794	49.3358	54.3470	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-95.6861	-129.8704	-179.6136	-193.8151	-202.0694	-185.8452	-183.2679	-176.2285	-163.0453	-144.3563	-103.2802	-83.3037	(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	-70.2660	-145.6642	-285.8047	-424.1180	-556.1009	-557.3628	-551.0493	-468.8779	-346.5976	-206.8477	-93.2917	-55.7508	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													

# Full SAP Calculation Printout



(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)
(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)
(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												12638.5490	(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												3127.2039	(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)												426.7509	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-5602.1135	(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												10676.3904	(238)

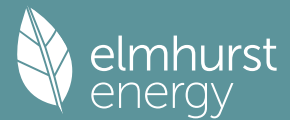
## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	12638.5490	0.2100	2654.0953	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3127.2039	0.2100	656.7128	(264)
Space and water heating			3310.8081	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	426.7509	0.1443	61.5933	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1840.3818	0.1355	-249.3253	
PV Unit electricity exported	-3761.7317	0.1262	-474.8938	
Total			-724.2191	(269)
Total CO2, kg/year			2660.1117	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.7900	(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	12638.5490	1.1300	14281.5604	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3127.2039	1.1300	3533.7404	(278)
Space and water heating			17815.3008	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	426.7509	1.5338	654.5648	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1840.3818	1.5007	-2761.9370	
PV Unit electricity exported	-3761.7317	0.4634	-1743.2414	
Total			-4505.1784	(283)
Total Primary energy kWh/year			14094.7880	(286)
Target Primary Energy Rate (TPER)			51.8800	(287)

# Full SAP Calculation Printout



Property Reference	Tony		Issued on Date	18/09/2023	
Assessment Reference	Heatpump Baseline	Prop Type Ref			
Property	29 BEECH HILL, TONY, EN4 0JN				
SAP Rating	84 B	DER	3.02	TER	9.79
Environmental	97 A	% DER < TER			69.15
CO <sub>2</sub> Emissions (t/year)	0.74	DFEE	64.63	TFEE	46.49
Compliance Check	See BREL	% DFEE < TFEE			-39.02
% DPER < TPER	39.74	DPER	31.26	TPER	51.88
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 <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	113.3400 (1b)	x 2.9400 (2b)	= 333.2196 (1b) -
First floor	93.2700 (1c)	x 2.9500 (2c)	= 275.1465 (1c) -
Second floor	65.0900 (1d)	x 2.8600 (2d)	= 186.1574 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	271.7000		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 794.5235 (5)

## 2. Ventilation rate

	m <sup>3</sup> 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	5 * 10 = 50.0000 (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) =	50.0000 / (5) = 0.0629 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.2129 (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) = 0.2129 (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	0.2715	0.2662	0.2608	0.2342	0.2289	0.2023	0.2023	0.1970	0.2129	0.2289	0.2395	0.2502 (22b)
Effective ac	0.5369	0.5354	0.5340	0.5274	0.5262	0.5205	0.5205	0.5194	0.5227	0.5262	0.5287	0.5313 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
FRONT (Uw = 1.60)			9.0200	1.5038	13.5639		(27)
SIDE (Uw = 1.60)			4.3200	1.5038	6.4962		(27)
REAR (Uw = 1.60)			6.0300	1.5038	9.0677		(27)
FRONT			2.8300	1.6000	4.5280		(26)
SIDE			12.4900	1.6000	19.9840		(26a)
REAR			18.8100	1.6000	30.0960		(26a)

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SIDE			2.4800	1.5038	3.7293								(27a)
FLAT ROOF			3.5000	1.5038	5.2632								(27a)
UNDERGROUND			113.3400	0.2200	24.9348	110.0000	12467.4000						(28a)
EXTERNAL	191.7500	53.5000	138.2500	0.1800	24.8850	70.0000	9677.5000						(29a)
ROOF WALL	17.3200		17.3200	0.1500	2.5980	70.0000	1212.4000						(29a)
FLAT ROOF @GF	8.2100		8.2100	0.1600	1.3136	9.0000	73.8900						(30)
FLAT ROOF @SF	38.2100	3.5000	34.7100	0.1600	5.5536	9.0000	312.3900						(30)
PITCHED ROOF RU	37.0400		37.0400	0.1600	5.9264	9.0000	333.3600						(30)
PITCHED RAFTER	26.8800	2.4800	24.4000	0.1600	3.9040	9.0000	219.6000						(30)
Total net area of external elements Aum(A, m2)			432.7500										(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		161.8437								(33)
PARTY WALL			117.4600	0.0000	0.0000	180.0000	21142.8000						(32)
INTERNAL FLOOR @FF			93.2700			18.0000	1678.8600						(32d)
INTERNAL FLOOR @SF			65.0900			18.0000	1171.6200						(32d)
INTERNAL CEILING @GF			93.2700			9.0000	839.4300						(32e)
INTERNAL CEILING @FF			65.0900			9.0000	585.8100						(32e)

Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	49715.0600						(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							182.9778						(35)
Thermal bridges (Default value 0.200 * total exposed area)							86.5500						(36)
Point Thermal bridges							0.0000						(36a) =
Total fabric heat loss						(33) + (36) + (36a) =	248.3937						(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(38)
Heat transfer coeff	140.7588	140.3836	140.0159	138.2884	137.9652	136.4607	136.4607	136.1821	137.0402	137.9652	138.6191	139.3026	(38)
Average = Sum(39)m / 12 =	389.1525	388.7773	388.4096	386.6821	386.3589	384.8544	384.8544	384.5758	385.4339	386.3589	387.0128	387.6963	(39)
													386.6806
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(40)
HLP (average)	1.4323	1.4309	1.4296	1.4232	1.4220	1.4165	1.4165	1.4154	1.4186	1.4220	1.4244	1.4269	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	(40)

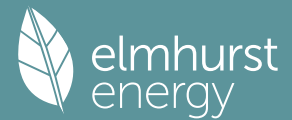
#### 4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.0951	(42)
Hot water usage for mixer showers													75.8236	(42a)
Hot water usage for baths													32.7442	(42b)
Hot water usage for other uses													46.3273	(42c)
Average daily hot water use (litres/day)													142.7534	(43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(44)	
Energy cont	155.2978	151.9814	147.9428	141.8020	136.8152	131.4539	129.3939	133.4151	137.6560	143.2843	149.5196	154.8951	(44)	
Energy content (annual)	245.9537	216.4194	227.3825	194.1198	184.1795	161.6380	156.4907	165.1957	169.7436	194.4354	213.0181	242.5283	(45)	
Distribution loss (46)m = 0.15 x (45)m													2371.1047	(45)
Water storage loss:													36.3792	(46)
Store volume													210.0000	(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	(56)
If cylinder contains dedicated solar storage													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	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	0.0000	(61)
Total heat required for water heating calculated for each month														
WVHRS	304.3701	269.1826	285.7989	250.6518	242.5959	218.1700	214.9071	223.6121	226.2756	252.8518	269.5501	300.9447	300.9447	(62)
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	0.0000	(63a)
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	0.0000	(63b)
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	0.0000	(63c)
Output from w/h	304.3701	269.1826	285.7989	250.6518	242.5959	218.1700	214.9071	223.6121	226.2756	252.8518	269.5501	300.9447	300.9447	(64)
12Total per year (kWh/year)													3058.9107	(64)
Electric shower(s)													3059	(64)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													0.0000	(64a)
Heat gains from water heating, kWh/month														
	128.5127	114.1700	122.3378	109.7704	107.9728	98.9702	98.7663	101.6607	101.6653	111.3829	116.0541	127.3738	127.3738	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	(66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	254.4872	281.7536	254.4872	262.9701	254.4872	262.9701	254.4872	254.4872	262.9701	254.4872	262.9701	254.4872	(67)

# Full SAP Calculation Printout



Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	434.9226	439.4358	428.0628	403.8511	373.2882	344.5634	325.3735	320.8604	332.2333	356.4450	387.0079	415.7327 (68)
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)	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056 (71)
Water heating gains (Table 5)	172.7322	169.8959	164.4325	152.4590	145.1247	137.4586	132.7504	136.6407	141.2019	149.7082	161.1863	171.2013 (72)
Total internal gains	931.5691	960.5124	916.4096	888.7073	842.3272	814.4192	782.0381	781.4153	805.8323	830.0674	880.5913	910.8483 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
South	9.0200	46.7521	0.5700	0.8000	0.7700	133.2617 (78)
West	4.3200	19.6403	0.5700	0.8000	0.7700	26.8120 (80)
North	6.0300	10.6334	0.5700	0.8000	0.7700	20.2622 (74)
West	2.4800	26.6072	0.5700	0.8000	1.0000	27.0806 (82)
North	3.5000	26.0000	0.5700	0.8000	1.0000	37.3464 (82)

Solar gains	244.7630	441.7352	662.6800	906.3120	1083.9075	1103.9065	1052.8766	917.7202	747.4709	504.6620	297.8733	206.3223 (83)
Total gains	1176.3320	1402.2476	1579.0896	1795.0193	1926.2347	1918.3257	1834.9147	1699.1355	1553.3032	1334.7294	1178.4647	1117.1706 (84)

## 7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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)												
tau	35.4867	35.5209	35.5546	35.7134	35.7433	35.8830	35.8830	35.9090	35.8291	35.7433	35.6829	35.6200
alpha	3.3658	3.3681	3.3703	3.3809	3.3829	3.3922	3.3922	3.3939	3.3886	3.3829	3.3789	3.3747
util living area	0.9974	0.9950	0.9901	0.9755	0.9398	0.8579	0.7404	0.7877	0.9257	0.9838	0.9954	0.9978 (86)
Living	18.4971	18.7133	19.0867	19.6212	20.1602	20.6145	20.8421	20.7969	20.4242	19.7259	19.0196	18.4598
Non living	16.8224	17.0998	17.5779	18.2600	18.9317	19.4622	19.6779	19.6466	19.2607	18.3984	17.4959	16.7771
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	19.7196	18.7133	19.0867	19.6212	20.1602	20.6145	20.8421	20.7969	20.4242	19.7259	19.0196	18.8151 (87)
Th 2	19.7387	19.7397	19.7407	19.7456	19.7465	19.7507	19.7507	19.7515	19.7491	19.7465	19.7447	19.7427 (88)
util rest of house	0.9967	0.9935	0.9870	0.9667	0.9141	0.7848	0.5952	0.6566	0.8819	0.9766	0.9938	0.9972 (89)
MIT 2	18.5761	17.0998	17.5779	18.2600	18.9317	19.4622	19.6779	19.6466	19.2607	18.3984	17.4959	17.3115 (90)
Living area fraction									fLA = Living area / (4) =			0.2939 (91)
MIT	18.9122	17.5740	18.0213	18.6601	19.2928	19.8009	20.0201	19.9847	19.6027	18.7886	17.9438	17.7535 (92)
Temperature adjustment												0.0000
adjusted MIT	18.9122	17.5740	18.0213	18.6601	19.2928	19.8009	20.0201	19.9847	19.6027	18.7886	17.9438	17.7535 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9961	0.9896	0.9805	0.9558	0.9017	0.7884	0.6317	0.6861	0.8750	0.9681	0.9901	0.9958 (94)
Useful gains	1171.6858	1387.6284	1548.2349	1715.6516	1736.8731	1512.4964	1159.1723	1165.7130	1359.1246	1292.1224	1166.8209	1112.4325 (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	5686.3688	4927.3689	4475.0011	3774.0578	2933.5520	2001.5940	1316.2278	1378.5969	2120.9167	3163.7328	4196.6739	5254.6352 (97)
Space heating kWh	3358.9241	2378.7056	2177.5140	1482.0525	890.3291	0.0000	0.0000	0.0000	0.0000	1392.4781	2181.4942	3081.7988 (98a)
Space heating requirement - total per year (kWh/year)												16943.2965
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	3358.9241	2378.7056	2177.5140	1482.0525	890.3291	0.0000	0.0000	0.0000	0.0000	1392.4781	2181.4942	3081.7988 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												16943.2965
Space heating per m2										(98c) / (4) =		62.3603 (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 %)												466.7314 (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												

# Full SAP Calculation Printout



3358.9241	2378.7056	2177.5140	1482.0525	890.3291	0.0000	0.0000	0.0000	0.0000	1392.4781	2181.4942	3081.7988	(98)
Space heating efficiency (main heating system 1)												
466.7314	466.7314	466.7314	466.7314	466.7314	0.0000	0.0000	0.0000	0.0000	466.7314	466.7314	466.7314	(210)
Space heating fuel (main heating system)												
719.6696	509.6519	466.5454	317.5386	190.7583	0.0000	0.0000	0.0000	0.0000	298.3468	467.3982	660.2939	(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												
304.3701	269.1826	285.7989	250.6518	242.5959	218.1700	214.9071	223.6121	226.2756	252.8518	269.5501	300.9447	(64)
Efficiency of water heater (217)m												
308.0402	308.0402	308.0402	308.0402	308.0402	308.0402	308.0402	308.0402	308.0402	308.0402	308.0402	308.0402	(216)
Fuel for water heating, kWh/month												
98.8086	87.3856	92.7798	81.3699	78.7546	70.8252	69.7659	72.5919	73.4565	82.0840	87.5049	97.6966	(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												
103.5120	83.0412	74.7694	54.7793	42.3131	34.5702	38.5994	50.1730	65.1697	85.5062	96.5791	106.3890	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year												
Space heating fuel - main system 1											3630.2028	(211)
Space heating fuel - main system 2											0.0000	(213)
Space heating fuel - secondary											0.0000	(215)
Efficiency of water heater											308.0402	
Water heating fuel used											993.0234	(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)											835.4015	(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											5458.6277	(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	3630.2028	0.1542	559.6002 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	993.0234	0.1409	139.9505 (264)
Space and water heating			699.5508 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	835.4015	0.1443	120.5743 (268)
Total CO2, kg/year			820.1250 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.0200 (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	3630.2028	1.5707	5701.8526 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	993.0234	1.5211	1510.5114 (278)
Space and water heating			7212.3640 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	835.4015	1.5338	1281.3667 (282)
Total Primary energy kWh/year			8493.7307 (286)
Dwelling Primary energy Rate (DPER)			31.2600 (287)

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	113.3400 (1b)	x 2.9400 (2b)	= 333.2196 (1b)
First floor	93.2700 (1c)	x 2.9500 (2c)	= 275.1465 (1c)
Second floor	65.0900 (1d)	x 2.8600 (2d)	= 186.1574 (1d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	271.7000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 794.5235 (5)

## 2. Ventilation rate

		m <sup>3</sup> 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) =	0.0503 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.3003	(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) =	0.3003 (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	0.3829	0.3754	0.3679	0.3304	0.3229	0.2853	0.2853	0.2778	0.3003	0.3229	0.3379	0.3529 (22b)
Effective ac	0.5733	0.5705	0.5677	0.5546	0.5521	0.5407	0.5407	0.5386	0.5451	0.5521	0.5571	0.5623 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
TER Opaque door			2.8300	1.0000	2.8300		(26)
TER Semi-glazed door			31.3000	1.0000	31.3000		(26a)
TER Opening Type (Uw = 1.20)			19.3700	1.1450	22.1794		(27)
SIDE			2.4800	2.0221	5.0147		(27a)
FLAT ROOF			3.5000	2.0221	7.0772		(27a)
UNDERGROUND			113.3400	0.1300	14.7342		(28a)
EXTERNAL	191.7500	53.5000	138.2500	0.1800	24.8850		(29a)
ROOF WALL	17.3200		17.3200	0.1800	3.1176		(29a)
FLAT ROOF @GF	8.2100		8.2100	0.1100	0.9031		(30)
FLAT ROOF @SF	38.2100	3.5000	34.7100	0.1100	3.8181		(30)
PITCHED ROOF RU	37.0400		37.0400	0.1100	4.0744		(30)
PITCHED RAFTER	26.8800	2.4800	24.4000	0.1100	2.6840		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			432.7500				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	122.6177		(33)
PARTY WALL			117.4600	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K		182.9778 (35)
Thermal bridges (User defined value 0.050 * total exposed area)		21.6375 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	144.2552 (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	150.3207	149.5742	148.8425	145.4056	144.7626	141.7692	141.7692	141.2148	142.9222	144.7626	146.0634	147.4234 (38)
Heat transfer coeff	294.5759	293.8294	293.0977	289.6608	289.0178	286.0244	286.0244	285.4700	287.1774	289.0178	290.3186	291.6786 (39)
Average = Sum(39)m / 12 =												289.6577



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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0842	1.0814	1.0788	1.0661	1.0637	1.0527	1.0527	1.0507	1.0570	1.0637	1.0685	1.0735 (40)
HLP (average)												1.0661
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.0951 (42)
Hot water usage for mixer showers	76.1152	74.9713	73.3045	70.1153	67.7618	65.1371	63.6453	65.2995	67.1128	69.9309	73.1886	75.8236 (42a)
Hot water usage for baths	32.8553	32.3673	31.6802	30.4132	29.4646	28.4126	27.8444	28.5267	29.2697	30.3953	31.6883	32.7442 (42b)
Hot water usage for other uses	46.3273	44.6427	42.9581	41.2734	39.5888	37.9042	37.9042	39.5888	41.2734	42.9581	44.6427	46.3273 (42c)
Average daily hot water use (litres/day)												142.7534 (43)
Daily hot water use	155.2978	151.9814	147.9428	141.8020	136.8152	131.4539	129.3939	133.4151	137.6560	143.2843	149.5196	154.8951 (44)
Energy content (annual)	245.9537	216.4194	227.3825	194.1198	184.1795	161.6380	156.4907	165.1957	169.7436	194.4354	213.0181	242.5283 (45)
Distribution loss (46)m = 0.15 x (45)m	36.8931	32.4629	34.1074	29.1180	27.6269	24.2457	23.4736	24.7794	25.4615	29.1653	31.9527	36.3792 (46)
Water storage loss:												210.0000 (47)
Store volume												1.7016 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.9188 (55)
Enter (49) or (54) in (55)												
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	297.7003	263.1583	279.1291	244.1972	235.9261	211.7153	208.2373	216.9423	219.8209	246.1820	263.0955	294.2749 (62)
WWHRS	-34.7967	-30.7745	-32.2253	-26.6838	-24.8683	-21.2800	-19.9466	-21.2112	-22.0171	-25.9558	-29.4047	-34.1523 (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	262.9036	232.3838	246.9038	217.5134	211.0577	190.4353	188.2907	195.7311	197.8038	220.2262	233.6907	260.1226 (64)
12Total per year (kWh/year)												2657.0628 (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	123.1769	109.3505	117.0020	104.6067	102.6370	93.8065	93.4304	96.3249	96.5016	106.0470	110.8904	122.0379 (65)

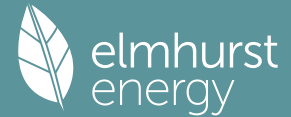
## 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	254.4872	281.7536	254.4872	262.9701	254.4872	262.9701	254.4872	254.4872	262.9701	254.4872	262.9701	254.4872 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	434.9226	439.4358	428.0628	403.8511	373.2882	344.5634	325.3735	320.8604	332.2333	356.4450	387.0079	415.7327 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757 (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)	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056 (71)
Water heating gains (Table 5)	165.5603	162.7240	157.2607	145.2871	137.9529	130.2868	125.5785	129.4689	134.0300	142.5363	154.0144	164.0295 (72)
Total internal gains	927.3972	956.3405	912.2378	884.5354	838.1554	807.2474	774.8663	774.2435	798.6605	825.8956	876.4195	906.6764 (73)

## 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
North	6.0300	10.6334	0.6300	0.7000	0.7700	19.5957 (74)						
South	9.0200	46.7521	0.6300	0.7000	0.7700	128.8781 (78)						
West	4.3200	19.6403	0.6300	0.7000	0.7700	25.9300 (80)						
North	3.5000	26.0000	0.6300	0.7000	1.0000	36.1179 (82)						
West	2.4800	26.6072	0.6300	0.7000	1.0000	26.1898 (82)						
Solar gains	236.7116	427.2045	640.8813	876.4991	1048.2526	1067.5937	1018.2425	887.5320	722.8830	488.0613	288.0749	199.5354 (83)

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Total gains 1164.1088 1383.5450 1553.1191 1761.0345 1886.4080 1874.8411 1793.1088 1661.7755 1521.5435 1313.9569 1164.4943 1106.2118 (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	46.8801	46.9992	47.1165	47.6756	47.7816	48.2817	48.2817	48.3754	48.0878	47.7816	47.5675	47.3457	
alpha	4.1253	4.1333	4.1411	4.1784	4.1854	4.2188	4.2188	4.2250	4.2059	4.1854	4.1712	4.1564	
util living area	0.9980	0.9956	0.9901	0.9711	0.9194	0.7986	0.6461	0.7036	0.8977	0.9821	0.9960	0.9984	(86)
MIT	19.0897	19.2942	19.6194	20.0837	20.5129	20.8293	20.9488	20.9262	20.6850	20.1238	19.5327	19.0655	(87)
Th 2	20.0138	20.0160	20.0182	20.0286	20.0306	20.0396	20.0396	20.0413	20.0361	20.0306	20.0266	20.0225	(88)
util rest of house	0.9975	0.9944	0.9873	0.9621	0.8914	0.7265	0.5281	0.5902	0.8509	0.9750	0.9948	0.9980	(89)
MIT 2	17.7516	18.0148	18.4318	19.0267	19.5545	19.9123	20.0154	20.0027	19.7669	19.0837	18.3279	17.7263	(90)
Living area fraction									flA = Living area / (4) =				0.2939 (91)
MIT	18.1449	18.3909	18.7809	19.3374	19.8362	20.1818	20.2897	20.2742	20.0367	19.3894	18.6820	18.1199	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1449	18.3909	18.7809	19.3374	19.8362	20.1818	20.2897	20.2742	20.0367	19.3894	18.6820	18.1199	(93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9959	0.9916	0.9823	0.9535	0.8845	0.7385	0.5609	0.6203	0.8509	0.9684	0.9921	0.9967	(94)
Useful gains	1159.3825	1371.8764	1525.5706	1679.1882	1668.6130	1384.5961	1005.8405	1030.7872	1294.6714	1272.4165	1155.3238	1102.5885	(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	4078.3780	3964.0182	3599.5030	3023.3081	2351.5176	1596.5424	1055.3528	1105.9609	1704.8994	2540.2947	3362.4780	4060.1467	(97)
Space heating kWh	2171.7327	1741.9193	1543.0058	967.7663	508.0810	0.0000	0.0000	0.0000	0.0000	943.3013	1589.1510	2200.4233	(98a)
Space heating requirement - total per year (kWh/year)												11665.3807	
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	2171.7327	1741.9193	1543.0058	967.7663	508.0810	0.0000	0.0000	0.0000	0.0000	943.3013	1589.1510	2200.4233	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												11665.3807	
Space heating per m2										(98c) / (4) =		42.9348	(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	2171.7327	1741.9193	1543.0058	967.7663	508.0810	0.0000	0.0000	0.0000	0.0000	943.3013	1589.1510	2200.4233	(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)	2352.9065	1887.2365	1671.7289	1048.5009	550.4670	0.0000	0.0000	0.0000	0.0000	1021.9950	1721.7238	2383.9906	(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	262.9036	232.3838	246.9038	217.5134	211.0577	190.4353	188.2907	195.7311	197.8038	220.2262	233.6907	260.1226	(64)
Efficiency of water heater	87.7315	87.6366	87.4397	86.9994	85.9549	79.8000	79.8000	79.8000	79.8000	86.9440	87.5344	87.7537	(216)
Fuel for water heating, kWh/month	299.6683	265.1674	282.3705	250.0172	245.5448	238.6407	235.9532	245.2771	247.8744	253.2966	266.9703	296.4234	(219)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
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	52.8774	42.4202	38.1947	27.9831	21.6149	17.6596	19.7179	25.6300	33.2909	43.6794	49.3358	54.3470	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	-95.6861	-129.8704	-179.6136	-193.8151	-202.0694	-185.8452	-183.2679	-176.2285	-163.0453	-144.3563	-103.2802	-83.3037	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)	-70.2660	-145.6642	-285.8047	-424.1180	-556.1009	-557.3628	-551.0493	-468.8779	-346.5976	-206.8477	-93.2917	-55.7508	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													

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(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)
(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)
(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												12638.5490	(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												3127.2039	(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)												426.7509	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-5602.1135	(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												10676.3904	(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	12638.5490	0.2100	2654.0953	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3127.2039	0.2100	656.7128	(264)
Space and water heating			3310.8081	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	426.7509	0.1443	61.5933	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1840.3818	0.1355	-249.3253	
PV Unit electricity exported	-3761.7317	0.1262	-474.8938	
Total			-724.2191	(269)
Total CO2, kg/year			2660.1117	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.7900	(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	12638.5490	1.1300	14281.5604	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3127.2039	1.1300	3533.7404	(278)
Space and water heating			17815.3008	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	426.7509	1.5338	654.5648	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1840.3818	1.5007	-2761.9370	
PV Unit electricity exported	-3761.7317	0.4634	-1743.2414	
Total			-4505.1784	(283)
Total Primary energy kWh/year			14094.7880	(286)
Target Primary Energy Rate (TPER)			51.8800	(287)

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Property Reference	Poli		Issued on Date	18/09/2023	
Assessment Reference	Heatpump Only	Prop Type Ref			
Property	29 BEECH HILL, POLI, EN4 0JN				
SAP Rating	90 B	DER	2.00	TER	8.83
Environmental	98 A	% DER < TER			77.35
CO <sub>2</sub> Emissions (t/year)	0.48	DFEE	40.15	TFEE	42.07
Compliance Check	See BREL	% DFEE < TFEE			4.55
% DPER < TPER	55.66	DPER	20.71	TPER	46.71
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 <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	113.3400 (1b)	x 2.9400 (2b)	= 333.2196 (1b) -
First floor	93.2700 (1c)	x 2.9500 (2c)	= 275.1465 (1c) -
Second floor	65.0900 (1d)	x 2.8600 (2d)	= 186.1574 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	271.7000		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 794.5235 (5)

## 2. Ventilation rate

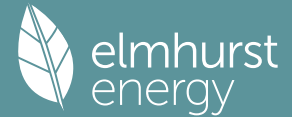
	m <sup>3</sup> per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	5 * 10 = 50.0000 (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) =	50.0000 / (5) = 0.0629 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.2129 (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) = 0.2129 (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	0.2715	0.2662	0.2608	0.2342	0.2289	0.2023	0.2023	0.1970	0.2129	0.2289	0.2395	0.2502 (22b)
Effective ac	0.5369	0.5354	0.5340	0.5274	0.5262	0.5205	0.5205	0.5194	0.5227	0.5262	0.5287	0.5313 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
FRONT (Uw = 1.30)			9.0200	1.2357	11.1464		(27)
SIDE (Uw = 2.20)			4.3200	2.0221	8.7353		(27)
REAR (Uw = 2.20)			6.0300	2.0221	12.1930		(27)
FRONT			2.8300	1.3000	3.6790		(26)
SIDE			12.4900	1.3000	16.2370		(26a)
REAR			18.8100	1.3000	24.4530		(26a)

# Full SAP Calculation Printout



SIDE			2.4800	1.2357	3.0646								(27a)
FLAT ROOF			3.5000	1.2357	4.3251								(27a)
UNDERGROUND			113.3400	0.1400	15.8676	110.0000	12467.4000						(28a)
EXTERNAL	191.7500	53.5000	138.2500	0.1200	16.5900	70.0000	9677.5000						(29a)
ROOF WALL	17.3200		17.3200	0.1100	1.9052	70.0000	1212.4000						(29a)
FLAT ROOF @GF	8.2100		8.2100	0.1100	0.9031	9.0000	73.8900						(30)
FLAT ROOF @SF	38.2100	3.5000	34.7100	0.1100	3.8181	9.0000	312.3900						(30)
PITCHED ROOF RU	37.0400		37.0400	0.1000	3.7040	9.0000	333.3600						(30)
PITCHED RAFTER	26.8800	2.4800	24.4000	0.1000	2.4400	9.0000	219.6000						(30)
Total net area of external elements Aum(A, m2)			432.7500										(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	129.0614								(33)
PARTY WALL			117.4600	0.0000	0.0000	180.0000	21142.8000						(32)
INTERNAL FLOOR @FF			93.2700			18.0000	1678.8600						(32d)
INTERNAL FLOOR @SF			65.0900			18.0000	1171.6200						(32d)
INTERNAL CEILING @GF			93.2700			9.0000	839.4300						(32e)
INTERNAL CEILING @FF			65.0900			9.0000	585.8100						(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 49715.0600 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 182.9778 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			0.0000	(36)
Point Thermal bridges			0.0000	(36a) =
Total fabric heat loss			129.0614	(33) + (36) + (36a) = (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	140.7588	140.3836	140.0159	138.2884	137.9652	136.4607	136.4607	136.1821	137.0402	137.9652	138.6191	139.3026	(38)
Average = Sum(39)m / 12 =	269.8203	269.4451	269.0773	267.3499	267.0267	265.5221	265.5221	265.2435	266.1017	267.0267	267.6805	268.3640	(39)
												267.3483	

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	0.9931	0.9917	0.9903	0.9840	0.9828	0.9773	0.9773	0.9762	0.9794	0.9828	0.9852	0.9877	(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													3.0951	(42)
Hot water usage for mixer showers														
Hot water usage for baths														
Hot water usage for other uses														
Average daily hot water use (litres/day)														142.7534
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Energy conte	155.2978	151.9814	147.9428	141.8020	136.8152	131.4539	129.3939	133.4151	137.6560	143.2843	149.5196	154.8951	(44)	
Energy content (annual)	245.9537	216.4194	227.3825	194.1198	184.1795	161.6380	156.4907	165.1957	169.7436	194.4354	213.0181	242.5283	(45)	
Distribution loss (46)m = 0.15 x (45)m														
Water storage loss:	36.8931	32.4629	34.1074	29.1180	27.6269	24.2457	23.4736	24.7794	25.4615	29.1653	31.9527	36.3792	(46)	
Store volume													210.0000	(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														
Primary 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	(57)	
Combi 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)	
Total heat required for water heating calculated for each month	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)	
WWHRS	304.3701	269.1826	285.7989	250.6518	242.5959	218.1700	214.9071	223.6121	226.2756	252.8518	269.5501	300.9447	(62)	
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	(63a)	
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	(63b)	
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	(63c)	
Output from w/h	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)	
Total per year (kWh/year) = Sum(64)m =	304.3701	269.1826	285.7989	250.6518	242.5959	218.1700	214.9071	223.6121	226.2756	252.8518	269.5501	300.9447	(64)	
Electric shower(s)													3058.9107	(64)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													3059	(64)
Heat gains from water heating, kWh/month	128.5127	114.1700	122.3378	109.7704	107.9728	98.9702	98.7663	101.6607	101.6653	111.3829	116.0541	127.3738	(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	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

# Full SAP Calculation Printout



Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	254.4872	281.7536	254.4872	262.9701	254.4872	262.9701	254.4872	254.4872	262.9701	254.4872	262.9701	254.4872	262.9701	254.4872 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	434.9226	439.4358	428.0628	403.8511	373.2882	344.5634	325.3735	320.8604	332.2333	356.4450	387.0079	415.7327	415.7327	(68)
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	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	(71)
Water heating gains (Table 5)	172.7322	169.8959	164.4325	152.4590	145.1247	137.4586	132.7504	136.6407	141.2019	149.7082	161.1863	171.2013	171.2013	(72)
Total internal gains	931.5691	960.5124	916.4096	888.7073	842.3272	814.4192	782.0381	781.4153	805.8323	830.0674	880.5913	910.8483	910.8483	(73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W
South	9.0200	46.7521	0.5700	0.5700	0.8000	0.7700	133.2617 (78)	
East	4.3200	19.6403	0.5700	0.5700	0.8000	0.7700	26.8120 (76)	
North	6.0300	10.6334	0.5700	0.5700	0.8000	0.7700	20.2622 (74)	
East	2.4800	26.6072	0.5700	0.5700	0.8000	1.0000	27.0806 (82)	
North	3.5000	26.0000	0.5700	0.5700	0.8000	1.0000	37.3464 (82)	

Solar gains	244.7630	441.7352	662.6800	906.3120	1083.9075	1103.9065	1052.8766	917.7202	747.4709	504.6620	297.8733	206.3223	206.3223	(83)
Total gains	1176.3320	1402.2476	1579.0896	1795.0193	1926.2347	1918.3257	1834.9147	1699.1355	1553.3032	1334.7294	1178.4647	1117.1706	1117.1706	(84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area, ni1,m (see Table 9a)	51.1812	51.2525	51.3226	51.6542	51.7167	52.0097	52.0097	52.0644	51.8965	51.7167	51.5904	51.4590	21.0000 (85)
tau	4.4121	4.4168	4.4215	4.4436	4.4478	4.4673	4.4673	4.4710	4.4598	4.4478	4.4394	4.4306	
util living area	0.9980	0.9954	0.9890	0.9661	0.9033	0.7644	0.6031	0.6630	0.8780	0.9797	0.9958	0.9984	(86)
Living	19.2691	19.4710	19.7837	20.2187	20.6129	20.8785	20.9678	20.9512	20.7538	20.2347	19.6743	19.2351	
Non living	18.0314	18.2906	18.6905	19.2434	19.7225	20.0132	20.0872	20.0780	19.8927	19.2698	18.5552	17.9909	
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	20.1145	19.4710	19.7837	20.2187	20.6129	20.8785	20.9678	20.9512	20.7538	20.2347	19.6743	19.4819	(87)
Th 2	20.0891	20.0903	20.0914	20.0967	20.0977	20.1023	20.1023	20.1032	20.1005	20.0977	20.0957	20.0936	(88)
util rest of house	0.9975	0.9942	0.9860	0.9560	0.8726	0.6921	0.4945	0.5559	0.8279	0.9719	0.9946	0.9980	(89)
MIT 2	19.2688	18.2906	18.6905	19.2434	19.7225	20.0132	20.0872	20.0780	19.8927	19.2698	18.5552	18.3698	(90)
Living area fraction	19.5174	18.6376	19.0118	19.5300	19.9842	20.2675	20.3461	20.3347	20.1458	19.5534	18.8841	18.6967	(92)
MIT	19.5174	18.6376	19.0118	19.5300	19.9842	20.2675	20.3461	20.3347	20.1458	19.5534	18.8841	18.6967	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5174	18.6376	19.0118	19.5300	19.9842	20.2675	20.3461	20.3347	20.1458	19.5534	18.8841	18.6967	(93)

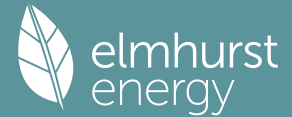
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9971	0.9914	0.9810	0.9479	0.8681	0.7067	0.5254	0.5854	0.8309	0.9655	0.9920	0.9972	(94)
Useful gains	1172.9500	1390.2149	1549.1017	1701.5183	1672.1620	1355.6164	964.0421	994.6903	1290.6150	1288.6910	1169.0897	1114.0026	(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	4105.9555	3701.5190	3366.6439	2841.9385	2212.0945	1504.8523	994.6595	1043.6430	1608.8050	2390.7979	3154.3761	3890.3920	(97)
Space heating kWh	2182.1561	1553.1963	1352.2513	821.1026	401.7097	0.0000	0.0000	0.0000	0.0000	819.9675	1429.4062	2065.6337	(98a)
Space heating requirement - total per year (kWh/year)												10625.4235	
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	2182.1561	1553.1963	1352.2513	821.1026	401.7097	0.0000	0.0000	0.0000	0.0000	819.9675	1429.4062	2065.6337	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10625.4235	
Space heating per m2										(98c) / (4) =		39.1072	(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 %)	470.7315	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2182.1561	1553.1963	1352.2513	821.1026	401.7097	0.0000	0.0000	0.0000	0.0000	819.9675	1429.4062	2065.6337	(98)
Space heating efficiency (main heating system 1)	470.7315	470.7315	470.7315	470.7315	470.7315	0.0000	0.0000	0.0000	0.0000	470.7315	470.7315	470.7315	(210)
Space heating fuel (main heating system)	463.5671	329.9538	287.2660	174.4312	85.3373	0.0000	0.0000	0.0000	0.0000	174.1901	303.6564	438.8136	(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	304.3701	269.1826	285.7989	250.6518	242.5959	218.1700	214.9071	223.6121	226.2756	252.8518	269.5501	300.9447	(64)
Efficiency of water heater (217)m	317.2758	317.2758	317.2758	317.2758	317.2758	317.2758	317.2758	317.2758	317.2758	317.2758	317.2758	317.2758	(216)
Fuel for water heating, kWh/month	95.9323	84.8418	90.0790	79.0012	76.4621	68.7635	67.7351	70.4788	71.3183	79.6946	84.9577	94.8527	(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	49.2027	39.4723	35.5404	26.0384	20.1128	16.4323	18.3476	23.8489	30.9773	40.6440	45.9073	50.5702	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1													2257.2155 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													317.2758
Water heating fuel used													964.1172 (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)													397.0942 (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													3618.4268 (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	2257.2155	0.1549	349.5825	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	964.1172	0.1409	135.8767	(264)
Space and water heating			485.4592	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	397.0942	0.1443	57.3130	(268)
Total CO2, kg/year			542.7721	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.0000	(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	2257.2155	1.5734	3551.3958	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	964.1172	1.5211	1466.5415	(278)
Space and water heating			5017.9373	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	397.0942	1.5338	609.0763	(282)
Total Primary energy kWh/year			5627.0136	(286)
Dwelling Primary energy Rate (DPER)			20.7100	(287)

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )		Storey height (m)		Volume (m <sup>3</sup> )
Ground floor	113.3400 (1b)	x	2.9400 (2b)	=	333.2196 (1b) -
First floor	93.2700 (1c)	x	2.9500 (2c)	=	275.1465 (1c) -
Second floor	65.0900 (1d)	x	2.8600 (2d)	=	186.1574 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	271.7000				(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	794.5235 (5)

## 2. Ventilation rate

		m <sup>3</sup> 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) =	0.0503 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3003 (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) =	0.3003 (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	0.3829	0.3754	0.3679	0.3304	0.3229	0.2853	0.2853	0.2778	0.3003	0.3229	0.3379	0.3529 (22b)
Effective ac	0.5733	0.5705	0.5677	0.5546	0.5521	0.5407	0.5407	0.5386	0.5451	0.5521	0.5571	0.5623 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
TER Opaque door			2.8300	1.0000	2.8300		(26)
TER Semi-glazed door			31.3000	1.0000	31.3000		(26a)
TER Opening Type (Uw = 1.20)			19.3700	1.1450	22.1794		(27)
SIDE			2.4800	2.0221	5.0147		(27a)
FLAT ROOF			3.5000	2.0221	7.0772		(27a)
UNDERGROUND			113.3400	0.1300	14.7342		(28a)
EXTERNAL	191.7500	53.5000	138.2500	0.1800	24.8850		(29a)
ROOF WALL	17.3200		17.3200	0.1800	3.1176		(29a)
FLAT ROOF @GF	8.2100		8.2100	0.1100	0.9031		(30)
FLAT ROOF @SF	38.2100	3.5000	34.7100	0.1100	3.8181		(30)
PITCHED ROOF RU	37.0400		37.0400	0.1100	4.0744		(30)
PITCHED RAFTER	26.8800	2.4800	24.4000	0.1100	2.6840		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			432.7500				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	122.6177		(33)
PARTY WALL			117.4600	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							182.9778 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)						0.0000 (36)	
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	122.6177 (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
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(38)m	150.3207	149.5742	148.8425	145.4056	144.7626	141.7692	141.7692	141.2148	142.9222	144.7626	146.0634	147.4234	(38)
Heat transfer coeff	272.9384	272.1919	271.4602	268.0233	267.3803	264.3869	264.3869	263.8325	265.5399	267.3803	268.6811	270.0411	(39)
Average = Sum(39)m / 12 =												268.0202	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0046	1.0018	0.9991	0.9865	0.9841	0.9731	0.9731	0.9710	0.9773	0.9841	0.9889	0.9939	(40)
HLP (average)												0.9865	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

#### 4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.0951	(42)
Hot water usage for mixer showers													75.8236	(42a)
Hot water usage for baths													32.7442	(42b)
Hot water usage for other uses													46.3273	(42c)
Average daily hot water use (litres/day)													142.7534	(43)
Daily hot water use														
Energy conte	155.2978	151.9814	147.9428	141.8020	136.8152	131.4539	129.3939	133.4151	137.6560	143.2843	149.5196	154.8951	(44)	
Energy content (annual)	245.9537	216.4194	227.3825	194.1198	184.1795	161.6380	156.4907	165.1957	169.7436	194.4354	213.0181	242.5283	(45)	
Distribution loss (46)m = 0.15 x (45)m													2371.1047	
Water storage loss:														
Store volume													210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):													1.7016	(48)
Temperature factor from Table 2b													0.5400	(49)
Enter (49) or (54) in (55)													0.9188	(55)
Total storage loss														
If cylinder contains dedicated solar storage														
Primary loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)	
Combi loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)	
Total heat required for water heating calculated for each month	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)	
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	(61)	
PV diverter	297.7003	263.1583	279.1291	244.1972	235.9261	211.7153	208.2373	216.9423	219.8209	246.1820	263.0955	294.2749	(62)	
Solar input	-34.7967	-30.7745	-32.2253	-26.6838	-24.8683	-21.2800	-19.9466	-21.2112	-22.0171	-25.9558	-29.4047	-34.1523	(63a)	
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	(63b)	
Output from w/h	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)	
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	(63d)	
Electric shower(s)	262.9036	232.3838	246.9038	217.5134	211.0577	190.4353	188.2907	195.7311	197.8038	220.2262	233.6907	260.1226	(64)	
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												2657.0628	(64)	
Heat gains from water heating, kWh/month													2657	(64)

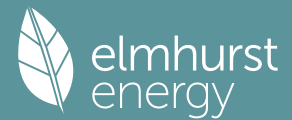
#### 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	254.4872	281.7536	254.4872	262.9701	254.4872	262.9701	254.4872	254.4872	262.9701	254.4872	262.9701	254.4872	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	434.9226	439.4358	428.0628	403.8511	373.2882	344.5634	325.3735	320.8604	332.2333	356.4450	387.0079	415.7327	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	(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)	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	(71)
Water heating gains (Table 5)	165.5603	162.7240	157.2607	145.2871	137.9529	130.2868	125.5785	129.4689	134.0300	142.5363	154.0144	164.0295	(72)
Total internal gains	927.3972	956.3405	912.2378	884.5354	838.1554	807.2474	774.8663	774.2435	798.6605	825.8956	876.4195	906.6764	(73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
North	6.0300	10.6334	0.6300	0.7000	0.7700	19.5957
East	4.3200	19.6403	0.6300	0.7000	0.7700	25.9300
South	9.0200	46.7521	0.6300	0.7000	0.7700	128.8781
North	3.5000	26.0000	0.6300	0.7000	1.0000	36.1179

# Full SAP Calculation Printout



East	2.4800	26.6072	0.6300	0.7000	1.0000	26.1898 (82)						
Solar gains	236.7116	427.2045	640.8813	876.4991	1048.2526	1067.5937	1018.2425	887.5320	722.8830	488.0613	288.0749	199.5354 (83)
Total gains	1164.1088	1383.5450	1553.1191	1761.0345	1886.4080	1874.8411	1793.1088	1661.7755	1521.5435	1313.9569	1164.4943	1106.2118 (84)
-----												
7. Mean internal temperature (heating season)												
-----												
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	50.5965	50.7353	50.8721	51.5244	51.6483	52.2331	52.2331	52.3428	52.0063	51.6483	51.3983	51.1394
alpha	4.3731	4.3824	4.3915	4.4350	4.4432	4.4822	4.4822	4.4895	4.4671	4.4432	4.4266	4.4093
util living area	0.9981	0.9956	0.9897	0.9684	0.9090	0.7733	0.6126	0.6719	0.8841	0.9808	0.9960	0.9985 (86)
MIT	19.2406	19.4423	19.7556	20.1999	20.5982	20.8736	20.9662	20.9493	20.7460	20.2232	19.6611	19.2174 (87)
Th 2	20.0795	20.0818	20.0841	20.0946	20.0966	20.1058	20.1058	20.1075	20.1023	20.0966	20.0926	20.0884 (88)
util rest of house	0.9976	0.9945	0.9869	0.9588	0.8796	0.7020	0.5036	0.5649	0.8355	0.9734	0.9948	0.9981 (89)
MIT 2	17.9885	18.2482	18.6498	19.2188	19.7053	20.0124	20.0898	20.0811	19.8864	19.2548	18.5363	17.9648 (90)
Living area fraction									fLA = Living area / (4) =			0.2939 (91)
MIT	18.3565	18.5992	18.9748	19.5071	19.9677	20.2655	20.3474	20.3363	20.1391	19.5394	18.8669	18.3330 (92)
Temperature adjustment												0.0000
adjusted MIT	18.3565	18.5992	18.9748	19.5071	19.9677	20.2655	20.3474	20.3363	20.1391	19.5394	18.8669	18.3330 (93)
-----												
8. Space heating requirement												
-----												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9962	0.9918	0.9821	0.9509	0.8746	0.7160	0.5345	0.5942	0.8379	0.9672	0.9924	0.9970 (94)
Useful gains	1159.6968	1372.2009	1525.2851	1674.5137	1649.9210	1342.3262	958.4730	987.4544	1274.8700	1270.8536	1155.6128	1102.8676 (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	3836.5625	3728.8082	3386.4100	2842.9615	2210.6263	1497.8841	990.7640	1038.5219	1603.6218	2390.2273	3161.5377	3816.4811 (97)
Space heating kWh	1991.5881	1583.6401	1384.6769	841.2824	417.1647	0.0000	0.0000	0.0000	0.0000	832.8140	1444.2659	2018.9284 (98a)
Space heating requirement - total per year (kWh/year)												10514.3606
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	1991.5881	1583.6401	1384.6769	841.2824	417.1647	0.0000	0.0000	0.0000	0.0000	832.8140	1444.2659	2018.9284 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10514.3606
Space heating per m2										(98c) / (4) =		38.6984 (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	1991.5881	1583.6401	1384.6769	841.2824	417.1647	0.0000	0.0000	0.0000	0.0000	832.8140	1444.2659	2018.9284 (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)	2157.7336	1715.7531	1500.1917	911.4653	451.9661	0.0000	0.0000	0.0000	0.0000	902.2904	1564.7518	2187.3547 (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	262.9036	232.3838	246.9038	217.5134	211.0577	190.4353	188.2907	195.7311	197.8038	220.2262	233.6907	260.1226 (64)
Efficiency of water heater (217)m	87.6473	87.5367	87.3099	86.7892	85.5582	79.8000	79.8000	79.8000	79.8000	86.7538	87.4268	79.8000 (216)
Fuel for water heating, kWh/month	299.9564	265.4702	282.7903	250.6228	246.6833	238.6407	235.9532	245.2771	247.8744	253.8520	267.2988	296.7016 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	52.8774	42.4202	38.1947	27.9831	21.6149	17.6596	19.7179	25.6300	33.2909	43.6794	49.3358	54.3470 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-95.6861	-129.8704	-179.6136	-193.8151	-202.0694	-185.8452	-183.2679	-176.2285	-163.0453	-144.3563	-103.2802	-83.3037 (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)												

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(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	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)														
(233b)m	-70.2660	-145.6642	-285.8047	-424.1180	-556.1009	-557.3628	-551.0493	-468.8779	-346.5976	-206.8477	-93.2917	-55.7508		(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													11391.5066	(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													3131.1208	(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)													426.7509	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-5602.1135	(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													9433.2649	(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	11391.5066	0.2100	2392.2164	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3131.1208	0.2100	657.5354	(264)
Space and water heating			3049.7518	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	426.7509	0.1443	61.5933	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1840.3818	0.1355	-249.3253	
PV Unit electricity exported	-3761.7317	0.1262	-474.8938	
Total			-724.2191	(269)
Total CO2, kg/year			2399.0553	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.8300	(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	11391.5066	1.1300	12872.4025	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3131.1208	1.1300	3538.1665	(278)
Space and water heating			16410.5690	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	426.7509	1.5338	654.5648	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1840.3818	1.5007	-2761.9370	
PV Unit electricity exported	-3761.7317	0.4634	-1743.2414	
Total			-4505.1784	(283)
Total Primary energy kWh/year			12690.0562	(286)
Target Primary Energy Rate (TPER)			46.7100	(287)

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Property Reference	Tony		Issued on Date	18/09/2023	
Assessment Reference	Heatpump Only	Prop Type Ref			
Property	29 BEECH HILL, TONY, EN4 0JN				
SAP Rating	90 B	DER	1.94	TER	8.83
Environmental	98 A	% DER < TER			78.03
CO <sub>2</sub> Emissions (t/year)	0.47	DFEE	39.58	TFEE	42.07
Compliance Check	See BREL	% DFEE < TFEE			5.92
% DPER < TPER	56.92	DPER	20.12	TPER	46.71
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 <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	113.3400 (1b)	2.9400 (2b)	333.2196 (1b)
First floor	93.2700 (1c)	2.9500 (2c)	275.1465 (1c)
Second floor	65.0900 (1d)	2.8600 (2d)	186.1574 (1d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	271.7000		794.5235 (5)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)

## 2. Ventilation rate

	m <sup>3</sup> 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	5 * 10 = 50.0000 (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) =	50.0000 / (5) = 0.0629 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.2129 (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) = 0.2129 (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	0.2715	0.2662	0.2608	0.2342	0.2289	0.2023	0.2023	0.1970	0.2129	0.2289	0.2395	0.2502 (22b)
Effective ac	0.5369	0.5354	0.5340	0.5274	0.5262	0.5205	0.5205	0.5194	0.5227	0.5262	0.5287	0.5313 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
FRONT (Uw = 1.30)			9.0200	1.2357	11.1464		(27)
SIDE (Uw = 1.30)			4.3200	1.2357	5.3384		(27)
REAR (Uw = 1.30)			6.0300	1.2357	7.4515		(27)
FRONT			2.8300	1.3000	3.6790		(26)
SIDE			12.4900	1.3000	16.2370		(26a)
REAR			18.8100	1.3000	24.4530		(26a)

# Full SAP Calculation Printout



SIDE			2.4800	1.2357	3.0646								(27a)
FLAT ROOF			3.5000	1.2357	4.3251								(27a)
UNDERGROUND			113.3400	0.1400	15.8676	110.0000	12467.4000						(28a)
EXTERNAL	191.7500	53.5000	138.2500	0.1200	16.5900	70.0000	9677.5000						(29a)
ROOF WALL	17.3200		17.3200	0.1100	1.9052	70.0000	1212.4000						(29a)
FLAT ROOF @GF	8.2100		8.2100	0.1100	0.9031	9.0000	73.8900						(30)
FLAT ROOF @SF	38.2100	3.5000	34.7100	0.1100	3.8181	9.0000	312.3900						(30)
PITCHED ROOF RU	37.0400		37.0400	0.1000	3.7040	9.0000	333.3600						(30)
PITCHED RAFTER	26.8800	2.4800	24.4000	0.1000	2.4400	9.0000	219.6000						(30)
Total net area of external elements Aum(A, m2)			432.7500										(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	120.9230								(33)
PARTY WALL			117.4600	0.0000	0.0000	180.0000	21142.8000						(32)
INTERNAL FLOOR @FF			93.2700			18.0000	1678.8600						(32d)
INTERNAL FLOOR @SF			65.0900			18.0000	1171.6200						(32d)
INTERNAL CEILING @GF			93.2700			9.0000	839.4300						(32e)
INTERNAL CEILING @FF			65.0900			9.0000	585.8100						(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 49715.0600 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 182.9778 (35)

List of Thermal Bridges

K1 Element						Length	Psi-value		Total				
Thermal bridges (Sum(L x Psi) calculated using Appendix K)													0.0000 (36)
Point Thermal bridges													(36a) = 0.0000
Total fabric heat loss													(33) + (36) + (36a) = 120.9230 (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	140.7588	140.3836	140.0159	138.2884	137.9652	136.4607	136.4607	136.1821	137.0402	137.9652	138.6191	139.3026	(38)
Average = Sum(39)m / 12 =	261.6819	261.3067	260.9389	259.2115	258.8883	257.3837	257.3837	257.1051	257.9633	258.8883	259.5421	260.2256	(39)
													259.2099

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	0.9631	0.9617	0.9604	0.9540	0.9528	0.9473	0.9473	0.9463	0.9494	0.9528	0.9553	0.9578	(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														3.0951 (42)
Hot water usage for mixer showers														
Hot water usage for baths														
Hot water usage for other uses														
Average daily hot water use (litres/day)														142.7534 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	155.2978	151.9814	147.9428	141.8020	136.8152	131.4539	129.3939	133.4151	137.6560	143.2843	149.5196	154.8951	(44)
Energy content (annual)	245.9537	216.4194	227.3825	194.1198	184.1795	161.6380	156.4907	165.1957	169.7436	194.4354	213.0181	242.5283	(45)
Distribution loss (46)m = 0.15 x (45)m													Total = Sum(45)m = 2371.1047
Water storage loss:													

Store volume 210.0000 (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													
Primary 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	(57)
Combi 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)
Total heat required for water heating calculated for each month	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)

WWHRS	304.3701	269.1826	285.7989	250.6518	242.5959	218.1700	214.9071	223.6121	226.2756	252.8518	269.5501	300.9447	(62)
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	(63a)
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	(63b)
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	(63c)
Output from w/h	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)
Total per year (kWh/year) = Sum(64)m =	304.3701	269.1826	285.7989	250.6518	242.5959	218.1700	214.9071	223.6121	226.2756	252.8518	269.5501	300.9447	(64)
Electric shower(s)													3058.9107 (64)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													3059 (64)

Heat gains from water heating, kWh/month	128.5127	114.1700	122.3378	109.7704	107.9728	98.9702	98.7663	101.6607	101.6653	111.3829	116.0541	127.3738	(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	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													

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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	254.4872	281.7536	254.4872	262.9701	254.4872	262.9701	254.4872	254.4872	262.9701	254.4872	262.9701	254.4872	262.9701	254.4872 (67)
434.9226	439.4358	428.0628	403.8511	373.2882	344.5634	325.3735	320.8604	332.2333	356.4450	387.0079	415.7327	434.9226	439.4358	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	(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	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	(71)
Water heating gains (Table 5)	172.7322	169.8959	164.4325	152.4590	145.1247	137.4586	132.7504	136.6407	141.2019	149.7082	161.1863	171.2013	172.7322	(72)
Total internal gains	931.5691	960.5124	916.4096	888.7073	842.3272	814.4192	782.0381	781.4153	805.8323	830.0674	880.5913	910.8483	931.5691	(73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W
South	9.0200	46.7521	0.5700	0.5700	0.8000	0.7700	133.2617	(78)
West	4.3200	19.6403	0.5700	0.5700	0.8000	0.7700	26.8120	(80)
North	6.0300	10.6334	0.5700	0.5700	0.8000	0.7700	20.2622	(74)
West	2.4800	26.6072	0.5700	0.5700	0.8000	1.0000	27.0806	(82)
North	3.5000	26.0000	0.5700	0.5700	0.8000	1.0000	37.3464	(82)

Solar gains	244.7630	441.7352	662.6800	906.3120	1083.9075	1103.9065	1052.8766	917.7202	747.4709	504.6620	297.8733	206.3223	244.7630	(83)
Total gains	1176.3320	1402.2476	1579.0896	1795.0193	1926.2347	1918.3257	1834.9147	1699.1355	1553.3032	1334.7294	1178.4647	1117.1706	1176.3320	(84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains for living area, n1,m (see Table 9a)													21.0000	(85)
tau	52.7730	52.8488	52.9233	53.2760	53.3425	53.6543	53.6543	53.7124	53.5337	53.3425	53.2081	53.0683		
alpha	4.5182	4.5233	4.5282	4.5517	4.5562	4.5770	4.5770	4.5808	4.5689	4.5562	4.5472	4.5379		
util living area	0.9981	0.9954	0.9888	0.9647	0.8982	0.7531	0.5894	0.6497	0.8714	0.9790	0.9958	0.9985	(86)	
Living	19.3277	19.5285	19.8364	20.2633	20.6446	20.8936	20.9732	20.9586	20.7762	20.2731	19.7240	19.2939		
Non living	18.1235	18.3813	18.7751	19.3172	19.7790	20.0497	20.1149	20.1070	19.9373	19.3358	18.6359	18.0834		
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	20.1445	19.5285	19.8364	20.2633	20.6446	20.8936	20.9732	20.9586	20.7762	20.2731	19.7240	19.5326	(87)	
Th 2	20.1142	20.1153	20.1165	20.1218	20.1228	20.1275	20.1275	20.1283	20.1257	20.1228	20.1208	20.1187	(88)	
util rest of house	0.9976	0.9942	0.9857	0.9543	0.8669	0.6815	0.4846	0.5455	0.8207	0.9710	0.9946	0.9981	(89)	
MIT 2	19.3206	18.3813	18.7751	19.3172	19.7790	20.0497	20.1149	20.1070	19.9373	19.3358	18.6359	18.4501	(90)	
Living area fraction									fLA = Living area / (4) =				0.2939	(91)
MIT	19.5628	18.7185	19.0870	19.5953	20.0334	20.2978	20.3672	20.3573	20.1839	19.6113	18.9557	18.7683	(92)	
Temperature adjustment												0.0000	(93)	
adjusted MIT	19.5628	18.7185	19.0870	19.5953	20.0334	20.2978	20.3672	20.3573	20.1839	19.6113	18.9557	18.7683	(93)	

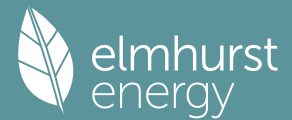
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9972	0.9915	0.9808	0.9465	0.8632	0.6966	0.5146	0.5745	0.8246	0.9648	0.9921	0.9972	(94)
Useful gains	1173.0137	1390.2915	1548.8080	1698.9174	1662.6807	1336.3729	944.2059	976.1210	1280.9175	1287.7641	1169.1670	1114.0873	(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	3993.9853	3610.8630	3284.4474	2772.3351	2157.4277	1466.5136	969.6039	1017.4449	1569.4236	2332.9148	3077.0530	3791.0437	(97)
Space heating kWh	2098.8029	1492.2241	1291.3157	772.8607	368.0917	0.0000	0.0000	0.0000	0.0000	777.5922	1373.6779	1991.6556	(98a)
Space heating requirement - total per year (kWh/year)												10166.2208	
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	2098.8029	1492.2241	1291.3157	772.8607	368.0917	0.0000	0.0000	0.0000	0.0000	777.5922	1373.6779	1991.6556	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10166.2208	
Space heating per m2										(98c) / (4) =		37.4171	(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 %)	470.8811	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2098.8029	1492.2241	1291.3157	772.8607	368.0917	0.0000	0.0000	0.0000	0.0000	777.5922	1373.6779	1991.6556	(98)
Space heating efficiency (main heating system 1)	470.8811	470.8811	470.8811	470.8811	470.8811	0.0000	0.0000	0.0000	0.0000	470.8811	470.8811	470.8811	(210)
Space heating fuel (main heating system)	445.7182	316.9004	274.2339	164.1307	78.1708	0.0000	0.0000	0.0000	0.0000	165.1356	291.7250	422.9635	(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	304.3701	269.1826	285.7989	250.6518	242.5959	218.1700	214.9071	223.6121	226.2756	252.8518	269.5501	300.9447	(64)
Efficiency of water heater (217)m	318.5504	318.5504	318.5504	318.5504	318.5504	318.5504	318.5504	318.5504	318.5504	318.5504	318.5504	318.5504	(216)
Fuel for water heating, kWh/month	95.5485	84.5024	89.7186	78.6851	76.1562	68.4884	67.4641	70.1968	71.0329	79.3758	84.6177	94.4732	(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	49.2027	39.4723	35.5404	26.0384	20.1128	16.4323	18.3476	23.8489	30.9773	40.6440	45.9073	50.5702	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1													2158.9781 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													318.5504
Water heating fuel used													960.2596 (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)													397.0942 (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													3516.3319 (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	2158.9781	0.1550	334.5551	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	960.2596	0.1409	135.3330	(264)
Space and water heating			469.8881	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	397.0942	0.1443	57.3130	(268)
Total CO2, kg/year			527.2011	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.9400	(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	2158.9781	1.5737	3397.5265	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	960.2596	1.5211	1460.6736	(278)
Space and water heating			4858.2002	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	397.0942	1.5338	609.0763	(282)
Total Primary energy kWh/year			5467.2765	(286)
Dwelling Primary energy Rate (DPER)			20.1200	(287)

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	113.3400 (1b)	x 2.9400 (2b)	= 333.2196 (1b) -
First floor	93.2700 (1c)	x 2.9500 (2c)	= 275.1465 (1c) -
Second floor	65.0900 (1d)	x 2.8600 (2d)	= 186.1574 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	271.7000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	794.5235 (5)

## 2. Ventilation rate

	m <sup>3</sup> 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) = 0.0503 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3003 (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) = 0.3003 (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	0.3829	0.3754	0.3679	0.3304	0.3229	0.2853	0.2853	0.2778	0.3003	0.3229	0.3379	0.3529 (22b)
Effective ac	0.5733	0.5705	0.5677	0.5546	0.5521	0.5407	0.5407	0.5386	0.5451	0.5521	0.5571	0.5623 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
TER Opaque door			2.8300	1.0000	2.8300		(26)
TER Semi-glazed door			31.3000	1.0000	31.3000		(26a)
TER Opening Type (Uw = 1.20)			19.3700	1.1450	22.1794		(27)
SIDE			2.4800	2.0221	5.0147		(27a)
FLAT ROOF			3.5000	2.0221	7.0772		(27a)
UNDERGROUND			113.3400	0.1300	14.7342		(28a)
EXTERNAL	191.7500	53.5000	138.2500	0.1800	24.8850		(29a)
ROOF WALL	17.3200		17.3200	0.1800	3.1176		(29a)
FLAT ROOF @GF	8.2100		8.2100	0.1100	0.9031		(30)
FLAT ROOF @SF	38.2100	3.5000	34.7100	0.1100	3.8181		(30)
PITCHED ROOF RU	37.0400		37.0400	0.1100	4.0744		(30)
PITCHED RAFTER	26.8800	2.4800	24.4000	0.1100	2.6840		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			432.7500				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	122.6177		(33)
PARTY WALL			117.4600	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							182.9778 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)						0.0000 (36)	
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	122.6177 (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
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(38)m	150.3207	149.5742	148.8425	145.4056	144.7626	141.7692	141.7692	141.2148	142.9222	144.7626	146.0634	147.4234	(38)
Heat transfer coeff	272.9384	272.1919	271.4602	268.0233	267.3803	264.3869	264.3869	263.8325	265.5399	267.3803	268.6811	270.0411	(39)
Average = Sum(39)m / 12 =												268.0202	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0046	1.0018	0.9991	0.9865	0.9841	0.9731	0.9731	0.9710	0.9773	0.9841	0.9889	0.9939	(40)
HLP (average)												0.9865	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.0951	(42)
Hot water usage for mixer showers													75.8236	(42a)
Hot water usage for baths													32.7442	(42b)
Hot water usage for other uses													46.3273	(42c)
Average daily hot water use (litres/day)													142.7534	(43)
Daily hot water use														
Energy conte	155.2978	151.9814	147.9428	141.8020	136.8152	131.4539	129.3939	133.4151	137.6560	143.2843	149.5196	154.8951	(44)	
Energy content (annual)	245.9537	216.4194	227.3825	194.1198	184.1795	161.6380	156.4907	165.1957	169.7436	194.4354	213.0181	242.5283	(45)	
Distribution loss (46)m = 0.15 x (45)m													2371.1047	
Water storage loss:														
Store volume													210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):													1.7016	(48)
Temperature factor from Table 2b													0.5400	(49)
Enter (49) or (54) in (55)													0.9188	(55)
Total storage loss														
If cylinder contains dedicated solar storage														
Primary loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	(56)
Combi loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	(57)
Total heat required for water heating calculated for each month	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	(59)
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	0.0000	(61)
PV diverter	297.7003	263.1583	279.1291	244.1972	235.9261	211.7153	208.2373	216.9423	219.8209	246.1820	263.0955	294.2749	(62)	
Solar input	-34.7967	-30.7745	-32.2253	-26.6838	-24.8683	-21.2800	-19.9466	-21.2112	-22.0171	-25.9558	-29.4047	-34.1523	(63a)	
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	(63b)	
Output from w/h	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)	
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	(63d)	
Electric shower(s)	262.9036	232.3838	246.9038	217.5134	211.0577	190.4353	188.2907	195.7311	197.8038	220.2262	233.6907	260.1226	(64)	
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												2657.0628	(64)	
Heat gains from water heating, kWh/month													2657	(64)

## 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	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	254.4872	281.7536	254.4872	262.9701	254.4872	262.9701	254.4872	254.4872	262.9701	254.4872	262.9701	254.4872	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	434.9226	439.4358	428.0628	403.8511	373.2882	344.5634	325.3735	320.8604	332.2333	356.4450	387.0079	415.7327	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	(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)	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	(71)
Water heating gains (Table 5)	165.5603	162.7240	157.2607	145.2871	137.9529	130.2868	125.5785	129.4689	134.0300	142.5363	154.0144	164.0295	(72)
Total internal gains	927.3972	956.3405	912.2378	884.5354	838.1554	807.2474	774.8663	774.2435	798.6605	825.8956	876.4195	906.6764	(73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
North	6.0300	10.6334	0.6300	0.7000	0.7700	19.5957 (74)
South	9.0200	46.7521	0.6300	0.7000	0.7700	128.8781 (78)
West	4.3200	19.6403	0.6300	0.7000	0.7700	25.9300 (80)
North	3.5000	26.0000	0.6300	0.7000	1.0000	36.1179 (82)

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West	2.4800	26.6072	0.6300	0.7000	1.0000	26.1898 (82)						
Solar gains	236.7116	427.2045	640.8813	876.4991	1048.2526	1067.5937	1018.2425	887.5320	722.8830	488.0613	288.0749	199.5354 (83)
Total gains	1164.1088	1383.5450	1553.1191	1761.0345	1886.4080	1874.8411	1793.1088	1661.7755	1521.5435	1313.9569	1164.4943	1106.2118 (84)
-----												
7. Mean internal temperature (heating season)												
-----												
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	50.5965	50.7353	50.8721	51.5244	51.6483	52.2331	52.2331	52.3428	52.0063	51.6483	51.3983	51.1394
alpha	4.3731	4.3824	4.3915	4.4350	4.4432	4.4822	4.4822	4.4895	4.4671	4.4432	4.4266	4.4093
util living area	0.9981	0.9956	0.9897	0.9684	0.9090	0.7733	0.6126	0.6719	0.8841	0.9808	0.9960	0.9985 (86)
MIT	19.2406	19.4423	19.7556	20.1999	20.5982	20.8736	20.9662	20.9493	20.7460	20.2232	19.6611	19.2174 (87)
Th 2	20.0795	20.0818	20.0841	20.0946	20.0966	20.1058	20.1058	20.1075	20.1023	20.0966	20.0926	20.0884 (88)
util rest of house	0.9976	0.9945	0.9869	0.9588	0.8796	0.7020	0.5036	0.5649	0.8355	0.9734	0.9948	0.9981 (89)
MIT 2	17.9885	18.2482	18.6498	19.2188	19.7053	20.0124	20.0898	20.0811	19.8864	19.2548	18.5363	17.9648 (90)
Living area fraction									fLA = Living area / (4) =			0.2939 (91)
MIT	18.3565	18.5992	18.9748	19.5071	19.9677	20.2655	20.3474	20.3363	20.1391	19.5394	18.8669	18.3330 (92)
Temperature adjustment												0.0000
adjusted MIT	18.3565	18.5992	18.9748	19.5071	19.9677	20.2655	20.3474	20.3363	20.1391	19.5394	18.8669	18.3330 (93)
-----												
8. Space heating requirement												
-----												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9962	0.9918	0.9821	0.9509	0.8746	0.7160	0.5345	0.5942	0.8379	0.9672	0.9924	0.9970 (94)
Useful gains	1159.6968	1372.2009	1525.2851	1674.5137	1649.9210	1342.3262	958.4730	987.4544	1274.8700	1270.8536	1155.6128	1102.8676 (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	3836.5625	3728.8082	3386.4100	2842.9615	2210.6263	1497.8841	990.7640	1038.5219	1603.6218	2390.2273	3161.5377	3816.4811 (97)
Space heating kWh	1991.5881	1583.6401	1384.6769	841.2824	417.1647	0.0000	0.0000	0.0000	0.0000	832.8140	1444.2659	2018.9284 (98a)
Space heating requirement - total per year (kWh/year)												10514.3606
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	1991.5881	1583.6401	1384.6769	841.2824	417.1647	0.0000	0.0000	0.0000	0.0000	832.8140	1444.2659	2018.9284 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10514.3606
Space heating per m2										(98c) / (4) =		38.6984 (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	1991.5881	1583.6401	1384.6769	841.2824	417.1647	0.0000	0.0000	0.0000	0.0000	832.8140	1444.2659	2018.9284 (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)	2157.7336	1715.7531	1500.1917	911.4653	451.9661	0.0000	0.0000	0.0000	0.0000	902.2904	1564.7518	2187.3547 (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	262.9036	232.3838	246.9038	217.5134	211.0577	190.4353	188.2907	195.7311	197.8038	220.2262	233.6907	260.1226 (64)
Efficiency of water heater (217)m	87.6473	87.5367	87.3099	86.7892	85.5582	79.8000	79.8000	79.8000	79.8000	86.7538	87.4268	79.8000 (216)
Fuel for water heating, kWh/month	299.9564	265.4702	282.7903	250.6228	246.6833	238.6407	235.9532	245.2771	247.8744	253.8520	267.2988	296.7016 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	52.8774	42.4202	38.1947	27.9831	21.6149	17.6596	19.7179	25.6300	33.2909	43.6794	49.3358	54.3470 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-95.6861	-129.8704	-179.6136	-193.8151	-202.0694	-185.8452	-183.2679	-176.2285	-163.0453	-144.3563	-103.2802	-83.3037 (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)												

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(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	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)														
(233b)m	-70.2660	-145.6642	-285.8047	-424.1180	-556.1009	-557.3628	-551.0493	-468.8779	-346.5976	-206.8477	-93.2917	-55.7508		(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													11391.5066	(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													3131.1208	(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)													426.7509	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-5602.1135	(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													9433.2649	(238)

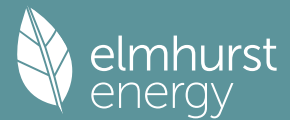
## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	11391.5066	0.2100	2392.2164	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3131.1208	0.2100	657.5354	(264)
Space and water heating			3049.7518	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	426.7509	0.1443	61.5933	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1840.3818	0.1355	-249.3253	
PV Unit electricity exported	-3761.7317	0.1262	-474.8938	
Total			-724.2191	(269)
Total CO2, kg/year			2399.0553	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.8300	(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	11391.5066	1.1300	12872.4025	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3131.1208	1.1300	3538.1665	(278)
Space and water heating			16410.5690	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	426.7509	1.5338	654.5648	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1840.3818	1.5007	-2761.9370	
PV Unit electricity exported	-3761.7317	0.4634	-1743.2414	
Total			-4505.1784	(283)
Total Primary energy kWh/year			12690.0562	(286)
Target Primary Energy Rate (TPER)			46.7100	(287)

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Property Reference	Poli		Issued on Date	18/09/2023	
Assessment Reference	Heatpump + PV	Prop Type Ref			
Property	29 BEECH HILL, POLI, EN4 0JN				
SAP Rating	92 A	DER	1.58	TER	8.83
Environmental	98 A	% DER < TER			82.11
CO <sub>2</sub> Emissions (t/year)	0.36	DFEE	40.15	TFEE	42.07
Compliance Check	See BREL	% DFEE < TFEE			4.55
% DPER < TPER	65.61	DPER	16.06	TPER	46.71
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 <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	113.3400 (1b)	x 2.9400 (2b)	= 333.2196 (1b) -
First floor	93.2700 (1c)	x 2.9500 (2c)	= 275.1465 (1c) -
Second floor	65.0900 (1d)	x 2.8600 (2d)	= 186.1574 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	271.7000		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 794.5235 (5)

## 2. Ventilation rate

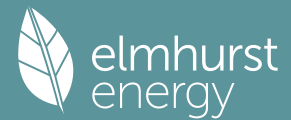
	m <sup>3</sup> per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	5 * 10 = 50.0000 (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) =	50.0000 / (5) = 0.0629 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.2129 (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) = 0.2129 (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	0.2715	0.2662	0.2608	0.2342	0.2289	0.2023	0.2023	0.1970	0.2129	0.2289	0.2395	0.2502 (22b)
Effective ac	0.5369	0.5354	0.5340	0.5274	0.5262	0.5205	0.5205	0.5194	0.5227	0.5262	0.5287	0.5313 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
FRONT (Uw = 1.30)			9.0200	1.2357	11.1464		(27)
SIDE (Uw = 2.20)			4.3200	2.0221	8.7353		(27)
REAR (Uw = 2.20)			6.0300	2.0221	12.1930		(27)
FRONT			2.8300	1.3000	3.6790		(26)
SIDE			12.4900	1.3000	16.2370		(26a)
REAR			18.8100	1.3000	24.4530		(26a)

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SIDE			2.4800	1.2357	3.0646								(27a)
FLAT ROOF			3.5000	1.2357	4.3251								(27a)
UNDERGROUND			113.3400	0.1400	15.8676	110.0000	12467.4000						(28a)
EXTERNAL	191.7500	53.5000	138.2500	0.1200	16.5900	70.0000	9677.5000						(29a)
ROOF WALL	17.3200		17.3200	0.1100	1.9052	70.0000	1212.4000						(29a)
FLAT ROOF @GF	8.2100		8.2100	0.1100	0.9031	9.0000	73.8900						(30)
FLAT ROOF @SF	38.2100	3.5000	34.7100	0.1100	3.8181	9.0000	312.3900						(30)
PITCHED ROOF RU	37.0400		37.0400	0.1000	3.7040	9.0000	333.3600						(30)
PITCHED RAFTER	26.8800	2.4800	24.4000	0.1000	2.4400	9.0000	219.6000						(30)
Total net area of external elements Aum(A, m2)			432.7500										(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		129.0614								(33)
PARTY WALL			117.4600	0.0000	0.0000	180.0000	21142.8000						(32)
INTERNAL FLOOR @FF			93.2700			18.0000	1678.8600						(32d)
INTERNAL FLOOR @SF			65.0900			18.0000	1171.6200						(32d)
INTERNAL CEILING @GF			93.2700			9.0000	839.4300						(32e)
INTERNAL CEILING @FF			65.0900			9.0000	585.8100						(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 49715.0600 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 182.9778 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			0.0000	(36)
Point Thermal bridges			0.0000	(36a) =
Total fabric heat loss			(33) + (36) + (36a) =	129.0614 (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	140.7588	140.3836	140.0159	138.2884	137.9652	136.4607	136.4607	136.1821	137.0402	137.9652	138.6191	139.3026	(38)
Average = Sum(39)m / 12 =	269.8203	269.4451	269.0773	267.3499	267.0267	265.5221	265.5221	265.2435	266.1017	267.0267	267.6805	268.3640	(39)
													267.3483

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	0.9931	0.9917	0.9903	0.9840	0.9828	0.9773	0.9773	0.9762	0.9794	0.9828	0.9852	0.9877	(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													3.0951	(42)
Hot water usage for mixer showers														
Hot water usage for baths														
Hot water usage for other uses														
Average daily hot water use (litres/day)														142.7534 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Energy conte	155.2978	151.9814	147.9428	141.8020	136.8152	131.4539	129.3939	133.4151	137.6560	143.2843	149.5196	154.8951	(44)	
Energy content (annual)	245.9537	216.4194	227.3825	194.1198	184.1795	161.6380	156.4907	165.1957	169.7436	194.4354	213.0181	242.5283	(45)	
Distribution loss (46)m = 0.15 x (45)m													Total = Sum(45)m =	2371.1047
Water storage loss:														
Store volume														210.0000 (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														
If cylinder contains dedicated solar storage														
Primary 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)	
Combi 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	(57)	
Total heat required for water heating calculated for each month	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)	
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	(61)	
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	(62)	
Solar input	304.3701	269.1826	285.7989	250.6518	242.5959	218.1700	214.9071	223.6121	226.2756	252.8518	269.5501	300.9447	(62)	
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	(63a)	
Output from w/h	-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)	
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	(63c)	
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	(63d)	
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													3058.9107 (64)	
Heat gains from water heating, kWh/month													3059 (64)	
	128.5127	114.1700	122.3378	109.7704	107.9728	98.9702	98.7663	101.6607	101.6653	111.3829	116.0541	127.3738	(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	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													

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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	254.4872	281.7536	254.4872	262.9701	254.4872	262.9701	254.4872	254.4872	262.9701	254.4872	262.9701	254.4872	262.9701	254.4872 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	434.9226	439.4358	428.0628	403.8511	373.2882	344.5634	325.3735	320.8604	332.2333	356.4450	387.0079	415.7327	415.7327	(68)
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	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	(71)
Water heating gains (Table 5)	172.7322	169.8959	164.4325	152.4590	145.1247	137.4586	132.7504	136.6407	141.2019	149.7082	161.1863	171.2013	171.2013	(72)
Total internal gains	931.5691	960.5124	916.4096	888.7073	842.3272	814.4192	782.0381	781.4153	805.8323	830.0674	880.5913	910.8483	910.8483	(73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W
South	9.0200	46.7521	0.5700	0.5700	0.8000	0.7700	133.2617	(78)
East	4.3200	19.6403	0.5700	0.5700	0.8000	0.7700	26.8120	(76)
North	6.0300	10.6334	0.5700	0.5700	0.8000	0.7700	20.2622	(74)
East	2.4800	26.6072	0.5700	0.5700	0.8000	1.0000	27.0806	(82)
North	3.5000	26.0000	0.5700	0.5700	0.8000	1.0000	37.3464	(82)

Solar gains	244.7630	441.7352	662.6800	906.3120	1083.9075	1103.9065	1052.8766	917.7202	747.4709	504.6620	297.8733	206.3223	206.3223	(83)
Total gains	1176.3320	1402.2476	1579.0896	1795.0193	1926.2347	1918.3257	1834.9147	1699.1355	1553.3032	1334.7294	1178.4647	1117.1706	1117.1706	(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, ni1,m (see Table 9a)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
tau	51.1812	51.2525	51.3226	51.6542	51.7167	52.0097	52.0097	52.0644	51.8965	51.7167	51.5904	51.4590		
alpha	4.4121	4.4168	4.4215	4.4436	4.4478	4.4673	4.4673	4.4710	4.4598	4.4478	4.4394	4.4306		
util living area	0.9980	0.9954	0.9890	0.9661	0.9033	0.7644	0.6031	0.6630	0.8780	0.9797	0.9958	0.9984		(86)
Living	19.2691	19.4710	19.7837	20.2187	20.6129	20.8785	20.9678	20.9512	20.7538	20.2347	19.6743	19.2351		
Non living	18.0314	18.2906	18.6905	19.2434	19.7225	20.0132	20.0872	20.0780	19.8927	19.2698	18.5552	17.9909		
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	20.1145	19.4710	19.7837	20.2187	20.6129	20.8785	20.9678	20.9512	20.7538	20.2347	19.6743	19.4819		(87)
Th 2	20.0891	20.0903	20.0914	20.0967	20.0977	20.1023	20.1023	20.1032	20.1005	20.0977	20.0957	20.0936		(88)
util rest of house	0.9975	0.9942	0.9860	0.9560	0.8726	0.6921	0.4945	0.5559	0.8279	0.9719	0.9946	0.9980		(89)
MIT 2	19.2688	18.2906	18.6905	19.2434	19.7225	20.0132	20.0872	20.0780	19.8927	19.2698	18.5552	18.3698		(90)
Living area fraction									fLA = Living area / (4) =			0.2939		(91)
MIT	19.5174	18.6376	19.0118	19.5300	19.9842	20.2675	20.3461	20.3347	20.1458	19.5534	18.8841	18.6967		(92)
Temperature adjustment												0.0000		
adjusted MIT	19.5174	18.6376	19.0118	19.5300	19.9842	20.2675	20.3461	20.3347	20.1458	19.5534	18.8841	18.6967		(93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation	0.9971	0.9914	0.9810	0.9479	0.8681	0.7067	0.5254	0.5854	0.8309	0.9655	0.9920	0.9972		(94)
Useful gains	1172.9500	1390.2149	1549.1017	1701.5183	1672.1620	1355.6164	964.0421	994.6903	1290.6150	1288.6910	1169.0897	1114.0026		(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	4105.9555	3701.5190	3366.6439	2841.9385	2212.0945	1504.8523	994.6595	1043.6430	1608.8050	2390.7979	3154.3761	3890.3920		(97)
Space heating kWh	2182.1561	1553.1963	1352.2513	821.1026	401.7097	0.0000	0.0000	0.0000	0.0000	819.9675	1429.4062	2065.6337		(98a)
Space heating requirement - total per year (kWh/year)												10625.4235		
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	2182.1561	1553.1963	1352.2513	821.1026	401.7097	0.0000	0.0000	0.0000	0.0000	819.9675	1429.4062	2065.6337		(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10625.4235		
Space heating per m2												(98c) / (4) =	39.1072	(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 %)	470.7315	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2182.1561	1553.1963	1352.2513	821.1026	401.7097	0.0000	0.0000	0.0000	0.0000	819.9675	1429.4062	2065.6337	(98)
Space heating efficiency (main heating system 1)	470.7315	470.7315	470.7315	470.7315	470.7315	0.0000	0.0000	0.0000	0.0000	470.7315	470.7315	470.7315	(210)
Space heating fuel (main heating system)	463.5671	329.9538	287.2660	174.4312	85.3373	0.0000	0.0000	0.0000	0.0000	174.1901	303.6564	438.8136	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	304.3701	269.1826	285.7989	250.6518	242.5959	218.1700	214.9071	223.6121	226.2756	252.8518	269.5501	300.9447	(64)
Efficiency of water heater (217)m	317.2758	317.2758	317.2758	317.2758	317.2758	317.2758	317.2758	317.2758	317.2758	317.2758	317.2758	317.2758	(216)
Fuel for water heating, kWh/month	95.9323	84.8418	90.0790	79.0012	76.4621	68.7635	67.7351	70.4788	71.3183	79.6946	84.9577	94.8527	(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	49.2027	39.4723	35.5404	26.0384	20.1128	16.4323	18.3476	23.8489	30.9773	40.6440	45.9073	50.5702	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-24.9967	-41.6021	-70.5487	-93.8161	-114.7239	-111.7195	-110.2302	-96.8803	-76.5246	-52.9774	-29.6121	-20.9240	(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	-0.0466	-0.1879	-0.6244	-1.5699	-3.1175	-4.1374	-4.0956	-3.0067	-1.7069	-0.4455	-0.0928	-0.0329	(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													2257.2155 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													317.2758
Water heating fuel used													964.1172 (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)													397.0942 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-863.6197 (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													2754.8071 (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	2257.2155	0.1549	349.5825	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	964.1172	0.1409	135.8767	(264)
Space and water heating			485.4592	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	397.0942	0.1443	57.3130	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-844.5557	0.1314	-110.9995	
PV Unit electricity exported	-19.0640	0.1135	-2.1628	
Total			-113.1623	(269)
Total CO2, kg/year			429.6098	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.5800	(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	2257.2155	1.5734	3551.3958	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	964.1172	1.5211	1466.5415	(278)
Space and water heating			5017.9373	(279)

# Full SAP Calculation Printout



Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	397.0942	1.5338	609.0763 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-844.5557	1.4856	-1254.6346
PV Unit electricity exported	-19.0640	0.4154	-7.9198
Total			-1262.5543 (283)
Total Primary energy kWh/year			4364.4593 (286)
Dwelling Primary energy Rate (DPER)			16.0600 (287)

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 SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF TARGET EMISSIONS  
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-----  
 1. Overall dwelling characteristics  
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	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	113.3400 (1b)	x 2.9400 (2b)	= 333.2196 (1b) -
First floor	93.2700 (1c)	x 2.9500 (2c)	= 275.1465 (1c) -
Second floor	65.0900 (1d)	x 2.8600 (2d)	= 186.1574 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	271.7000		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 794.5235 (5)

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 2. Ventilation rate  
 -----

	Number of open chimneys	Number of open flues	Number of chimneys / flues attached to closed fire	Number of flues attached to solid fuel boiler	Number of flues attached to other heater	Number of blocked chimneys	Number of intermittent extract fans	Number of passive vents	Number of flueless gas fires	Air changes per hour
										m3 per hour
										0 * 80 = 0.0000 (6a)
										0 * 20 = 0.0000 (6b)
										0 * 10 = 0.0000 (6c)
										0 * 20 = 0.0000 (6d)
										0 * 35 = 0.0000 (6e)
										0 * 20 = 0.0000 (6f)
										4 * 10 = 40.0000 (7a)
										0 * 10 = 0.0000 (7b)
										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) = 0.0503 (8)
Pressure test										Yes
Pressure Test Method										Blower Door
Measured/design AP50										5.0000 (17)
Infiltration rate										0.3003 (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) = 0.3003 (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 infiltr rate												
Effective ac	0.3829	0.3754	0.3679	0.3304	0.3229	0.2853	0.2853	0.2778	0.3003	0.3229	0.3379	0.3529 (22b)
	0.5733	0.5705	0.5677	0.5546	0.5521	0.5407	0.5407	0.5386	0.5451	0.5521	0.5571	0.5623 (25)

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 3. Heat losses and heat loss parameter  
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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 Opaque door			2.8300	1.0000	2.8300		(26)
TER Semi-glazed door			31.3000	1.0000	31.3000		(26a)
TER Opening Type (Uw = 1.20)			19.3700	1.1450	22.1794		(27)
SIDE			2.4800	2.0221	5.0147		(27a)
FLAT ROOF			3.5000	2.0221	7.0772		(27a)
UNDERGROUND			113.3400	0.1300	14.7342		(28a)
EXTERNAL	191.7500	53.5000	138.2500	0.1800	24.8850		(29a)
ROOF WALL	17.3200		17.3200	0.1800	3.1176		(29a)
FLAT ROOF @GF	8.2100		8.2100	0.1100	0.9031		(30)
FLAT ROOF @SF	38.2100	3.5000	34.7100	0.1100	3.8181		(30)
PITCHED ROOF RU	37.0400		37.0400	0.1100	4.0744		(30)
PITCHED RAFTER	26.8800	2.4800	24.4000	0.1100	2.6840		(30)
Total net area of external elements Aum(A, m2)			432.7500				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 122.6177		(33)
PARTY WALL			117.4600	0.0000	0.0000		(32)



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Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K													182.9778 (35)
List of Thermal Bridges													
K1 Element													
Thermal bridges (Sum(L x Psi) calculated using Appendix K)													
Point Thermal bridges													
Total fabric heat loss													(33) + (36) + (36a) = 122.6177 (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	150.3207	149.5742	148.8425	145.4056	144.7626	141.7692	141.7692	141.2148	142.9222	144.7626	146.0634	147.4234	(38)
Average = Sum(39)m / 12 =	272.9384	272.1919	271.4602	268.0233	267.3803	264.3869	264.3869	263.8325	265.5399	267.3803	268.6811	270.0411	(39)
	268.0202												

HLP													
HLP (average)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Days in mont	1.0046	1.0018	0.9991	0.9865	0.9841	0.9731	0.9731	0.9710	0.9773	0.9841	0.9889	0.9939	(40)
	0.9865												
	31	28	31	30	31	30	31	31	30	31	30	31	

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.0951 (42)
Hot water usage for mixer showers													75.8236 (42a)
Hot water usage for baths													32.7442 (42b)
Hot water usage for other uses													46.3273 (42c)
Average daily hot water use (litres/day)													142.7534 (43)

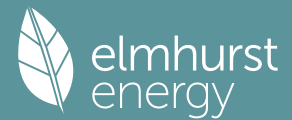
Daily hot water use													
Energy conte	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content (annual)	155.2978	151.9814	147.9428	141.8020	136.8152	131.4539	129.3939	133.4151	137.6560	143.2843	149.5196	154.8951	(44)
Distribution loss (46)m = 0.15 x (45)m	245.9537	216.4194	227.3825	194.1198	184.1795	161.6380	156.4907	165.1957	169.7436	194.4354	213.0181	242.5283	(45)
Water storage loss:	36.8931	32.4629	34.1074	29.1180	27.6269	24.2457	23.4736	24.7794	25.4615	29.1653	31.9527	36.3792	(46)
Store volume													210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.7016 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.9188 (55)
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	297.7003	263.1583	279.1291	244.1972	235.9261	211.7153	208.2373	216.9423	219.8209	246.1820	263.0955	294.2749	(62)
WWHRS	-34.7967	-30.7745	-32.2253	-26.6838	-24.8683	-21.2800	-19.9466	-21.2112	-22.0171	-25.9558	-29.4047	-34.1523	(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	262.9036	232.3838	246.9038	217.5134	211.0577	190.4353	188.2907	195.7311	197.8038	220.2262	233.6907	260.1226	(64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											2657.0628 (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													
	123.1769	109.3505	117.0020	104.6067	102.6370	93.8065	93.4304	96.3249	96.5016	106.0470	110.8904	122.0379	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	(66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	254.4872	281.7536	254.4872	262.9701	254.4872	262.9701	254.4872	254.4872	262.9701	254.4872	262.9701	254.4872	(67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	434.9226	439.4358	428.0628	403.8511	373.2882	344.5634	325.3735	320.8604	332.2333	356.4450	387.0079	415.7327	(68)
Pumps, fans	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	(69)
Losses e.g. evaporation (negative values) (Table 5)	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Water heating gains (Table 5)	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	(71)
Total internal gains	165.5603	162.7240	157.2607	145.2871	137.9529	130.2868	125.5785	129.4689	134.0300	142.5363	154.0144	164.0295	(72)
	927.3972	956.3405	912.2378	884.5354	838.1554	807.2474	774.8663	774.2435	798.6605	825.8956	876.4195	906.6764	(73)

## 6. Solar gains

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[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	6.0300	10.6334	0.6300	0.7000	0.7700	19.5957 (74)
East	4.3200	19.6403	0.6300	0.7000	0.7700	25.9300 (76)
South	9.0200	46.7521	0.6300	0.7000	0.7700	128.8781 (78)
North	3.5000	26.0000	0.6300	0.7000	1.0000	36.1179 (82)
East	2.4800	26.6072	0.6300	0.7000	1.0000	26.1898 (82)

Solar gains	236.7116	427.2045	640.8813	876.4991	1048.2526	1067.5937	1018.2425	887.5320	722.8830	488.0613	288.0749	199.5354 (83)
Total gains	1164.1088	1383.5450	1553.1191	1761.0345	1886.4080	1874.8411	1793.1088	1661.7755	1521.5435	1313.9569	1164.4943	1106.2118 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	50.5965	50.7353	50.8721	51.5244	51.6483	52.2331	52.2331	52.3428	52.0063	51.6483	51.3983	51.1394	
alpha	4.3731	4.3824	4.3915	4.4350	4.4432	4.4822	4.4822	4.4895	4.4671	4.4432	4.4266	4.4093	
util living area	0.9981	0.9956	0.9897	0.9684	0.9090	0.7733	0.6126	0.6719	0.8841	0.9808	0.9960	0.9985 (86)	
MIT	19.2406	19.4423	19.7556	20.1999	20.5982	20.8736	20.9662	20.9493	20.7460	20.2232	19.6611	19.2174 (87)	
Th 2	20.0795	20.0818	20.0841	20.0946	20.0966	20.1058	20.1058	20.1075	20.1023	20.0966	20.0926	20.0884 (88)	
util rest of house	0.9976	0.9945	0.9869	0.9588	0.8796	0.7020	0.5036	0.5649	0.8355	0.9734	0.9948	0.9981 (89)	
MIT 2	17.9885	18.2482	18.6498	19.2188	19.7053	20.0124	20.0898	20.0811	19.8864	19.2548	18.5363	17.9648 (90)	
Living area fraction	fLA = Living area / (4) =												
MIT	18.3565	18.5992	18.9748	19.5071	19.9677	20.2655	20.3474	20.3363	20.1391	19.5394	18.8669	18.3330 (92)	
Temperature adjustment	0.0000												
adjusted MIT	18.3565	18.5992	18.9748	19.5071	19.9677	20.2655	20.3474	20.3363	20.1391	19.5394	18.8669	18.3330 (93)	

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9962	0.9918	0.9821	0.9509	0.8746	0.7160	0.5345	0.5942	0.8379	0.9672	0.9924	0.9970 (94)
Useful gains	1159.6968	1372.2009	1525.2851	1674.5137	1649.9210	1342.3262	958.4730	987.4544	1274.8700	1270.8536	1155.6128	1102.8676 (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	3836.5625	3728.8082	3386.4100	2842.9615	2210.6263	1497.8841	990.7640	1038.5219	1603.6218	2390.2273	3161.5377	3816.4811 (97)
Space heating kWh	1991.5881	1583.6401	1384.6769	841.2824	417.1647	0.0000	0.0000	0.0000	0.0000	832.8140	1444.2659	2018.9284 (98a)
Space heating requirement - total per year (kWh/year)												10514.3606
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	1991.5881	1583.6401	1384.6769	841.2824	417.1647	0.0000	0.0000	0.0000	0.0000	832.8140	1444.2659	2018.9284 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10514.3606
Space heating per m2												(98c) / (4) = 38.6984 (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	1991.5881	1583.6401	1384.6769	841.2824	417.1647	0.0000	0.0000	0.0000	0.0000	832.8140	1444.2659	2018.9284 (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)	2157.7336	1715.7531	1500.1917	911.4653	451.9661	0.0000	0.0000	0.0000	0.0000	902.2904	1564.7518	2187.3547 (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	262.9036	232.3838	246.9038	217.5134	211.0577	190.4353	188.2907	195.7311	197.8038	220.2262	233.6907	260.1226 (64)	
Efficiency of water heater (217)m	87.6473	87.5367	87.3099	86.7892	85.5582	79.8000	79.8000	79.8000	79.8000	86.7538	87.4268	79.8000 (216)	
Fuel for water heating, kWh/month	299.9564	265.4702	282.7903	250.6228	246.6833	238.6407	235.9532	245.2771	247.8744	253.8520	267.2988	296.7016 (219)	
Space cooling fuel requirement													

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(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	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	52.8774	42.4202	38.1947	27.9831	21.6149	17.6596	19.7179	25.6300	33.2909	43.6794	49.3358	54.3470	54.3470	(232)
Electricity generated by PVs (Appendix M) (negative quantity)														
(233a)m	-95.6861	-129.8704	-179.6136	-193.8151	-202.0694	-185.8452	-183.2679	-176.2285	-163.0453	-144.3563	-103.2802	-83.3037	-83.3037	(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	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	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	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)														
(233b)m	-70.2660	-145.6642	-285.8047	-424.1180	-556.1009	-557.3628	-551.0493	-468.8779	-346.5976	-206.8477	-93.2917	-55.7508	-55.7508	(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	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	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	0.0000	(235d)
Annual totals kWh/year														
Space heating fuel - main system 1													11391.5066	(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													3131.1208	(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)													426.7509	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-5602.1135	(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													9433.2649	(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	11391.5066	0.2100	2392.2164 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3131.1208	0.2100	657.5354 (264)
Space and water heating			3049.7518 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	426.7509	0.1443	61.5933 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1840.3818	0.1355	-249.3253
PV Unit electricity exported	-3761.7317	0.1262	-474.8938
Total			-724.2191 (269)
Total CO2, kg/year			2399.0553 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.8300 (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	11391.5066	1.1300	12872.4025 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3131.1208	1.1300	3538.1665 (278)
Space and water heating			16410.5690 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	426.7509	1.5338	654.5648 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1840.3818	1.5007	-2761.9370
PV Unit electricity exported	-3761.7317	0.4634	-1743.2414
Total			-4505.1784 (283)
Total Primary energy kWh/year			12690.0562 (286)
Target Primary Energy Rate (TPER)			46.7100 (287)

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Property Reference	Tony		Issued on Date	18/09/2023	
Assessment Reference	Heatpump + PV	Prop Type Ref			
Property	29 BEECH HILL, TONY, EN4 0JN				
SAP Rating	92 A	DER	1.52	TER	8.83
Environmental	98 A	% DER < TER			82.79
CO <sub>2</sub> Emissions (t/year)	0.35	DFEE	39.58	TFEE	42.07
Compliance Check	See BREL	% DFEE < TFEE			5.92
% DPER < TPER	66.87	DPER	15.48	TPER	46.71
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 <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	113.3400 (1b)	x 2.9400 (2b)	= 333.2196 (1b) -
First floor	93.2700 (1c)	x 2.9500 (2c)	= 275.1465 (1c) -
Second floor	65.0900 (1d)	x 2.8600 (2d)	= 186.1574 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	271.7000		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 794.5235 (5)

## 2. Ventilation rate

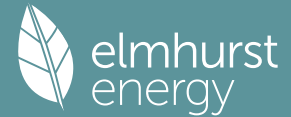
	m <sup>3</sup> per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	5 * 10 = 50.0000 (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) =	50.0000 / (5) = 0.0629 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.2129 (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) = 0.2129 (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	0.2715	0.2662	0.2608	0.2342	0.2289	0.2023	0.2023	0.1970	0.2129	0.2289	0.2395	0.2502 (22b)
Effective ac	0.5369	0.5354	0.5340	0.5274	0.5262	0.5205	0.5205	0.5194	0.5227	0.5262	0.5287	0.5313 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
FRONT (Uw = 1.30)			9.0200	1.2357	11.1464		(27)
SIDE (Uw = 1.30)			4.3200	1.2357	5.3384		(27)
REAR (Uw = 1.30)			6.0300	1.2357	7.4515		(27)
FRONT			2.8300	1.3000	3.6790		(26)
SIDE			12.4900	1.3000	16.2370		(26a)
REAR			18.8100	1.3000	24.4530		(26a)

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SIDE			2.4800	1.2357	3.0646								(27a)
FLAT ROOF			3.5000	1.2357	4.3251								(27a)
UNDERGROUND			113.3400	0.1400	15.8676	110.0000	12467.4000						(28a)
EXTERNAL	191.7500	53.5000	138.2500	0.1200	16.5900	70.0000	9677.5000						(29a)
ROOF WALL	17.3200		17.3200	0.1100	1.9052	70.0000	1212.4000						(29a)
FLAT ROOF @GF	8.2100		8.2100	0.1100	0.9031	9.0000	73.8900						(30)
FLAT ROOF @SF	38.2100	3.5000	34.7100	0.1100	3.8181	9.0000	312.3900						(30)
PITCHED ROOF RU	37.0400		37.0400	0.1000	3.7040	9.0000	333.3600						(30)
PITCHED RAFTER	26.8800	2.4800	24.4000	0.1000	2.4400	9.0000	219.6000						(30)
Total net area of external elements Aum(A, m2)			432.7500										(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	120.9230								(33)
PARTY WALL			117.4600	0.0000	0.0000	180.0000	21142.8000						(32)
INTERNAL FLOOR @FF			93.2700			18.0000	1678.8600						(32d)
INTERNAL FLOOR @SF			65.0900			18.0000	1171.6200						(32d)
INTERNAL CEILING @GF			93.2700			9.0000	839.4300						(32e)
INTERNAL CEILING @FF			65.0900			9.0000	585.8100						(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 49715.0600 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 182.9778 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				0.0000 (36)
Point Thermal bridges				(36a) = 0.0000
Total fabric heat loss				(33) + (36) + (36a) = 120.9230 (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	140.7588	140.3836	140.0159	138.2884	137.9652	136.4607	136.4607	136.1821	137.0402	137.9652	138.6191	139.3026	(38)
Average = Sum(39)m / 12 =	261.6819	261.3067	260.9389	259.2115	258.8883	257.3837	257.3837	257.1051	257.9633	258.8883	259.5421	260.2256	(39)
													259.2099

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9631	0.9617	0.9604	0.9540	0.9528	0.9473	0.9473	0.9463	0.9494	0.9528	0.9553	0.9578	(40)
HLP (average)													0.9540
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

#### 4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.0951 (42)
Hot water usage for mixer showers													
Hot water usage for baths													
Hot water usage for other uses													
Average daily hot water use (litres/day)													142.7534 (43)
Daily hot water use	155.2978	151.9814	147.9428	141.8020	136.8152	131.4539	129.3939	133.4151	137.6560	143.2843	149.5196	154.8951	(44)
Energy conte	245.9537	216.4194	227.3825	194.1198	184.1795	161.6380	156.4907	165.1957	169.7436	194.4354	213.0181	242.5283	(45)
Energy content (annual)													Total = Sum(45)m = 2371.1047
Distribution loss (46)m = 0.15 x (45)m	36.8931	32.4629	34.1074	29.1180	27.6269	24.2457	23.4736	24.7794	25.4615	29.1653	31.9527	36.3792	(46)
Water storage loss:													
Store volume													210.0000 (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													
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	(57)
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	304.3701	269.1826	285.7989	250.6518	242.5959	218.1700	214.9071	223.6121	226.2756	252.8518	269.5501	300.9447	(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	304.3701	269.1826	285.7989	250.6518	242.5959	218.1700	214.9071	223.6121	226.2756	252.8518	269.5501	300.9447	(64)
Total per year (kWh/year) = Sum(64)m =													3058.9107 (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	128.5127	114.1700	122.3378	109.7704	107.9728	98.9702	98.7663	101.6607	101.6653	111.3829	116.0541	127.3738	(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	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													

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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	254.4872	281.7536	254.4872	262.9701	254.4872	262.9701	254.4872	254.4872	262.9701	254.4872	262.9701	254.4872	(67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	434.9226	439.4358	428.0628	403.8511	373.2882	344.5634	325.3735	320.8604	332.2333	356.4450	387.0079	415.7327	(68)
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)	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	(71)
Water heating gains (Table 5)	172.7322	169.8959	164.4325	152.4590	145.1247	137.4586	132.7504	136.6407	141.2019	149.7082	161.1863	171.2013	(72)
Total internal gains	931.5691	960.5124	916.4096	888.7073	842.3272	814.4192	782.0381	781.4153	805.8323	830.0674	880.5913	910.8483	(73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W
South	9.0200	46.7521	0.5700	0.5700	0.8000	0.7700	133.2617	(78)
West	4.3200	19.6403	0.5700	0.5700	0.8000	0.7700	26.8120	(80)
North	6.0300	10.6334	0.5700	0.5700	0.8000	0.7700	20.2622	(74)
West	2.4800	26.6072	0.5700	0.5700	0.8000	1.0000	27.0806	(82)
North	3.5000	26.0000	0.5700	0.5700	0.8000	1.0000	37.3464	(82)

Solar gains	244.7630	441.7352	662.6800	906.3120	1083.9075	1103.9065	1052.8766	917.7202	747.4709	504.6620	297.8733	206.3223	(83)
Total gains	1176.3320	1402.2476	1579.0896	1795.0193	1926.2347	1918.3257	1834.9147	1699.1355	1553.3032	1334.7294	1178.4647	1117.1706	(84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains for living area, ni1,m (see Table 9a)													21.0000	(85)
tau	52.7730	52.8488	52.9233	53.2760	53.3425	53.6543	53.6543	53.7124	53.5337	53.3425	53.2081	53.0683		
alpha	4.5182	4.5233	4.5282	4.5517	4.5562	4.5770	4.5770	4.5808	4.5689	4.5562	4.5472	4.5379		
util living area	0.9981	0.9954	0.9888	0.9647	0.8982	0.7531	0.5894	0.6497	0.8714	0.9790	0.9958	0.9985	(86)	
Living	19.3277	19.5285	19.8364	20.2633	20.6446	20.8936	20.9732	20.9586	20.7762	20.2731	19.7240	19.2939		
Non living	18.1235	18.3813	18.7751	19.3172	19.7790	20.0497	20.1149	20.1070	19.9373	19.3358	18.6359	18.0834		
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	20.1445	19.5285	19.8364	20.2633	20.6446	20.8936	20.9732	20.9586	20.7762	20.2731	19.7240	19.5326	(87)	
Th 2	20.1142	20.1153	20.1165	20.1218	20.1228	20.1275	20.1275	20.1283	20.1257	20.1228	20.1208	20.1187	(88)	
util rest of house	0.9976	0.9942	0.9857	0.9543	0.8669	0.6815	0.4846	0.5455	0.8207	0.9710	0.9946	0.9981	(89)	
MIT 2	19.3206	18.3813	18.7751	19.3172	19.7790	20.0497	20.1149	20.1070	19.9373	19.3358	18.6359	18.4501	(90)	
Living area fraction									fLA = Living area / (4) =			0.2939	(91)	
MIT	19.5628	18.7185	19.0870	19.5953	20.0334	20.2978	20.3672	20.3573	20.1839	19.6113	18.9557	18.7683	(92)	
Temperature adjustment												0.0000		
adjusted MIT	19.5628	18.7185	19.0870	19.5953	20.0334	20.2978	20.3672	20.3573	20.1839	19.6113	18.9557	18.7683	(93)	

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9972	0.9915	0.9808	0.9465	0.8632	0.6966	0.5146	0.5745	0.8246	0.9648	0.9921	0.9972	(94)
Useful gains	1173.0137	1390.2915	1548.8080	1698.9174	1662.6807	1336.3729	944.2059	976.1210	1280.9175	1287.7641	1169.1670	1114.0873	(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	3993.9853	3610.8630	3284.4474	2772.3351	2157.4277	1466.5136	969.6039	1017.4449	1569.4236	2332.9148	3077.0530	3791.0437	(97)
Space heating kWh	2098.8029	1492.2241	1291.3157	772.8607	368.0917	0.0000	0.0000	0.0000	0.0000	777.5922	1373.6779	1991.6556	(98a)
Space heating requirement - total per year (kWh/year)												10166.2208	
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	2098.8029	1492.2241	1291.3157	772.8607	368.0917	0.0000	0.0000	0.0000	0.0000	777.5922	1373.6779	1991.6556	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10166.2208	
Space heating per m2										(98c) / (4) =		37.4171	(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 %)	470.8811	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2098.8029	1492.2241	1291.3157	772.8607	368.0917	0.0000	0.0000	0.0000	0.0000	777.5922	1373.6779	1991.6556	(98)
Space heating efficiency (main heating system 1)	470.8811	470.8811	470.8811	470.8811	470.8811	0.0000	0.0000	0.0000	0.0000	470.8811	470.8811	470.8811	(210)
Space heating fuel (main heating system)	445.7182	316.9004	274.2339	164.1307	78.1708	0.0000	0.0000	0.0000	0.0000	165.1356	291.7250	422.9635	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	304.3701	269.1826	285.7989	250.6518	242.5959	218.1700	214.9071	223.6121	226.2756	252.8518	269.5501	300.9447	(64)
Efficiency of water heater (217)m	318.5504	318.5504	318.5504	318.5504	318.5504	318.5504	318.5504	318.5504	318.5504	318.5504	318.5504	318.5504	(216)
Fuel for water heating, kWh/month	95.5485	84.5024	89.7186	78.6851	76.1562	68.4884	67.4641	70.1968	71.0329	79.3758	84.6177	94.4732	(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	49.2027	39.4723	35.5404	26.0384	20.1128	16.4323	18.3476	23.8489	30.9773	40.6440	45.9073	50.5702	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-24.9957	-41.5986	-70.5371	-93.7875	-114.6767	-111.7165	-110.2273	-96.8780	-76.5234	-52.9700	-29.6105	-20.9234	(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	-0.0475	-0.1913	-0.6360	-1.5985	-3.1647	-4.1403	-4.0985	-3.0089	-1.7082	-0.4529	-0.0944	-0.0335	(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													2158.9781 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													318.5504
Water heating fuel used													960.2596 (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)													397.0942 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-863.6197 (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													2652.7122 (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	2158.9781	0.1550	334.5551	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	960.2596	0.1409	135.3330	(264)
Space and water heating			469.8881	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	397.0942	0.1443	57.3130	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-844.4447	0.1314	-110.9842	
PV Unit electricity exported	-19.1750	0.1136	-2.1785	
Total			-113.1627	(269)
Total CO2, kg/year			414.0383	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.5200	(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	2158.9781	1.5737	3397.5265	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	960.2596	1.5211	1460.6736	(278)
Space and water heating			4858.2002	(279)

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Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	397.0942	1.5338	609.0763 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-844.4447	1.4856	-1254.4671
PV Unit electricity exported	-19.1750	0.4161	-7.9779
Total			-1262.4450 (283)
Total Primary energy kWh/year			4204.8315 (286)
Dwelling Primary energy Rate (DPER)			15.4800 (287)

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 SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF TARGET EMISSIONS  
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 1. Overall dwelling characteristics  
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	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	113.3400 (1b)	x 2.9400 (2b)	= 333.2196 (1b) -
First floor	93.2700 (1c)	x 2.9500 (2c)	= 275.1465 (1c) -
Second floor	65.0900 (1d)	x 2.8600 (2d)	= 186.1574 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	271.7000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	794.5235 (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) = 0.0503 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3003 (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) = 0.3003 (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	0.3829	0.3754	0.3679	0.3304	0.3229	0.2853	0.2853	0.2778	0.3003	0.3229	0.3379	0.3529 (22b)
Effective ac	0.5733	0.5705	0.5677	0.5546	0.5521	0.5407	0.5407	0.5386	0.5451	0.5521	0.5571	0.5623 (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 Opaque door			2.8300	1.0000	2.8300		(26)
TER Semi-glazed door			31.3000	1.0000	31.3000		(26a)
TER Opening Type (Uw = 1.20)			19.3700	1.1450	22.1794		(27)
SIDE			2.4800	2.0221	5.0147		(27a)
FLAT ROOF			3.5000	2.0221	7.0772		(27a)
UNDERGROUND			113.3400	0.1300	14.7342		(28a)
EXTERNAL	191.7500	53.5000	138.2500	0.1800	24.8850		(29a)
ROOF WALL	17.3200		17.3200	0.1800	3.1176		(29a)
FLAT ROOF @GF	8.2100		8.2100	0.1100	0.9031		(30)
FLAT ROOF @SF	38.2100	3.5000	34.7100	0.1100	3.8181		(30)
PITCHED ROOF RU	37.0400		37.0400	0.1100	4.0744		(30)
PITCHED RAFTER	26.8800	2.4800	24.4000	0.1100	2.6840		(30)
Total net area of external elements Aum(A, m2)			432.7500				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	122.6177		(33)
PARTY WALL			117.4600	0.0000	0.0000		(32)



# Full SAP Calculation Printout



Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K													182.9778 (35)
List of Thermal Bridges													
K1 Element													
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	Length	Psi-value										Total	0.0000 (36)
Point Thermal bridges												(36a) =	0.0000
Total fabric heat loss												(33) + (36) + (36a) =	122.6177 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(38)
Heat transfer coeff	150.3207	149.5742	148.8425	145.4056	144.7626	141.7692	141.7692	141.2148	142.9222	144.7626	146.0634	147.4234	
Average = Sum(39)m / 12 =	272.9384	272.1919	271.4602	268.0233	267.3803	264.3869	264.3869	263.8325	265.5399	267.3803	268.6811	270.0411	(39)
HLP	1.0046	1.0018	0.9991	0.9865	0.9841	0.9731	0.9731	0.9710	0.9773	0.9841	0.9889	0.9939	(40)
HLP (average)													0.9865
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

## 4. Water heating energy requirements (kWh/year)

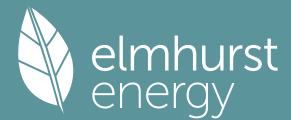
Assumed occupancy													3.0951 (42)
Hot water usage for mixer showers	76.1152	74.9713	73.3045	70.1153	67.7618	65.1371	63.6453	65.2995	67.1128	69.9309	73.1886	75.8236	(42a)
Hot water usage for baths	32.8553	32.3673	31.6802	30.4132	29.4646	28.4126	27.8444	28.5267	29.2697	30.3953	31.6883	32.7442	(42b)
Hot water usage for other uses	46.3273	44.6427	42.9581	41.2734	39.5888	37.9042	37.9042	39.5888	41.2734	42.9581	44.6427	46.3273	(42c)
Average daily hot water use (litres/day)													142.7534 (43)
Daily hot water use	155.2978	151.9814	147.9428	141.8020	136.8152	131.4539	129.3939	133.4151	137.6560	143.2843	149.5196	154.8951	(44)
Energy conte	245.9537	216.4194	227.3825	194.1198	184.1795	161.6380	156.4907	165.1957	169.7436	194.4354	213.0181	242.5283	(45)
Energy content (annual)													Total = Sum(45)m = 2371.1047
Distribution loss (46)m = 0.15 x (45)m	36.8931	32.4629	34.1074	29.1180	27.6269	24.2457	23.4736	24.7794	25.4615	29.1653	31.9527	36.3792	(46)
Water storage loss:													210.0000 (47)
Store volume													1.7016 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.5400 (49)
Temperature factor from Table 2b													0.9188 (55)
Enter (49) or (54) in (55)													
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	297.7003	263.1583	279.1291	244.1972	235.9261	211.7153	208.2373	216.9423	219.8209	246.1820	263.0955	294.2749	(62)
WWHRS	-34.7967	-30.7745	-32.2253	-26.6838	-24.8683	-21.2800	-19.9466	-21.2112	-22.0171	-25.9558	-29.4047	-34.1523	(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	262.9036	232.3838	246.9038	217.5134	211.0577	190.4353	188.2907	195.7311	197.8038	220.2262	233.6907	260.1226	(64)
12Total per year (kWh/year)													Total per year (kWh/year) = Sum(64)m = 2657.0628 (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	123.1769	109.3505	117.0020	104.6067	102.6370	93.8065	93.4304	96.3249	96.5016	106.0470	110.8904	122.0379	(65)

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

Metabolic gains (Table 5), Watts	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	154.7570	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	254.4872	281.7536	254.4872	262.9701	254.4872	262.9701	254.4872	254.4872	262.9701	254.4872	262.9701	254.4872	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	434.9226	439.4358	428.0628	403.8511	373.2882	344.5634	325.3735	320.8604	332.2333	356.4450	387.0079	415.7327	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	38.4757	(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)	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	-123.8056	(71)
Water heating gains (Table 5)	165.5603	162.7240	157.2607	145.2871	137.9529	130.2868	125.5785	129.4689	134.0300	142.5363	154.0144	164.0295	(72)
Total internal gains	927.3972	956.3405	912.2378	884.5354	838.1554	807.2474	774.8663	774.2435	798.6605	825.8956	876.4195	906.6764	(73)

## 6. Solar gains

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[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	6.0300	10.6334	0.6300	0.7000	0.7700	19.5957 (74)
South	9.0200	46.7521	0.6300	0.7000	0.7700	128.8781 (78)
West	4.3200	19.6403	0.6300	0.7000	0.7700	25.9300 (80)
North	3.5000	26.0000	0.6300	0.7000	1.0000	36.1179 (82)
West	2.4800	26.6072	0.6300	0.7000	1.0000	26.1898 (82)

Solar gains	236.7116	427.2045	640.8813	876.4991	1048.2526	1067.5937	1018.2425	887.5320	722.8830	488.0613	288.0749	199.5354 (83)
Total gains	1164.1088	1383.5450	1553.1191	1761.0345	1886.4080	1874.8411	1793.1088	1661.7755	1521.5435	1313.9569	1164.4943	1106.2118 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	50.5965	50.7353	50.8721	51.5244	51.6483	52.2331	52.2331	52.3428	52.0063	51.6483	51.3983	51.1394
alpha	4.3731	4.3824	4.3915	4.4350	4.4432	4.4822	4.4822	4.4895	4.4671	4.4432	4.4266	4.4093
util living area	0.9981	0.9956	0.9897	0.9684	0.9090	0.7733	0.6126	0.6719	0.8841	0.9808	0.9960	0.9985 (86)
MIT	19.2406	19.4423	19.7556	20.1999	20.5982	20.8736	20.9662	20.9493	20.7460	20.2232	19.6611	19.2174 (87)
Th 2	20.0795	20.0818	20.0841	20.0946	20.0966	20.1058	20.1058	20.1075	20.1023	20.0966	20.0926	20.0884 (88)
util rest of house	0.9976	0.9945	0.9869	0.9588	0.8796	0.7020	0.5036	0.5649	0.8355	0.9734	0.9948	0.9981 (89)
MIT 2	17.9885	18.2482	18.6498	19.2188	19.7053	20.0124	20.0898	20.0811	19.8864	19.2548	18.5363	17.9648 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	18.3565	18.5992	18.9748	19.5071	19.9677	20.2655	20.3474	20.3363	20.1391	19.5394	18.8669	18.3330 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.3565	18.5992	18.9748	19.5071	19.9677	20.2655	20.3474	20.3363	20.1391	19.5394	18.8669	18.3330 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9962	0.9918	0.9821	0.9509	0.8746	0.7160	0.5345	0.5942	0.8379	0.9672	0.9924	0.9970 (94)
Useful gains	1159.6968	1372.2009	1525.2851	1674.5137	1649.9210	1342.3262	958.4730	987.4544	1274.8700	1270.8536	1155.6128	1102.8676 (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	3836.5625	3728.8082	3386.4100	2842.9615	2210.6263	1497.8841	990.7640	1038.5219	1603.6218	2390.2273	3161.5377	3816.4811 (97)
Space heating kWh	1991.5881	1583.6401	1384.6769	841.2824	417.1647	0.0000	0.0000	0.0000	0.0000	832.8140	1444.2659	2018.9284 (98a)
Space heating requirement - total per year (kWh/year)												10514.3606
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	1991.5881	1583.6401	1384.6769	841.2824	417.1647	0.0000	0.0000	0.0000	0.0000	832.8140	1444.2659	2018.9284 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10514.3606
Space heating per m2												(98c) / (4) = 38.6984 (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	1991.5881	1583.6401	1384.6769	841.2824	417.1647	0.0000	0.0000	0.0000	0.0000	832.8140	1444.2659	2018.9284 (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)	2157.7336	1715.7531	1500.1917	911.4653	451.9661	0.0000	0.0000	0.0000	0.0000	902.2904	1564.7518	2187.3547 (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	262.9036	232.3838	246.9038	217.5134	211.0577	190.4353	188.2907	195.7311	197.8038	220.2262	233.6907	260.1226 (64)
Efficiency of water heater (217)m	87.6473	87.5367	87.3099	86.7892	85.5582	79.8000	79.8000	79.8000	79.8000	86.7538	87.4268	79.8000 (216)
Fuel for water heating, kWh/month	299.9564	265.4702	282.7903	250.6228	246.6833	238.6407	235.9532	245.2771	247.8744	253.8520	267.2988	296.7016 (219)
Space cooling fuel requirement												

# Full SAP Calculation Printout



(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	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	52.8774	42.4202	38.1947	27.9831	21.6149	17.6596	19.7179	25.6300	33.2909	43.6794	49.3358	54.3470	54.3470	(232)
Electricity generated by PVs (Appendix M) (negative quantity)														
(233a)m	-95.6861	-129.8704	-179.6136	-193.8151	-202.0694	-185.8452	-183.2679	-176.2285	-163.0453	-144.3563	-103.2802	-83.3037	-83.3037	(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	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	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	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)														
(233b)m	-70.2660	-145.6642	-285.8047	-424.1180	-556.1009	-557.3628	-551.0493	-468.8779	-346.5976	-206.8477	-93.2917	-55.7508	-55.7508	(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	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	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	0.0000	(235d)
Annual totals kWh/year														
Space heating fuel - main system 1													11391.5066	(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													3131.1208	(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)													426.7509	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-5602.1135	(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													9433.2649	(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	11391.5066	0.2100	2392.2164 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3131.1208	0.2100	657.5354 (264)
Space and water heating			3049.7518 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	426.7509	0.1443	61.5933 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1840.3818	0.1355	-249.3253
PV Unit electricity exported	-3761.7317	0.1262	-474.8938
Total			-724.2191 (269)
Total CO2, kg/year			2399.0553 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.8300 (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	11391.5066	1.1300	12872.4025 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3131.1208	1.1300	3538.1665 (278)
Space and water heating			16410.5690 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	426.7509	1.5338	654.5648 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1840.3818	1.5007	-2761.9370
PV Unit electricity exported	-3761.7317	0.4634	-1743.2414
Total			-4505.1784 (283)
Total Primary energy kWh/year			12690.0562 (286)
Target Primary Energy Rate (TPER)			46.7100 (287)