

Shellbrook, High Street, Ardingly Energy & Sustainability Strategy

Version -

NU PLANET

Project Details

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Executive Summary

The purpose of this Energy & Sustainability strategy is to demonstrate that the proposed development at Shellbrook, High Street, Ardingly is considered a sustainable development, as measured against relevant local and national planning policies.

The applicant is applying for the demolition of the existing property and construction of a two storey, four-bedroom, family home.

Through the incorporation of sustainable design and construction methods, energy and water saving measures, sustainable transport methods, waste reduction techniques, and measures to enhance the ecological value of the site, a high quality and sustainable development is proposed.

The analysis shows that the proposed designs will achieve significant reductions in carbon emissions over Part L 2021 across all stages of the Energy Hierarchy and is fully compliant with all relevant planning policies.

ENERGY STRATEGY SUMMARY

BE LEAN

Significant reductions in CO₂ emissions have been achieved through a fabric first approach and incorporation of passive design features.

- 14.11% Reduction in CO₂ Emissions

BE CLEAN

The availability of district heating networks has been assessed as part of this energy strategy, but no opportunities have been identified.

- 14.11% Reduction in CO₂ Emissions

BE GREEN

The use of LZCs and renewable energy systems has been reviewed, and an Air Source Heat pump has been identified as a suitable solution for the development leading to further reductions in carbon emissions.

- 66.19% Reduction in CO₂ Emissions

The savings in carbon reductions achieved through energy efficient design, the use of low carbon heating systems, and the incorporation of renewable technologies equate to a CO₂ reduction of 2,712kg/yr.

Furthermore 22% of the site's energy demand will be met through a solar PV array

KEY SUSTAINABILITY FEATURES

- 66.19% reduction in CO₂ emission
- Low carbon heating & hot water systems throughout
- Maximum internal water consumption of 110l/pp/day
- Segregated bins for refuse, and recycling.
- Use of materials with low environmental impact
- Dwellings designed to meet Part M4[2] to create an accessible, inclusive development

Introduction

This Energy & Sustainability Strategy has been prepared on behalf of the client by NuPlanet, a specialist Building Performance Consultancy.

This strategy sets out the design and construction measures to be followed to ensure the delivery of a high quality, low energy, sustainable development at Shellbrook, High Street, Ardingly.

Development overview

The proposed development involves the demolition of the existing fire damaged property and construction of a two-storey, four-bedroom family home. The site in Ardingly extends to around 0.3 hectares [0.74 acres] and is within the Mid Sussex planning boundary.

The scheme design is for a two-storey dwelling with bedrooms at first floor and living accommodation at ground floor. Ancillary accommodation is provided in an adjacent, single storey structure, connected to the main dwelling for a glazed link.

Off-street car parking and secure cycle storage will be provided by way of an integral garage at the south-west end of the building.

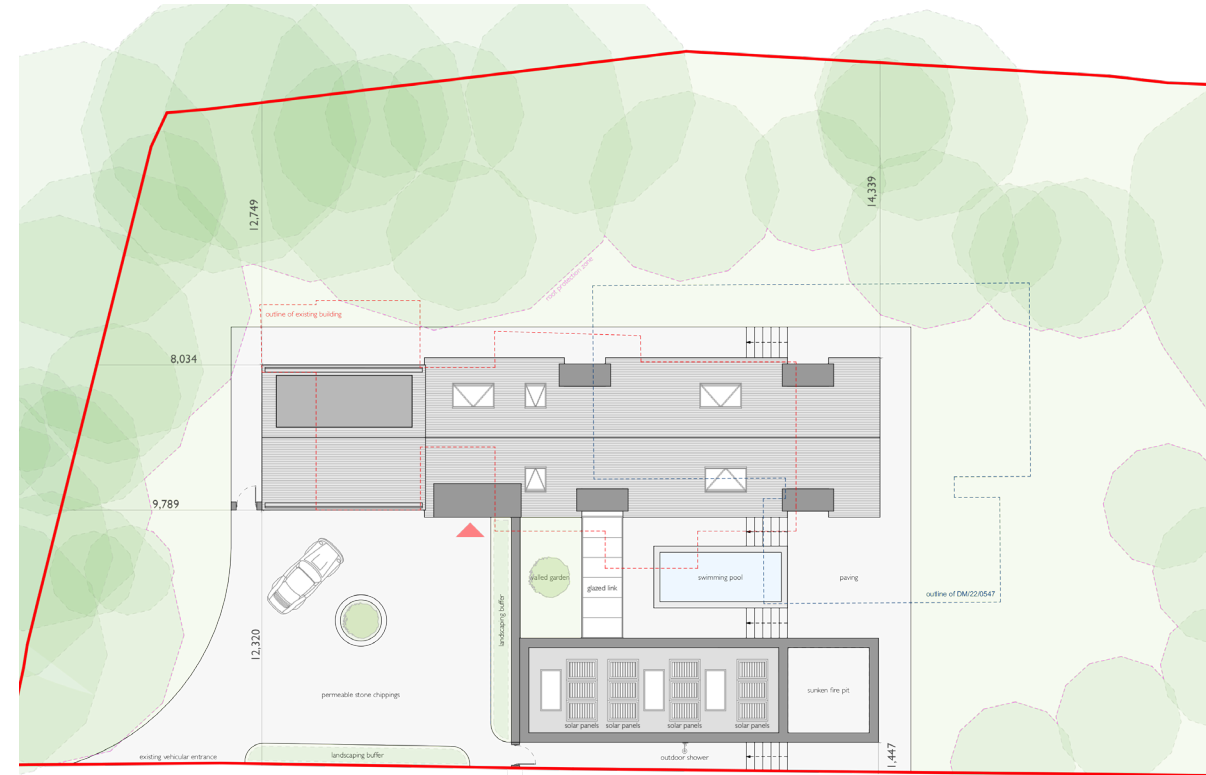


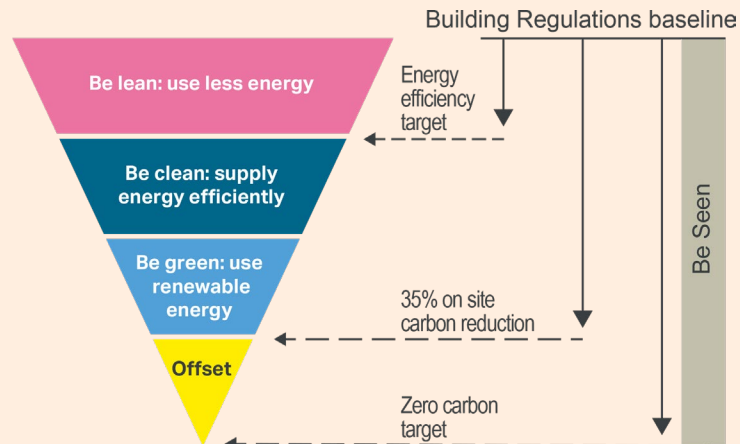
FIGURE 01 – SITE PLAN [PMR ARCHITECTURE]

Objectives

The objectives for this report are to demonstrate how the development responds to national and local planning sustainability policies, and how CO₂ emissions from will be minimised in accordance with national building regulations requirements.

Energy hierarchy

- The purpose of the Energy Hierarchy is to demonstrate that climate change mitigation measures are a fundamental part of the development's design philosophy.
- Be Lean: Considers passive design and energy efficiency measures.
- Be Clean: Exploit local energy resources [such as secondary heat] and supply energy efficiently and cleanly.
- Be Green: Maximise opportunities for renewable energy producing, storing, and using renewable energy on-site.
- Be Seen: Monitor, verify, and report on energy performance



Methodology

This document has been prepared in line with the Energy Planning GLA Guidance on the preparation of Energy Assessments [GLA, 06.22].

All calculations are based on drawings and information provided for planning approval. The results provide an initial assessment of the design ensuring planning policy requirements can be met.

The assessment has followed the Standard Assessment Procedure for the Energy Rating of Dwellings [SAP], using SAP10.2 versions of the software to establish baseline and target efficiencies for the proposed development.

The formulation of the Energy & Sustainability Strategy for the proposed development has considered several important objectives, including:

- All national and local planning policies and requirements.
- A viable reduction in CO₂ emissions with an affordable, deliverable, and technically appropriate strategy.
- A high-quality development that is adaptable to future changes in climate.
- Minimising the negative impact of the proposed development on both the local and wider climate and environment.
- To achieve the highest viable levels of sustainable design and construction.
- Minimising emissions of pollutants such as oxides of nitrogen and particulate matter; and
- To create a pleasant, safe, and friendly living environment that will be flexible to its occupants' needs.

Planning policy and drivers

All new developments are governed by national and local planning requirements that set out how we will meet the challenges of a changing environment.

The NPPF sets out the Government’s planning policies for England and how these should be applied. It provides a framework within which Local Authorities can prepare local development plans. The framework sets out a presumption in favour of sustainable development, promoting high standards of design that reduce carbon emissions and support renewable and low carbon technologies.

Mid Sussex District Council’s latest Local Plan 2014-2031 contains various planning policies that cover sustainable development, and how projects are expected to tackle climate change through their design and construction.

The relevant policies considered as part of this study are listed opposite, more detailed information on each policy can be found in Appendices 03.

NATIONAL POLICY – NPPF

Relevant policies

- Chapter 02. Achieving Sustainable Development
- Chapter 14. Meeting the challenge of climate change, flooding, and coastal change

LOCAL POLICY MID SUSSEX DISTRICT COUNCIL

Relevant policies

- Policy DP21 Transport
- Policy DP29 Noise, Air and Light Pollution
- Policy DP39 Sustainable Design and Construction
- Policy DP42 Water Infrastructure and Water Environment

BUILDING REGULATIONS

The applicable Building Regulations addressed in this report include:

- Approved Document Part L
- Approved Document Part O
- Approved Document Part F
- Approved Document Part G

The latest version of the above documents has been used in each case.

Further details of planning policy and key drivers can be found in Appendix 01.

Energy Strategy

The Energy Hierarchy provides a standardised route for assessing the energy efficiency of new developments at planning. The hierarchy follows a fabric first approach to ensure energy consumption is minimised before low zero carbon or renewable technologies are considered.

To accurately measure the improvements over the minimum standards set out in Part L1 2021, the proposals have been modelled using the latest SAP10 software in full compliance with UK Building Regulations.

The modelling sets a Target Emission Rating [TER] and Target Fabric Energy Efficiency [TFEE] for the notional development, which acts as a baseline for assessing improvement measures against in each of the Be Lean, Be Clean, Be Green stages.

The specifications used and resulting reduction in carbon emissions at each stage of the Energy Hierarchy are set out on the following pages. Sample SAP assessments are provided for each stage in Appendix 02.

Be Lean

The Be Lean stage of the Energy Hierarchy is a fundamental first step as it focuses on reducing energy demand through efficiency measures. Minimising energy waste at design and operation levels can lead to significant reductions in carbon emissions and energy consumption.

Prioritising energy efficiency before implementing low-carbon or renewable systems helps to optimise the design proposals and embed sustainability into the scheme from the early stages.

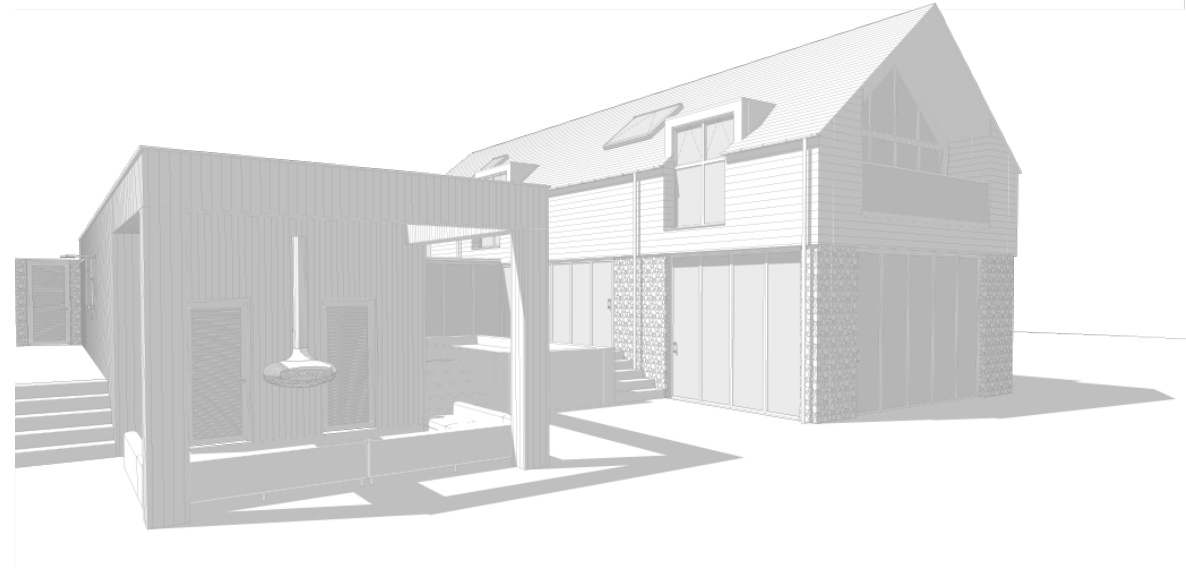


FIGURE 02 – 3D VISUALISATION [PMR ARCHITECTURE]

Building Design

Every effort has been made to optimise the orientation of the development to maximise access to natural light, whilst minimising potential for overheating. By optimising orientation and fenestration details internal daylight levels have been maximised, reducing artificial lighting demand throughout the development.

Thermal Envelope

A fabric first approach has been adopted for the development to minimise energy consumption through passive design measures. The building fabric [walls, floors, and roofs] has been designed to exceed the minimum requirements of Building Regulations Part L.

Thermal Bridging

30% of heat loss can occur through thermal bridging through the building fabric. By adopting enhanced construction details throughout the development further improvements in energy efficiency and emissions reductions will be achieved.

Air Permeability [Airtightness]

All new buildings are required to have air permeability tests on completion to confirm heat losses through uncontrolled ventilation [draughts]. To build on the higher standards of thermal efficiency in the building fabric, a target air permeability rate of 5m3/hr.m² has been specified.

Fenestration

Windows and external doors are designed to exceed the minimum requirements of Building Regulations Part L. The size and orientation of glazed elements has been optimised to provide all interior space with a high standard of daylight to reduce reliance on artificial lighting.

This optimised approach also maximises solar gains during the winter months, whilst minimizing overheating during the summer.

Ventilation

A natural ventilation strategy has been adopted for

Heating

For the purposes of the ‘Be Lean’ phase of the report the heating is assumed to be provided by electric panels with programmer & room thermostats.

Further investigations into suitable heating systems are explored in the ‘Be Green’ phase of the report.

Domestic hot water [DHW]

The hot water demand in the ‘Be Lean’ section of the report is provided by a 300L cylinder with a heat loss efficiency of 3.00kWh/day.

The cylinder is fed by a dual immersion heater.

Lighting

Low energy, LED lighting with a minimum efficacy of 85lm/W will be used throughout the development to minimise the energy requirement for the artificial lighting systems. External and common area lighting will be linked to daylight or motion sensors to prevent unnecessary use.

Be Lean: Summary

Following the implementation of passive design and energy efficiency measures set out on the previous page, the ‘Be Lean’ stage delivers an 14.11% reduction in CO₂ emissions beyond the baseline notional development.

The fabric and services specifications used in the analysis are shown in Table 02, with the result carbon emissions reductions in Table 03.

In addition to minimising energy consumption across the development, the strategy outlined in this phase will deliver a thermally efficient, comfortable development with high levels of natural daylight.

TABLE 02		BE LEAN
U-VALUES [W/M ² K]	GROUND FLOOR	0.13
	EXTERNAL WALLS	0.18
	ROOF	0.11
	WINDOWS	1.2 [0.63 G-VALUE]
	EXTERNAL DOORS	1.2 [0.63 G-VALUE]
THERMAL BRIDGING [PSI VALUES]		PSI VALUES TAKEN FROM TABLE R1 [SAP10 DOCUMENT]
AIR PERMEABILITY		5 M ³ /HR.M ² @50PA
VENTILATION STRATEGY		NATURAL WITH INTERMITTENT FANS
HEATING		ELECTRIC PANEL HEATERS WITH PROGRAMMER & ROOMSTAT
HOT WATER SYSTEM		300L DHW CYLINDER WITH IMMERSION
RENEWABLES		NOT INCLUDED AT THIS STAGE

TABLE 03	BE LEAN
TARGET ENERGY RATING [TER]	11.27kgCO ₂ /m ²
DWELLING ENERGY RATING [DER]	9.68kgCO ₂ /m ²
CO ₂ REDUCTION OVER PART L1 2021 [%]	14.11
TARGET FABRIC ENERGY EFFICIENCY [TFEE]	60.39kgCO ₂ /m ²
DWELLING FABRIC ENERGY EFFICIENCY [DFEE]	59.89kgCO ₂ /m ²
IMPROVEMENT OVER PART L [%]	0.84

Be Clean

Be Clean investigates how energy can be supplied efficiently to proposed developments by connecting sites to a heating or cooling network to further reduce carbon emissions. Due to the decarbonization of the electricity grid Combined Heat and Power systems [CHP] will not be considered as the use of these systems will create a net increase in carbon emissions.

District energy systems

There are no existing or planned Heat Networks within the vicinity of the development site.

Summary

Further reductions in emissions are unachievable at this stage, so the total reduction through the first two stages of the Energy Hierarchy remains as calculated at the Be Lean phase. Tables 04 and 05 provide the specifications and results, respectively.

TABLE 04		BE LEAN	TABLE 05	BE LEAN
U-VALUES [W/M²K]	GROUND FLOOR	0.13	TARGET ENERGY RATING [TER]	11.27kgCO ₂ /m²
	EXTERNAL WALLS	0.18	DWELLING ENERGY RATING [DER]	9.68kgCO ₂ /m²
	ROOF	0.11	CO ₂ REDUCTION OVER PART L1 2021 [%]	14.11
	WINDOWS	1.2 [0.63 G-VALUE]	TARGET FABRIC ENERGY EFFICIENCY [TFEE]	60.39kgCO ₂ /m²
	EXTERNAL DOORS	1.2 [0.63 G-VALUE]	DWELLING FABRIC ENERGY EFFICIENCY [DFEE]	59.89kgCO ₂ /m²
THERMAL BRIDGING [PSI VALUES]		PSI VALUES TAKEN FROM TABLE R1 [SAP10 DOCUMENT]	IMPROVEMENT OVER PART L [%]	0.84
AIR PERMEABILITY		5 M³/HR.M² @50PA		
VENTILATION STRATEGY		NATURAL WITH INTERMITTENT FANS		
HEATING		ELECTRIC PANEL HEATERS WITH PROGRAMMER & ROOMSTAT		
HOT WATER SYSTEM		300L DHW CYLINDER WITH IMMERSION		
RENEWABLES		NOT INCLUDED AT THIS STAGE		

Be Green encourages the incorporation of Low and Zero Carbon [LZC] technologies in a development to reduce site dependency on grid services and lower CO₂ emissions. A feasibility study has been undertaken to assess the suitability of each technology for the development, the study is provided in the following tabulated form.

LZC Feasibility study

Photovoltaics [PV]	Proposed	Solar thermal [hot water]	Suitable
PVs generate electricity from sunlight. PV systems require accessible roof space for the system to be installed and function correctly.		Solar thermal collectors provide hot water by utilising the energy present in sunlight to heat a collector; this is then transferred to a circulating fluid and used to heat hot water.	
SUITABILITY		SUITABILITY	
Available roof area – 85m²		Available roof area – 85m²	
The PV panels can be installed on the flat roof to the annex building, which would minimise visual impact within the setting.		Typical installation capital costs of a solar thermal system are around £4,000– £5,000 for an average 3.6m2 system.	
The typical install costs of a 4.0kWp PV system on a roof is £5,000–£7,500.		Potential – Solar thermal is considered a viable technology for the project due to the location and available roof area.	
Potential energy generation – A PV array on the proposed development would generate a proficient level of regular solar electricity due to the open surrounding allowing for minimal overshadowing, this would help running costs by reducing the need for grid electricity.		PROPOSAL	
PROPOSAL		Other technologies may offer further benefits, so no system has been included at the preliminary design stage.	
The flat roof space to the annex would allow for a 4kWp PV array to offset electric consumption on site.			

LZC Feasibility study

Small scale wind turbines Whilst small scale wind turbines can produce a high degree of energy, this is dependent on a consistent flow of air which makes them difficult to design into most developments. SUITABILITY Available space – There is limited available space on the site to support a wind turbine. A small-scale wind turbine system will have a big visual impact on this project, with a reasonably high installation capital cost of around £20,000 for a 2.5kW system. PROPOSAL Due to the highly complex requirements for a wind turbine installation to run efficiently, and potential impact of reverberation and noise on the occupants this technology is not considered appropriate for the development	Not Suitable	Ground source heat pump [GSHP] GSHPs extract heat [or coolth] from the ground. Systems can be installed horizontally in the ground over a large area, or vertically in boreholes. A heat exchanger is used to convert the extracted heat for use in heating and DHW. SUITABILITY Available space – There is limited space for horizontal heat loops, but the site could support vertical borehole loops. A typical installation cost for a horizontal GSHP system is around £25,000 to £40,000, a vertical borehole system will cost more [around £40,000–£60,000] for a system of this size. GSHPs are regarded as a very efficient way to meet the heating & hot water demand of a low energy house. PROPOSAL It is considered that a GSHP system is not suitable for this project due to limited space and high installation costs make the project unviable.	Suitable	Air source heat pump [ASHP] ASHPs utilise the temperature difference between external and internal spaces. A heat exchanger is used to convert the extracted heat for use in heating and DHW. SUITABILITY Available space– ASHP systems will require external compressor units which could easily be accommodated within the site area. The typical installed capital costs of an 5kW ASHP system is around £8,000–£14,000 each. PROPOSAL It is considered that an ASHP would be an ideal solution for this development.	Proposed	Biomass boiler Biomass boilers use a carbon neutral fuel source, such as wood pellets, to generate heat for hot water and heating. These systems require significant space for both the boilers and storage of the fuel. SUITABILITY Available space – Communal biomass boiler systems will require a storage facility for the fuel and plant space, which is not available on this project. There are several pros and cons for using this technology. Historically this type of system was regarded as a defer carbon neutral system that will generate the dwellings heat & hot water demand using largely waste material. However, more recent studies have confirmed that burning biomass fuel can lead to high pollution issues. PROPOSAL Biomass has been ruled out given limited space and high pollution issues.	Not Suitable
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LZC Feasibility study

Exhaust air
heat pump

Not suitable

Exhaust air heat pumps are a commonly adopted technology for smaller dwellings with lower heat loss, such as flats.

Heat is recovered from exhaust air extracted from the kitchen and bathrooms and used to heat the dwelling, provide hot water, and meet ventilation requirements.

SUITABILITY

Available space – Exhaust air heat pumps will commonly provide a heating, hot water and ventilation solution through one large unit. There is often no need for an external unit.

These systems normally have a built-in electric immersion heater or require an electric boiler to top up the heat demand, which is why they are more suited for efficient buildings to help keep running costs to a minimum.

An Exhaust air heat pump will typically cost between £15,000–£20,000 per dwelling, but will offer a compact heating, hot water and ventilation solution.

PROPOSAL

It is considered that this technology would not be suitable this project due to the size of the proposed property.

Energy storage

Proposed

Energy storage allows for energy created on site to be captured and stored for use later, this would be achieved through the installation of an accumulator or battery system.

Typically, these systems are paired with photovoltaics to maximise on-site energy use before electricity is exported back to the grid.

SUITABILITY

Available space – battery storage could potentially be installed within the garage.

Battery storage is an ideal partner for PV, allowing solar electricity to be stored during periods when the house is unoccupied, for use when the occupant returns.

The battery storage systems are normally wall mounted and can be located either internally or externally.

Capital install costs of a storage system are between £5,000–£10,000, but in the current energy market could be regarded as a good investment, especially if connect to EV charging.

PROPOSAL

It is considered that battery storage would be a viable technology for this project.

Be Green: Summary

The feasibility study has highlighted several appropriate Low or Zero Carbon Technologies [LZC] for the proposed development. In discussion with the Client and Architect, the following are seen as the most appropriate for inclusion:

- Air source heat pump [ASHP]
- A 4.00kWp PV array with 7kW battery

The specifications and reductions in carbon emissions are set out in Tables 06 and 07 respectively.

The ‘Be Green’ stage delivers an 60.39% reduction in CO₂ emissions over Part L1 2021 minimum standards. With a predicted total reduction CO₂ of 2,712kg per year.

The proposed PV array would approximately 2,433kWh/yr which would provide 22% of the site’s calculated regulated energy demand [11,094kWh/Yr].

TABLE 06		BE LEAN	TABLE 07		BE LEAN
U-VALUES [W/M²K]	GROUND FLOOR	0.13	TARGET ENERGY RATING [TER]	11.27kgCO ₂ /m²	
	EXTERNAL WALLS	0.18	DWELLING ENERGY RATING [DER]	3.81kgCO ₂ /m²	
	ROOF	0.11	CO ₂ REDUCTION OVER PART L1 2021 [%]	66.19	
	WINDOWS	1.2 [0.63 G-VALUE]	TARGET FABRIC ENERGY EFFICIENCY [TFEE]	60.39kgCO ₂ /m²	
	EXTERNAL DOORS	1.2 [0.63 G-VALUE]	DWELLING FABRIC ENERGY EFFICIENCY [DFEE]	59.89kgCO ₂ /m²	
THERMAL BRIDGING [PSI VALUES]		PSI VALUES TAKEN FROM TABLE R1 [SAP10 DOCUMENT]	IMPROVEMENT OVER PART L [%]	0.84	
AIR PERMEABILITY		5 M³/HR.M² @50PA	TARGET PRIMARY ENERGY RATING [TPER]	60.76kgCO ₂ /m²	
VENTILATION STRATEGY		NATURAL WITH INTERMITTENT FANS	DWELLING PRIMARY ENERGY RATING [DPER]	38.59kgCO ₂ /m²	
HEATING		ASHP, UNDERFLOOR HEATING & RADIATORS WITH PROGRAMMER & ROOMSTAT	IMPROVEMENT OVER PART L [%]	36.48	
HOT WATER SYSTEM		ASHP FED 300L DHW CYLINDER			
RENEWABLES		4KWp PV ARRAY ON ANNEX ROOF & 7KW BATTERY			

Monitoring and reporting

Energy display devices that can monitor electricity and primary heating fuel consumption will be provided to each dwelling. These will be installed in a visible location such as a hallway or a kitchen. This can empower occupants to be more aware of their usage and therefore make energy and cost savings, where possible.



Operational cost

Considering operational costs for the end user is important when reviewing Energy Strategy options.

The energy hierarchy focuses predominately on carbon emissions, which can lead to unintended consequences in the form of higher operational energy bills.

The proposed development is predicted to achieve a 45.5% reduction in CO₂ emissions through passive design measures at the Be Lean stage, which in turn will result in lower heat demand, and savings in energy consumption and cost.

The Be Green stage of the Energy Strategy has highlighted that PV is a suitable LZC technology, which will reduce dependency in grid electricity through onsite generation, resulting in financial savings to the end user.

Unregulated Energy

Unregulated energy includes small power electricity use from computers, plug in entertainment devices, washing machines, refrigeration, and cooking appliances.

It is anticipated that the proportion of unregulated energy will significantly increase when compared with regulated energy as the efficiency of buildings improved under each revision of Building Regulation Part L.

It is therefore foreseeable that deciding which appliances are purchased and how they are used will become a bigger consideration when looking to improve energy efficiency across our homes and workplace.

Educating the building users on how to reduce energy consumption through the use of their equipment will play a major role in future.

This can be through providing user guides, which will include guidance measures on selecting high rated white goods, energy star rated computers and monitors, and installing voltage optimization and power factor equipment.

Sustainability Strategy

The purpose of this section of the report is to demonstrate that the proposed development at Shellbrook, High Street, Ardingly is considered a high quality and sustainable development, as measured against relevant local and national planning policies.

The proposal is to create a high quality, highly sustainable, family home, which is sympathetic to the local area, whilst also considering its commitments to climate and environmental responsibility.

The following chapters of the report will help demonstrate how the proposed scheme has been designed to adapt to climate change through the incorporation of sustainable design and construction methods, energy and water saving measures, sustainable transport methods, waste reduction techniques, and measures to protect the ecological value of the site.

Flood risk & drainage

The risk of flooding in both rural & urban areas has increased over recent years through a mix of climate change bringing high levels of rain fall which are closer to 100-year storm levels, and extensive development of greenfield sites resulting in the reduction of permeable surfaces. This has led to increased surface water run-off into an already over loaded drainage system.

Flood risk

The site is within flood zone 1 has a low probability of flooding from rivers and the sea.

Sustainable drainage design

The proposed drainage strategy for the site will be to incorporate rainwater harvesting tanks and permeable paving systems to minimise surface water run-off from the site and maximise the sustainability credentials of the development.

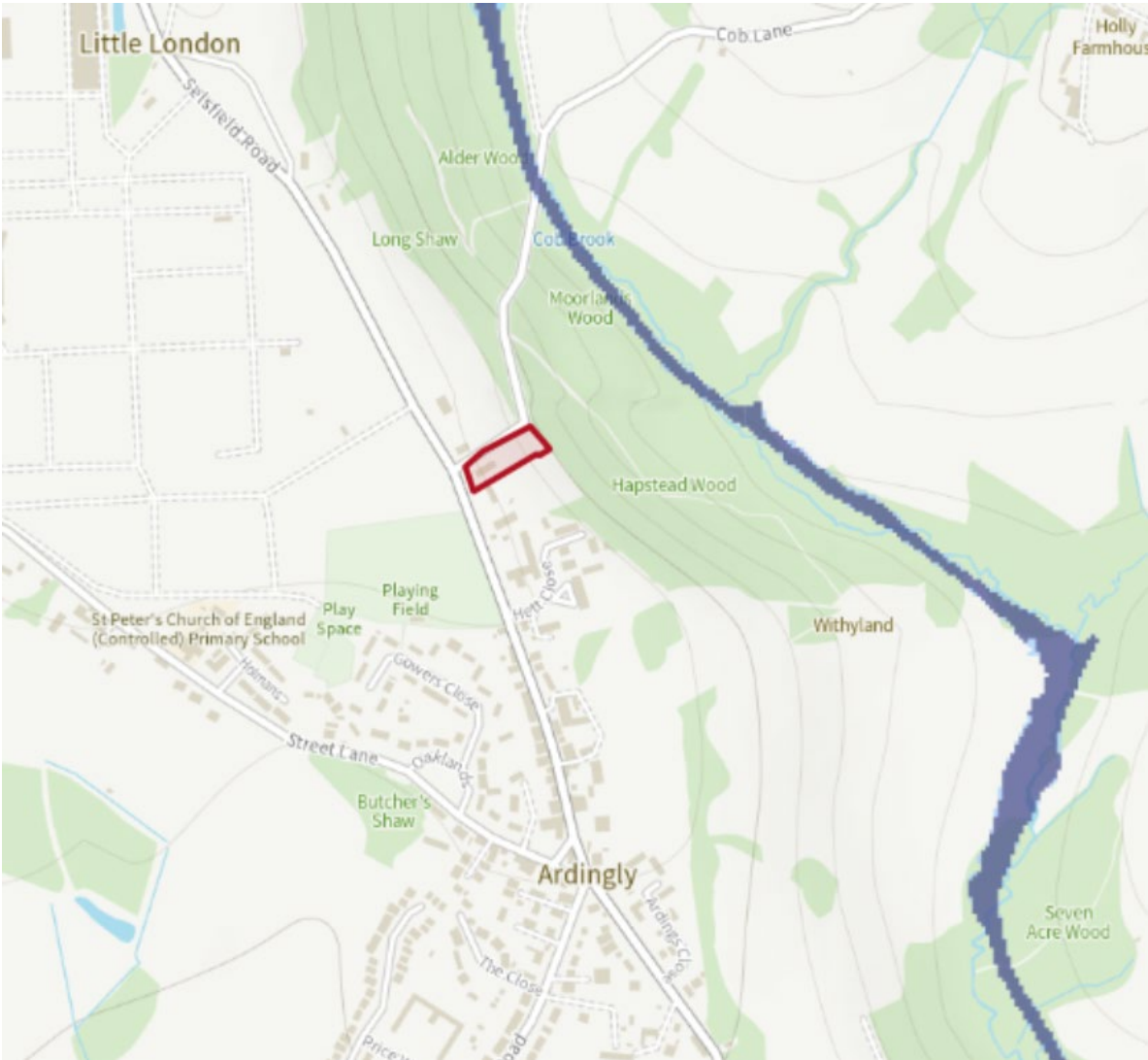


FIGURE 03 – FLOOD RISK MAP [GOV.UK]

Reducing water consumption

Conservation of water is an important factor in any sustainable development as the processing of fresh drinking water uses a lot of energy. Water use in our homes contributes around 35 million tonnes of CO₂ per annum [which is on average 1.5tonnes per family]. Global warming and climate change has also seen longer periods of drought over recent years.

Part G of the Building Regulations requires new dwellings to have a maximum water consumption of 125 litres/person/day [l/p/d], with an optional target of 105 l/p/d.

Mid Sussex Planning policy requires all new dwellings will targets a minimum water efficiency of 105 litres/person/day.

Table 11 sets out the flow / flush rate targets for sanitaryware fittings and appliances that will be installed to minimise water consumption and meet planning policy.

TABLE 11	TARGET
DUAL FLUSH TOILET FLUSH RATE	6 / 3L
TAP FLOW RATE [BATHROOMS / ENSUITES / W.C.]	5L/MIN
TAP FLOW RATE [KITCHENS]	5L/MIN
BATH VOLUME TO OVERFLOW	180L
SHOWER FLOW RATES	8L/MIN
WASHING MACHINE CONSUMPTION	8.17L/KG OF WASHING
DISHWASHER CONSUMPTION	1.0L PER PLACE SETTING

Energy efficiency

Energy efficient white goods

The EU Energy Labelling Scheme was updated in March 2021 and now uses A to G rankings only, instead of A+++ to D ratings as before. The new regulations incorporate updated standards with stricter performance requirements and calculations, making it easier to compare efficiency across products. As the energy classes are intended to be in place for at least 10 years, no products will fall into the category of Class A at this current time.

Under the new labelling scheme, the proposed development will set the following minimum standards:

- Fridges, freezers, and fridge-freezers – C rating
- Washing machines an – C rating
- Dishwashers – C rating

Lighting

High quality lighting design is an important and desirable feature that supports how you feel and use your home and workplace. The proposed development will provide adequate access to and control of lighting within the dwelling.

This is a basic function that will contribute to comfort and health living.

Careful consideration will be made to ensure that background lighting levels will meet the requirements as set out in CIBSE Internal Lighting guide & SLL Lighting Guide with the following targets set as shown in Table 10.

All internal lighting will be energy efficient with a maximum average wattage of 9W/m² and will offer pave luminous efficacy greater than 110 lumens per circuit watt.

External & communal lighting will be controlled through a mix of motion sensors, dusk to dawn sensors, and timer controls.

TABLE 10	LUX LEVELS
ENTRANCE LOBBIES AND STAIRWELLS	150
KITCHENS	500
LIVING SPACE	200
BATHROOMS	200
BEDROOMS	150
HOME OFFICE	500
CIRCULATION SPACE AND STORES	100

Sustainable transport

Sustainable transport links are central to the sustainability debate. They provide a positive contribution to environmental, and economic sustainability of the places they serve.

The provision of alternative sustainable transport options and associated facilities reduces dependency on traditionally fuelled cars and has the following benefits:

- Encourages active travel and helps improve people's health and wellbeing.
- Reduces congestion and encourages clean travel which helps to improve the air quality of the local area; and
- Provides cost savings compared with maintaining and running traditionally fuelled cars.

Cycling and walking

Dedicated long-term cycle storage will be provided within the secure garage.

Electric Vehicle [EV] charging

The new dwelling will be provided with one Fast charging [7kW] electric vehicle [EV] charging point. This is in line with Approved Document Part S of the Building Regulations.

Public transport

The site is within 500m of two bus stops offering regular services to Crawley, Haywards Heath, and Brighton.

Pollution

Light pollution

Reducing the impact of light pollution from artificial street lighting on Dark Skies is essential for preserving natural ecosystems, improving human health, and allowing us to appreciate the night sky. Light pollution, caused by excessive or poorly directed artificial lighting, diminishes the visibility of stars and disrupts nocturnal wildlife. Fortunately, there are effective measures to mitigate its impact.

The first step is the widespread adoption of fully shielded streetlights on low level lighting columns that focus light downward and prevent it from spilling into the sky or neighbouring areas. This ensures that light is directed where it is needed, minimizing waste and glare. Transitioning to energy-efficient LED lighting is another key strategy, but it is crucial to choose LEDs with warmer colour temperatures, such as 3000K or lower, to reduce blue light emissions. Blue light contributes significantly to skyglow and can interfere with the circadian rhythms of both humans and wildlife.

Employing ‘Smart’ lighting technologies, such as pre-set dimming photocells, Central Management Systems that control light switching times, motion sensors, timers, and dimmers, can further reduce unnecessary lighting. These systems allow streetlights to operate only when needed, conserving energy and minimizing environmental impact.

Public awareness and education are vital for fostering a cultural shift toward preserving Dark Skies. By promoting the benefits of reduced light pollution—such as energy savings, enhanced stargazing opportunities, and healthier ecosystems—local governments and advocacy groups can encourage residents and businesses to participate in the effort.

By implementing these strategies, we can significantly reduce the impact of light pollution from street lighting on Dark Skies, restoring the natural beauty of the night and creating a more sustainable and harmonious coexistence with our environment.



MMA Consultancy [Exterior lighting design specialists] have been appointed to provide a compliant lighting design.

The following design criteria will be followed:

- All external lights will offer downlighting only
- Wall lights to be fitted with a 36-degree beam angle, and at no higher than 1500mm from floor surface
- All ramp or step lighting will illuminate only the ramp deck or tread.
- All lighting to offer warm lighting [3000K], with a maximum illuminance of <500Lux
- Lighting controls to be dusk to down with a timer to limit the usage.
- Lighting to be fitted with a master switch to allow all external lighting to be switched off when the site is not occupied
- All windows to be fitted with curtains/shades to reduce light pollution

Sustainable materials

Responsible sourcing of materials

Whilst not a component of UK planning or building regulations legislation, material choice can have a significant effect on the carbon footprint of a development.

The applicant is committed to minimising the developments environmental impact through best practice procurement management.

All timber products will be sourced from FSC or PEFC sources, with all other materials to be purchased from suppliers/manufacturers that have an accredited Environmental Management System [EMS] [BES6001, ISO14001 OR BS8555] for the extraction and manufacturing process of the proposed material.



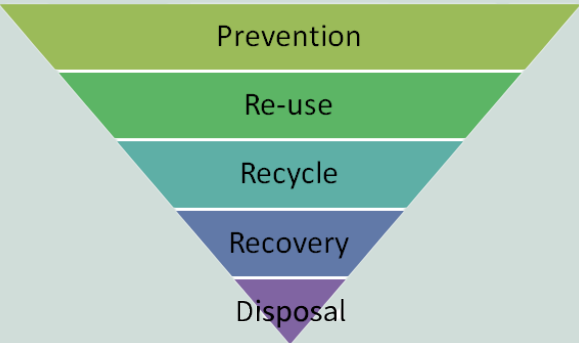
Green Guide rated materials

All construction materials will be considered to maximise the selection of materials with low embodied energy that score highly in the Building Research Establishment (BRE) Green Guide for Building Specification. It is anticipated most of the materials will achieve an A+ and A rating.

Waste management

Reduce, reuse, recycle

Waste reduction and recycling is another key challenge of sustainable development. The Waste Hierarchy [Figure 02] illustrates the priorities waste management should follow to reduce impact on the environment.



Household waste management

The applicant is committed to following the above waste hierarchy to help reduce waste sent to landfill.

Suitable internal storage containers for household waste will be provided in each dwelling, containers will allow for waste and recycling separation to encourage sustainable recycling habits by the occupants.

Adequate storage is to be provided near the entrance to the site, where both recyclable and non-recyclable waste can be stored in accordance with Mid Sussex District Council waste collection service.

Composting

Managing green waste through onsite composting allows some kitchen and garden waste to be re-used to enrich the soil, whilst also reducing CO₂ emissions by limiting the need to transport waste from site. It is proposed to include communal composting bins in the gardens.

An internal 8l caddy bin will also be provided in each new dwelling along with an information leaflet outlining what should and should not be composted.



Build Quality

Security

The applicant is committed to ensuring the development is safe & secure for the residents, which will reduce the fear of crimes being committed and the risk and associated costs of crime.

Sound insulation

To reduce the likelihood of noise complaints and to ensure a high-quality development is created, the development will be aiming to achieve airborne sound insulation values that will improve upon the performance standards outlined in Building Regulation Approved Document Part E.

Inclusive design

The new dwellings are in-line with Approved Document M4[2] standards. These standards will ensure accessible and adaptable accommodation for everyone, regardless of age, mobility, or disability.

This will ensure flexibility, and futureproofing i.e., the accommodation will be adaptable and able to respond to changing technological and environmental conditions.

Recent global events have highlighted the need for new homes to offer the flexibility for the homeowner to work remotely from home, either on a part time or a more permanent basis.

The proposed development design will include for a suitable position for a home working, with the provision of additional power sockets and good WIFI connectivity [in Approved Document Part R].

Daylight & Sunlight

The promotion of good daylighting levels contributes to sustainability through improving the occupant's quality of life and reducing the building's energy consumption by minimising the need for artificial lighting.



Where possible, the layout of the Proposed Development has been carefully designed to optimise the daylight and sunlight quality within the home.

Health & Wellbeing

Internal air quality

Air quality in modern homes is becoming a bigger consideration in new development design. The reality is that poor air quality will impact on the homeowner’s health, leading to respiratory illnesses.

All internal and external finishes within the development will aim to have low volatile organic compound [VOC] content.

Amenity space

Extensive private amenity space, is provided on site. The building is designed around a private courtyard offering a swimming pool and seating areas with easy access to the established garden areas.

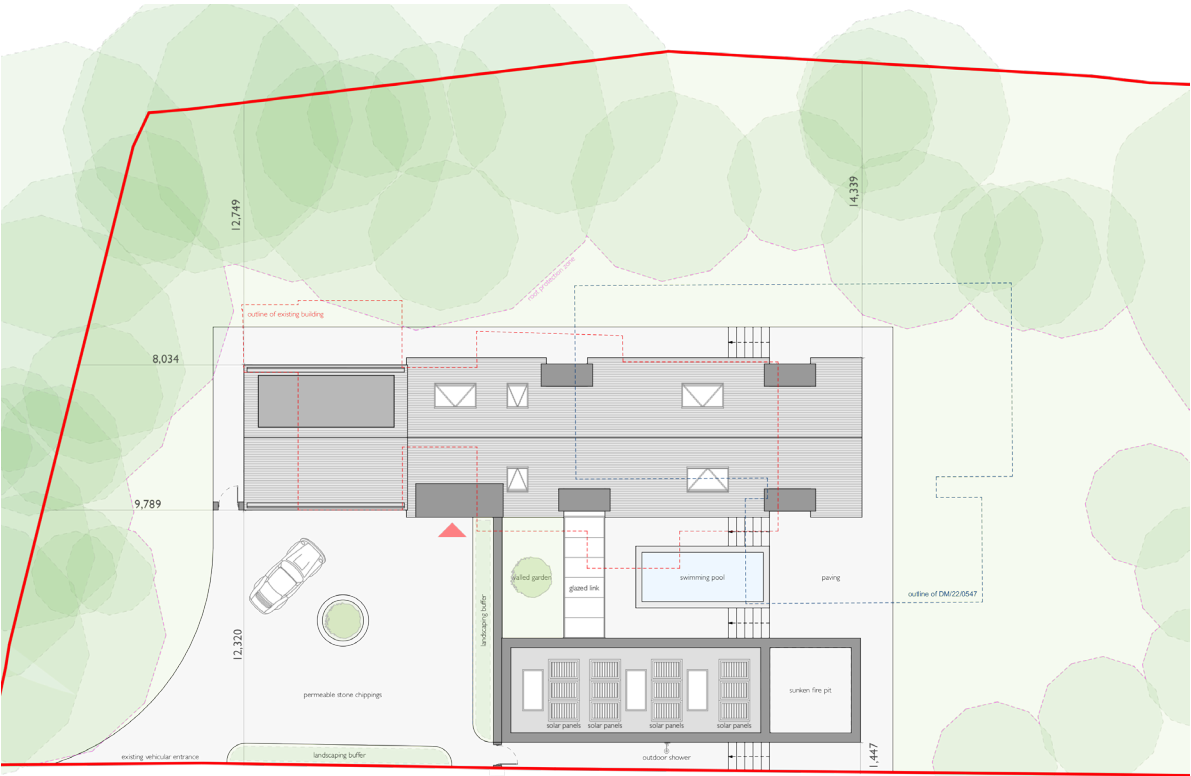


FIGURE 04 – SITE PLAN [PMR ARCHITECTURE]

Ecology

Enhancing Ecological value

The existing site has not had an ecological surveys carried out however the client is committed to protecting and enhancing the existing ecological features of the established flora and fauna.

The applicant has committed to improving the ecological value of the site by following the recommendations set out in the Ecology Report in association with the proposed landscape design.

This will include:

- The installation of swift and bat boxes, bee bricks.
- Introducing new planters and beds to allow for the planting of nectar rich plants, to encourage butterflies, moths, insects, and other wildlife.

Reducing construction impact

Minimising the impact of the development on the neighbouring community is key to ensuring the scheme becomes fully integrated into the area.

Monitoring construction site impact

During the construction phase, control procedures will be put in place to minimise noise, dust pollution, and keep roads clean and clear of debris. The management systems will generally comprise procedures and working methods that are approved by the development team together with commercial agreements to ensure compliance.

Additional measures will be adopted to minimise the impact on the local area during construction. This will include the limiting of air & water pollution in accordance with best practise.

Construction traffic noise will be reduced through restricted delivery and arrival times to manage potential impact on existing and future neighbouring occupants. Work will be limited to appropriate hours to be agreed with the council, and suppressors will be used to reduce noise from machinery in line with the Considerate Contractor scheme.

Construction waste

Construction waste is a key element to be considered in achieving a reduction in all waste. It is estimated that 40% of all waste is construction related. There are two key considerations to assist in reducing the amount of construction waste sent to landfill:

- Appropriate construction methods of effective management
- Re-use and recycling of materials on site

The applicant is committed to reduce waste during construction phase through the incorporation of a Site Waste Management Plan [SWMP], which will set targets for waste minimisation through efficient material ordering and outline proposals to segregation waste into the following different streams.

Site waste segregation streams

- Mix construction, and demolition waste – EWC code 17-09-04
- Mixed concrete, brick, tiles and ceramics (INERT) – EWC code 17-01-07
- Mixed metal – EWC code 17-04-07
- Plasterboard – EWC code 17-08-02
- Hazardous – EWC code 08-01-12
- Soil and Stone – EWC code 17-05-04
- Waste paint and varnish – EWC code 08-01-21
- Wooden packaging – EWC code 15-01-03
- Plastics – EWC code 17-02-03
- Paper/cardboard – EWC code 15-01-01

Conclusion

The purpose of this Energy & Sustainability strategy is to demonstrate that the proposed development at Shellbrook, High Street, Ardingly is considered a sustainable development, as measured against relevant local and national planning policies.

The applicant is applying for the demolition of the existing property and construction of a two storey, four-bedroom, family home.

Through the incorporation of sustainable design and construction methods, energy and water saving measures, sustainable transport methods, waste reduction techniques, and measures to enhance the ecological value of the site, a high quality and sustainable development is proposed.

Through energy efficient design and specification, the proposed development will satisfy the requirements of Planning Policies DP21, 29, 39, and 42, ensuring a fire damaged dwelling is replaced with a highly sustainable and future proofed family dwelling.

KEY FEATURES

- 14.11% reduction in CO₂ emissions through energy efficient design and passive measures
- 66.19% reduction in CO₂ emission
- Annual CO₂ reduction of over 2.7t per annum for the life of the building
- Low carbon heating & hot water systems throughout
- 22% of regulated energy demand met through on site solar generation
- Maximum internal water consumption of 110l/pp/day
- Segregated bins for refuse, and recycling.
- Use of materials with low environmental impact
- Dwellings designed to meet Part M4[2] to create an accessible, inclusive development

Core Policy SD2: Ecosystem

- 1. Development proposals will be permitted where they have an overall positive impact on the ability of the natural environment to contribute goods and services. This will be achieved through the use of high quality design, and by delivering all opportunities to:
 - Sustainably manage land and water environments;
 - Protect and provide more, better and joined up natural habitats;
 - Conserve water resources and improve water quality;
 - Manage and mitigate the risk of flooding;
 - Improve the National Park’s resilience to, and mitigation of, climate change;
 - Increase the ability to store carbon through new planting or other means;
 - Conserve and enhance soils, use soils sustainably and protect the best and most versatile agricultural land;
 - Support the sustainable production and use of food, forestry and raw materials;
 - Reduce levels of pollution;
 - Improve opportunities for peoples’ health and wellbeing; and
 - Provide opportunities for access to the natural and cultural resources which contribute to the special qualities.
- 2. Development proposals must be supported by a statement that sets out how the development proposal impacts, both positively and negatively, on ecosystem services.

Strategic Policy SD5: Design

- 1. Development proposals will only be permitted where they adopt a landscape-led approach and respect the local character, through sensitive and high quality design that makes a positive contribution to the overall character and appearance of the area. The following design principles should be adopted as appropriate:
 - Integrated with, respect and sympathetically complement the landscape character by ensuring development proposals are demonstrably informed by an assessment of the landscape context;
 - Achieve effective and high quality routes for people and wildlife, taking opportunities to connect GI;
 - Contribute to local distinctiveness and sense of place through its relationship to adjoining buildings, spaces and landscape features, including historic settlement pattern;
 - Create high-quality, clearly defined public and private spaces within the public realm;
 - Incorporate hard and soft landscape treatment which takes opportunities to connect to the wider landscape, enhances GI, and is consistent with local character;
 - Utilise architectural design which is appropriate and sympathetic to its setting in terms of height, massing, density, roof form, materials, night and day visibility, elevational and, where relevant, vernacular detailing;
 - Provide high quality, secure, accessible, and where possible, integrated storage for general and recycling waste, heating fuel, and transport related equipment;

- Provide high quality outdoor amenity space appropriate to the needs of its occupiers or users;
- Ensure development proposals are durable, sustainable and adaptable over time, and provide sufficient internal space to meet the needs of a range of users;
- Give regard to improving safety and perceptions of safety, and be inclusive and accessible for all; and
- Have regard to avoiding harmful impact upon, or from, any surrounding uses and amenities.

Policy SD13: Listed Buildings

- 1. Development proposals which affect a listed building or its setting will only be permitted and listed building consent granted where:
 - They preserve and enhance the significance of the listed building and its setting by demonstrating that loss of historic fabric and detail of significance, including internal features, floor plans and the integrity of the rooms, is avoided; or
 - Harm to the significance of the listed building or its setting is considered to be outweighed by public benefits by the Authority, when appropriate mitigation measures will be expected, including archaeological investigation (including a written report) or recording.
- 2. Development proposals will be refused planning permission and/or listed building consent where they cause substantial harm to a listed building or its setting.

Policy DP21 - Transport

Strategic Objectives: 6) To ensure that development is accompanied by the necessary infrastructure in the right place at the right time that supports development and sustainable communities. This includes the provision of efficient and sustainable transport networks; and 15) To create places that encourage a healthy and enjoyable lifestyle by the provision of first class cultural and sporting facilities, informal leisure space and the opportunity to walk, cycle or ride to common destinations.

Evidence Base: Mid Sussex Transport Study; West Sussex Transport Plan 2011-2026.

Development will be required to support the objectives of the West Sussex Transport Plan 2011- 2026, which are:

- A high-quality transport network that promotes a competitive and prosperous economy;
- A resilient transport network that complements the built and natural environment whilst reducing carbon emissions over time;
- Access to services, employment and housing; and
- A transport network that feels, and is, safer and healthier to use.

To meet these objectives, decisions on development proposals will take account of whether:

- The scheme is sustainably located to minimise the need for travel noting there might be circumstances where development needs to be located in the countryside, such as rural economic uses (see policy DP14: Sustainable Rural Development and the Rural Economy);
- Appropriate opportunities to facilitate and promote the increased use of alternative means of transport to the private car, such as the provision of, and access to, safe and convenient routes for walking, cycling and public transport, including suitable facilities for secure and safe cycle parking, have been fully explored and taken up;
- The scheme is designed to adoptable standards, or other standards as agreed by the Local

Planning Authority, including road widths and size of garages;

The scheme provides adequate car parking for the proposed development taking into account the accessibility of the development, the type, mix and use of the development and the availability and opportunities for public transport; and with the relevant Neighbourhood Plan where applicable;

- Development which generates significant amounts of movement is supported by a Transport Assessment/ Statement and a Travel Plan that is effective and demonstrably deliverable including setting out how schemes will be funded;
- The scheme provides appropriate mitigation to support new development on the local and strategic road network, including the transport network outside of the district, secured where necessary through appropriate legal agreements;

The scheme avoids severe additional traffic congestion, individually or cumulatively, taking account of any proposed mitigation;

- The scheme protects the safety of road users and pedestrians; and
- The scheme does not harm the special qualities of the South Downs National Park or the High Weald Area of Outstanding Natural Beauty through its transport impacts.

Where practical and viable, developments should be located and designed to incorporate facilities for charging plug-in and other ultra-low emission vehicles.

Neighbourhood Plans can set local standards for car parking provision provided that it is based upon evidence that provides clear and compelling justification for doing so.

Policy DP29 – Noise, Air and Light Pollution

DStrategic Objectives: 3) To protect valued landscapes for their visual, historical and biodiversity qualities; and 12) To support sustainable communities which are safe, healthy and inclusive. Evidence Base: Data held by Environmental Health, Air Quality Action Plan – Stonepound Crossroads, Hassocks.

The environment, including nationally designated environmental sites, nationally protected landscapes, areas of nature conservation or geological interest, wildlife habitats, and the quality of people’s life will be protected from unacceptable levels of noise, light and air pollution by only permitting development where:

Noise pollution:

- It is designed, located and controlled to minimise the impact of noise on health and quality of life, neighbouring properties and the surrounding area;
- If it is likely to generate significant levels of noise it incorporates appropriate noise attenuation measures;

Noise sensitive development, such as residential, will not be permitted in close proximity to existing or proposed development generating high levels of noise unless adequate sound insulation measures, as supported by a noise assessment are incorporated within the development.

In appropriate circumstances, the applicant will be required to provide:

Appendices 01 – South Downs National Park

- an assessment of the impact of noise generated by a proposed development; or
- an assessment of the effect of noise by an existing noise source upon a proposed development;

Light pollution:

- The impact on local amenity, intrinsically dark landscapes and nature conservation areas of artificial lighting proposals (including floodlighting) is minimised, in terms of intensity and number of fittings;
- The applicant can demonstrate good design including fittings to restrict emissions from the proposed lighting scheme

Air pollution:

- It does not cause unacceptable levels of air pollution;
- Development on land adjacent to an existing use which generates air pollution or odour would not cause any adverse effects on the proposed development or can be mitigated to reduce exposure to poor air quality to recognised and acceptable levels;
- Development proposals (where appropriate) are consistent with Air Quality Management Plans.

The degree of the impact of noise and light pollution from new development or change of use is likely to be greater in rural locations, especially where it is in or close to specially designated areas and sites.

Policy DP39 – Sustainable Design and Construction

Strategic Objectives: 1) To promote development that makes the best use of resources and increases the sustainability of communities within Mid Sussex, and its ability to adapt to climate change.

Evidence Base: Gatwick Sub Region Water Cycle Study; West Sussex Sustainable Energy Study, Mid Sussex Sustainable Energy Study.

All development proposals must seek to improve the sustainability of development and should where appropriate and feasible according to the type and size of development and location, incorporate the following measures:

- Minimise energy use through the design and layout of the scheme including through the use of natural lighting and ventilation;
- Explore opportunities for efficient energy supply through the use of communal heating networks where viable and feasible;
- Use renewable sources of energy;
- Maximise efficient use of resources, including minimising waste and maximising recycling/ re-use of materials through both construction and occupation;
- Limit water use to 110 litres/person/day in accordance with Policy DP42: Water Infrastructure and the Water Environment;
- Demonstrate how the risks associated with future climate change have been planned for as part of the layout of the scheme and design of its buildings to ensure its longer-term resilience.

Policy DP42 – Water Infrastructure and Water Environment

Strategic Objectives: 1) To promote development that makes the best use of resources and increases the sustainability of communities within Mid Sussex, and its ability to adapt to climate change; 6) To ensure that development is accompanied by the necessary infrastructure in the right place at the right time that supports development and sustainable communities. This includes the provision of efficient and sustainable transport networks.

Evidence Base: Building Regulations (Approved Document G); Gatwick Sub Region Water Cycle Study; DCLG Housing Standards Review: Technical Consultation, September 2014; Southeast Water - Water Resources Management Plan 2014, Strategic Flood Risk Assessment.

New development proposals must be in accordance with the objectives of the Water Framework Directive and accord with the findings of the Gatwick Sub Region Water Cycle Study with respect to water quality, water supply and wastewater treatment and consequently the optional requirement under Building Regulations – Part G applies to all new residential development in the district. Development must meet the following water consumption standards:

- Residential units should meet a water consumption standard of 110 litres per person per day (including external water use);
- Non-residential buildings should meet the equivalent of a ‘Good’ standard, as a minimum, with regard to the BREEAM water consumption targets for the development type.

Development proposals which increase the demand for off-site service infrastructure will be permitted where the applicant can demonstrate;

- that sufficient capacity already exists off-site for foul and surface water provision. Where capacity off-site is not available, plans must set out how appropriate infrastructure improvements approved by the statutory undertaker will be completed ahead of the development’s occupation; and
- that there is adequate water supply to serve the development. Planning conditions will be used to secure necessary infrastructure provision.

Development should connect to a public sewage treatment works. If this is not feasible, proposals should be supported by sufficient information to understand the potential implications for the water environment.

The development or expansion of water supply or sewerage/sewage treatment facilities will normally be permitted, either where needed to serve existing or proposed new development, or in the interests of long-term water supply and waste water management, provided that the need for such facilities outweighs any adverse land use or environmental impacts and that any such adverse impact is minimised.

Appendices 01 – Building Regulations

Approved Document L

Approved Document Part L [2021, England edition], referred to ADL2021, is the Building Regulation relating to the conservation of fuel and power in buildings. Part L1 relates to dwellings, and Part L2 related to buildings other than dwellings.

ADL2021 is driving the reduction in the regulated CO₂ emissions new build, refurbishment and change of use. There are four performance metrics:

- Primary energy target [DPER / TPER]
- CO₂ emissions targets [DER / TER]
- Fabric Energy Efficiency targets [DFEE / TFEE]
- Minimum standards for fabric and fixed building services

Approved Document O

Approved Document Part O [2021, England edition], referred to ADO2021, is the Building Regulation is the standard for overheating in new residential buildings.

ADO2021 sets out guidance on overheating risk assessment and mitigation. The sim of the regulation is to protect the health and wellbeing of occupants of the building by reducing the occurrence of high indoor temperatures.

The building should be design and constructed to limit unwanted solar gain in the summer and provide adequate means to remove excess heat from the indoor environment.

Compliance can be demonstrated by using one of the following methods:

- The simplified method for limiting solar gain
- Dynamic thermal modelling method

The simplified method has limitations, so the designed building is required to meet certain criteria to allow for this method to be used. If these criteria is not met, then dynamic thermal modelling method must be followed in line with TM59 requirements.

Approved Document F

Approved Document Part F [2021, England edition], referred to ADF2021, is the Building Regulation relating to Means of ventilation within buildings.

Key considerations are:

- F1 [1]. There shall be adequate means of ventilation provided for people in the building.
- F1 [2]. Fixed systems for mechanical ventilation and any associated controls must be commissioned by testing and adjusting as necessary to secure that the objective referred to in sub-paragraph (1) is met.

Limits on application

Requirement F1 does not apply to a building or space within a building:

- into which people do not normally go; or
- which is used solely for storage; or
- which is a garage used solely in connection with a single dwelling

Approved Document G

Approved Document Part G [2015 with 2016 and 2024 amendments, England edition], referred to ADG2021, is the Building Regulation relating to Sanitation, hot water safety and water efficiency within buildings.

Key considerations:

- G2. Reasonable provision must be made by the installation of fittings and fixed appliances that use water efficiently for the prevention of undue consumption of water.

Water efficiency of new dwellings

- 36.(1) The potential consumption of wholesome water by persons occupying a new dwelling must not exceed the requirement in paragraph (2).
- 36.(2) The requirement referred to in paragraph (1) is either—
 - i. 125 litres per person per day; or
 - ii. in a case to which paragraph (3) applies, the optional requirement of 110 litres per person per day, as measured in either case in accordance with a methodology approved by the Secretary of State.

36.(3) This paragraph applies where the planning permission under which the building work is carried out—

- i. specifies the optional requirement in paragraph (2)(b); and
- ii. makes it a condition that that requirement must be complied with.

36. (4) In this Part, “new dwelling” does not include a dwelling that is formed by a material change of use of a building within the meaning of regulation 5(g)

Appendices 02 – SAP Calculations

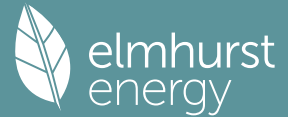
Be Lean

SAP calculation worksheets confirming the reduction in carbon emissions over TER achieved through passive design measures.

Be Green

SAP calculation worksheets confirming the reduction in carbon emissions over TER achieved through passive design measures and preferred LZC technologies.

Full SAP Calculation Printout



Property Reference	Shellbrook				Issued on Date	12/03/2025	
Assessment Reference	BE LEAN			Prop Type Ref			
Property							
SAP Rating	47 E	DER	9.68	TER	11.27		
Environmental	89 B	% DER < TER				14.11	
CO ₂ Emissions (t/year)	3.06	DFEE	59.89	TFEE	60.39		
Compliance Check	See BREL	% DFEE < TFEE				0.84	
% DPER < TPER	-62.61	DPER	98.80	TPER	60.76		
Assessor Details	Mr. Giles Murgatroyd				Assessor ID	V385-0001	
Client							

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling			
Ground floor	196.7600 (1b)	x 2.9500 (2b)	= 580.4420 (1b) - (3b)
First floor	166.7600 (1c)	x 2.7300 (2c)	= 455.2548 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	363.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1035.6968 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	7 * 10 = 70.0000 (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) =	70.0000 / (5) = 0.0676 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3176 (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) = 0.3176 (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	0.4049	0.3970	0.3890	0.3493	0.3414	0.3017	0.3017	0.2938	0.3176	0.3414	0.3573	0.3732 (22b)
Effective ac	0.5820	0.5788	0.5757	0.5610	0.5583	0.5455	0.5455	0.5431	0.5504	0.5583	0.5638	0.5696 (25)

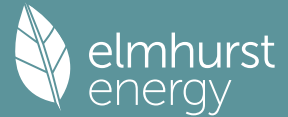
3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Solid doors			3.2400	1.2000	3.8880		(26)
Windows Dbl LowE			173.8200	1.1450	199.0305		(27)
Rooflights Dbl LowE			20.0500	1.1450	22.9580		(27a)
FT01 GF			196.7600	0.1300	25.5788		(28a)
FT02 FF Exposed			50.0000	0.1300	6.5000		(28b)
WT01 GF	164.0800	76.5400	87.5400	0.1800	15.7572		(29a)
WT02 Glazed corridor	32.6400	28.8000	3.8400	0.1800	0.6912		(29a)
WT03 Annex	68.4000	20.7700	47.6300	0.1800	8.5734		(29a)
WT04 FF	251.1400	45.2700	205.8700	0.1800	37.0566		(29a)
WT05 Dormer	21.9600	5.6800	16.2800	0.1800	2.9304		(29a)
RT01 Main roof	177.3200	14.0500	163.2700	0.1100	17.9597		(30)
RT02 Flat dormer	24.5100		24.5100	0.1100	2.6961		(30)
RT03 Flat annex	86.1800	6.0000	80.1800	0.1100	8.8198		(30)
RT04 Balcony	5.1200		5.1200	0.1100	0.5632		(30)
Total net area of external elements A _{um} (A, m ²)			1078.1100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	353.0029		(33)
Thermal mass parameter (TMP = C _m / TFA) in kJ/m ² K						250.0000	(35)
List of Thermal Bridges							

4. Water heating energy requirements (kWh/year)												
Assumed occupancy												
Hot water usage for mixer showers	107.4104	105.7962	103.4440	98.9436	95.6224	91.9186	89.8134	92.1477	94.7066	98.6834	103.2805	106.9988 (42a)
Hot water usage for baths	35.4904	34.9634	34.2211	32.8526	31.8278	30.6915	30.0777	30.8148	31.6173	32.8332	34.2299	35.3705 (42b)
Hot water usage for other uses	50.0524	48.2323	46.4122	44.5921	42.7720	40.9519	40.9519	42.7720	44.5921	46.4122	48.2323	50.0524 (42c)
Average daily hot water use (litres/day)												177.4361 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	192.9532	188.9918	184.0773	176.3883	170.2222	163.5620	160.8430	165.7345	170.9160	177.9287	185.7427	192.4217 (44)
Energy content (annual)	305.5907	269.1219	282.9200	241.4667	229.1518	201.1186	194.5257	205.2140	210.7565	241.4476	264.6245	301.2858 (45)
Distribution loss (46)m = 0.15 x (45)m												2947.2238
	45.8386	40.3683	42.4380	36.2200	34.3728	30.1678	29.1789	30.7821	31.6135	36.2171	39.6937	45.1929 (46)
Water storage loss:												
Store volume												300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												3.0000 (48)
Temperature factor from Table 2b												0.6000 (49)
Enter (49) or (54) in (55)												1.8000 (55)
Total storage loss	55.8000	50.4000	55.8000	54.0000	55.8000	54.0000	55.8000	55.8000	54.0000	55.8000	54.0000	55.8000 (56)
If cylinder contains dedicated solar storage	55.8000	50.4000	55.8000	54.0000	55.8000	54.0000	55.8000	55.8000	54.0000	55.8000	54.0000	55.8000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	361.3907	319.5219	338.7200	295.4667	284.9518	255.1186	250.3257	261.0140	264.7565	297.2476	318.6245	357.0858 (62)
VVHRS	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	361.3907	319.5219	338.7200	295.4667	284.9518	255.1186	250.3257	261.0140	264.7565	297.2476	318.6245	357.0858 (64)
12Total per year (kWh/year)												3604.2238 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
												0.0000 (64a)
Heat gains from water heating, kWh/month	101.6089	89.4830	94.0709	80.2877	76.1930	66.8719	64.6798	68.2336	70.0766	80.2813	87.9876	100.1775 (65)

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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
Northeast					48.4100	11.2829		0.6300		0.7000	0.7700	166.9280 (75)
Southeast					56.9700	36.7938		0.6300		0.7000	0.7700	640.6091 (77)
Southwest					14.4000	36.7938		0.6300		0.7000	0.7700	161.9233 (79)
Northwest					54.0400	11.2829		0.6300		0.7000	0.7700	186.3415 (81)
Southeast					5.2800	39.9751		0.6300		0.7000	1.0000	83.7732 (82)
Northwest					8.7700	16.3666		0.6300		0.7000	1.0000	56.9690 (82)
Horizontal					6.0000	26.0000		0.6300		0.7000	1.0000	61.9164 (82)
Solar gains	1358.4604	2485.9388	3845.7913	5489.8088	6795.8612	7027.3204	6658.6006	5643.9142	4410.1225	2868.5157	1658.7415	1141.9366 (83)
Total gains	2330.2981	3487.0814	4799.4867	6408.8412	7661.5641	7858.4866	7452.8763	6437.6964	5231.3410	3720.0450	2568.7996	2089.4413 (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	41.7079	41.7830	41.8569	42.2075	42.2737	42.5848	42.5848	42.6430	42.4645	42.2737	42.1399	42.0009
alpha	3.7805	3.7855	3.7905	3.8138	3.8182	3.8390	3.8390	3.8429	3.8310	3.8182	3.8093	3.8001
util living area	0.9970	0.9867	0.9508	0.8375	0.6508	0.4671	0.3459	0.4139	0.6876	0.9381	0.9921	0.9980 (86)
MIT	18.9013	19.3043	19.8715	20.4942	20.8464	20.9665	20.9918	20.9841	20.8633	20.2638	19.4377	18.8357 (87)
Th 2	19.5660	19.5682	19.5703	19.5803	19.5821	19.5909	19.5909	19.5925	19.5875	19.5821	19.5784	19.5744 (88)
util rest of house	0.9959	0.9820	0.9343	0.7910	0.5736	0.3709	0.2372	0.2917	0.5808	0.9085	0.9887	0.9973 (89)
MIT 2	17.1723	17.6861	18.3933	19.1226	19.4737	19.5756	19.5890	19.5883	19.5096	18.8932	17.8661	17.0937 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	17.3617	17.8633	18.5552	19.2728	19.6240	19.7280	19.7426	19.7412	19.6579	19.0434	18.0382	17.2845 (92)
Temperature adjustment	0.0000											
adjusted MIT	17.3617	17.8633	18.5552	19.2728	19.6240	19.7280	19.7426	19.7412	19.6579	19.0434	18.0382	17.2845 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9930	0.9735	0.9184	0.7792	0.5760	0.3806	0.2491	0.3050	0.5867	0.8932	0.9826	0.9952 (94)
Useful gains	2314.0311	3394.7399	4408.0482	4993.8148	4413.3249	2990.7703	1856.1402	1963.2271	3069.2333	3322.8219	2524.2096	2079.4594 (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	7905.8381	7832.1823	7270.6624	6204.0236	4731.9699	3039.8997	1862.9682	1977.9749	3304.0914	5042.0888	6552.6952	7864.3902 (97)
Space heating kWh	4160.3045	2981.9613	2129.7849	871.3504	237.0719	0.0000	0.0000	0.0000	0.0000	1279.1346	2900.5096	4303.9885 (98a)
Space heating requirement - total per year (kWh/year)	18864.1057											
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	4160.3045	2981.9613	2129.7849	871.3504	237.0719	0.0000	0.0000	0.0000	0.0000	1279.1346	2900.5096	4303.9885 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	18864.1057											
Space heating per m2	(98c) / (4) = 51.8929 (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 %)												100.0000 (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	4160.3045	2981.9613	2129.7849	871.3504	237.0719	0.0000	0.0000	0.0000	0.0000	1279.1346	2900.5096	4303.9885 (98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000 (210)
Space heating fuel (main heating system)	4160.3045	2981.9613	2129.7849	871.3504	237.0719	0.0000	0.0000	0.0000	0.0000	1279.1346	2900.5096	4303.9885 (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	361.3907	319.5219	338.7200	295.4667	284.9518	255.1186	250.3257	261.0140	264.7565	297.2476	318.6245	357.0858 (64)
Water heating requirement	361.3907	319.5219	338.7200	295.4667	284.9518	255.1186	250.3257	261.0140	264.7565	297.2476	318.6245	357.0858 (216)
Efficiency of water heater	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000 (217)
Fuel for water heating, kWh/month	361.3907	319.5219	338.7200	295.4667	284.9518	255.1186	250.3257	261.0140	264.7565	297.2476	318.6245	357.0858 (219)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	52.1387	41.8276	37.6611	27.5921	21.3130	17.4129	19.4424	25.2720	32.8258	43.0692	48.6466	53.5878 (232)
Lighting	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 PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
(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)	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)
(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)	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)
(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)	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)
(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)	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)
(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)

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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													18864.1057	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													100.0000	
Water heating fuel used													3604.2238	(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)													420.7890	(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													22889.1185	(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	18864.1057	0.1564	2950.4865 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3604.2238	0.1411	508.3969 (264)
Space and water heating			3458.8834 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	420.7890	0.1443	60.7329 (268)
Total CO2, kg/year			3519.6163 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			9.6800 (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	18864.1057	1.5790	29786.6769 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3604.2238	1.5216	5484.1197 (278)
Space and water heating			35270.7965 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	420.7890	1.5338	645.4202 (282)
Total Primary energy kWh/year			35916.2167 (286)
Dwelling Primary energy Rate (DPER)			98.8000 (287)

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Ground floor	196.7600 (1b)	x 2.9500 (2b)	= 580.4420 (1b) - (3b)
First floor	166.7600 (1c)	x 2.7300 (2c)	= 455.2548 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	363.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1035.6968 (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) = 0.0386 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.2886 (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) = 0.2886 (21)

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Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate													
Effective ac	0.3680	0.3608	0.3536	0.3175	0.3103	0.2742	0.2742	0.2670	0.2886	0.3103	0.3247	0.3391	(22b)
	0.5677	0.5651	0.5625	0.5504	0.5481	0.5376	0.5376	0.5356	0.5417	0.5481	0.5527	0.5575	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Main dwelling							
TER Opaque door			3.2400	1.0000	3.2400		(26)
TER Opening Type			78.5500	1.1450	89.9427		(27)
TER Roof Light			9.0600	1.5918	17.2373		(27a)
FT01 GF			196.7600	0.1300	25.5788		(28a)
FT02 FF Exposed			50.0000	0.1300	6.5000		(28b)
WT01 GF	164.0800	36.3600	127.7200	0.1800	22.9896		(29a)
WT02 Glazed corridor	32.6400	13.0200	19.6200	0.1800	3.5316		(29a)
WT03 Annex	68.4000	9.3800	59.0200	0.1800	10.6236		(29a)
WT04 FF	251.1400	20.4600	230.6800	0.1800	41.5224		(29a)
WT05 Dormer	21.9600	2.5700	19.3900	0.1800	3.4902		(29a)
RT01 Main roof	177.3200	6.3600	170.9600	0.1100	18.8056		(30)
RT02 Flat dormer	24.5100		24.5100	0.1100	2.6961		(30)
RT03 Flat annex	86.1800	2.7000	83.4800	0.1100	9.1828		(30)
RT04 Balcony	5.1200		5.1200	0.1100	0.5632		(30)
Total net area of external elements Aum(A, m2)			1078.1100				(31)
Fabric heat loss, W/K = Sum (A x U)					255.9040		(33)

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

250.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	49.2300	0.0500	2.4615
E2 Other lintels (including other steel lintels)	17.3900	0.0500	0.8695
E3 Sill	17.7300	0.0500	0.8865
E4 Jamb	97.6800	0.0500	4.8840
E5 Ground floor (normal)	96.0000	0.1600	15.3600
E19 Ground floor (inverted)	6.7800	0.0700	0.4746
E6 Intermediate floor within a dwelling	43.4800	0.0000	0.0000
E8 Balcony within a dwelling, wall insulation continuous	6.7500	0.0000	0.0000
E11 Eaves (insulation at rafter level)	42.9500	0.0400	1.7180
E13 Gable (insulation at rafter level)	24.5200	0.0800	1.9616
E14 Flat roof	51.8400	0.0800	4.1472
E15 Flat roof with parapet	36.5900	0.5600	20.4904
E16 Corner (normal)	27.2000	0.0900	2.4480
E17 Corner (inverted - internal area greater than external area)	16.2000	-0.0900	-1.4580
R1 Head of roof window	8.2700	0.0800	0.6616
R2 Sill of roof window	8.2700	0.0600	0.4962
R3 Jamb of roof window	34.0000	0.0800	2.7200
R4 Ridge (vaulted ceiling)	28.1500	0.0800	2.2520
R8 Roof to wall (rafter)	18.3200	0.0600	1.0992
R10 All other roof or room-in-roof junctions	6.5000	0.0800	0.5200
R11 Upstands or kerbs of rooflights	18.0000	0.0800	1.4400
E20 Exposed floor (normal)	22.2500	0.3200	7.1200

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

Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	326.4563 (37)

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

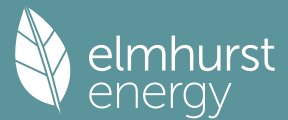
(38)m	Jan 194.0316	Feb 193.1330	Mar 192.2522	Apr 188.1150	May 187.3409	Jun 183.7375	Jul 183.7375	Aug 183.0702	Sep 185.1255	Oct 187.3409	Nov 188.9068	Dec 190.5439	(38)
Heat transfer coeff	520.4879	519.5893	518.7084	514.5712	513.7972	510.1938	510.1938	509.5265	511.5818	513.7972	515.3631	517.0002	(39)
Average = Sum(39)m / 12 =												514.5675	

HLP	Jan 1.4318	Feb 1.4293	Mar 1.4269	Apr 1.4155	May 1.4134	Jun 1.4035	Jul 1.4035	Aug 1.4016	Sep 1.4073	Oct 1.4134	Nov 1.4177	Dec 1.4222	(40)
HLP (average)												1.4155	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.2145 (42)
Hot water usage for mixer showers	78.1166	76.9427	75.2320	71.9590	69.5436	66.8499	65.3188	67.0165	68.8775	71.7697	75.1131	77.8173 (42a)
Hot water usage for baths	33.7159	33.2152	32.5101	31.2099	30.2364	29.1569	28.5738	29.2740	30.0364	31.1915	32.5184	33.6019 (42b)
Hot water usage for other uses	47.5498	45.8207	44.0916	42.3625	40.6334	38.9043	38.9043	40.6334	42.3625	44.0916	45.8207	47.5498 (42c)
Average daily hot water use (litres/day)												146.5079 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	159.3823	155.9785	151.8337	145.5314	140.4134	134.9112	132.7970	136.9240	141.2765	147.0528	153.4522	158.9690 (44)
Energy content (annual)	252.4226	222.1114	233.3627	199.2252	189.0234	165.8890	160.6065	169.5405	174.2080	199.5493	218.6207	248.9071 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 2433.4664
	37.8634	33.3167	35.0044	29.8838	28.3535	24.8834	24.0910	25.4311	26.1312	29.9324	32.7931	37.3361 (46)
Water storage loss:												
Store volume												300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.1127 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.1409 (55)
Total storage loss	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664 (56)
If cylinder contains dedicated solar storage	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664 (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	311.0514	275.0664	291.9915	255.9628	247.6522	222.6266	219.2353	228.1693	230.9456	258.1781	275.3583	307.5359 (62)
WWHRS	-35.7117	-31.5837	-33.0726	-27.3854	-25.5222	-21.8396	-20.4711	-21.7690	-22.5960	-26.6383	-30.1779	-35.0503 (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)

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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	275.3398	243.4827	258.9189	228.5774	222.1300	200.7870	198.7642	206.4003	208.3495	231.5398	245.1804	272.4856 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											2791.9556 (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)
Heat gains from water heating, kWh/month	130.8336	116.2161	124.4961	111.6324	109.7533	100.5481	100.3047	103.2753	103.3142	113.2532	118.0814	129.6647 (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	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	256.1678	283.6143	256.1678	264.7067	256.1678	264.7067	256.1678	256.1678	264.7067	256.1678	264.7067	256.1678	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	507.8812	513.1515	499.8707	471.5975	435.9076	402.3642	379.9551	374.6849	387.9657	416.2389	451.9287	485.4722	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	(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)	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	(71)
Water heating gains (Table 5)	175.8516	172.9406	167.3335	155.0451	147.5179	139.6502	134.8181	138.8108	143.4920	152.2220	164.0020	174.2804	(72)
Total internal gains	1014.1182	1043.9239	997.5896	965.5668	913.8109	877.9387	842.1586	840.8811	867.3819	898.8463	954.8550	990.1380	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
Northeast				21.8800	11.2829	0.6300	0.7000	0.7700	75.4469 (75)			
Southeast				25.7400	36.7938	0.6300	0.7000	0.7700	289.4379 (77)			
Southwest				6.5100	36.7938	0.6300	0.7000	0.7700	73.2028 (79)			
Northwest				24.4200	11.2829	0.6300	0.7000	0.7700	84.2054 (81)			
Southeast				2.3900	39.9751	0.6300	0.7000	1.0000	37.9201 (82)			
Northwest				3.9700	16.3666	0.6300	0.7000	1.0000	25.7887 (82)			
Horizontal				2.7000	26.0000	0.6300	0.7000	1.0000	27.8624 (82)			
Solar gains	613.8642	1123.3382	1737.8047	2480.6835	3070.8613	3175.4601	3008.8415	2550.3220	1992.8057	1296.2094	749.5531	516.0229 (83)
Total gains	1627.9823	2167.2622	2735.3943	3446.2503	3984.6722	4053.3987	3851.0002	3391.2031	2860.1877	2195.0556	1704.4081	1506.1608 (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	48.5015	48.5854	48.6679	49.0592	49.1331	49.4801	49.4801	49.5449	49.3459	49.1331	48.9838	48.8287	
alpha	4.2334	4.2390	4.2445	4.2706	4.2755	4.2987	4.2987	4.3030	4.2897	4.2755	4.2656	4.2552	
util living area	0.9993	0.9976	0.9913	0.9626	0.8761	0.7149	0.5576	0.6404	0.8854	0.9867	0.9983	0.9995	(86)
MIT	19.0183	19.2593	19.6498	20.1818	20.6377	20.8964	20.9725	20.9515	20.7190	20.1059	19.4642	18.9827	(87)
Th 2	19.7390	19.7409	19.7428	19.7515	19.7531	19.7607	19.7607	19.7621	19.7577	19.7531	19.7498	19.7464	(88)
util rest of house	0.9991	0.9967	0.9878	0.9471	0.8254	0.6099	0.4129	0.4916	0.8157	0.9791	0.9976	0.9993	(89)
MIT 2	17.4322	17.7421	18.2417	18.9141	19.4466	19.7025	19.7525	19.7454	19.5549	18.8310	18.0111	17.3913	(90)
Living area fraction	17.6059	17.9083	18.3959	19.0530	19.5771	19.8333	19.8862	19.8775	19.6824	18.9707	18.1703	17.5656	(91)
MIT	17.6059	17.9083	18.3959	19.0530	19.5771	19.8333	19.8862	19.8775	19.6824	18.9707	18.1703	17.5656	(92)
Temperature adjustment	17.6059	17.9083	18.3959	19.0530	19.5771	19.8333	19.8862	19.8775	19.6824	18.9707	18.1703	17.5656	(93)
adjusted MIT	17.6059	17.9083	18.3959	19.0530	19.5771	19.8333	19.8862	19.8775	19.6824	18.9707	18.1703	17.5656	(93)

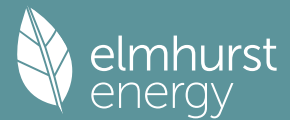
8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
alpha	0.9983	0.9945	0.9821	0.9352	0.8167	0.6168	0.4284	0.5067	0.8103	0.9716	0.9959	0.9988	(94)
Useful gains	1625.2691	2155.3722	2686.5089	3222.8894	3254.2981	2499.9370	1649.7307	1718.3716	2317.7223	2132.6722	1697.4889	1504.3581	(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	6925.5703	6758.9722	6170.5176	5224.4270	4047.2296	2669.9990	1676.5886	1771.8818	2855.8566	4300.8337	5705.2130	6910.0431	(97)
Space heating kWh	3943.4241	3093.6192	2592.1025	1441.1070	589.9411	0.0000	0.0000	0.0000	0.0000	1613.1121	2885.5614	4021.8296	(98a)
Space heating requirement - total per year (kWh/year)												20180.6970	
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	3943.4241	3093.6192	2592.1025	1441.1070	589.9411	0.0000	0.0000	0.0000	0.0000	1613.1121	2885.5614	4021.8296	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												20180.6970	
Space heating per m2												(98c) / (4) =	55.5147 (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)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	3943.4241	3093.6192	2592.1025	1441.1070	589.9411	0.0000	0.0000	0.0000	0.0000	1613.1121	2885.5614	4021.8296	(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)	4272.3988	3351.7001	2808.3451	1561.3294	639.1561	0.0000	0.0000	0.0000	0.0000	1747.6838	3126.2853	4357.3452	(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	275.3398	243.4827	258.9189	228.5774	222.1300	200.7870	198.7642	206.4003	208.3495	231.5398	245.1804	272.4856	(64)
Efficiency of water heater	88.1511	88.0752	87.8997	87.4498	86.1425	79.8000	79.8000	79.8000	79.8000	87.5605	88.0226	88.1690	(216)
Fuel for water heating, kWh/month	312.3496	276.4486	294.5618	261.3812	257.8633	251.6128	249.0779	258.6471	261.0896	264.4342	278.5427	309.0490	(217)
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	7.0685	7.3041	7.0685	7.3041	7.0685	(231)
Lighting	53.2266	42.7004	38.4469	28.1679	21.7577	17.7762	19.8481	25.7993	33.5107	43.9679	49.6616	54.7059	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	-145.8017	-188.7952	-249.3095	-256.4908	-257.5982	-233.3976	-229.8142	-225.3475	-216.0851	-202.8708	-153.8453	-128.0437	(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)	-142.2937	-289.5372	-558.6639	-816.2506	-1058.5972	-1056.8230	-1044.9719	-894.5673	-668.6629	-406.8247	-187.4066	-113.3572	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												21864.2437	(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												3275.0579	(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)												429.5692	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-9725.3560	(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												15929.5148	(238)

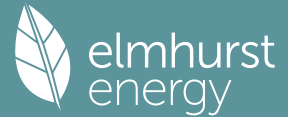
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	21864.2437	0.2100	4591.4912 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3275.0579	0.2100	687.7622 (264)
Space and water heating			5279.2533 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	429.5692	0.1443	62.0001 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2487.3998	0.1365	-339.6090
PV Unit electricity exported	-7237.9562	0.1267	-917.1664
Total			-1256.7754 (269)
Total CO2, kg/year			4096.4073 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.2700 (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	21864.2437	1.1300	24706.5954 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3275.0579	1.1300	3700.8154 (278)
Space and water heating			28407.4108 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	429.5692	1.5338	658.8875 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2487.3998	1.5047	-3742.8001
PV Unit electricity exported	-7237.9562	0.4652	-3366.8830
Total			-7109.6831 (283)
Total Primary energy kWh/year			22086.7160 (286)
Target Primary Energy Rate (TPER)			60.7600 (287)

Full SAP Calculation Printout



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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling			
Ground floor	196.7600 (1b)	x 2.9500 (2b)	= 580.4420 (1b) - (3b)
First floor	166.7600 (1c)	x 2.7300 (2c)	= 455.2548 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	363.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1035.6968 (5)

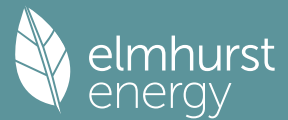
2. Ventilation rate

		m ³ per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)	
Number of open flues	0 * 20 =	0.0000 (6b)	
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)	
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)	
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)	
Number of blocked chimneys	0 * 20 =	0.0000 (6f)	
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)	
Number of passive vents	0 * 10 =	0.0000 (7b)	
Number of flueless gas fires	0 * 40 =	0.0000 (7c)	
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0386 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000 (17)	
Infiltration rate		0.2886 (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) =	0.2886 (21)	
Wind speed	Jan 5.1000 Feb 5.0000 Mar 4.9000 Apr 4.4000 May 4.3000 Jun 3.8000 Jul 3.8000 Aug 3.7000 Sep 4.0000 Oct 4.3000 Nov 4.5000 Dec 4.7000		(22)
Wind factor	1.2750 1.2500 1.2250 1.1000 1.0750 0.9500 0.9500 0.9250 1.0000 1.0750 1.1250 1.1750		(22a)
Adj infilt rate	0.3680 0.3608 0.3536 0.3175 0.3103 0.2742 0.2742 0.2670 0.2886 0.3103 0.3247 0.3391		(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)			0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =			0.0000 (23c)
Effective ac	0.5677 0.5651 0.5625 0.5504 0.5481 0.5376 0.5376 0.5356 0.5417 0.5481 0.5527 0.5575		(25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Solid doors			3.2400	1.2000	3.8880		(26)
Windows Dbl LowE			173.8200	1.1450	199.0305		(27)
Rooflights Dbl LowE			20.0500	1.1450	22.9580		(27a)
FT01 GF			196.7600	0.1300	25.5788		(28a)
FT02 FF Exposed			50.0000	0.1300	6.5000		(28b)
WT01 GF	164.0800	76.5400	87.5400	0.1800	15.7572		(29a)
WT02 Glazed corridor	32.6400	28.8000	3.8400	0.1800	0.6912		(29a)
WT03 Annex	68.4000	20.7700	47.6300	0.1800	8.5734		(29a)
WT04 FF	251.1400	45.2700	205.8700	0.1800	37.0566		(29a)
WT05 Dormer	21.9600	5.6800	16.2800	0.1800	2.9304		(29a)
RT01 Main roof	177.3200	14.0500	163.2700	0.1100	17.9597		(30)
RT02 Flat dormer	24.5100		24.5100	0.1100	2.6961		(30)
RT03 Flat annex	86.1800	6.0000	80.1800	0.1100	8.8198		(30)
RT04 Balcony	5.1200		5.1200	0.1100	0.5632		(30)
Total net area of external elements Aum(A, m ²)			1078.1100				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	353.0029			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
List of Thermal Bridges							
K1 Element			Length	Psi-value	Total		
E1 Steel lintel with perforated steel base plate			49.2300	0.0500	2.4615		
E2 Other lintels (including other steel lintels)			17.3900	0.0500	0.8695		
E3 Sill			17.7300	0.0500	0.8865		
E4 Jamb			97.6800	0.0500	4.8840		
E5 Ground floor (normal)			96.0000	0.1600	15.3600		
E19 Ground floor (inverted)			6.7800	0.0700	0.4746		
E6 Intermediate floor within a dwelling			43.4800	0.0000	0.0000		
E8 Balcony within a dwelling, wall insulation continuous			6.7500	0.0000	0.0000		
E11 Eaves (insulation at rafter level)			42.9500	0.0400	1.7180		
E13 Gable (insulation at rafter level)			24.5200	0.0800	1.9616		
E14 Flat roof			51.8400	0.0800	4.1472		
E15 Flat roof with parapet			36.5900	0.0900	3.2931		
E16 Corner (normal)			27.2000	0.0900	2.4480		
E17 Corner (inverted - internal area greater than external area)			16.2000	-0.0900	-1.4580		
R1 Head of roof window			8.2700	0.0800	0.6616		
R2 Sill of roof window			8.2700	0.0600	0.4962		
R3 Jamb of roof window			34.0000	0.0800	2.7200		
R4 Ridge (vaulted ceiling)			28.1500	0.0800	2.2520		
R8 Roof to wall (rafter)			18.3200	0.0600	1.0992		
R10 All other roof or room-in-roof junctions			6.5000	0.0800	0.5200		
R11 Upstands or kerbs of rooflights			18.0000	0.0800	1.4400		
E20 Exposed floor (normal)			22.2500	0.3200	7.1200		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)					53.3550		(36)
Point Thermal bridges					(36a) =	0.0000	
Total fabric heat loss					(33) + (36) + (36a) =	406.3579	(37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	194.0316	193.1330	192.2522	188.1150	187.3409	183.7375	183.7375	183.0702	185.1255	187.3409	188.9068	190.5439	(38)
Heat transfer coeff	600.3895	599.4909	598.6101	594.4729	593.6988	590.0955	590.0955	589.4282	591.4834	593.6988	595.2648	596.9018	(39)
Average = Sum(39)m / 12 =												594.4692	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.6516	1.6491	1.6467	1.6353	1.6332	1.6233	1.6233	1.6214	1.6271	1.6332	1.6375	1.6420	(40)
HLP (average)												1.6353	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.2145 (42)
Hot water usage for mixer showers													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths													
33.7159	33.2152	32.5101	31.2099	30.2364	29.1569	28.5738	29.2740	30.0364	31.1915	32.5184	33.6019		(42b)
Hot water usage for other uses													
47.5498	45.8207	44.0916	42.3625	40.6334	38.9043	38.9043	40.6334	42.3625	44.0916	45.8207	47.5498		(42c)
Average daily hot water use (litres/day)												74.4870	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	81.2657	79.0359	76.6017	73.5724	70.8698	68.0613	67.4782	69.9075	72.3989	75.2831	78.3391	81.1517	(44)
Energy conte	128.7050	112.5460	117.7339	100.7170	95.4044	83.6893	81.6090	86.5600	89.2751	102.1585	111.6084	127.0639	(45)
Energy content (annual)										Total = Sum(45)m =		1237.0705	
Distribution loss (46)m = 0.15 x (45)m													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
109.3992	95.6641	100.0738	85.6094	81.0938	71.1359	69.3677	73.5760	75.8839	86.8347	94.8671	108.0044		(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	109.3992	95.6641	100.0738	85.6094	81.0938	71.1359	69.3677	73.5760	75.8839	86.8347	94.8671	108.0044	(64)
Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		1051.5099	(64)
Electric shower(s)	62.5584	55.7400	60.8660	58.0837	59.1736	56.4459	58.3274	59.1736	58.0837	60.8660	59.7215	62.5584	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												711.5981	(64a)
Heat gains from water heating, kWh/month													
42.9894	37.8510	40.2350	35.9233	35.0668	31.8954	31.9238	33.1874	33.4919	36.9252	38.6472	42.6407		(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	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
256.1678	283.6143	256.1678	264.7067	256.1678	256.1678	264.7067	256.1678	256.1678	264.7067	256.1678	264.7067	256.1678	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
507.8812	513.1515	499.8707	471.5975	435.9076	402.3642	379.9551	374.6849	387.9657	416.2389	451.9287	485.4722		(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	(71)
Water heating gains (Table 5)													
57.7815	56.3260	54.0792	49.8934	47.1328	44.2992	42.9083	44.6067	46.5165	49.6306	53.6766	57.3128		(72)
Total internal gains	893.0480	924.3093	881.3353	857.4152	810.4258	782.5877	750.2488	746.6770	770.4065	793.2549	841.5296	870.1703	(73)

6. Solar gains

[Jan]														
					Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d		Gains W	
Northeast					48.4100	11.2829		0.6300	0.7000		0.7700		166.9280 (75)	
Southeast					56.9700	36.7938		0.6300	0.7000		0.7700		640.6091 (77)	
Southwest					14.4000	36.7938		0.6300	0.7000		0.7700		161.9233 (79)	
Northwest					54.0400	11.2829		0.6300	0.7000		0.7700		186.3415 (81)	
Southeast					5.2800	39.9751		0.6300	0.7000		1.0000		83.7732 (82)	
Northwest					8.7700	16.3666		0.6300	0.7000		1.0000		56.9690 (82)	
Horizontal					6.0000	26.0000		0.6300	0.7000		1.0000		61.9164 (82)	
Solar gains	1358.4604	2485.9388	3845.7913	5489.8088		6795.8612	7027.3204	6658.6006	5643.9142	4410.1225	2868.5157	1658.7415	1141.9366	(83)
Total gains	2251.5085	3410.2481	4727.1266	6347.2240		7606.2870	7809.9081	7408.8494	6390.5912	5180.5290	3661.7706	2500.2711	2012.1069	(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	42.0468	42.1098	42.1718	42.4653	42.5206	42.7803	42.7803	42.8287	42.6799	42.5206	42.4088	42.2925	
alpha	3.8031	3.8073	3.8115	3.8310	3.8347	3.8520	3.8520	3.8552	3.8453	3.8347	3.8273	3.8195	
util living area	0.9974	0.9876	0.9525	0.8395	0.6519	0.4679	0.3464	0.4152	0.6903	0.9403	0.9928	0.9983	(86)

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MIT	18.8976	19.3014	19.8704	20.4947	20.8475	20.9668	20.9919	20.9842	20.8629	20.2598	19.4313	18.8297 (87)
Th 2	19.5757	19.5775	19.5793	19.5875	19.5891	19.5963	19.5963	19.5976	19.5935	19.5891	19.5859	19.5827 (88)
util rest of house	0.9964	0.9832	0.9365	0.7934	0.5750	0.3719	0.2379	0.2930	0.5838	0.9117	0.9897	0.9976 (89)
MIT 2	17.7038	18.1054	18.6592	19.2305	19.5050	19.5845	19.5948	19.5944	19.5325	19.0474	18.2431	17.6410 (90)
Living area fraction									fLA = Living area / (4) =			0.1095 (91)
MIT	17.8345	18.2364	18.7918	19.3690	19.6521	19.7359	19.7479	19.7466	19.6782	19.1802	18.3733	17.7712 (92)
Temperature adjustment												0.0000
adjusted MIT	17.8345	18.2364	18.7918	19.3690	19.6521	19.7359	19.7479	19.7466	19.6782	19.1802	18.3733	17.7712 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9945	0.9773	0.9249	0.7851	0.5787	0.3818	0.2498	0.3064	0.5909	0.9006	0.9855	0.9963	(94)
Useful gains	2239.1316	3332.6719	4371.8856	4983.4018	4401.7164	2981.8117	1850.7870	1957.8667	3061.3018	3297.6587	2464.1111	2004.6959	(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	8125.9925	7995.0580	7358.0196	6223.5519	4721.1509	3030.6868	1857.5443	1972.5914	3299.4274	5094.0734	6710.6003	8100.6724	(97)
Space heating kWh	4379.8245	3133.1234	2221.6837	892.9081	237.6592	0.0000	0.0000	0.0000	0.0000	1336.5325	3057.4722	4535.4065	(98a)
Space heating requirement - total per year (kWh/year)												19794.6102	
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	4379.8245	3133.1234	2221.6837	892.9081	237.6592	0.0000	0.0000	0.0000	0.0000	1336.5325	3057.4722	4535.4065	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												19794.6102	
Space heating per m2											(98c) / (4) =	54.4526	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	5546.8975	4366.7066	4479.6543	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9293	0.9585	0.9318	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	5154.9178	4185.2918	4174.3104	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	8766.2391	8315.6563	7169.3541	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	2600.1514	3072.9912	2228.3125	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fc = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	650.0378	768.2478	557.0781	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												1975.3638 (107)
Energy for space heating												54.4526 (99)
Energy for space cooling												5.4340 (108)
Total												59.8866 (109)
Fabric Energy Efficiency (DFEE)												59.9 (109)

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

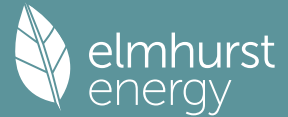
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Ground floor	196.7600 (1b)	x 2.9500 (2b)	= 580.4420 (1b) - (3b)
First floor	166.7600 (1c)	x 2.7300 (2c)	= 455.2548 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	363.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1035.6968 (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)
Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) = 0.0386 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.2886 (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) = 0.2886 (21)

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Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind factor	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)
Adj infilt rate	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)
	0.3680	0.3608	0.3536	0.3175	0.3103	0.2742	0.2742	0.2670	0.2886	0.3103	0.3247	0.3391	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													0.0000 (23c)
Effective ac	0.5677	0.5651	0.5625	0.5504	0.5481	0.5376	0.5376	0.5356	0.5417	0.5481	0.5527	0.5575	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
TER Opaque door			3.2400	1.0000	3.2400			(26)
TER Opening Type			78.5500	1.1450	89.9427			(27)
TER Roof Light			9.0600	1.5918	17.2373			(27a)
FT01 GF			196.7600	0.1300	25.5788			(28a)
FT02 FF Exposed			50.0000	0.1300	6.5000			(28b)
WT01 GF	164.0800	36.3600	127.7200	0.1800	22.9896			(29a)
WT02 Glazed corridor	32.6400	13.0200	19.6200	0.1800	3.5316			(29a)
WT03 Annex	68.4000	9.3800	59.0200	0.1800	10.6236			(29a)
WT04 FF	251.1400	20.4600	230.6800	0.1800	41.5224			(29a)
WT05 Dormer	21.9600	2.5700	19.3900	0.1800	3.4902			(29a)
RT01 Main roof	177.3200	6.3600	170.9600	0.1100	18.8056			(30)
RT02 Flat dormer	24.5100		24.5100	0.1100	2.6961			(30)
RT03 Flat annex	86.1800	2.7000	83.4800	0.1100	9.1828			(30)
RT04 Balcony	5.1200		5.1200	0.1100	0.5632			(30)
Total net area of external elements Aum(A, m2)			1078.1100					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	255.9040		(33)

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

250.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	49.2300	0.0500	2.4615
E2 Other lintels (including other steel lintels)	17.3900	0.0500	0.8695
E3 Sill	17.7300	0.0500	0.8865
E4 Jamb	97.6800	0.0500	4.8840
E5 Ground floor (normal)	96.0000	0.1600	15.3600
E19 Ground floor (inverted)	6.7800	0.0700	0.4746
E6 Intermediate floor within a dwelling	43.4800	0.0000	0.0000
E8 Balcony within a dwelling, wall insulation continuous	6.7500	0.0000	0.0000
E11 Eaves (insulation at rafter level)	42.9500	0.0400	1.7180
E13 Gable (insulation at rafter level)	24.5200	0.0800	1.9616
E14 Flat roof	51.8400	0.0800	4.1472
E15 Flat roof with parapet	36.5900	0.5600	20.4904
E16 Corner (normal)	27.2000	0.0900	2.4480
E17 Corner (inverted - internal area greater than external area)	16.2000	-0.0900	-1.4580
R1 Head of roof window	8.2700	0.0800	0.6616
R2 Sill of roof window	8.2700	0.0600	0.4962
R3 Jamb of roof window	34.0000	0.0800	2.7200
R4 Ridge (vaulted ceiling)	28.1500	0.0800	2.2520
R8 Roof to wall (rafter)	18.3200	0.0600	1.0992
R10 All other roof or room-in-roof junctions	6.5000	0.0800	0.5200
R11 Upstands or kerbs of rooflights	18.0000	0.0800	1.4400
E20 Exposed floor (normal)	22.2500	0.3200	7.1200

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

70.5523 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 326.4563 (37)

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

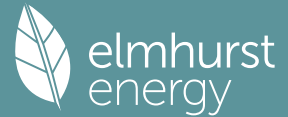
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat transfer coeff	194.0316	193.1330	192.2522	188.1150	187.3409	183.7375	183.7375	183.0702	185.1255	187.3409	188.9068	190.5439	(38)
Average = Sum(39)m / 12 =	520.4879	519.5893	518.7084	514.5712	513.7972	510.1938	510.1938	509.5265	511.5818	513.7972	515.3631	517.0002	(39)
												514.5675	

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.4318	1.4293	1.4269	1.4155	1.4134	1.4035	1.4035	1.4016	1.4073	1.4134	1.4177	1.4222	(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													3.2145 (42)
Hot water usage for mixer showers													(42a)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Hot water usage for baths													(42b)
	33.7159	33.2152	32.5101	31.2099	30.2364	29.1569	28.5738	29.2740	30.0364	31.1915	32.5184	33.6019	
Hot water usage for other uses													(42c)
	47.5498	45.8207	44.0916	42.3625	40.6334	38.9043	38.9043	40.6334	42.3625	44.0916	45.8207	47.5498	
Average daily hot water use (litres/day)												74.4870	(43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	81.2657	79.0359	76.6017	73.5724	70.8698	68.0613	67.4782	69.9075	72.3989	75.2831	78.3391	81.1517	(44)
Energy content (annual)	128.7050	112.5460	117.7339	100.7170	95.4044	83.6893	81.6090	86.5600	89.2751	102.1585	111.6084	127.0639	(45)
Distribution loss	(46)m = 0.15 x (45)m												Total = Sum(45)m = 1237.0705
Water storage loss:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
WWHRS	109.3992	95.6641	100.0738	85.6094	81.0938	71.1359	69.3677	73.5760	75.8839	86.8347	94.8671	108.0044	(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)

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Output from w/h	109.3992	95.6641	100.0738	85.6094	81.0938	71.1359	69.3677	73.5760	75.8839	86.8347	94.8671	108.0044 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											1051.5099 (64)
Electric shower(s)	62.5584	55.7400	60.8660	58.0837	59.1736	56.4459	58.3274	59.1736	58.0837	60.8660	59.7215	62.5584 (64a)
Heat gains from water heating, kWh/month	42.9894	37.8510	40.2350	35.9233	35.0668	31.8954	31.9238	33.1874	33.4919	36.9252	38.6472	42.6407 (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	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	256.1678	283.6143	256.1678	264.7067	256.1678	264.7067	256.1678	256.1678	264.7067	256.1678	264.7067	256.1678 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	507.8812	513.1515	499.8707	471.5975	435.9076	402.3642	379.9551	374.6849	387.9657	416.2389	451.9287	485.4722 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802 (71)
Water heating gains (Table 5)	57.7815	56.3260	54.0792	49.8934	47.1328	44.2992	42.9083	44.6067	46.5165	49.6306	53.6766	57.3128 (72)
Total internal gains	893.0480	924.3093	881.3353	857.4152	810.4258	782.5877	750.2488	746.6770	770.4065	793.2549	841.5296	870.1703 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c				Access factor Table 6d	Gains W

Northeast					21.8800	11.2829	0.6300	0.7000				0.7700	75.4469 (75)
Southeast					25.7400	36.7938	0.6300	0.7000				0.7700	289.4379 (77)
Southwest					6.5100	36.7938	0.6300	0.7000				0.7700	73.2028 (79)
Northwest					24.4200	11.2829	0.6300	0.7000				0.7700	84.2054 (81)
Southeast					2.3900	39.9751	0.6300	0.7000				1.0000	37.9201 (82)
Northwest					3.9700	16.3666	0.6300	0.7000				1.0000	25.7887 (82)
Horizontal					2.7000	26.0000	0.6300	0.7000				1.0000	27.8624 (82)

Solar gains	613.8642	1123.3382	1737.8047	2480.6835	3070.8613	3175.4601	3008.8415	2550.3220	1992.8057	1296.2094	749.5531	516.0229 (83)	
Total gains	1506.9122	2047.6475	2619.1400	3338.0987	3881.2871	3958.0477	3759.0903	3296.9990	2763.2122	2089.4642	1591.0827	1386.1931 (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	48.5015	48.5854	48.6679	49.0592	49.1331	49.4801	49.4801	49.5449	49.3459	49.1331	48.9838	48.8287
alpha	4.2334	4.2390	4.2445	4.2706	4.2755	4.2987	4.2987	4.3030	4.2897	4.2755	4.2656	4.2552
util living area	0.9995	0.9981	0.9926	0.9664	0.8841	0.7262	0.5691	0.6543	0.8954	0.9889	0.9987	0.9997 (86)
MIT	18.9844	19.2261	19.6184	20.1560	20.6211	20.8898	20.9703	20.9474	20.7026	20.0779	19.4326	18.9490 (87)
Th 2	19.7390	19.7409	19.7428	19.7515	19.7531	19.7607	19.7607	19.7621	19.7577	19.7531	19.7498	19.7464 (88)
util rest of house	0.9993	0.9973	0.9896	0.9521	0.8354	0.6216	0.4225	0.5042	0.8293	0.9824	0.9982	0.9995 (89)
MIT 2	17.9075	18.1501	18.5420	19.0748	19.5012	19.7120	19.7538	19.7478	19.5879	19.0074	18.3633	17.8774 (90)
Living area fraction	18.0254	18.2680	18.6599	19.1932	19.6239	19.8410	19.8870	19.8792	19.7100	19.1246	18.4804	17.9948 (92)
MIT	18.0254	18.2680	18.6599	19.1932	19.6239	19.8410	19.8870	19.8792	19.7100	19.1246	18.4804	17.9948 (93)
Temperature adjustment												0.0000
adjusted MIT	18.0254	18.2680	18.6599	19.1932	19.6239	19.8410	19.8870	19.8792	19.7100	19.1246	18.4804	17.9948 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9989	0.9960	0.9858	0.9436	0.8293	0.6292	0.4383	0.5198	0.8260	0.9775	0.9972	0.9992 (94)
Useful gains	1505.2748	2039.4891	2582.0411	3149.7074	3218.7123	2490.2075	1647.6976	1713.7733	2282.4096	2042.3630	1586.6373	1385.1438 (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	7143.9176	6945.8711	6307.4601	5296.6093	4071.2625	2673.9221	1677.0161	1772.7266	2869.9757	4379.9400	5865.0456	7131.9308 (97)
Space heating kWh	4195.1503	3297.0887	2771.7118	1545.7694	634.2974	0.0000	0.0000	0.0000	0.0000	1739.1573	3080.4540	4275.6095 (98a)
Space heating requirement - total per year (kWh/year)												21539.2384
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	4195.1503	3297.0887	2771.7118	1545.7694	634.2974	0.0000	0.0000	0.0000	0.0000	1739.1573	3080.4540	4275.6095 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												21539.2384
Space heating per m2												(98c) / (4) = 59.2519 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	4795.8219	3775.4342	3872.4016	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7742	0.8494	0.7872	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	3712.6948	3206.9982	3048.4604	0.0000	0.0000	0.0000	0.0000 (102)

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Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	4393.7562	4172.0383	3654.6397	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	490.3642	717.9898	450.9974	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000	490.3642	717.9898	450.9974	0.0000	0.0000	0.0000	1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	122.5911	179.4975	112.7493	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												414.8379 (107)
Energy for space heating												59.2519 (99)
Energy for space cooling												1.1412 (108)
Total												60.3930 (109)
Fabric Energy Efficiency (TFEE)												60.4 (109)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling			
Ground floor	196.7600 (1b)	x 2.9500 (2b)	= 580.4420 (1b) - (3b)
First floor	166.7600 (1c)	x 2.7300 (2c)	= 455.2548 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	363.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1035.6968 (5)

2. Ventilation rate

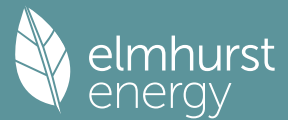
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	7 * 10 = 70.0000 (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) =	70.0000 / (5) = 0.0676 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3176 (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) = 0.3176 (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	0.4049	0.3970	0.3890	0.3493	0.3414	0.3017	0.3017	0.2938	0.3176	0.3414	0.3573	0.3732 (22b)
Effective ac	0.5820	0.5788	0.5757	0.5610	0.5583	0.5455	0.5455	0.5431	0.5504	0.5583	0.5638	0.5696 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Solid doors			3.2400	1.2000	3.8880		(26)
Windows Dbl LowE			173.8200	1.1450	199.0305		(27)
Rooflights Dbl LowE			20.0500	1.1450	22.9580		(27a)
FT01 GF			196.7600	0.1300	25.5788		(28a)
FT02 FF Exposed			50.0000	0.1300	6.5000		(28b)
WT01 GF	164.0800	76.5400	87.5400	0.1800	15.7572		(29a)
WT02 Glazed corridor	32.6400	28.8000	3.8400	0.1800	0.6912		(29a)
WT03 Annex	68.4000	20.7700	47.6300	0.1800	8.5734		(29a)
WT04 FF	251.1400	45.2700	205.8700	0.1800	37.0566		(29a)
WT05 Dormer	21.9600	5.6800	16.2800	0.1800	2.9304		(29a)
RT01 Main roof	177.3200	14.0500	163.2700	0.1100	17.9597		(30)
RT02 Flat dormer	24.5100		24.5100	0.1100	2.6961		(30)
RT03 Flat annex	86.1800	6.0000	80.1800	0.1100	8.8198		(30)
RT04 Balcony	5.1200		5.1200	0.1100	0.5632		(30)
Total net area of external elements Aum(A, m ²)			1078.1100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	353.0029		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E1 Steel lintel with perforated steel base plate				49.2300	0.0500	2.4615	
E2 Other lintels (including other steel lintels)				17.3900	0.0500	0.8695	
E3 Sill				17.7300	0.0500	0.8865	
E4 Jamb				97.6800	0.0500	4.8840	
E5 Ground floor (normal)				96.0000	0.1600	15.3600	
E19 Ground floor (inverted)				6.7800	0.0700	0.4746	
E6 Intermediate floor within a dwelling				43.4800	0.0000	0.0000	
E8 Balcony within a dwelling, wall insulation continuous				6.7500	0.0000	0.0000	
E11 Eaves (insulation at rafter level)				42.9500	0.0400	1.7180	

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E13 Gable (insulation at rafter level)	24.5200	0.0800	1.9616
E14 Flat roof	51.8400	0.0800	4.1472
E15 Flat roof with parapet	36.5900	0.0900	3.2931
E16 Corner (normal)	27.2000	0.0900	2.4480
E17 Corner (inverted - internal area greater than external area)	16.2000	-0.0900	-1.4580
R1 Head of roof window	8.2700	0.0800	0.6616
R2 Sill of roof window	8.2700	0.0600	0.4962
R3 Jamb of roof window	34.0000	0.0800	2.7200
R4 Ridge (vaulted ceiling)	28.1500	0.0800	2.2520
R8 Roof to wall (rafter)	18.3200	0.0600	1.0992
R10 All other roof or room-in-roof junctions	6.5000	0.0800	0.5200
R11 Upstands or kerbs of rooflights	18.0000	0.0800	1.4400
E20 Exposed floor (normal)	22.2500	0.3200	7.1200
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			53.3550 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss		(33) + (36) + (36a) =	406.3579 (37)

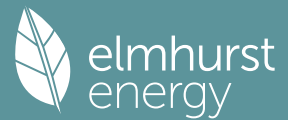
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	198.9097	197.8216	196.7551	191.7458	190.8086	186.4457	186.4457	185.6377	188.1262	190.8086	192.7046	194.6868	(38)
Heat transfer coeff	605.2676	604.1796	603.1131	598.1038	597.1666	592.8036	592.8036	591.9957	594.4842	597.1666	599.0626	601.0447	(39)
Average = Sum(39)m / 12 =												598.0993	
HLP	1.6650	1.6620	1.6591	1.6453	1.6427	1.6307	1.6307	1.6285	1.6354	1.6427	1.6479	1.6534	(40)
HLP (average)												1.6453	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)													
Assumed occupancy													3.2145 (42)
Hot water usage for mixer showers	107.4104	105.7962	103.4440	98.9436	95.6224	91.9186	89.8134	92.1477	94.7066	98.6834	103.2805	106.9988	(42a)
Hot water usage for baths	35.4904	34.9634	34.2211	32.8526	31.8278	30.6915	30.0777	30.8148	31.6173	32.8332	34.2299	35.3705	(42b)
Hot water usage for other uses	50.0524	48.2323	46.4122	44.5921	42.7720	40.9519	40.9519	42.7720	44.5921	46.4122	48.2323	50.0524	(42c)
Average daily hot water use (litres/day)												177.4361	(43)
Daily hot water use	192.9532	188.9918	184.0773	176.3883	170.2222	163.5620	160.8430	165.7345	170.9160	177.9287	185.7427	192.4217	(44)
Energy conte	305.5907	269.1219	282.9200	241.4667	229.1518	201.1186	194.5257	205.2140	210.7565	241.4476	264.6245	301.2858	(45)
Energy content (annual)										Total = Sum(45)m =		2947.2238	
Distribution loss (46)m = 0.15 x (45)m	45.8386	40.3683	42.4380	36.2200	34.3728	30.1678	29.1789	30.7821	31.6135	36.2171	39.6937	45.1929	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												3.0000	(48)
Temperature factor from Table 2b												0.6000	(49)
Enter (49) or (54) in (55)												1.8000	(55)
Total storage loss	55.8000	50.4000	55.8000	54.0000	55.8000	54.0000	55.8000	55.8000	54.0000	55.8000	54.0000	55.8000	(56)
If cylinder contains dedicated solar storage	55.8000	50.4000	55.8000	54.0000	55.8000	54.0000	55.8000	55.8000	54.0000	55.8000	54.0000	55.8000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	361.3907	319.5219	338.7200	295.4667	284.9518	255.1186	250.3257	261.0140	264.7565	297.2476	318.6245	357.0858	(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	361.3907	319.5219	338.7200	295.4667	284.9518	255.1186	250.3257	261.0140	264.7565	297.2476	318.6245	357.0858	(64)
								Total per year (kWh/year) = Sum(64)m =				3604.2238	(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	101.6089	89.4830	94.0709	80.2877	76.1930	66.8719	64.6798	68.2336	70.0766	80.2813	87.9876	100.1775	(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	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	59.5670	52.9069	43.0268	32.5740	24.3495	20.5569	22.2124	28.8725	38.7527	49.2054	57.4300	61.2226	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	758.0317	765.8977	746.0756	703.8768	650.6084	600.5436	567.0972	559.2312	579.0533	621.2521	674.5205	724.5853	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	(71)
Water heating gains (Table 5)	136.5711	133.1593	126.4394	111.5107	102.4099	92.8777	86.9352	91.7119	97.3285	107.9050	122.2051	134.6472	(72)
Total internal gains	1075.9615	1073.7555	1037.3335	969.7532	899.1595	835.7698	798.0365	801.6073	836.9261	900.1542	975.9472	1042.2468	(73)

6. Solar gains							
[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	48.4100	11.2829	0.6300	0.7000	0.7700	166.9280	(75)
Southeast	56.9700	36.7938	0.6300	0.7000	0.7700	640.6091	(77)
Southwest	14.4000	36.7938	0.6300	0.7000	0.7700	161.9233	(79)

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Northwest			54.0400		11.2829		0.6300		0.7000		0.7700		186.3415 (81)
Southeast			5.2800		39.9751		0.6300		0.7000		1.0000		83.7732 (82)
Northwest			8.7700		16.3666		0.6300		0.7000		1.0000		56.9690 (82)
Horizontal			6.0000		26.0000		0.6300		0.7000		1.0000		61.9164 (82)

Solar gains	1358.4604	2485.9388	3845.7913	5489.8088	6795.8612	7027.3204	6658.6006	5643.9142	4410.1225	2868.5157	1658.7415	1141.9366 (83)
Total gains	2434.4219	3559.6943	4883.1248	6459.5620	7695.0206	7863.0902	7456.6372	6445.5215	5247.0487	3768.6699	2634.6887	2184.1834 (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	41.7079	41.7830	41.8569	42.2075	42.2737	42.5848	42.5848	42.6430	42.4645	42.2737	42.1399	42.0009	
alpha	3.7805	3.7855	3.7905	3.8138	3.8182	3.8390	3.8390	3.8429	3.8310	3.8182	3.8093	3.8001	
util living area	0.9965	0.9858	0.9483	0.8347	0.6487	0.4668	0.3457	0.4135	0.6863	0.9358	0.9914	0.9977 (86)	
MIT	18.9289	19.3228	19.8897	20.5009	20.8480	20.9666	20.9918	20.9842	20.8642	20.2738	19.4549	18.8611 (87)	
Th 2	19.5660	19.5682	19.5703	19.5803	19.5821	19.5909	19.5909	19.5925	19.5875	19.5821	19.5784	19.5744 (88)	
util rest of house	0.9952	0.9808	0.9311	0.7878	0.5716	0.3707	0.2370	0.2914	0.5794	0.9055	0.9877	0.9968 (89)	
MIT 2	17.2076	17.7093	18.4150	19.1294	19.4750	19.5757	19.5890	19.5883	19.5103	18.9045	17.8878	17.1261 (90)	
Living area fraction									FLA = Living area / (4) =			0.1095 (91)	
MIT	17.3962	17.8860	18.5766	19.2797	19.6254	19.7280	19.7426	19.7412	19.6586	19.0545	18.0595	17.3162 (92)	
Temperature adjustment												0.0000	
adjusted MIT	17.3962	17.8860	18.5766	19.2797	19.6254	19.7280	19.7426	19.7412	19.6586	19.0545	18.0595	17.3162 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9920	0.9719	0.9151	0.7763	0.5741	0.3804	0.2489	0.3046	0.5854	0.8901	0.9813	0.9945 (94)	
Useful gains	2414.9085	3459.7993	4468.5085	5014.2546	4417.6885	2990.8820	1856.1549	1963.3009	3071.4261	3354.6269	2585.3903	2172.1314 (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	7926.7048	7845.8732	7283.5318	6208.1246	4732.7621	3039.9190	1862.9708	1977.9881	3304.4897	5048.7662	6565.3978	7883.4007 (97)	
Space heating kWh	4100.7764	2947.4417	2094.3774	859.5864	234.4148	0.0000	0.0000	0.0000	0.0000	1260.4396	2865.6054	4249.1844 (98a)	
Space heating requirement - total per year (kWh/year)												18611.8261	
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	4100.7764	2947.4417	2094.3774	859.5864	234.4148	0.0000	0.0000	0.0000	0.0000	1260.4396	2865.6054	4249.1844 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												18611.8261	
Space heating per m2										(98c) / (4) =		51.1989 (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 %)													100.0000 (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	4100.7764	2947.4417	2094.3774	859.5864	234.4148	0.0000	0.0000	0.0000	0.0000	1260.4396	2865.6054	4249.1844 (98)	
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000 (210)	
Space heating fuel (main heating system)	4100.7764	2947.4417	2094.3774	859.5864	234.4148	0.0000	0.0000	0.0000	0.0000	1260.4396	2865.6054	4249.1844 (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	361.3907	319.5219	338.7200	295.4667	284.9518	255.1186	250.3257	261.0140	264.7565	297.2476	318.6245	357.0858 (64)	
Efficiency of water heater (217)m	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000 (216)	
Fuel for water heating, kWh/month	361.3907	319.5219	338.7200	295.4667	284.9518	255.1186	250.3257	261.0140	264.7565	297.2476	318.6245	357.0858 (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	52.1387	41.8276	37.6611	27.5921	21.3130	17.4129	19.4424	25.2720	32.8258	43.0692	48.6466	53.5878 (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												18611.8261 (211)	
Space heating fuel - main system 2												0.0000 (213)	
Space heating fuel - secondary												0.0000 (215)	
Efficiency of water heater												100.0000	

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Water heating fuel used	3604.2238 (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)	420.7890 (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	22636.8388 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	18611.8261	16.4900	3069.0901 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3604.2238	16.4900	594.3365 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Energy for lighting	420.7890	16.4900	69.3881 (250)
Additional standing charges			0.0000 (251)
Total energy cost			3732.8147 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.3600 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] = 3.2895 (257)
SAP value	46.6777
SAP rating (Section 12)	47 (258)
SAP band	E

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	18611.8261	0.1564	2911.0638 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3604.2238	0.1411	508.3969 (264)
Space and water heating			3419.4608 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	420.7890	0.1443	60.7329 (268)
Total CO2, kg/year			3480.1936 (272)
CO2 emissions per m2			9.5700 (273)
EI value			88.5845
EI rating			89 (274)
EI band			B

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Ground floor	196.7600 (1b)	x 2.9500 (2b)	= 580.4420 (1b) - (3b)
First floor	166.7600 (1c)	x 2.7300 (2c)	= 455.2548 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	363.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1035.6968 (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	7 * 10 = 70.0000 (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) =	70.0000 / (5) = 0.0676 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3176 (18)

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Number of sides sheltered

0 (19)

Shelter factor

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

Infiltration rate adjusted to include shelter factor

$$(21) = (18) \times (20) = 0.3176 \quad (21)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.8000	4.5000	4.4000	3.9000	3.9000	3.6000	3.7000	3.5000	3.7000	4.0000	4.1000	4.4000	(22)
Wind factor	1.2000	1.1250	1.1000	0.9750	0.9750	0.9000	0.9250	0.8750	0.9250	1.0000	1.0250	1.1000	(22a)
Adj infilt rate													
Effective ac	0.3811	0.3573	0.3493	0.3096	0.3096	0.2858	0.2938	0.2779	0.2938	0.3176	0.3255	0.3493	(22b)
	0.5726	0.5638	0.5610	0.5479	0.5479	0.5408	0.5431	0.5386	0.5431	0.5504	0.5530	0.5610	(25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K	
Main dwelling								
Solid doors			3.2400	1.2000	3.8880			(26)
Windows Dbl LowE			173.8200	1.1450	199.0305			(27)
Rooflights Dbl LowE			20.0500	1.1450	22.9580			(27a)
FT01 GF			196.7600	0.1300	25.5788			(28a)
FT02 FF Exposed			50.0000	0.1300	6.5000			(28b)
WT01 GF	164.0800	76.5400	87.5400	0.1800	15.7572			(29a)
WT02 Glazed corridor	32.6400	28.8000	3.8400	0.1800	0.6912			(29a)
WT03 Annex	68.4000	20.7700	47.6300	0.1800	8.5734			(29a)
WT04 FF	251.1400	45.2700	205.8700	0.1800	37.0566			(29a)
WT05 Dormer	21.9600	5.6800	16.2800	0.1800	2.9304			(29a)
RT01 Main roof	177.3200	14.0500	163.2700	0.1100	17.9597			(30)
RT02 Flat dormer	24.5100		24.5100	0.1100	2.6961			(30)
RT03 Flat annex	86.1800	6.0000	80.1800	0.1100	8.8198			(30)
RT04 Balcony	5.1200		5.1200	0.1100	0.5632			(30)
Total net area of external elements Aum(A, m ²)			1078.1100					(31)
Fabric heat loss, W/K = Sum (A x U)					353.0029			(33)
								(26)...(30) + (32) =

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

250.0000 (35)

List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element	49.2300	0.0500	2.4615	
E1 Steel lintel with perforated steel base plate	17.3900	0.0500	0.8695	
E2 Other lintels (including other steel lintels)	17.7300	0.0500	0.8865	
E3 Sill	97.6800	0.0500	4.8840	
E4 Jamb	96.0000	0.1600	15.3600	
E5 Ground floor (normal)	6.7800	0.0700	0.4746	
E19 Ground floor (inverted)	43.4800	0.0000	0.0000	
E6 Intermediate floor within a dwelling	6.7500	0.0000	0.0000	
E8 Balcony within a dwelling, wall insulation continuous	42.9500	0.0400	1.7180	
E11 Eaves (insulation at rafter level)	24.5200	0.0800	1.9616	
E13 Gable (insulation at rafter level)	51.8400	0.0800	4.1472	
E14 Flat roof	36.5900	0.0900	3.2931	
E15 Flat roof with parapet	27.2000	0.0900	2.4480	
E16 Corner (normal)	16.2000	-0.0900	-1.4580	
E17 Corner (inverted - internal area greater than external area)	8.2700	0.0800	0.6616	
R1 Head of roof window	8.2700	0.0600	0.4962	
R2 Sill of roof window	34.0000	0.0800	2.7200	
R3 Jamb of roof window	28.1500	0.0800	2.2520	
R4 Ridge (vaulted ceiling)	18.3200	0.0600	1.0992	
R8 Roof to wall (rafter)	6.5000	0.0800	0.5200	
R10 All other roof or room-in-roof junctions	18.0000	0.0800	1.4400	
R11 Upstands or kerbs of rooflights	22.2500	0.3200	7.1200	
E20 Exposed floor (normal)				

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

53.3550 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

$$(33) + (36) + (36a) = 406.3579 \quad (37)$$

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

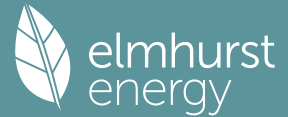
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	195.7102	192.7046	191.7458	187.2752	187.2752	184.8513	185.6377	184.0865	185.6377	188.1262	188.9988	191.7458	(38)
Heat transfer coeff	602.0681	599.0626	598.1038	593.6331	593.6331	591.2093	591.9957	590.4444	591.9957	594.4842	595.3568	598.1038	(39)
Average = Sum(39)m / 12 =												595.0076	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.6562	1.6479	1.6453	1.6330	1.6330	1.6263	1.6285	1.6242	1.6285	1.6354	1.6378	1.6453	(40)
HLP (average)												1.6368	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.2145 (42)
Hot water usage for mixer showers													
107.4104	105.7962	103.4440	98.9436	95.6224	91.9186	89.8134	92.1477	94.7066	98.6834	103.2805	106.9988	106.9988	(42a)
Hot water usage for baths													
35.4904	34.9634	34.2211	32.8526	31.8278	30.6915	30.0777	30.8148	31.6173	32.8332	34.2299	35.3705	35.3705	(42b)
Hot water usage for other uses													
50.0524	48.2323	46.4122	44.5921	42.7720	40.9519	40.9519	42.7720	44.5921	46.4122	48.2323	50.0524	50.0524	(42c)
Average daily hot water use (litres/day)												177.4361	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	192.9532	188.9918	184.0773	176.3883	170.2222	163.5620	160.8430	165.7345	170.9160	177.9287	185.7427	192.4217	(44)
Energy conte	305.5907	269.1219	282.9200	241.4667	229.1518	201.1186	194.5257	205.2140	210.7565	241.4476	264.6245	301.2858	(45)
Energy content (annual)													
Distribution loss (46)m = 0.15 x (45)m													2947.2238
45.8386	40.3683	42.4380	36.2200	34.3728	30.1678	29.1789	30.7821	31.6135	36.2171	39.6937	45.1929	45.1929	(46)
Water storage loss:													
Store volume													300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													3.0000 (48)
Temperature factor from Table 2b													0.6000 (49)
Enter (49) or (54) in (55)													1.8000 (55)
Total storage loss													
55.8000	50.4000	55.8000	54.0000	55.8000	54.0000	55.8000	55.8000	54.0000	55.8000	54.0000	55.8000	55.8000	(56)
If cylinder contains dedicated solar storage													
55.8000	50.4000	55.8000	54.0000	55.8000	54.0000	55.8000	55.8000	54.0000	55.8000	54.0000	55.8000	55.8000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

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Total heat required for water heating calculated for each month												
	361.3907	319.5219	338.7200	295.4667	284.9518	255.1186	250.3257	261.0140	264.7565	297.2476	318.6245	357.0858 (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	361.3907	319.5219	338.7200	295.4667	284.9518	255.1186	250.3257	261.0140	264.7565	297.2476	318.6245	357.0858 (64)
Total per year (kWh/year) = Sum(64)m =												3604.2238 (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	101.6089	89.4830	94.0709	80.2877	76.1930	66.8719	64.6798	68.2336	70.0766	80.2813	87.9876	100.1775 (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	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	59.5670	52.9069	43.0268	32.5740	24.3495	20.5569	22.2124	28.8725	38.7527	49.2054	57.4300	61.2226 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	758.0317	765.8977	746.0756	703.8768	650.6084	600.5436	567.0972	559.2312	579.0533	621.2521	674.5205	724.5853 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802 (71)
Water heating gains (Table 5)	136.5711	133.1593	126.4394	111.5107	102.4099	92.8777	86.9352	91.7119	97.3285	107.9050	122.2051	134.6472 (72)
Total internal gains	1075.9615	1073.7555	1037.3335	969.7532	899.1595	835.7698	798.0365	801.6073	836.9261	900.1542	975.9472	1042.2468 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
Northeast					48.4100	13.7622	0.6300	0.7000	0.7700		203.6078 (75)	
Southeast					56.9700	42.6275	0.6300	0.7000	0.7700		742.1785 (77)	
Southwest					14.4000	42.6275	0.6300	0.7000	0.7700		187.5965 (79)	
Northwest					54.0400	13.7622	0.6300	0.7000	0.7700		227.2870 (81)	
Southeast					5.2800	47.3724	0.6300	0.7000	1.0000		99.2751 (82)	
Northwest					8.7700	20.0162	0.6300	0.7000	1.0000		69.6726 (82)	
Horizontal					6.0000	32.0000	0.6300	0.7000	1.0000		76.2048 (82)	
Solar gains	1605.8222	2624.1628	4069.4387	6149.3962	7327.9838	8098.1190	7585.1841	6488.3453	5006.7019	3245.6585	1982.3186	1303.9802 (83)
Total gains	2681.7837	3697.9184	5106.7722	7119.1494	8227.1432	8933.8888	8383.2206	7289.9526	5843.6281	4145.8127	2958.2658	2346.2270 (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	41.9295	42.1399	42.2075	42.5253	42.5253	42.6997	42.6430	42.7550	42.6430	42.4645	42.4022	42.2075
alpha	3.7953	3.8093	3.8138	3.8350	3.8350	3.8466	3.8429	3.8503	3.8429	3.8310	3.8268	3.8138
util living area	0.9944	0.9821	0.9335	0.7762	0.5677	0.3654	0.2532	0.2819	0.5692	0.8895	0.9839	0.9963 (86)
MIT	19.1191	19.4552	20.0407	20.6475	20.9144	20.9875	20.9978	20.9969	20.9387	20.5012	19.7083	19.0762 (87)
Th 2	19.5724	19.5784	19.5803	19.5892	19.5892	19.5941	19.5925	19.5956	19.5925	19.5875	19.5858	19.5803 (88)
util rest of house	0.9922	0.9758	0.9115	0.7198	0.4855	0.2761	0.1547	0.1696	0.4518	0.8388	0.9766	0.9949 (89)
MIT 2	17.4547	17.8835	18.6051	19.2884	19.5355	19.5896	19.5922	19.5952	19.5651	19.1663	18.2134	17.4052 (90)
Living area fraction	17.6370	18.0557	18.7624	19.4372	19.6865	19.7427	19.7462	19.7488	19.7156	19.3125	18.3771	17.5882 (91)
MIT	17.6370	18.0557	18.7624	19.4372	19.6865	19.7427	19.7462	19.7488	19.7156	19.3125	18.3771	17.5882 (92)
Temperature adjustment	17.6370	18.0557	18.7624	19.4372	19.6865	19.7427	19.7462	19.7488	19.7156	19.3125	18.3771	17.5882 (93)
adjusted MIT	17.6370	18.0557	18.7624	19.4372	19.6865	19.7427	19.7462	19.7488	19.7156	19.3125	18.3771	17.5882 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9875	0.9657	0.8950	0.7130	0.4915	0.2857	0.1655	0.1819	0.4627	0.8262	0.9670	0.9915 (94)
Useful gains	2648.3758	3570.9606	4570.7825	5075.6493	4043.4280	2552.2907	1387.7616	1326.2215	2703.8549	3425.4080	2860.6460	2326.1805 (95)
Ext temp.	5.0000	5.4000	7.1000	9.5000	12.6000	15.4000	17.4000	17.5000	15.0000	11.7000	8.1000	5.2000 (96)
Heat loss rate W	7608.3312	7581.5333	6975.2985	5899.0680	4206.7797	2567.4358	1388.9200	1327.7639	2791.5863	4525.5149	6118.5657	7409.4584 (97)
Space heating kWh	3690.2068	2695.1048	1788.9599	592.8615	121.5337	0.0000	0.0000	0.0000	0.0000	818.4795	2345.7021	3781.9587 (98a)
Space heating requirement - total per year (kWh/year)												15834.8071
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	3690.2068	2695.1048	1788.9599	592.8615	121.5337	0.0000	0.0000	0.0000	0.0000	818.4795	2345.7021	3781.9587 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												15834.8071
Space heating per m ²												43.5597 (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)

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Efficiency of main space heating system 1 (in %)												100.0000	(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	3690.2068	2695.1048	1788.9599	592.8615	121.5337	0.0000	0.0000	0.0000	0.0000	818.4795	2345.7021	3781.9587	(98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)	3690.2068	2695.1048	1788.9599	592.8615	121.5337	0.0000	0.0000	0.0000	0.0000	818.4795	2345.7021	3781.9587	(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	361.3907	319.5219	338.7200	295.4667	284.9518	255.1186	250.3257	261.0140	264.7565	297.2476	318.6245	357.0858	(64)
Efficiency of water heater	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	(216)
Fuel for water heating, kWh/month	361.3907	319.5219	338.7200	295.4667	284.9518	255.1186	250.3257	261.0140	264.7565	297.2476	318.6245	357.0858	(217)
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	(219)
(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	(221)
Lighting	52.1387	41.8276	37.6611	27.5921	21.3130	17.4129	19.4424	25.2720	32.8258	43.0692	48.6466	53.5878	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
(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)	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)
(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)	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)
(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)	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)
(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)	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)
(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)	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)
(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)	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)
(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)	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)
(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												15834.8071	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												100.0000	
Water heating fuel used												3604.2238	(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)												420.7890	(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												19859.8199	(238)

10a. Fuel costs - using BEDF prices (567)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	15834.8071	26.0600	4126.5507	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3604.2238	26.0600	939.2607	(247)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Energy for lighting	420.7890	26.0600	109.6576	(250)
Additional standing charges			0.0000	(251)
Total energy cost			5175.4691	(255)

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	15834.8071	0.1572	2489.2265	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3604.2238	0.1411	508.3969	(264)
Space and water heating			2997.6234	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	420.7890	0.1443	60.7329	(268)
Total CO2, kg/year			3058.3563	(272)

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	15834.8071	1.5819	25049.7600	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3604.2238	1.5216	5484.1197	(278)
Space and water heating			30533.8797	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	420.7890	1.5338	645.4202	(282)

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Total Primary energy kWh/year

31179.2999 (286)

SAP 10 EPC IMPROVEMENTS

BE LEAN

Current energy efficiency rating:
Current environmental impact rating:

E 47
B 89

N Solar water heating
U Solar photovoltaic panels
V2 Wind turbine
Recommended
Recommended
Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.9	-£ 243	-120 kg (3.9%)
U Solar photovoltaic panels	+ 3.2	-£ 359	-248 kg (8.4%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£243	0.33 kg/m ²	E 49 B 89
Solar photovoltaic panels	£359	0.68 kg/m ²	E 52 B 90
Total Savings	£602	1.01 kg/m ²	

Potential energy efficiency rating: E 52
Potential environmental impact rating: B 90

Fuel prices for cost data on this page from database revision number 567 TEST (07 Mar 2025)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, South East England):

	Current	Potential	Saving
Electricity	£5175	£4932	£243
Space heating	£4127	£4147	-£21
Water heating	£939	£675	£264
Lighting	£110	£110	£0
Generated (PV)	-£0	-£359	£359
Total cost of fuels	£5175	£4573	£602
Total cost of uses	£5176	£4573	£602
Delivered energy	55 kWh/m ²	47 kWh/m ²	8 kWh/m ²
Carbon dioxide emissions	3.1 tonnes	2.7 tonnes	0.4 tonnes
CO2 emissions per m ²	8 kg/m ²	7 kg/m ²	1 kg/m ²
Primary energy	86 kWh/m ²	76 kWh/m ²	10 kWh/m ²

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

1. Overall dwelling characteristics

Main dwelling	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	196.7600 (1b)	x 2.9500 (2b)	= 580.4420 (1b) - (3b)
First floor	166.7600 (1c)	x 2.7300 (2c)	= 455.2548 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	363.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1035.6968 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	7 * 10 = 70.0000 (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) = 70.0000 / (5) = 0.0676 (8)

Pressure test
Pressure Test Method
Measured/design AP50
Infiltration rate
Number of sides sheltered

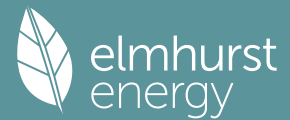
Blower Door
Yes
5.0000 (17)
0.3176 (18)
0 (19)

Shelter factor
Infiltration rate adjusted to include shelter factor

(20) = 1 - [0.075 x (19)] = 1.0000 (20)
(21) = (18) x (20) = 0.3176 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)

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Adj infilt rate	0.4049	0.3970	0.3890	0.3493	0.3414	0.3017	0.3017	0.2938	0.3176	0.3414	0.3573	0.3732 (22b)
Effective ac	0.5820	0.5788	0.5757	0.5610	0.5583	0.5455	0.5455	0.5431	0.5504	0.5583	0.5638	0.5696 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Main dwelling							
Solid doors			3.2400	1.2000	3.8880		(26)
Windows Dbl LowE			173.8200	1.1450	199.0305		(27)
Rooflights Dbl LowE			20.0500	1.1450	22.9580		(27a)
FT01 GF			196.7600	0.1300	25.5788		(28a)
FT02 FF Exposed			50.0000	0.1300	6.5000		(28b)
WT01 GF	164.0800	76.5400	87.5400	0.1800	15.7572		(29a)
WT02 Glazed corridor	32.6400	28.8000	3.8400	0.1800	0.6912		(29a)
WT03 Annex	68.4000	20.7700	47.6300	0.1800	8.5734		(29a)
WT04 FF	251.1400	45.2700	205.8700	0.1800	37.0566		(29a)
WT05 Dormer	21.9600	5.6800	16.2800	0.1800	2.9304		(29a)
RT01 Main roof	177.3200	14.0500	163.2700	0.1100	17.9597		(30)
RT02 Flat dormer	24.5100		24.5100	0.1100	2.6961		(30)
RT03 Flat annex	86.1800	6.0000	80.1800	0.1100	8.8198		(30)
RT04 Balcony	5.1200		5.1200	0.1100	0.5632		(30)
Total net area of external elements Aum(A, m2)			1078.1100				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		353.0029		(33)

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

250.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	49.2300	0.0500	2.4615
E2 Other lintels (including other steel lintels)	17.3900	0.0500	0.8695
E3 Sill	17.7300	0.0500	0.8865
E4 Jamb	97.6800	0.0500	4.8840
E5 Ground floor (normal)	96.0000	0.1600	15.3600
E19 Ground floor (inverted)	6.7800	0.0700	0.4746
E6 Intermediate floor within a dwelling	43.4800	0.0000	0.0000
E8 Balcony within a dwelling, wall insulation continuous	6.7500	0.0000	0.0000
E11 Eaves (insulation at rafter level)	42.9500	0.0400	1.7180
E13 Gable (insulation at rafter level)	24.5200	0.0800	1.9616
E14 Flat roof	51.8400	0.0800	4.1472
E15 Flat roof with parapet	36.5900	0.0900	3.2931
E16 Corner (normal)	27.2000	0.0900	2.4480
E17 Corner (inverted - internal area greater than external area)	16.2000	-0.0900	-1.4580
R1 Head of roof window	8.2700	0.0800	0.6616
R2 Sill of roof window	8.2700	0.0600	0.4962
R3 Jamb of roof window	34.0000	0.0800	2.7200
R4 Ridge (vaulted ceiling)	28.1500	0.0800	2.2520
R8 Roof to wall (rafter)	18.3200	0.0600	1.0992
R10 All other roof or room-in-roof junctions	6.5000	0.0800	0.5200
R11 Upstands or kerbs of rooflights	18.0000	0.0800	1.4400
E20 Exposed floor (normal)	22.2500	0.3200	7.1200

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

53.3550 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 406.3579 (37)

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

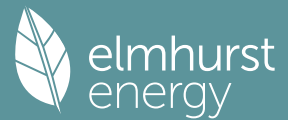
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	198.9097	197.8216	196.7551	191.7458	190.8086	186.4457	186.4457	185.6377	188.1262	190.8086	192.7046	194.6868 (38)
Heat transfer coeff	605.2676	604.1796	603.1131	598.1038	597.1666	592.8036	592.8036	591.9957	594.4842	597.1666	599.0626	601.0447 (39)
Average = Sum(39)m / 12 =												598.0993

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.6650	1.6620	1.6591	1.6453	1.6427	1.6307	1.6307	1.6285	1.6354	1.6427	1.6479	1.6534 (40)
HLP (average)												1.6453
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.2145 (42)
Hot water usage for mixer showers													
107.4104	105.7962	103.4440	98.9436	95.6224	91.9186	89.8134	92.1477	94.7066	98.6834	103.2805	106.9988	(42a)	
Hot water usage for baths													
35.4904	34.9634	34.2211	32.8526	31.8278	30.6915	30.0777	30.8148	31.6173	32.8332	34.2299	35.3705	(42b)	
Hot water usage for other uses													
50.0524	48.2323	46.4122	44.5921	42.7720	40.9519	40.9519	42.7720	44.5921	46.4122	48.2323	50.0524	(42c)	
Average daily hot water use (litres/day)												177.4361 (43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	192.9532	188.9918	184.0773	176.3883	170.2222	163.5620	160.8430	165.7345	170.9160	177.9287	185.7427	192.4217 (44)	
Energy content (annual)	305.5907	269.1219	282.9200	241.4667	229.1518	201.1186	194.5257	205.2140	210.7565	241.4476	264.6245	301.2858 (45)	
Distribution loss (46)m = 0.15 x (45)m										Total =	Sum(45)m =	2947.2238	
45.8386	40.3683	42.4380	36.2200	34.3728	30.1678	29.1789	30.7821	31.6135	36.2171	39.6937	45.1929	(46)	
Water storage loss:													
Store volume												300.0000 (47)	
a) If manufacturer declared loss factor is known (kWh/day):												3.0000 (48)	
Temperature factor from Table 2b												0.6000 (49)	
Enter (49) or (54) in (55)												1.8000 (55)	
Total storage loss													
55.8000	50.4000	55.8000	54.0000	55.8000	54.0000	55.8000	55.8000	54.0000	55.8000	54.0000	55.8000	(56)	
If cylinder contains dedicated solar storage													
41.8500	37.8000	41.8500	40.5000	41.8500	40.5000	41.8500	41.8500	40.5000	41.8500	40.5000	41.8500	(57)	
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)	
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)	
Total heat required for water heating calculated for each month													
347.4407	306.9219	324.7700	281.9667	271.0018	241.6186	236.3757	247.0640	251.2565	283.2976	305.1245	343.1358	(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)	
Aperture area of solar collector												3.0000 (H1)	
Zero-loss collector efficiency												0.8000 (H2)	
Collector linear heat loss coefficient												1.8000 (H3)	
Collector 2nd order heat loss coefficient												0.0000 (H4)	
Collector loop efficiency												0.9000 (H5)	

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Incidence angle modifier												1.0000 (H6)
Overshading factor												0.8000 (H8)
Overall heat loss coefficient of system												6.5000 (H10)
Heat loss coefficient of collector loop												3.9667 (H11)
Dedicated solar storage volume												75.0000 (H12)
If combined cylinder, total volume of cylinder												300.0000 (H13)
Effective solar volume												142.5000 (H14)
Reference volume												225.0000 (H15)
Storage tank correction coefficient												1.1210 (H16)
Heat delivered to hot water												721.9981 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												721.9981
Solar input	-0.0000	-22.2163	-66.6538	-90.8793	-119.2993	-110.6289	-110.2981	-95.9859	-66.8416	-36.1509	-3.0439	-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	347.4407	284.7056	258.1162	191.0874	151.7025	130.9897	126.0776	151.0781	184.4150	247.1467	302.0805	343.1358 (64)
												Total per year (kWh/year) = Sum(64)m = 2717.9757 (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	101.6089	89.4830	94.0709	80.2877	76.1930	66.8719	64.6798	68.2336	70.0766	80.2813	87.9876	100.1775 (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	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	59.5670	52.9069	43.0268	32.5740	24.3495	20.5569	22.2124	28.8725	38.7527	49.2054	57.4300	61.2226	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	758.0317	765.8977	746.0756	703.8768	650.6084	600.5436	567.0972	559.2312	579.0533	621.2521	674.5205	724.5853	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	(71)
Water heating gains (Table 5)	136.5711	133.1593	126.4394	111.5107	102.4099	92.8777	86.9352	91.7119	97.3285	107.9050	122.2051	134.6472	(72)
Total internal gains	1075.9615	1073.7555	1037.3335	969.7532	899.1595	835.7698	798.0365	801.6073	836.9261	900.1542	975.9472	1042.2468	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W				
Northeast				48.4100	11.2829	0.6300	0.7000	0.7700	166.9280 (75)				
Southeast				56.9700	36.7938	0.6300	0.7000	0.7700	640.6091 (77)				
Southwest				14.4000	36.7938	0.6300	0.7000	0.7700	161.9233 (79)				
Northwest				54.0400	11.2829	0.6300	0.7000	0.7700	186.3415 (81)				
Southeast				5.2800	39.9751	0.6300	0.7000	1.0000	83.7732 (82)				
Northwest				8.7700	16.3666	0.6300	0.7000	1.0000	56.9690 (82)				
Horizontal				6.0000	26.0000	0.6300	0.7000	1.0000	61.9164 (82)				
Solar gains	1358.4604	2485.9388	3845.7913	5489.8088	6795.8612	7027.3204	6658.6006	5643.9142	4410.1225	2868.5157	1658.7415	1141.9366	(83)
Total gains	2434.4219	3559.6943	4883.1248	6459.5620	7695.0206	7863.0902	7456.6372	6445.5215	5247.0487	3768.6699	2634.6887	2184.1834	(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)													
tau	41.7079	41.7830	41.8569	42.2075	42.2737	42.5848	42.5848	42.6430	42.4645	42.2737	42.1399	42.0009	
alpha	3.7805	3.7855	3.7905	3.8138	3.8182	3.8390	3.8390	3.8429	3.8310	3.8182	3.8093	3.8001	
util living area	0.9965	0.9858	0.9483	0.8347	0.6487	0.4668	0.3457	0.4135	0.6863	0.9358	0.9914	0.9977	(86)
MIT	18.9289	19.3228	19.8897	20.5009	20.8480	20.9666	20.9918	20.9842	20.8642	20.2738	19.4549	18.8611	(87)
Th 2	19.5660	19.5682	19.5703	19.5803	19.5821	19.5909	19.5909	19.5925	19.5875	19.5821	19.5784	19.5744	(88)
util rest of house	0.9952	0.9808	0.9311	0.7878	0.5716	0.3707	0.2370	0.2914	0.5794	0.9055	0.9877	0.9968	(89)
MIT 2	17.2076	17.7093	18.4150	19.1294	19.4750	19.5757	19.5890	19.5883	19.5103	18.9045	17.8878	17.1261	(90)
Living area fraction	17.3962	17.8860	18.5766	19.2797	19.6254	19.7280	19.7426	19.7412	19.6586	19.0545	18.0595	17.3162	(91)
MIT	17.3962	17.8860	18.5766	19.2797	19.6254	19.7280	19.7426	19.7412	19.6586	19.0545	18.0595	17.3162	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3962	17.8860	18.5766	19.2797	19.6254	19.7280	19.7426	19.7412	19.6586	19.0545	18.0595	17.3162	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9920	0.9719	0.9151	0.7763	0.5741	0.3804	0.2489	0.3046	0.5854	0.8901	0.9813	0.9945	(94)
Useful gains	2414.9085	3459.7993	4468.5085	5014.2546	4417.6885	2990.8820	1856.1549	1963.3009	3071.4261	3354.6269	2585.3903	2172.1314	(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	7926.7048	7845.8732	7283.5318	6208.1246	4732.7621	3039.9190	1862.9708	1977.9881	3304.4897	5048.7662	6565.3978	7883.4007	(97)
Space heating kWh	4100.7764	2947.4417	2094.3774	859.5864	234.4148	0.0000	0.0000	0.0000	0.0000	1260.4396	2865.6054	4249.1844	(98a)
Space heating requirement - total per year (kWh/year)												18611.8261	
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	4100.7764	2947.4417	2094.3774	859.5864	234.4148	0.0000	0.0000	0.0000	0.0000	1260.4396	2865.6054	4249.1844	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												18611.8261	
Space heating per m2												(98c) / (4) = 51.1989	(99)

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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 %)												100.0000	(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	4100.7764	2947.4417	2094.3774	859.5864	234.4148	0.0000	0.0000	0.0000	0.0000	1260.4396	2865.6054	4249.1844	(98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)	4100.7764	2947.4417	2094.3774	859.5864	234.4148	0.0000	0.0000	0.0000	0.0000	1260.4396	2865.6054	4249.1844	(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	347.4407	284.7056	258.1162	191.0874	151.7025	130.9897	126.0776	151.0781	184.4150	247.1467	302.0805	343.1358	(64)
Efficiency of water heater	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	(216)
Fuel for water heating, kWh/month	347.4407	284.7056	258.1162	191.0874	151.7025	130.9897	126.0776	151.0781	184.4150	247.1467	302.0805	343.1358	(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	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945	(231)
Lighting	52.1387	41.8276	37.6611	27.5921	21.3130	17.4129	19.4424	25.2720	32.8258	43.0692	48.6466	53.5878	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-45.4636	-72.2383	-114.5292	-135.0622	-141.1251	-123.6030	-121.6736	-112.2420	-95.6166	-85.0941	-52.4861	-38.4076	(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	-4.6229	-11.3417	-27.8171	-55.7099	-94.5577	-108.1107	-106.9780	-87.5320	-60.8465	-21.7518	-6.9237	-3.5063	(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												18611.8261	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												100.0000	
Water heating fuel used												2717.9757	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
pump for solar water heating												80.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												420.7890	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1727.2394	(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												20103.3514	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	18611.8261	16.4900	3069.0901
Total CO2 associated with community systems			0.0000
Water heating (other fuel)	2717.9757	16.4900	448.1942
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000
Pump for solar water heating	80.0000	16.4900	13.1920
Energy for lighting	420.7890	16.4900	69.3881
Additional standing charges			0.0000
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1137.5414	16.4900	-187.5806
PV Unit electricity exported	-589.6980	5.5900	-32.9641
Total			-220.5447
Total energy cost			3379.3197

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)		2.9780	(257)
SAP value		51.7273	
SAP rating (Section 12)		52	(258)
SAP band		E	

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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	18611.8261	0.1564	2911.0638 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2717.9757	0.1447	393.3177 (264)
Space and water heating			3304.3816 (265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970 (267)
Energy for lighting	420.7890	0.1443	60.7329 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1137.5414	0.1343	-152.7672
PV Unit electricity exported	-589.6980	0.1181	-69.6484
Total			-222.4156 (269)
Total CO2, kg/year			3153.7958 (272)
CO2 emissions per m2			8.6800 (273)
EI value			89.6551
EI rating			90 (274)
EI band			B

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Ground floor	196.7600 (1b)	x 2.9500 (2b)	= 580.4420 (1b) - (3b)
First floor	166.7600 (1c)	x 2.7300 (2c)	= 455.2548 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	363.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1035.6968 (5)

2. Ventilation rate

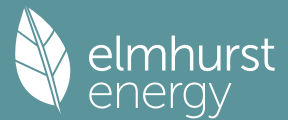
	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	7 * 10 = 70.0000 (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) =	70.0000 / (5) = 0.0676 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3176 (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) = 0.3176 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.8000	4.5000	4.4000	3.9000	3.9000	3.6000	3.7000	3.5000	3.7000	4.0000	4.1000	4.4000 (22)
Wind factor	1.2000	1.1250	1.1000	0.9750	0.9750	0.9000	0.9250	0.8750	0.9250	1.0000	1.0250	1.1000 (22a)
Adj infilt rate	0.3811	0.3573	0.3493	0.3096	0.3096	0.2858	0.2938	0.2779	0.2938	0.3176	0.3255	0.3493 (22b)
Effective ac	0.5726	0.5638	0.5610	0.5479	0.5479	0.5408	0.5431	0.5386	0.5431	0.5504	0.5530	0.5610 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Main dwelling							
Solid doors			3.2400	1.2000	3.8880		(26)
Windows Db1 LowE			173.8200	1.1450	199.0305		(27)
Rooflights Db1 LowE			20.0500	1.1450	22.9580		(27a)
FT01 GF			196.7600	0.1300	25.5788		(28a)
FT02 FF Exposed			50.0000	0.1300	6.5000		(28b)
WT01 GF	164.0800	76.5400	87.5400	0.1800	15.7572		(29a)
WT02 Glazed corridor	32.6400	28.8000	3.8400	0.1800	0.6912		(29a)
WT03 Annex	68.4000	20.7700	47.6300	0.1800	8.5734		(29a)
WT04 FF	251.1400	45.2700	205.8700	0.1800	37.0566		(29a)
WT05 Dormer	21.9600	5.6800	16.2800	0.1800	2.9304		(29a)
RT01 Main roof	177.3200	14.0500	163.2700	0.1100	17.9597		(30)
RT02 Flat dormer	24.5100		24.5100	0.1100	2.6961		(30)
RT03 Flat annex	86.1800	6.0000	80.1800	0.1100	8.8198		(30)
RT04 Balcony	5.1200		5.1200	0.1100	0.5632		(30)
Total net area of external elements Aum(A, m2)			1078.1100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	353.0029		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E1 Steel lintel with perforated steel base plate				49.2300	0.0500	2.4615	

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E2 Other lintels (including other steel lintels)													17.3900	0.0500	0.8695	
E3 Sill													17.7300	0.0500	0.8865	
E4 Jamb													97.6800	0.0500	4.8840	
E5 Ground floor (normal)													96.0000	0.1600	15.3600	
E19 Ground floor (inverted)													6.7800	0.0700	0.4746	
E6 Intermediate floor within a dwelling													43.4800	0.0000	0.0000	
E8 Balcony within a dwelling, wall insulation continuous													6.7500	0.0000	0.0000	
E11 Eaves (insulation at rafter level)													42.9500	0.0400	1.7180	
E13 Gable (insulation at rafter level)													24.5200	0.0800	1.9616	
E14 Flat roof													51.8400	0.0800	4.1472	
E15 Flat roof with parapet													36.5900	0.0900	3.2931	
E16 Corner (normal)													27.2000	0.0900	2.4480	
E17 Corner (inverted - internal area greater than external area)													16.2000	-0.0900	-1.4580	
R1 Head of roof window													8.2700	0.0800	0.6616	
R2 Sill of roof window													8.2700	0.0600	0.4962	
R3 Jamb of roof window													34.0000	0.0800	2.7200	
R4 Ridge (vaulted ceiling)													28.1500	0.0800	2.2520	
R8 Roof to wall (rafter)													18.3200	0.0600	1.0992	
R10 All other roof or room-in-roof junctions													6.5000	0.0800	0.5200	
R11 Upstands or kerbs of rooflights													18.0000	0.0800	1.4400	
E20 Exposed floor (normal)													22.2500	0.3200	7.1200	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)																53.3550 (36)
Point Thermal bridges																0.0000
Total fabric heat loss																(33) + (36) + (36a) = 406.3579 (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	195.7102	192.7046	191.7458	187.2752	187.2752	184.8513	185.6377	184.0865	185.6377	188.1262	188.9988	191.7458	(38)			
Average = Sum(39)m / 12 =	602.0681	599.0626	598.1038	593.6331	593.6331	591.2093	591.9957	590.4444	591.9957	594.4842	595.3568	598.1038	(39)			595.0076
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec				
HLP (average)	1.6562	1.6479	1.6453	1.6330	1.6330	1.6263	1.6285	1.6242	1.6285	1.6354	1.6378	1.6453	(40)			
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31				

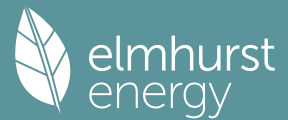
4. Water heating energy requirements (kWh/year)																

Assumed occupancy																3.2145 (42)
Hot water usage for mixer showers																
	107.4104	105.7962	103.4440	98.9436	95.6224	91.9186	89.8134	92.1477	94.7066	98.6834	103.2805	106.9988	(42a)			
Hot water usage for baths																
	35.4904	34.9634	34.2211	32.8526	31.8278	30.6915	30.0777	30.8148	31.6173	32.8332	34.2299	35.3705	(42b)			
Hot water usage for other uses																
	50.0524	48.2323	46.4122	44.5921	42.7720	40.9519	40.9519	42.7720	44.5921	46.4122	48.2323	50.0524	(42c)			
Average daily hot water use (litres/day)																177.4361 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec				
Energy conte	192.9532	188.9918	184.0773	176.3883	170.2222	163.5620	160.8430	165.7345	170.9160	177.9287	185.7427	192.4217	(44)			
Energy content (annual)	305.5907	269.1219	282.9200	241.4667	229.1518	201.1186	194.5257	205.2140	210.7565	241.4476	264.6245	301.2858	(45)			
Distribution loss (46)m = 0.15 x (45)m																
	45.8386	40.3683	42.4380	36.2200	34.3728	30.1678	29.1789	30.7821	31.6135	36.2171	39.6937	45.1929	(46)			
Water storage loss:																
Store volume																300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):																3.0000 (48)
Temperature factor from Table 2b																0.6000 (49)
Enter (49) or (54) in (55)																1.8000 (55)
Total storage loss																
	55.8000	50.4000	55.8000	54.0000	55.8000	54.0000	55.8000	55.8000	54.0000	55.8000	54.0000	55.8000	(56)			
If cylinder contains dedicated solar storage																
	41.8500	37.8000	41.8500	40.5000	41.8500	40.5000	41.8500	41.8500	40.5000	41.8500	40.5000	41.8500	(57)			
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(58)			
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	(59)			
Total heat required for water heating calculated for each month																
	347.4407	306.9219	324.7700	281.9667	271.0018	241.6186	236.3757	247.0640	251.2565	283.2976	305.1245	343.1358	(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)			
Aperture area of solar collector																3.0000 (H1)
Zero-loss collector efficiency																0.8000 (H2)
Collector linear heat loss coefficient																1.8000 (H3)
Collector 2nd order heat loss coefficient																0.0000 (H4)
Collector loop efficiency																0.9000 (H5)
Incidence angle modifier																1.0000 (H6)
Overshading factor																0.8000 (H8)
Overall heat loss coefficient of system																6.5000 (H10)
Heat loss coefficient of collector loop																3.9667 (H11)
Dedicated solar storage volume																75.0000 (H12)
If combined cylinder, total volume of cylinder																300.0000 (H13)
Effective solar volume																142.5000 (H14)
Reference volume																225.0000 (H15)
Storage tank correction coefficient																1.1210 (H16)
Heat delivered to hot water																848.2247 (H24)
Heat delivered to space heating																0.0000 (H29)
Solar input																848.2247
Solar input	-6.7119	-25.9483	-72.6366	-104.2837	-129.4128	-128.7763	-126.8880	-113.2547	-80.1876	-47.2242	-12.9006	-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	(64d)			
Output from w/h	340.7287	280.9736	252.1334	177.6830	141.5890	112.8423	109.4877	133.8092	171.0689	236.0734	292.2239	343.1358	(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)			
Heat gains from water heating, kWh/month																
	101.6089	89.4830	94.0709	80.2877	76.1930	66.8719	64.6798	68.2336	70.0766	80.2813	87.9876	100.1775	(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	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	(66)			
	59.5670	52.9069	43.0268	32.5740	24.3495	20.5569	22.2124	28.8725	38.7527	49.2054	57.4300	61.2226	(67)			

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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	758.0317	765.8977	746.0756	703.8768	650.6084	600.5436	567.0972	559.2312	579.0533	621.2521	674.5205	724.5853 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802 (71)
Water heating gains (Table 5)	136.5711	133.1593	126.4394	111.5107	102.4099	92.8777	86.9352	91.7119	97.3285	107.9050	122.2051	134.6472 (72)
Total internal gains	1075.9615	1073.7555	1037.3335	969.7532	899.1595	835.7698	798.0365	801.6073	836.9261	900.1542	975.9472	1042.2468 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
Northeast				48.4100	13.7622	0.6300	0.7000	0.7700	203.6078 (75)			
Southeast				56.9700	42.6275	0.6300	0.7000	0.7700	742.1785 (77)			
Southwest				14.4000	42.6275	0.6300	0.7000	0.7700	187.5965 (79)			
Northwest				54.0400	13.7622	0.6300	0.7000	0.7700	227.2870 (81)			
Southeast				5.2800	47.3724	0.6300	0.7000	1.0000	99.2751 (82)			
Northwest				8.7700	20.0162	0.6300	0.7000	1.0000	69.6726 (82)			
Horizontal				6.0000	32.0000	0.6300	0.7000	1.0000	76.2048 (82)			
Solar gains	1605.8222	2624.1628	4069.4387	6149.3962	7327.9838	8098.1190	7585.1841	6488.3453	5006.7019	3245.6585	1982.3186	1303.9802 (83)
Total gains	2681.7837	3697.9184	5106.7722	7119.1494	8227.1432	8933.8888	8383.2206	7289.9526	5843.6281	4145.8127	2958.2658	2346.2270 (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	41.9295	42.1399	42.2075	42.5253	42.5253	42.6997	42.6430	42.7550	42.6430	42.4645	42.4022	42.2075
alpha	3.7953	3.8093	3.8138	3.8350	3.8350	3.8466	3.8429	3.8503	3.8429	3.8310	3.8268	3.8138
util living area	0.9944	0.9821	0.9335	0.7762	0.5677	0.3654	0.2532	0.2819	0.5692	0.8895	0.9839	0.9963 (86)
MIT	19.1191	19.4552	20.0407	20.6475	20.9144	20.9875	20.9978	20.9969	20.9387	20.5012	19.7083	19.0762 (87)
Th 2	19.5724	19.5784	19.5803	19.5892	19.5892	19.5941	19.5925	19.5956	19.5925	19.5875	19.5858	19.5803 (88)
util rest of house	0.9922	0.9758	0.9115	0.7198	0.4855	0.2761	0.1547	0.1696	0.4518	0.8388	0.9766	0.9949 (89)
MIT 2	17.4547	17.8835	18.6051	19.2884	19.5355	19.5896	19.5922	19.5952	19.5651	19.1663	18.2134	17.4052 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	17.6370	18.0557	18.7624	19.4372	19.6865	19.7427	19.7462	19.7488	19.7156	19.3125	18.3771	17.5882 (92)
Temperature adjustment	0.0000											
adjusted MIT	17.6370	18.0557	18.7624	19.4372	19.6865	19.7427	19.7462	19.7488	19.7156	19.3125	18.3771	17.5882 (93)

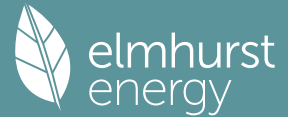
8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9875	0.9657	0.8950	0.7130	0.4915	0.2857	0.1655	0.1819	0.4627	0.8262	0.9670	0.9915 (94)
Ext temp.	2648.3758	3570.9606	4570.7825	5075.6493	4043.4280	2552.2907	1387.7616	1326.2215	2703.8549	3425.4080	2860.6460	2326.1805 (95)
Heat loss rate W	5.0000	5.4000	7.1000	9.5000	12.6000	15.4000	17.4000	17.5000	15.0000	11.7000	8.1000	5.2000 (96)
Space heating kWh	7608.3312	7581.5333	6975.2985	5899.0680	4206.7797	2567.4358	1388.9200	1327.7639	2791.5863	4525.5149	6118.5657	7409.4584 (97)
Space heating requirement - total per year (kWh/year)	3690.2068	2695.1048	1788.9599	592.8615	121.5337	0.0000	0.0000	0.0000	0.0000	818.4795	2345.7021	3781.9587 (98a)
Solar heating kWh	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (98b)
Solar heating contribution - total per year (kWh/year)	3690.2068	2695.1048	1788.9599	592.8615	121.5337	0.0000	0.0000	0.0000	0.0000	818.4795	2345.7021	3781.9587 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	15834.8071											
Space heating per m2	(98c) / (4) = 43.5597 (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 %)	100.0000 (206)											
Efficiency of main space heating system 2 (in %)	0.0000 (207)											
Efficiency of secondary/supplementary heating system, %	0.0000 (208)											
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating efficiency (main heating system 1)	3690.2068	2695.1048	1788.9599	592.8615	121.5337	0.0000	0.0000	0.0000	0.0000	818.4795	2345.7021	3781.9587 (98)
Space heating fuel (main heating system)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000 (210)
Space heating efficiency (main heating system 2)	3690.2068	2695.1048	1788.9599	592.8615	121.5337	0.0000	0.0000	0.0000	0.0000	818.4795	2345.7021	3781.9587 (211)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating requirement	340.7287	280.9736	252.1334	177.6830	141.5890	112.8423	109.4877	133.8092	171.0689	236.0734	292.2239	343.1358 (64)
Efficiency of water heater (217)m	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000 (216)
Fuel for water heating, kWh/month	340.7287	280.9736	252.1334	177.6830	141.5890	112.8423	109.4877	133.8092	171.0689	236.0734	292.2239	343.1358 (219)

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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	0.0000	(221)
Pumps and Fa	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	(231)
Lighting	52.1387	41.8276	37.6611	27.5921	21.3130	17.4129	19.4424	25.2720	32.8258	43.0692	48.6466	53.5878	53.5878	(232)
Electricity generated by PVs (Appendix M) (negative quantity)														
(233a)m	-53.2266	-75.5868	-118.4046	-141.7628	-142.1990	-133.5904	-130.5754	-121.7608	-103.9649	-91.6765	-61.4826	-43.5835	-43.5835	(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	-6.2138	-12.7086	-31.5615	-70.0856	-109.4387	-130.8519	-127.3432	-105.7408	-72.5311	-29.0812	-9.7372	-4.5030	-4.5030	(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													15834.8071	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													100.0000	
Water heating fuel used													2591.7491	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans:														
pump for solar water heating													80.0000	(230g)
Total electricity for the above, kWh/year													80.0000	(231)
Electricity for lighting (calculated in Appendix L)													420.7890	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-1927.6103	(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													16999.7349	(238)

10a. Fuel costs - using BEDF prices (567)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	15834.8071	26.0600	4126.5507	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2591.7491	26.0600	675.4098	(247)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	80.0000	26.0600	20.8480	(249)
Energy for lighting	420.7890	26.0600	109.6576	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1217.8138	26.0600	-317.3623	
PV Unit electricity exported	-709.7965	5.8100	-41.2392	
Total			-358.6014	(252)
Total energy cost			4573.8647	(255)

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	15834.8071	0.1572	2489.2265	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2591.7491	0.1454	376.8836	(264)
Space and water heating			2866.1101	(265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970	(267)
Energy for lighting	420.7890	0.1443	60.7329	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1217.8138	0.1344	-163.6297	
PV Unit electricity exported	-709.7965	0.1183	-83.9406	
Total			-247.5702	(269)
Total CO2, kg/year			2690.3697	(272)

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	15834.8071	1.5819	25049.7600	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2591.7491	1.5379	3985.8453	(278)
Space and water heating			29035.6054	(279)
Pumps, fans and electric keep-hot	80.0000	1.5128	121.0240	(281)
Energy for lighting	420.7890	1.5338	645.4202	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1217.8138	1.4966	-1822.5715	
PV Unit electricity exported	-709.7965	0.4336	-307.7548	
Total			-2130.3263	(283)
Total Primary energy kWh/year			27671.7232	(286)

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Property Reference	Shellbrook				Issued on Date	12/03/2025
Assessment Reference	BE GREEN		Prop Type Ref			
Property						
SAP Rating	80 C	DER	3.81	TER	11.27	
Environmental	96 A	% DER < TER				66.19
CO ₂ Emissions (t/year)	1.13	DFEE	59.89	TFEE	60.39	
Compliance Check	See BREL	% DFEE < TFEE				0.84
% DPER < TPER	36.48	DPER	38.59	TPER	60.76	
Assessor Details	Mr. Giles Murgatroyd				Assessor ID	V385-0001
Client						

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling			
Ground floor	196.7600 (1b)	x 2.9500 (2b)	= 580.4420 (1b) - (3b)
First floor	166.7600 (1c)	x 2.7300 (2c)	= 455.2548 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	363.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1035.6968 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	7 * 10 = 70.0000 (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) =	70.0000 / (5) = 0.0676 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3176 (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) = 0.3176 (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	0.4049	0.3970	0.3890	0.3493	0.3414	0.3017	0.3017	0.2938	0.3176	0.3414	0.3573	0.3732 (22b)
Effective ac	0.5820	0.5788	0.5757	0.5610	0.5583	0.5455	0.5455	0.5431	0.5504	0.5583	0.5638	0.5696 (25)

3. Heat losses and heat loss parameter

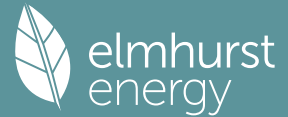
Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Solid doors			3.2400	1.2000	3.8880		(26)
Windows Dbl LowE			173.8200	1.1450	199.0305		(27)
Rooflights Dbl LowE			20.0500	1.1450	22.9580		(27a)
FT01 GF			196.7600	0.1300	25.5788		(28a)
FT02 FF Exposed			50.0000	0.1300	6.5000		(28b)
WT01 GF	164.0800	76.5400	87.5400	0.1800	15.7572		(29a)
WT02 Glazed corridor	32.6400	28.8000	3.8400	0.1800	0.6912		(29a)
WT03 Annex	68.4000	20.7700	47.6300	0.1800	8.5734		(29a)
WT04 FF	251.1400	45.2700	205.8700	0.1800	37.0566		(29a)
WT05 Dormer	21.9600	5.6800	16.2800	0.1800	2.9304		(29a)
RT01 Main roof	177.3200	14.0500	163.2700	0.1100	17.9597		(30)
RT02 Flat dormer	24.5100		24.5100	0.1100	2.6961		(30)
RT03 Flat annex	86.1800	6.0000	80.1800	0.1100	8.8198		(30)
RT04 Balcony	5.1200		5.1200	0.1100	0.5632		(30)
Total net area of external elements A _{um} (A, m ²)			1078.1100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	353.0029		(33)
Thermal mass parameter (TMP = C _m / TFA) in kJ/m ² K						250.0000	(35)
List of Thermal Bridges							

elmhurst
energy

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	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	256.1678	283.6143	256.1678	264.7067	256.1678	264.7067	256.1678	256.1678	264.7067	256.1678	264.7067	256.1678 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	507.8812	513.1515	499.8707	471.5975	435.9076	402.3642	379.9551	374.6849	387.9657	416.2389	451.9287	485.4722 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802 (71)
Water heating gains (Table 5)	161.5844	158.1726	151.4527	136.5240	127.4232	117.8910	111.9485	116.7252	122.3419	132.9183	147.2184	159.6606 (72)
Total internal gains	996.8510	1026.1559	978.7088	944.0458	890.7162	856.1795	819.2890	818.7955	846.2319	876.5426	935.0714	972.5181 (73)

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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
Northeast					48.4100	11.2829		0.6300		0.7000	0.7700	166.9280 (75)
Southeast					56.9700	36.7938		0.6300		0.7000	0.7700	640.6091 (77)
Southwest					14.4000	36.7938		0.6300		0.7000	0.7700	161.9233 (79)
Northwest					54.0400	11.2829		0.6300		0.7000	0.7700	186.3415 (81)
Southeast					5.2800	39.9751		0.6300		0.7000	1.0000	83.7732 (82)
Northwest					8.7700	16.3666		0.6300		0.7000	1.0000	56.9690 (82)
Horizontal					6.0000	26.0000		0.6300		0.7000	1.0000	61.9164 (82)
Solar gains	1358.4604	2485.9388	3845.7913	5489.8088	6795.8612	7027.3204	6658.6006	5643.9142	4410.1225	2868.5157	1658.7415	1141.9366 (83)
Total gains	2355.3114	3512.0947	4824.5001	6433.8546	7686.5774	7883.4999	7477.8897	6462.7097	5256.3544	3745.0583	2593.8129	2114.4547 (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	41.7079	41.7830	41.8569	42.2075	42.2737	42.5848	42.5848	42.6430	42.4645	42.2737	42.1399	42.0009
alpha	3.7805	3.7855	3.7905	3.8138	3.8182	3.8390	3.8390	3.8429	3.8310	3.8182	3.8093	3.8001
util living area	0.9969	0.9864	0.9501	0.8361	0.6493	0.4657	0.3448	0.4124	0.6854	0.9369	0.9919	0.9979 (86)
MIT	20.2322	20.3332	20.4751	20.6317	20.7195	20.7506	20.7569	20.7552	20.7246	20.5748	20.3681	20.2171 (87)
Th 2	19.5660	19.5682	19.5703	19.5803	19.5821	19.5909	19.5909	19.5925	19.5875	19.5821	19.5784	19.5744 (88)
util rest of house	0.9957	0.9816	0.9333	0.7894	0.5721	0.3698	0.2364	0.2906	0.5786	0.9070	0.9883	0.9972 (89)
MIT 2	18.6556	18.7860	18.9644	19.1553	19.2442	19.2777	19.2810	19.2824	19.2583	19.1003	18.8406	18.6439 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	18.8283	18.9555	19.1299	19.3170	19.4058	19.4391	19.4427	19.4437	19.4189	19.2619	19.0079	18.8162 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.8283	18.9555	19.1299	19.3170	19.4058	19.4391	19.4427	19.4437	19.4189	19.2619	19.0079	18.8162 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9950	0.9790	0.9269	0.7794	0.5617	0.3591	0.2248	0.2773	0.5641	0.8981	0.9864	0.9966 (94)
Useful gains	2343.4386	3438.1968	4471.6999	5014.2458	4317.2543	2830.6857	1680.8739	1792.2513	2965.3362	3363.3383	2558.5497	2107.2836 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	14.1000	10.6000	7.1000	4.2000	4.2000 (96)
Heat loss rate W	8793.5266	8492.0196	7617.2484	6230.4708	4601.6693	2868.6165	1685.1565	1801.8688	3162.0004	5172.5745	7133.5961	8784.9952 (97)
Space heating kWh	4798.8655	3396.1689	2340.2880	875.6820	211.6047	0.0000	0.0000	0.0000	0.0000	1346.0717	3294.0334	4968.2174 (98a)
Space heating requirement - total per year (kWh/year)	21230.9317											
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	4798.8655	3396.1689	2340.2880	875.6820	211.6047	0.0000	0.0000	0.0000	0.0000	1346.0717	3294.0334	4968.2174 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	21230.9317											
Space heating per m2	(98c) / (4) = 58.4038 (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 %)												249.9000 (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	4798.8655	3396.1689	2340.2880	875.6820	211.6047	0.0000	0.0000	0.0000	0.0000	1346.0717	3294.0334	4968.2174 (98)
Space heating efficiency (main heating system 1)	249.9000	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000 (210)
Space heating fuel (main heating system)	1920.3143	1359.0112	936.4898	350.4130	84.6758	0.0000	0.0000	0.0000	0.0000	538.6442	1318.1406	1988.0822 (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	379.0731	335.4931	356.4024	312.5787	302.6342	272.2306	268.0081	278.6964	281.8685	314.9300	335.7365	374.7682 (64)
Efficiency of water heater	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000 (216)
Fuel for water heating, kWh/month	216.4895	191.6008	203.5422	178.5144	172.8351	155.4715	153.0600	159.1641	160.9758	179.8572	191.7398	214.0310 (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	52.1387	41.8276	37.6611	27.5921	21.3130	17.4129	19.4424	25.2720	32.8258	43.0692	48.6466	53.5878 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-49.3568	-92.0643	-178.5442	-259.1486	-322.0336	-312.5298	-305.5924	-262.1368	-194.0882	-122.8502	-60.4738	-39.8949 (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	-0.1638	-0.8330	-4.3013	-17.3314	-43.6573	-56.1102	-54.3846	-36.8917	-17.8798	-2.8560	-0.3518	-0.1025 (233b)

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

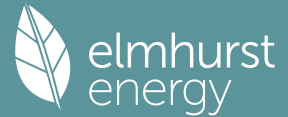
13a. Primary energy - Individual heating systems including micro-CHP

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling			
Ground floor	196.7600 (1b)	x 2.9500 (2b)	= 580.4420 (1b) - (3b)
First floor	166.7600 (1c)	x 2.7300 (2c)	= 455.2548 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	363.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1035.6968 (5)

		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)

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Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 40.0000 / (5) = 0.0386 (8)
 Pressure test Yes
 Pressure Test Method Blower Door
 Measured/design AP50 5.0000 (17)
 Infiltration rate 0.2886 (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) = 0.2886 (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												
Effective ac	0.3680	0.3608	0.3536	0.3175	0.3103	0.2742	0.2742	0.2670	0.2886	0.3103	0.3247	0.3391 (22b)
	0.5677	0.5651	0.5625	0.5504	0.5481	0.5376	0.5376	0.5356	0.5417	0.5481	0.5527	0.5575 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Main dwelling							
TER Opaque door			3.2400	1.0000	3.2400		(26)
TER Opening Type			78.5500	1.1450	89.9427		(27)
TER Roof Light			9.0600	1.5918	17.2373		(27a)
FT01 GF			196.7600	0.1300	25.5788		(28a)
FT02 FF Exposed			50.0000	0.1300	6.5000		(28b)
WT01 GF	164.0800	36.3600	127.7200	0.1800	22.9896		(29a)
WT02 Glazed corridor	32.6400	13.0200	19.6200	0.1800	3.5316		(29a)
WT03 Annex	68.4000	9.3800	59.0200	0.1800	10.6236		(29a)
WT04 FF	251.1400	20.4600	230.6800	0.1800	41.5224		(29a)
WT05 Dormer	21.9600	2.5700	19.3900	0.1800	3.4902		(29a)
RT01 Main roof	177.3200	6.3600	170.9600	0.1100	18.8056		(30)
RT02 Flat dormer	24.5100		24.5100	0.1100	2.6961		(30)
RT03 Flat annex	86.1800	2.7000	83.4800	0.1100	9.1828		(30)
RT04 Balcony	5.1200		5.1200	0.1100	0.5632		(30)
Total net area of external elements Aum(A, m2)			1078.1100				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 255.9040		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	49.2300	0.0500	2.4615
E2 Other lintels (including other steel lintels)	17.3900	0.0500	0.8695
E3 Sill	17.7300	0.0500	0.8865
E4 Jamb	97.6800	0.0500	4.8840
E5 Ground floor (normal)	96.0000	0.1600	15.3600
E19 Ground floor (inverted)	6.7800	0.0700	0.4746
E6 Intermediate floor within a dwelling	43.4800	0.0000	0.0000
E8 Balcony within a dwelling, wall insulation continuous	6.7500	0.0000	0.0000
E11 Eaves (insulation at rafter level)	42.9500	0.0400	1.7180
E13 Gable (insulation at rafter level)	24.5200	0.0800	1.9616
E14 Flat roof	51.8400	0.0800	4.1472
E15 Flat roof with parapet	36.5900	0.5600	20.4904
E16 Corner (normal)	27.2000	0.0900	2.4480
E17 Corner (inverted - internal area greater than external area)	16.2000	-0.0900	-1.4580
R1 Head of roof window	8.2700	0.0800	0.6616
R2 Sill of roof window	8.2700	0.0600	0.4962
R3 Jamb of roof window	34.0000	0.0800	2.7200
R4 Ridge (vaulted ceiling)	28.1500	0.0800	2.2520
R8 Roof to wall (rafter)	18.3200	0.0600	1.0992
R10 All other roof or room-in-roof junctions	6.5000	0.0800	0.5200
R11 Upstands or kerbs of rooflights	18.0000	0.0800	1.4400
E20 Exposed floor (normal)	22.2500	0.3200	7.1200

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 70.5523 (36)

Point Thermal bridges (36a) = 0.0000
 Total fabric heat loss (33) + (36) + (36a) = 326.4563 (37)

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

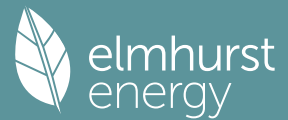
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	194.0316	193.1330	192.2522	188.1150	187.3409	183.7375	183.7375	183.0702	185.1255	187.3409	188.9068	190.5439 (38)
Heat transfer coeff	520.4879	519.5893	518.7084	514.5712	513.7972	510.1938	510.1938	509.5265	511.5818	513.7972	515.3631	517.0002 (39)
Average = Sum(39)m / 12 =												514.5675

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.4318	1.4293	1.4269	1.4155	1.4134	1.4035	1.4035	1.4016	1.4073	1.4134	1.4177	1.4222 (40)
HLP (average)												1.4155
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.2145 (42)
Hot water usage for mixer showers													
78.1166	76.9427	75.2320	71.9590	69.5436	66.8499	65.3188	67.0165	68.8775	71.7697	75.1131	77.8173	(42a)	
Hot water usage for baths													
33.7159	33.2152	32.5101	31.2099	30.2364	29.1569	28.5738	29.2740	30.0364	31.1915	32.5184	33.6019	(42b)	
Hot water usage for other uses													
47.5498	45.8207	44.0916	42.3625	40.6334	38.9043	38.9043	40.6334	42.3625	44.0916	45.8207	47.5498	(42c)	
Average daily hot water use (litres/day)												146.5079 (43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
159.3823	155.9785	151.8337	145.5314	140.4134	134.9112	132.7970	136.9240	141.2765	147.0528	153.4522	158.9690	(44)	
Energy conte	252.4226	222.1114	233.3627	199.2252	189.0234	165.8890	160.6065	169.5405	174.2080	199.5493	218.6207	248.9071 (45)	
Energy content (annual)										Total = Sum(45)m =		2433.4664	
Distribution loss (46)m = 0.15 x (45)m													
37.8634	33.3167	35.0044	29.8838	28.3535	24.8834	24.0910	25.4311	26.1312	29.9324	32.7931	37.3361	(46)	
Water storage loss:													
Store volume												300.0000 (47)	
a) If manufacturer declared loss factor is known (kWh/day):												2.1127 (48)	
Temperature factor from Table 2b												0.5400 (49)	
Enter (49) or (54) in (55)												1.1409 (55)	

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Total storage loss	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664 (56)
If cylinder contains dedicated solar storage	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664 (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	311.0514	275.0664	291.9915	255.9628	247.6522	222.6266	219.2353	228.1693	230.9456	258.1781	275.3583	307.5359 (62)
WWHRS	-35.7117	-31.5837	-33.0726	-27.3854	-25.5222	-21.8396	-20.4711	-21.7690	-22.5960	-26.6383	-30.1779	-35.0503 (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	275.3398	243.4827	258.9189	228.5774	222.1300	200.7870	198.7642	206.4003	208.3495	231.5398	245.1804	272.4856 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											2791.9556 (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	130.8336	116.2161	124.4961	111.6324	109.7533	100.5481	100.3047	103.2753	103.3142	113.2532	118.0814	129.6647 (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	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	256.1678	283.6143	256.1678	264.7067	256.1678	264.7067	256.1678	256.1678	264.7067	256.1678	264.7067	256.1678 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	507.8812	513.1515	499.8707	471.5975	435.9076	402.3642	379.9551	374.6849	387.9657	416.2389	451.9287	485.4722 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725 (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)	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802 (71)
Water heating gains (Table 5)	175.8516	172.9406	167.3335	155.0451	147.5179	139.6502	134.8181	138.8108	143.4920	152.2220	164.0020	174.2804 (72)
Total internal gains	1014.1182	1043.9239	997.5896	965.5668	913.8109	877.9387	842.1586	840.8811	867.3819	898.8463	954.8550	990.1380 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d			Gains W	
Northeast				21.8800	11.2829	0.6300	0.7000	0.7700			75.4469 (75)	
Southeast				25.7400	36.7938	0.6300	0.7000	0.7700			289.4379 (77)	
Southwest				6.5100	36.7938	0.6300	0.7000	0.7700			73.2028 (79)	
Northwest				24.4200	11.2829	0.6300	0.7000	0.7700			84.2054 (81)	
Southeast				2.3900	39.9751	0.6300	0.7000	1.0000			37.9201 (82)	
Northwest				3.9700	16.3666	0.6300	0.7000	1.0000			25.7887 (82)	
Horizontal				2.7000	26.0000	0.6300	0.7000	1.0000			27.8624 (82)	
Solar gains	613.8642	1123.3382	1737.8047	2480.6835	3070.8613	3175.4601	3008.8415	2550.3220	1992.8057	1296.2094	749.5531	516.0229 (83)
Total gains	1627.9823	2167.2622	2735.3943	3446.2503	3984.6722	4053.3987	3851.0002	3391.2031	2860.1877	2195.0556	1704.4081	1506.1608 (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	48.5015	48.5854	48.6679	49.0592	49.1331	49.4801	49.4801	49.5449	49.3459	49.1331	48.9838	48.8287
alpha	4.2334	4.2390	4.2445	4.2706	4.2755	4.2987	4.2987	4.3030	4.2897	4.2755	4.2656	4.2552
util living area	0.9993	0.9976	0.9913	0.9626	0.8761	0.7149	0.5576	0.6404	0.8854	0.9867	0.9983	0.9995 (86)
MIT	19.0183	19.2593	19.6498	20.1818	20.6377	20.8964	20.9725	20.9515	20.7190	20.1059	19.4642	18.9827 (87)
Th 2	19.7390	19.7409	19.7428	19.7515	19.7531	19.7607	19.7607	19.7621	19.7577	19.7531	19.7498	19.7464 (88)
util rest of house	0.9991	0.9967	0.9878	0.9471	0.8254	0.6099	0.4129	0.4916	0.8157	0.9791	0.9976	0.9993 (89)
MIT 2	17.4322	17.7421	18.2417	18.9141	19.4466	19.7025	19.7525	19.7454	19.5549	18.8310	18.0111	17.3913 (90)
Living area fraction	FLA = Living area / (4) =											
MIT	17.6059	17.9083	18.3959	19.0530	19.5771	19.8333	19.8862	19.8775	19.6824	18.9707	18.1703	17.5656 (92)
Temperature adjustment	0.0000											
adjusted MIT	17.6059	17.9083	18.3959	19.0530	19.5771	19.8333	19.8862	19.8775	19.6824	18.9707	18.1703	17.5656 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9983	0.9945	0.9821	0.9352	0.8167	0.6168	0.4284	0.5067	0.8103	0.9716	0.9959	0.9988 (94)
Useful gains	1625.2691	2155.3722	2686.5089	3222.8894	3254.2981	2499.9370	1649.7307	1718.3716	2317.7223	2132.6722	1697.4889	1504.3581 (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	6925.5703	6758.9722	6170.5176	5224.4270	4047.2296	2669.9990	1676.5886	1771.8818	2855.8566	4300.8337	5705.2130	6910.0431 (97)
Space heating kWh	3943.4241	3093.6192	2592.1025	1441.1070	589.9411	0.0000	0.0000	0.0000	0.0000	1613.1121	2885.5614	4021.8296 (98a)
Space heating requirement - total per year (kWh/year)												20180.6970
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	3943.4241	3093.6192	2592.1025	1441.1070	589.9411	0.0000	0.0000	0.0000	0.0000	1613.1121	2885.5614	4021.8296 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												20180.6970
Space heating per m2												(98c) / (4) = 55.5147 (99)

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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	3943.4241	3093.6192	2592.1025	1441.1070	589.9411	0.0000	0.0000	0.0000	0.0000	1613.1121	2885.5614	4021.8296	(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)	4272.3988	3351.7001	2808.3451	1561.3294	639.1561	0.0000	0.0000	0.0000	0.0000	1747.6838	3126.2853	4357.3452	(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	275.3398	243.4827	258.9189	228.5774	222.1300	200.7870	198.7642	206.4003	208.3495	231.5398	245.1804	272.4856	(64)
Efficiency of water heater (217)m	88.1511	88.0752	87.8997	87.4498	86.1425	79.8000	79.8000	79.8000	79.8000	87.5605	88.0226	88.1690	(216)
Fuel for water heating, kWh/month	312.3496	276.4486	294.5618	261.3812	257.8633	251.6128	249.0779	258.6471	261.0896	264.4342	278.5427	309.0490	(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	53.2266	42.7004	38.4469	28.1679	21.7577	17.7762	19.8481	25.7993	33.5107	43.9679	49.6616	54.7059	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-145.8017	-188.7952	-249.3095	-256.4908	-257.5982	-233.3976	-229.8142	-225.3475	-216.0851	-202.8708	-153.8453	-128.0437	(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	-142.2937	-289.5372	-558.6639	-816.2506	-1058.5972	-1056.8230	-1044.9719	-894.5673	-668.6629	-406.8247	-187.4066	-113.3572	(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												21864.2437	(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												3275.0579	(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)												429.5692	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-9725.3560	(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												15929.5148	(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	21864.2437	0.2100	4591.4912 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3275.0579	0.2100	687.7622 (264)
Space and water heating			5279.2533 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	429.5692	0.1443	62.0001 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2487.3998	0.1365	-339.6090
PV Unit electricity exported	-7237.9562	0.1267	-917.1664
Total			-1256.7754 (269)
Total CO2, kg/year			4096.4073 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.2700 (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	21864.2437	1.1300	24706.5954 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3275.0579	1.1300	3700.8154 (278)
Space and water heating			28407.4108 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	429.5692	1.5338	658.8875 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2487.3998	1.5047	-3742.8001
PV Unit electricity exported	-7237.9562	0.4652	-3366.8830

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Total
Total Primary energy kWh/year
Target Primary Energy Rate (TPER)

-7109.6831 (283)
22086.7160 (286)
60.7600 (287)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling			
Ground floor	196.7600 (1b)	x 2.9500 (2b)	= 580.4420 (1b) - (3b)
First floor	166.7600 (1c)	x 2.7300 (2c)	= 455.2548 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	363.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1035.6968 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) = 0.0386 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.2886 (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) = 0.2886 (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	0.3680	0.3608	0.3536	0.3175	0.3103	0.2742	0.2742	0.2670	0.2886	0.3103	0.3247	0.3391 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.5677	0.5651	0.5625	0.5504	0.5481	0.5376	0.5376	0.5356	0.5417	0.5481	0.5527	0.5575 (25)

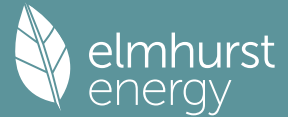
3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Solid doors			3.2400	1.2000	3.8880		(26)
Windows Dbl LowE			173.8200	1.1450	199.0305		(27)
Rooflights Dbl LowE			20.0500	1.1450	22.9580		(27a)
FT01 GF			196.7600	0.1300	25.5788		(28a)
FT02 FF Exposed			50.0000	0.1300	6.5000		(28b)
WT01 GF	164.0800	76.5400	87.5400	0.1800	15.7572		(29a)
WT02 Glazed corridor	32.6400	28.8000	3.8400	0.1800	0.6912		(29a)
WT03 Annex	68.4000	20.7700	47.6300	0.1800	8.5734		(29a)
WT04 FF	251.1400	45.2700	205.8700	0.1800	37.0566		(29a)
WT05 Dormer	21.9600	5.6800	16.2800	0.1800	2.9304		(29a)
RT01 Main roof	177.3200	14.0500	163.2700	0.1100	17.9597		(30)
RT02 Flat dormer	24.5100		24.5100	0.1100	2.6961		(30)
RT03 Flat annex	86.1800	6.0000	80.1800	0.1100	8.8198		(30)
RT04 Balcony	5.1200		5.1200	0.1100	0.5632		(30)
Total net area of external elements Aum(A, m ²)			1078.1100				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	353.0029	(33)

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

List of Thermal Bridges	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	49.2300	0.0500	2.4615
E2 Other lintels (including other steel lintels)	17.3900	0.0500	0.8695
E3 Sill	17.7300	0.0500	0.8865
E4 Jamb	97.6800	0.0500	4.8840
E5 Ground floor (normal)	96.0000	0.1600	15.3600
E19 Ground floor (inverted)	6.7800	0.0700	0.4746
E6 Intermediate floor within a dwelling	43.4800	0.0000	0.0000
E8 Balcony within a dwelling, wall insulation continuous	6.7500	0.0000	0.0000
E11 Eaves (insulation at rafter level)	42.9500	0.0400	1.7180
E13 Gable (insulation at rafter level)	24.5200	0.0800	1.9616
E14 Flat roof	51.8400	0.0800	4.1472
E15 Flat roof with parapet	36.5900	0.0900	3.2931
E16 Corner (normal)	27.2000	0.0900	2.4480
E17 Corner (inverted - internal area greater than external area)	16.2000	-0.0900	-1.4580
R1 Head of roof window	8.2700	0.0800	0.6616
R2 Sill of roof window	8.2700	0.0600	0.4962
R3 Jamb of roof window	34.0000	0.0800	2.7200

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R4 Ridge (vaulted ceiling)	28.1500	0.0800	2.2520
R8 Roof to wall (rafter)	18.3200	0.0600	1.0992
R10 All other roof or room-in-roof junctions	6.5000	0.0800	0.5200
R11 Upstands or kerbs of rooflights	18.0000	0.0800	1.4400
E20 Exposed floor (normal)	22.2500	0.3200	7.1200
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			53.3550 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss		(33) + (36) + (36a) =	406.3579 (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	194.0316	193.1330	192.2522	188.1150	187.3409	183.7375	183.7375	183.0702	185.1255	187.3409	188.9068	190.5439 (38)
Average = Sum(39)m / 12 =	600.3895	599.4909	598.6101	594.4729	593.6988	590.0955	590.0955	589.4282	591.4834	593.6988	595.2648	596.9018 (39)
												594.4692
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.6516	1.6491	1.6467	1.6353	1.6332	1.6233	1.6233	1.6214	1.6271	1.6332	1.6375	1.6420 (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												3.2145 (42)
Hot water usage for mixer showers												0.0000 (42a)
Hot water usage for baths												33.7159 (42b)
Hot water usage for other uses												47.5498 (42c)
Average daily hot water use (litres/day)												74.4870 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	81.2657	79.0359	76.6017	73.5724	70.8698	68.0613	67.4782	69.9075	72.3989	75.2831	78.3391	81.1517 (44)
Energy content (annual)	128.7050	112.5460	117.7339	100.7170	95.4044	83.6893	81.6090	86.5600	89.2751	102.1585	111.6084	127.0639 (45)
Distribution loss (46)m = 0.15 x (45)m												1237.0705
Water storage loss:												
Total storage loss												0.0000 (46)
If cylinder contains dedicated solar storage												0.0000 (56)
Primary loss												0.0000 (57)
Combi loss												0.0000 (59)
Total heat required for water heating calculated for each month												0.0000 (61)
WWHRS	109.3992	95.6641	100.0738	85.6094	81.0938	71.1359	69.3677	73.5760	75.8839	86.8347	94.8671	108.0044 (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	109.3992	95.6641	100.0738	85.6094	81.0938	71.1359	69.3677	73.5760	75.8839	86.8347	94.8671	108.0044 (64)
12Total per year (kWh/year)												1051.5099 (64)
Electric shower(s)												1052 (64)
Heat gains from water heating, kWh/month												
	62.5584	55.7400	60.8660	58.0837	59.1736	56.4459	58.3274	59.1736	58.0837	60.8660	59.7215	62.5584 (64a)
	42.9894	37.8510	40.2350	35.9233	35.0668	31.8954	31.9238	33.1874	33.4919	36.9252	38.6472	42.6407 (65)
												711.5981 (64a)

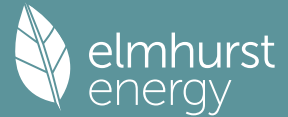
5. Internal gains (see Table 5 and 5a)

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	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	256.1678	283.6143	256.1678	264.7067	256.1678	264.7067	256.1678	256.1678	264.7067	256.1678	264.7067	256.1678 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	507.8812	513.1515	499.8707	471.5975	435.9076	402.3642	379.9551	374.6849	387.9657	416.2389	451.9287	485.4722 (68)
Pumps, fans	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725 (69)
Losses e.g. evaporation (negative values) (Table 5)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Water heating gains (Table 5)	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802 (71)
Total internal gains	57.7815	56.3260	54.0792	49.8934	47.1328	44.2992	42.9083	44.6067	46.5165	49.6306	53.6766	57.3128 (72)
	893.0480	924.3093	881.3353	857.4152	810.4258	782.5877	750.2488	746.6770	770.4065	793.2549	841.5296	870.1703 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
Northeast				48.4100	11.2829	0.6300	0.7000	0.7700	166.9280 (75)			
Southeast				56.9700	36.7938	0.6300	0.7000	0.7700	640.6091 (77)			
Southwest				14.4000	36.7938	0.6300	0.7000	0.7700	161.9233 (79)			
Northwest				54.0400	11.2829	0.6300	0.7000	0.7700	186.3415 (81)			
Southeast				5.2800	39.9751	0.6300	0.7000	1.0000	83.7732 (82)			
Northwest				8.7700	16.3666	0.6300	0.7000	1.0000	56.9690 (82)			
Horizontal				6.0000	26.0000	0.6300	0.7000	1.0000	61.9164 (82)			
Solar gains	1358.4604	2485.9388	3845.7913	5489.8088	6795.8612	7027.3204	6658.6006	5643.9142	4410.1225	2868.5157	1658.7415	1141.9366 (83)
Total gains	2251.5085	3410.2481	4727.1266	6347.2240	7606.2870	7809.9081	7408.8494	6390.5912	5180.5290	3661.7706	2500.2711	2012.1069 (84)

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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	42.0468	42.1098	42.1718	42.4653	42.5206	42.7803	42.7803	42.8287	42.6799	42.5206	42.4088	42.2925
alpha	3.8031	3.8073	3.8115	3.8310	3.8347	3.8520	3.8520	3.8552	3.8453	3.8347	3.8273	3.8195
util living area	0.9974	0.9876	0.9525	0.8395	0.6519	0.4679	0.3464	0.4152	0.6903	0.9403	0.9928	0.9983 (86)
MIT	18.8976	19.3014	19.8704	20.4947	20.8475	20.9668	20.9919	20.9842	20.8629	20.2598	19.4313	18.8297 (87)
Th 2	19.5757	19.5775	19.5793	19.5875	19.5891	19.5963	19.5963	19.5976	19.5935	19.5891	19.5859	19.5827 (88)
util rest of house	0.9964	0.9832	0.9365	0.7934	0.5750	0.3719	0.2379	0.2930	0.5838	0.9117	0.9897	0.9976 (89)
MIT 2	17.7038	18.1054	18.6592	19.2305	19.5050	19.5845	19.5948	19.5944	19.5325	19.0474	18.2431	17.6410 (90)
Living area fraction									fLA = Living area /	(4) =		0.1095 (91)
MIT	17.8345	18.2364	18.7918	19.3690	19.6521	19.7359	19.7479	19.7466	19.6782	19.1802	18.3733	17.7712 (92)
Temperature adjustment												0.0000
adjusted MIT	17.8345	18.2364	18.7918	19.3690	19.6521	19.7359	19.7479	19.7466	19.6782	19.1802	18.3733	17.7712 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9945	0.9773	0.9249	0.7851	0.5787	0.3818	0.2498	0.3064	0.5909	0.9006	0.9855	0.9963 (94)
Useful gains	2239.1316	3332.6719	4371.8856	4983.4018	4401.7164	2981.8117	1850.7870	1957.8667	3061.3018	3297.6587	2464.1111	2004.6959 (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	8125.9925	7995.0580	7358.0196	6223.5519	4721.1509	3030.6868	1857.5443	1972.5914	3299.4274	5094.0734	6710.6003	8100.6724 (97)
Space heating kWh	4379.8245	3133.1234	2221.6837	892.9081	237.6592	0.0000	0.0000	0.0000	0.0000	1336.5325	3057.4722	4535.4065 (98a)
Space heating requirement - total per year (kWh/year)												19794.6102
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	4379.8245	3133.1234	2221.6837	892.9081	237.6592	0.0000	0.0000	0.0000	0.0000	1336.5325	3057.4722	4535.4065 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												19794.6102
Space heating per m2										(98c) / (4) =		54.4526 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												
	0.0000	0.0000	0.0000	0.0000	0.0000	5546.8975	4366.7066	4479.6543	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9293	0.9585	0.9318	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	5154.9178	4185.2918	4174.3104	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	8766.2391	8315.6563	7169.3541	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	2600.1514	3072.9912	2228.3125	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction												
Intermittency factor (Table 10b)									fC = cooled area /	(4) =		1.0000 (105)
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	650.0378	768.2478	557.0781	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												1975.3638 (107)
Energy for space heating												54.4526 (99)
Energy for space cooling												5.4340 (108)
Total												59.8866 (109)
Fabric Energy Efficiency (DFEE)												59.9 (109)

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

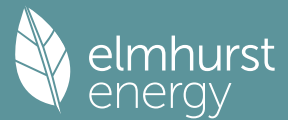
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Ground floor	196.7600 (1b)	x 2.9500 (2b)	= 580.4420 (1b) - (3b)
First floor	166.7600 (1c)	x 2.7300 (2c)	= 455.2548 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	363.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1035.6968 (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)

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Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =											Air changes per hour
Pressure test												40.0000 / (5) =
Pressure Test Method												0.0386 (8)
Measured/design AP50												Yes
Infiltration rate												Blower Door
Number of sides sheltered												5.0000 (17)
												0.2886 (18)
												0 (19)
Shelter factor												(20) = 1 - [0.075 x (19)] =
Infiltration rate adjusted to include shelter factor												1.0000 (20)
												(21) = (18) x (20) =
												0.2886 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	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)
Adj infilt rate	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)
	0.3680	0.3608	0.3536	0.3175	0.3103	0.2742	0.2742	0.2670	0.2886	0.3103	0.3247	0.3391 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.5677	0.5651	0.5625	0.5504	0.5481	0.5376	0.5376	0.5356	0.5417	0.5481	0.5527	0.5575 (25)

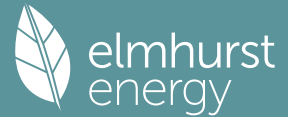
3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Main dwelling							
TER Opaque door			3.2400	1.0000	3.2400		(26)
TER Opening Type			78.5500	1.1450	89.9427		(27)
TER Roof Light			9.0600	1.5918	17.2373		(27a)
FT01 GF			196.7600	0.1300	25.5788		(28a)
FT02 FF Exposed			50.0000	0.1300	6.5000		(28b)
WT01 GF	164.0800	36.3600	127.7200	0.1800	22.9896		(29a)
WT02 Glazed corridor	32.6400	13.0200	19.6200	0.1800	3.5316		(29a)
WT03 Annex	68.4000	9.3800	59.0200	0.1800	10.6236		(29a)
WT04 FF	251.1400	20.4600	230.6800	0.1800	41.5224		(29a)
WT05 Dormer	21.9600	2.5700	19.3900	0.1800	3.4902		(29a)
RT01 Main roof	177.3200	6.3600	170.9600	0.1100	18.8056		(30)
RT02 Flat dormer	24.5100		24.5100	0.1100	2.6961		(30)
RT03 Flat annex	86.1800	2.7000	83.4800	0.1100	9.1828		(30)
RT04 Balcony	5.1200		5.1200	0.1100	0.5632		(30)
Total net area of external elements Aum(A, m2)			1078.1100				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	255.9040	(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.2145 (42)
Hot water usage for mixer showers												0.0000 (42a)
Hot water usage for baths	33.7159	33.2152	32.5101	31.2099	30.2364	29.1569	28.5738	29.2740	30.0364	31.1915	32.5184	33.6019 (42b)
Hot water usage for other uses	47.5498	45.8207	44.0916	42.3625	40.6334	38.9043	38.9043	40.6334	42.3625	44.0916	45.8207	47.5498 (42c)
Average daily hot water use (litres/day)												74.4870 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	81.2657	79.0359	76.6017	73.5724	70.8698	68.0613	67.4782	69.9075	72.3989	75.2831	78.3391	81.1517 (44)
Energy content (annual)	128.7050	112.5460	117.7339	100.7170	95.4044	83.6893	81.6090	86.5600	89.2751	102.1585	111.6084	127.0639 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m =
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1237.0705
Water storage loss:												0.0000 (46)
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

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If cylinder contains dedicated solar storage											
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month											
	109.3992	95.6641	100.0738	85.6094	81.0938	71.1359	69.3677	73.5760	75.8839	86.8347	94.8671 108.0044 (62)
WWHRS	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 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h											
	109.3992	95.6641	100.0738	85.6094	81.0938	71.1359	69.3677	73.5760	75.8839	86.8347	94.8671 108.0044 (64)
Total per year (kWh/year)											1051.5099 (64)
Electric shower(s)											1052 (64)
	62.5584	55.7400	60.8660	58.0837	59.1736	56.4459	58.3274	59.1736	58.0837	60.8660	59.7215 62.5584 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =											711.5981 (64a)
Heat gains from water heating, kWh/month											
	42.9894	37.8510	40.2350	35.9233	35.0668	31.8954	31.9238	33.1874	33.4919	36.9252	38.6472 42.6407 (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	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253	160.7253 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5											
	256.1678	283.6143	256.1678	264.7067	256.1678	264.7067	256.1678	256.1678	264.7067	256.1678	264.7067 256.1678 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5											
	507.8812	513.1515	499.8707	471.5975	435.9076	402.3642	379.9551	374.6849	387.9657	416.2389	451.9287 485.4722 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5											
	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725	39.0725 39.0725 (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 (70)
Losses e.g. evaporation (negative values) (Table 5)											
	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802 -128.5802 (71)
Water heating gains (Table 5)											
	57.7815	56.3260	54.0792	49.8934	47.1328	44.2992	42.9083	44.6067	46.5165	49.6306	53.6766 57.3128 (72)
Total internal gains											
	893.0480	924.3093	881.3353	857.4152	810.4258	782.5877	750.2488	746.6770	770.4065	793.2549	841.5296 870.1703 (73)

6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains
	m2	Table 6a	Specific data	Specific data	factor	W
		W/m2	or Table 6b	or Table 6c	Table 6d	
Northeast	21.8800	11.2829	0.6300	0.7000	0.7700	75.4469 (75)
Southeast	25.7400	36.7938	0.6300	0.7000	0.7700	289.4379 (77)
Southwest	6.5100	36.7938	0.6300	0.7000	0.7700	73.2028 (79)
Northwest	24.4200	11.2829	0.6300	0.7000	0.7700	84.2054 (81)
Southeast	2.3900	39.9751	0.6300	0.7000	1.0000	37.9201 (82)
Northwest	3.9700	16.3666	0.6300	0.7000	1.0000	25.7887 (82)
Horizontal	2.7000	26.0000	0.6300	0.7000	1.0000	27.8624 (82)
Solar gains	613.8642	1123.3382	1737.8047	2480.6835	3070.8613	3175.4601 3008.8415 2550.3220 1992.8057 1296.2094 749.5531 516.0229 (83)
Total gains	1506.9122	2047.6475	2619.1400	3338.0987	3881.2871	3958.0477 3759.0903 3296.9990 2763.2122 2089.4642 1591.0827 1386.1931 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)											
Utilisation factor for gains for living area, nil,m (see Table 9a)											21.0000 (85)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov Dec
tau	48.5015	48.5854	48.6679	49.0592	49.1331	49.4801	49.4801	49.5449	49.3459	49.1331	48.9838 48.8287
alpha	4.2334	4.2390	4.2445	4.2706	4.2755	4.2987	4.2987	4.3030	4.2897	4.2755	4.2656 4.2552
util living area											
	0.9995	0.9981	0.9926	0.9664	0.8841	0.7262	0.5691	0.6543	0.8954	0.9889	0.9987 0.9997 (86)
MIT	18.9844	19.2261	19.6184	20.1560	20.6211	20.8898	20.9703	20.9474	20.7026	20.0779	19.4326 18.9490 (87)
Th 2	19.7390	19.7409	19.7428	19.7515	19.7531	19.7607	19.7607	19.7621	19.7577	19.7531	19.7498 19.7464 (88)
util rest of house											
	0.9993	0.9973	0.9896	0.9521	0.8354	0.6216	0.4225	0.5042	0.8293	0.9824	0.9982 0.9995 (89)
MIT 2	17.9075	18.1501	18.5420	19.0748	19.5012	19.7120	19.7538	19.7478	19.5879	19.0074	18.3633 17.8774 (90)
Living area fraction											
	18.0254	18.2680	18.6599	19.1932	19.6239	19.8410	19.8870	19.8792	19.7100	19.1246	18.4804 17.9948 (92)
Temperature adjustment											
	18.0254	18.2680	18.6599	19.1932	19.6239	19.8410	19.8870	19.8792	19.7100	19.1246	18.4804 17.9948 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9989	0.9960	0.9858	0.9436	0.8293	0.6292	0.4383	0.5198	0.8260	0.9775	0.9972	0.9992 (94)
Useful gains	1505.2748	2039.4891	2582.0411	3149.7074	3218.7123	2490.2075	1647.6976	1713.7733	2282.4096	2042.3630	1586.6373	1385.1438 (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												
	7143.9176	6945.8711	6307.4601	5296.6093	4071.2625	2673.9221	1677.0161	1772.7266	2869.9757	4379.9400	5865.0456	7131.9308 (97)
Space heating kWh												
	4195.1503	3297.0887	2771.7118	1545.7694	634.2974	0.0000	0.0000	0.0000	0.0000	1739.1573	3080.4540	4275.6095 (98a)
Space heating requirement - total per year (kWh/year)												
												21539.2384
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												
	4195.1503	3297.0887	2771.7118	1545.7694	634.2974	0.0000	0.0000	0.0000	0.0000	1739.1573	3080.4540	4275.6095 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												
												21539.2384
Space heating per m2											(98c) / (4) =	59.2519 (99)

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8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	4795.8219	3775.4342	3872.4016	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.7742	0.8494	0.7872	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3712.6948	3206.9982	3048.4604	0.0000	0.0000	0.0000	0.0000 (102)
Space cooling kWh												
Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000	490.3642	717.9898	450.9974	0.0000	0.0000	0.0000	0.0000 (104)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (105)
Space cooling kWh												
Space cooling requirement	0.0000	0.0000	0.0000	0.0000	0.0000	122.5911	179.4975	112.7493	0.0000	0.0000	0.0000	0.0000 (107)
Energy for space heating												414.8379 (107)
Energy for space cooling												59.2519 (99)
Total												1.1412 (108)
Fabric Energy Efficiency (TFEE)												60.3930 (109)
												60.4 (109)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling			
Ground floor	196.7600 (1b)	x 2.9500 (2b)	= 580.4420 (1b) - (3b)
First floor	166.7600 (1c)	x 2.7300 (2c)	= 455.2548 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	363.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1035.6968 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	7 * 10 = 70.0000 (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) =	70.0000 / (5) = 0.0676 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3176 (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) = 0.3176 (21)

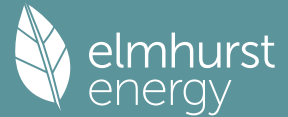
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4049	0.3970	0.3890	0.3493	0.3414	0.3017	0.3017	0.2938	0.3176	0.3414	0.3573	0.3732 (22b)
Effective ac	0.5820	0.5788	0.5757	0.5610	0.5583	0.5455	0.5455	0.5431	0.5504	0.5583	0.5638	0.5696 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Solid doors			3.2400	1.2000	3.8880		(26)
Windows Dbl LowE			173.8200	1.1450	199.0305		(27)
Rooflights Dbl LowE			20.0500	1.1450	22.9580		(27a)
FT01 GF			196.7600	0.1300	25.5788		(28a)
FT02 FF Exposed			50.0000	0.1300	6.5000		(28b)
WT01 GF	164.0800	76.5400	87.5400	0.1800	15.7572		(29a)
WT02 Glazed corridor	32.6400	28.8000	3.8400	0.1800	0.6912		(29a)
WT03 Annex	68.4000	20.7700	47.6300	0.1800	8.5734		(29a)
WT04 FF	251.1400	45.2700	205.8700	0.1800	37.0566		(29a)
WT05 Dormer	21.9600	5.6800	16.2800	0.1800	2.9304		(29a)
RT01 Main roof	177.3200	14.0500	163.2700	0.1100	17.9597		(30)
RT02 Flat dormer	24.5100		24.5100	0.1100	2.6961		(30)
RT03 Flat annex	86.1800	6.0000	80.1800	0.1100	8.8198		(30)
RT04 Balcony	5.1200		5.1200	0.1100	0.5632		(30)
Total net area of external elements Aum(A, m ²)			1078.1100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	353.0029		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
List of Thermal Bridges							

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6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W		
Northeast					48.4100	11.2829	0.6300	0.7000	0.7700	166.9280	(75)	
Southeast					56.9700	36.7938	0.6300	0.7000	0.7700	640.6091	(77)	
Southwest					14.4000	36.7938	0.6300	0.7000	0.7700	161.9233	(79)	
Northwest					54.0400	11.2829	0.6300	0.7000	0.7700	186.3415	(81)	
Southeast					5.2800	39.9751	0.6300	0.7000	1.0000	83.7732	(82)	
Northwest					8.7700	16.3666	0.6300	0.7000	1.0000	56.9690	(82)	
Horizontal					6.0000	26.0000	0.6300	0.7000	1.0000	61.9164	(82)	
Solar gains	1358.4604	2485.9388	3845.7913	5489.8088	6795.8612	7027.3204	6658.6006	5643.9142	4410.1225	2868.5157	1658.7415	1141.9366 (83)
Total gains	2459.4352	3584.7076	4908.1381	6484.5753	7720.0340	7888.1036	7481.6505	6470.5349	5272.0620	3793.6832	2659.7020	2209.1967 (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	41.7079	41.7830	41.8569	42.2075	42.2737	42.5848	42.5848	42.6430	42.4645	42.2737	42.1399	42.0009
alpha	3.7805	3.7855	3.7905	3.8138	3.8182	3.8390	3.8390	3.8429	3.8310	3.8182	3.8093	3.8001
util living area	0.9964	0.9855	0.9476	0.8334	0.6472	0.4655	0.3446	0.4120	0.6841	0.9347	0.9912	0.9976 (86)
MIT	20.2391	20.3378	20.4796	20.6334	20.7199	20.7506	20.7569	20.7552	20.7248	20.5773	20.3724	20.2234 (87)
Th 2	19.5660	19.5682	19.5703	19.5803	19.5821	19.5909	19.5909	19.5925	19.5875	19.5821	19.5784	19.5744 (88)
util rest of house	0.9951	0.9804	0.9301	0.7863	0.5701	0.3696	0.2363	0.2903	0.5772	0.9039	0.9873	0.9967 (89)
MIT 2	18.6645	18.7918	18.9698	19.1570	19.2446	19.2777	19.2810	19.2824	19.2584	19.1032	18.8460	18.6520 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	18.8369	18.9611	19.1352	19.3187	19.4062	19.4391	19.4427	19.4437	19.4191	19.2646	19.0132	18.8241 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.8369	18.9611	19.1352	19.3187	19.4062	19.4391	19.4427	19.4437	19.4191	19.2646	19.0132	18.8241 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9942	0.9776	0.9235	0.7762	0.5597	0.3589	0.2247	0.2770	0.5628	0.8949	0.9853	0.9961 (94)
Useful gains	2445.0937	3504.3734	4532.8774	5033.3827	4320.8109	2830.7633	1680.8822	1792.2947	2967.0343	3394.7895	2620.5124	2200.4863 (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	8798.7396	8495.4364	7620.4530	6231.4884	4601.8653	2868.6213	1685.1572	1801.8721	3162.0985	5174.2327	7136.7667	8789.7452 (97)
Space heating kWh	4727.1125	3353.9943	2297.1562	862.6361	209.1044	0.0000	0.0000	0.0000	0.0000	1323.9058	3251.7031	4902.4086 (98a)
Space heating requirement - total per year (kWh/year)	20928.0211											
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	4727.1125	3353.9943	2297.1562	862.6361	209.1044	0.0000	0.0000	0.0000	0.0000	1323.9058	3251.7031	4902.4086 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	20928.0211											
Space heating per m2	(98c) / (4) = 57.5705 (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 %)	249.9000 (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	4727.1125	3353.9943	2297.1562	862.6361	209.1044	0.0000	0.0000	0.0000	0.0000	1323.9058	3251.7031	4902.4086 (98)
Space heating efficiency (main heating system 1)	249.9000	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000 (210)
Space heating fuel (main heating system)	1891.6017	1342.1346	919.2302	345.1925	83.6752	0.0000	0.0000	0.0000	0.0000	529.7742	1301.2017	1961.7481 (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	379.0731	335.4931	356.4024	312.5787	302.6342	272.2306	268.0081	278.6964	281.8685	314.9300	335.7365	374.7682 (64)
Efficiency of water heater	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000 (216)
Fuel for water heating, kWh/month	216.4895	191.6008	203.5422	178.5144	172.8351	155.4715	153.0600	159.1641	160.9758	179.8572	191.7398	214.0310 (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	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	52.1387	41.8276	37.6611	27.5921	21.3130	17.4129	19.4424	25.2720	32.8258	43.0692	48.6466	53.5878 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-49.3549	-92.0568	-178.4969	-259.0578	-321.9750	-312.5298	-305.5924	-262.1368	-194.0882	-122.8275	-60.4706	-39.8938 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	-0.1657	-0.8404	-4.3485	-17.4222	-43.7159	-56.1102	-54.3846	-36.8917	-17.8798	-2.8787	-0.3550	-0.1036 (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)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												8374.5583	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												175.1000	
Water heating fuel used												2177.2814	(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)												420.7890	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-2433.5770	(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												8539.0517	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	8374.5583	16.4900	1380.9647	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2177.2814	16.4900	359.0337	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Energy for lighting	420.7890	16.4900	69.3881	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2198.4806	16.4900	-362.5295	
PV Unit electricity exported	-235.0963	5.5900	-13.1419	
Total			-375.6713	(252)
Total energy cost			1433.7151	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)		1.2634	(257)
SAP value	$[(255) \times (256)] / [(4) + 45.0] =$	79.5198	
SAP rating (Section 12)		80	(258)
SAP band		C	

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

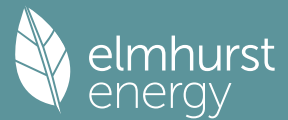
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	8374.5583	0.1567	1312.4182	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2177.2814	0.1409	306.8397	(264)
Space and water heating			1619.2579	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	420.7890	0.1443	60.7329	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2198.4806	0.1303	-286.4307	
PV Unit electricity exported	-235.0963	0.1110	-26.0845	
Total			-312.5152	(269)
Total CO2, kg/year			1367.4755	(272)
CO2 emissions per m2			3.7600	(273)
EI value			95.5145	
EI rating			96	(274)
EI band			A	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Main dwelling				
Ground floor	196.7600 (1b)	x 2.9500 (2b)	= 580.4420 (1b) - (3b)	
First floor	166.7600 (1c)	x 2.7300 (2c)	= 455.2548 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)... (1n)	363.5200		(4)	
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)... (3n) =	1035.6968 (5)	

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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												7 * 10 =	70.0000 (7a)
Number of passive vents												0 * 10 =	0.0000 (7b)
Number of flueless gas fires												0 * 40 =	0.0000 (7c)
												Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =												70.0000 / (5) =	0.0676 (8)
Pressure test												Yes	
Pressure Test Method												Blower Door	
Measured/design AP50												5.0000 (17)	
Infiltration rate												0.3176 (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) = 0.3176 (21)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.8000	4.5000	4.4000	3.9000	3.9000	3.6000	3.7000	3.5000	3.7000	4.0000	4.1000	4.4000	(22)
Wind factor	1.2000	1.1250	1.1000	0.9750	0.9750	0.9000	0.9250	0.8750	0.9250	1.0000	1.0250	1.1000	(22a)
Adj infilt rate	0.3811	0.3573	0.3493	0.3096	0.3096	0.2858	0.2938	0.2779	0.2938	0.3176	0.3255	0.3493	(22b)
Effective ac	0.5726	0.5638	0.5610	0.5479	0.5479	0.5408	0.5431	0.5386	0.5431	0.5504	0.5530	0.5610	(25)

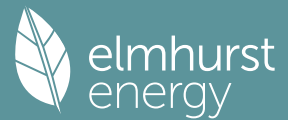
3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
Main dwelling													
Solid doors			3.2400	1.2000	3.8880		(26)						
Windows Dbl LowE			173.8200	1.1450	199.0305		(27)						
Rooflights Dbl LowE			20.0500	1.1450	22.9580		(27a)						
FT01 GF			196.7600	0.1300	25.5788		(28a)						
FT02 FF Exposed			50.0000	0.1300	6.5000		(28b)						
WT01 GF	164.0800	76.5400	87.5400	0.1800	15.7572		(29a)						
WT02 Glazed corridor	32.6400	28.8000	3.8400	0.1800	0.6912		(29a)						
WT03 Annex	68.4000	20.7700	47.6300	0.1800	8.5734		(29a)						
WT04 FF	251.1400	45.2700	205.8700	0.1800	37.0566		(29a)						
WT05 Dormer	21.9600	5.6800	16.2800	0.1800	2.9304		(29a)						
RT01 Main roof	177.3200	14.0500	163.2700	0.1100	17.9597		(30)						
RT02 Flat dormer	24.5100		24.5100	0.1100	2.6961		(30)						
RT03 Flat annex	86.1800	6.0000	80.1800	0.1100	8.8198		(30)						
RT04 Balcony	5.1200		5.1200	0.1100	0.5632		(30)						
Total net area of external elements Aum(A, m2)			1078.1100				(31)						
Fabric heat loss, W/K = Sum (A x U)				(26)... (30) + (32) =	353.0029		(33)						
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)						
List of Thermal Bridges													
K1 Element				Length	Psi-value	Total							
E1 Steel lintel with perforated steel base plate				49.2300	0.0500	2.4615							
E2 Other lintels (including other steel lintels)				17.3900	0.0500	0.8695							
E3 Sill				17.7300	0.0500	0.8865							
E4 Jamb				97.6800	0.0500	4.8840							
E5 Ground floor (normal)				96.0000	0.1600	15.3600							
E19 Ground floor (inverted)				6.7800	0.0700	0.4746							
E6 Intermediate floor within a dwelling				43.4800	0.0000	0.0000							
E8 Balcony within a dwelling, wall insulation continuous				6.7500	0.0000	0.0000							
E11 Eaves (insulation at rafter level)				42.9500	0.0400	1.7180							
E13 Gable (insulation at rafter level)				24.5200	0.0800	1.9616							
E14 Flat roof				51.8400	0.0800	4.1472							
E15 Flat roof with parapet				36.5900	0.0900	3.2931							
E16 Corner (normal)				27.2000	0.0900	2.4480							
E17 Corner (inverted - internal area greater than external area)				16.2000	-0.0900	-1.4580							
R1 Head of roof window				8.2700	0.0800	0.6616							
R2 Sill of roof window				8.2700	0.0600	0.4962							
R3 Jamb of roof window				34.0000	0.0800	2.7200							
R4 Ridge (vaulted ceiling)				28.1500	0.0800	2.2520							
R8 Roof to wall (rafter)				18.3200	0.0600	1.0992							
R10 All other roof or room-in-roof junctions				6.5000	0.0800	0.5200							
R11 Upstands or kerbs of rooflights				18.0000	0.0800	1.4400							
E20 Exposed floor (normal)				22.2500	0.3200	7.1200							
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							53.3550 (36)						
Point Thermal Bridges						(36a) =	0.0000						
Total fabric heat loss						(33) + (36) + (36a) =	406.3579 (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	195.7102	192.7046	191.7458	187.2752	187.2752	184.8513	185.6377	184.0865	185.6377	188.1262	188.9988	191.7458	(38)
Average = Sum(39)m / 12 =	602.0681	599.0626	598.1038	593.6331	593.6331	591.2093	591.9957	590.4444	591.9957	594.4842	595.3568	598.1038	(39)
												595.0076	
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(40)
HLP (average)	1.6562	1.6479	1.6453	1.6330	1.6330	1.6263	1.6285	1.6242	1.6285	1.6354	1.6378	1.6453	(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													3,2145 (42)
Hot water usage for mixer showers													
	107.4104	105.7962	103.4440	98.9436	95.6224	91.9186	89.8134	92.1477	94.7066	98.6834	103.2805	106.9988 (42a)	
Hot water usage for baths	35.4904	34.9634	34.2211	32.8526	31.8278	30.6915	30.0777	30.8148	31.6173	32.8332	34.2299	35.3705 (42b)	
Hot water usage for other uses	50.0524	48.2323	46.4122	44.5921	42.7720	40.9519	40.9519	42.7720	44.5921	46.4122	48.2323	50.0524 (42c)	

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Average daily hot water use (litres/day)												177.4361 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	192.9532	188.9918	184.0773	176.3883	170.2222	163.5620	160.8430	165.7345	170.9160	177.9287	185.7427	192.4217 (44)
Energy content	305.5907	269.1219	282.9200	241.4667	229.1518	201.1186	194.5257	205.2140	210.7565	241.4476	264.6245	301.2858 (45)
Energy content (annual)												Total = Sum(45)m = 2947.2238
Distribution loss (46)m = 0.15 x (45)m	45.8386	40.3683	42.4380	36.2200	34.3728	30.1678	29.1789	30.7821	31.6135	36.2171	39.6937	45.1929 (46)
Water storage loss:												
Store volume												300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												3.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.6200 (55)
Total storage loss	50.2200	45.3600	50.2200	48.6000	50.2200	48.6000	50.2200	50.2200	48.6000	50.2200	48.6000	50.2200 (56)
If cylinder contains dedicated solar storage	50.2200	45.3600	50.2200	48.6000	50.2200	48.6000	50.2200	50.2200	48.6000	50.2200	48.6000	50.2200 (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	379.0731	335.4931	356.4024	312.5787	302.6342	272.2306	268.0081	278.6964	281.8685	314.9300	335.7365	374.7682 (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	379.0731	335.4931	356.4024	312.5787	302.6342	272.2306	268.0081	278.6964	281.8685	314.9300	335.7365	374.7682 (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	120.2188	106.2920	112.6808	98.2973	94.8029	84.8815	83.2897	86.8436	88.0862	98.8912	105.9972	118.7875 (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	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	59.5670	52.9069	43.0268	32.5740	24.3495	20.5569	22.2124	28.8725	38.7527	49.2054	57.4300	61.2226 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	758.0317	765.8977	746.0756	703.8768	650.6084	600.5436	567.0972	559.2312	579.0533	621.2521	674.5205	724.5853 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802 (71)
Water heating gains (Table 5)	161.5844	158.1726	151.4527	136.5240	127.4232	117.8910	111.9485	116.7252	122.3419	132.9183	147.2184	159.6606 (72)
Total internal gains	1100.9748	1098.7689	1062.3468	994.7665	924.1728	860.7831	823.0498	826.6206	861.9395	925.1675	1000.9605	1067.2601 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d	Gains W		
Northeast				48.4100	13.7622	0.6300	0.7000		0.7700	203.6078 (75)		
Southeast				56.9700	42.6275	0.6300	0.7000		0.7700	742.1785 (77)		
Southwest				14.4000	42.6275	0.6300	0.7000		0.7700	187.5965 (79)		
Northwest				54.0400	13.7622	0.6300	0.7000		0.7700	227.2870 (81)		
Southeast				5.2800	47.3724	0.6300	0.7000		1.0000	99.2751 (82)		
Northwest				8.7700	20.0162	0.6300	0.7000		1.0000	69.6726 (82)		
Horizontal				6.0000	32.0000	0.6300	0.7000		1.0000	76.2048 (82)		
Solar gains	1605.8222	2624.1628	4069.4387	6149.3962	7327.9838	8098.1190	7585.1841	6488.3453	5006.7019	3245.6585	1982.3186	1303.9802 (83)
Total gains	2706.7970	3722.9317	5131.7855	7144.1628	8252.1566	8958.9022	8408.2339	7314.9659	5868.6414	4170.8260	2983.2791	2371.2403 (84)

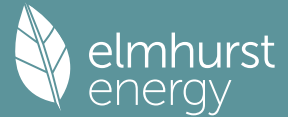
7. Mean internal temperature (heating season)

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	41.9295	42.1399	42.2075	42.5253	42.5253	42.6997	42.6430	42.7550	42.6430	42.4645	42.4022	42.2075
alpha	3.7953	3.8093	3.8138	3.8350	3.8350	3.8466	3.8429	3.8503	3.8429	3.8310	3.8268	3.8138
util living area	0.9942	0.9817	0.9326	0.7748	0.5663	0.3644	0.2525	0.2809	0.5672	0.8878	0.9834	0.9962 (86)
MIT	20.2876	20.3724	20.5188	20.6711	20.7374	20.7563	20.7586	20.7588	20.7440	20.6347	20.4368	20.2780 (87)
Th 2	19.5724	19.5784	19.5803	19.5892	19.5892	19.5941	19.5925	19.5956	19.5925	19.5875	19.5858	19.5803 (88)
util rest of house	0.9920	0.9753	0.9104	0.7182	0.4842	0.2753	0.1543	0.1690	0.4500	0.8367	0.9760	0.9947 (89)
MIT 2	18.7322	18.8448	19.0266	19.2049	19.2662	19.2842	19.2833	19.2870	19.2767	19.1733	18.9343	18.7272 (90)
Living area fraction	18.9025	19.0122	19.1900	19.3655	19.4274	19.4454	19.4449	19.4482	19.4374	19.3333	19.0989	18.8971 (92)
MIT	18.9025	19.0122	19.1900	19.3655	19.4274	19.4454	19.4449	19.4482	19.4374	19.3333	19.0989	18.8971 (92)
Temperature adjustment	18.9025	19.0122	19.1900	19.3655	19.4274	19.4454	19.4449	19.4482	19.4374	19.3333	19.0989	18.8971 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	2681.4480	3618.4512	4633.2974	5058.7474	3913.5296	2380.7739	1209.9947	1149.5484	2559.4443	3441.1227	2901.2613	2356.3054 (95)
Ext temp.	5.0000	5.4000	7.1000	9.5000	12.6000	15.4000	17.4000	17.5000	15.0000	11.7000	8.1000	5.2000 (96)

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Heat loss rate W	8370.2763	8154.5462	7231.0941	5856.4900	4052.9460	2391.6962	1210.5986	1150.3305	2626.9159	4537.9027	6548.2504	8192.2980	(97)
Space heating kWh	4232.4883	3048.2558	1932.7607	574.3747	103.7258	0.0000	0.0000	0.0000	0.0000	816.0044	2625.8322	4341.9785	(98a)
Space heating requirement - total per year (kWh/year)												17675.4203	
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	4232.4883	3048.2558	1932.7607	574.3747	103.7258	0.0000	0.0000	0.0000	0.0000	816.0044	2625.8322	4341.9785	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												17675.4203	
Space heating per m2												48.6230	(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 %)													249.9000	(206)
Efficiency of main space heating system 2 (in %)													0.0000	(207)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
4232.4883	3048.2558	1932.7607	574.3747	103.7258	0.0000	0.0000	0.0000	0.0000	0.0000	816.0044	2625.8322	4341.9785	(98)	
Space heating efficiency (main heating system 1)	249.9000	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000	(210)	
Space heating fuel (main heating system)	1693.6728	1219.7903	773.4136	229.8418	41.5069	0.0000	0.0000	0.0000	0.0000	326.5324	1050.7532	1737.4864	(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	379.0731	335.4931	356.4024	312.5787	302.6342	272.2306	268.0081	278.6964	281.8685	314.9300	335.7365	374.7682	(64)	
Efficiency of water heater	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(216)	
Fuel for water heating, kWh/month	216.4895	191.6008	203.5422	178.5144	172.8351	155.4715	153.0600	159.1641	160.9758	179.8572	191.7398	214.0310	(219)	
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)	
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)	
Pumps and Fa	52.1387	41.8276	37.6611	27.5921	21.3130	17.4129	19.4424	25.2720	32.8258	43.0692	48.6466	53.5878	(232)	
Lighting	-60.6690	-100.4160	-192.4141	-287.8226	-341.6215	-350.7095	-340.1657	-296.7809	-221.0049	-141.8047	-74.9217	-47.4515	(233a)	
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)	
(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	(235a)	
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	(235a)	
(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	(235c)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)	
(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	(235b)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)	
(235c)m	-0.2795	-1.0829	-5.6685	-25.5214	-54.5436	-75.0697	-71.2366	-49.8636	-24.1407	-4.8525	-0.6495	-0.1645	(233b)	
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)	
(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	(235b)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)	
(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	(235d)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)	
(235d)m														
Annual totals kWh/year														
Space heating fuel - main system 1													7072.9973	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													175.1000	
Water heating fuel used													2177.2814	(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)													420.7890	(232)

Energy saving/generation technologies (Appendices M ,N and Q)

PV generation													-2768.8550	(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													6902.2127	(238)

10a. Fuel costs - using BEDF prices (567)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	7072.9973	26.0600	1843.2231	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2177.2814	26.0600	567.3995	(247)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Energy for lighting	420.7890	26.0600	109.6576	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2455.7821	26.0600	-639.9768	
PV Unit electricity exported	-313.0729	5.8100	-18.1895	
Total			-658.1664	(252)
Total energy cost			1862.1139	(255)

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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	7072.9973	0.1575	1114.1961 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2177.2814	0.1409	306.8397 (264)
Space and water heating			1421.0358 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	420.7890	0.1443	60.7329 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2455.7821	0.1303	-320.0264
PV Unit electricity exported	-313.0729	0.1112	-34.8092
Total			-354.8356 (269)
Total CO2, kg/year			1126.9330 (272)

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	7072.9973	1.5831	11197.5873 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2177.2814	1.5211	3311.8667 (278)
Space and water heating			14509.4540 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	420.7890	1.5338	645.4202 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2455.7821	1.4814	-3637.9276
PV Unit electricity exported	-313.0729	0.4070	-127.4066
Total			-3765.3342 (283)
Total Primary energy kWh/year			11389.5399 (286)

SAP 10 EPC IMPROVEMENTS

BE GREEN

Current energy efficiency rating: C 80
Current environmental impact rating: A 96

N Solar water heating SAP increase too small
U Solar photovoltaic panels Already installed
V2 Wind turbine Not applicable

Recommended measures: SAP change Cost change CO2 change
(none)

Measures omitted - SAP change or cost saving too small:
N Solar water heating + 0.8 -£ 98 -50 kg (4.4%)

Recommended measures Typical annual savings Energy Environmental
(none) Total Savings £0 0.00 kg/m² efficiency impact
Potential energy efficiency rating: C 80
Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 567 TEST (07 Mar 2025)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, South East England):

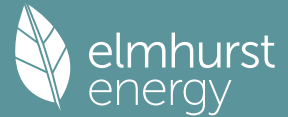
	Current £2520	Potential £2520	Saving £0
Electricity			
Space heating	£1843	£1843	£0
Water heating	£567	£567	£0
Lighting	£110	£110	£0
Generated (PV)	-£658	-£658	£0
Total cost of fuels	£1862	£1862	£0
Total cost of uses	£1862	£1862	£0
Delivered energy	19 kWh/m²	19 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.1 tonnes	1.1 tonnes	0.0 tonnes
CO2 emissions per m²	3 kg/m²	3 kg/m²	0 kg/m²
Primary energy	31 kWh/m²	31 kWh/m²	0 kWh/m²

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m²)	Storey height (m)	Volume (m³)
Main dwelling			
Ground floor	196.7600 (1b)	x 2.9500 (2b)	= 580.4420 (1b) - (3b)
First floor	166.7600 (1c)	x 2.7300 (2c)	= 455.2548 (1c) - (3c)

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Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)
Dwelling volume

363.5200

(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 1035.6968 (4)
(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	7 * 10 =	70.0000 (7a)		
Number of passive vents	0 * 10 =	0.0000 (7b)		
Number of flueless gas fires	0 * 40 =	0.0000 (7c)		
			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	70.0000	/ (5) =	0.0676	(8)
Pressure test	Yes			
Pressure Test Method	Blower Door			
Measured/design AP50	5.0000 (17)			
Infiltration rate	0.3176 (18)			
Number of sides sheltered	0 (19)			
Shelter factor				
Infiltration rate adjusted to include shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)		
	(21) = (18) x (20) =	0.3176 (21)		

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750
Effective ac	0.4049	0.3970	0.3890	0.3493	0.3414	0.3017	0.3017	0.2938	0.3176	0.3414	0.3573	0.3732
	0.5820	0.5788	0.5757	0.5610	0.5583	0.5455	0.5455	0.5431	0.5504	0.5583	0.5638	0.5696

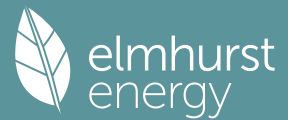
3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K
	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K
Main dwelling							
Solid doors			3.2400	1.2000	3.8880		(26)
Windows Dbl LowE			173.8200	1.1450	199.0305		(27)
Rooflights Dbl LowE			20.0500	1.1450	22.9580		(27a)
FT01 GF			196.7600	0.1300	25.5788		(28a)
FT02 FF Exposed			50.0000	0.1300	6.5000		(28b)
WT01 GF	164.0800	76.5400	87.5400	0.1800	15.7572		(29a)
WT02 Glazed corridor	32.6400	28.8000	3.8400	0.1800	0.6912		(29a)
WT03 Annex	68.4000	20.7700	47.6300	0.1800	8.5734		(29a)
WT04 FF	251.1400	45.2700	205.8700	0.1800	37.0566		(29a)
WT05 Dormer	21.9600	5.6800	16.2800	0.1800	2.9304		(29a)
RT01 Main roof	177.3200	14.0500	163.2700	0.1100	17.9597		(30)
RT02 Flat dormer	24.5100		24.5100	0.1100	2.6961		(30)
RT03 Flat annex	86.1800	6.0000	80.1800	0.1100	8.8198		(30)
RT04 Balcony	5.1200		5.1200	0.1100	0.5632		(30)
Total net area of external elements Aum(A, m2)			1078.1100				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		353.0029		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)
List of Thermal Bridges							
K1 Element	Length	Psi-value	Total				
E1 Steel lintel with perforated steel base plate	49.2300	0.0500	2.4615				
E2 Other lintels (including other steel lintels)	17.3900	0.0500	0.8695				
E3 Sill	17.7300	0.0500	0.8865				
E4 Jamb	97.6800	0.0500	4.8840				
E5 Ground floor (normal)	96.0000	0.1600	15.3600				
E19 Ground floor (inverted)	6.7800	0.0700	0.4746				
E6 Intermediate floor within a dwelling	43.4800	0.0000	0.0000				
E8 Balcony within a dwelling, wall insulation continuous	6.7500	0.0000	0.0000				
E11 Eaves (insulation at rafter level)	42.9500	0.0400	1.7180				
E13 Gable (insulation at rafter level)	24.5200	0.0800	1.9616				
E14 Flat roof	51.8400	0.0800	4.1472				
E15 Flat roof with parapet	36.5900	0.0900	3.2931				
E16 Corner (normal)	27.2000	0.0900	2.4480				
E17 Corner (inverted - internal area greater than external area)	16.2000	-0.0900	-1.4580				
R1 Head of roof window	8.2700	0.0800	0.6616				
R2 Sill of roof window	8.2700	0.0600	0.4962				
R3 Jamb of roof window	34.0000	0.0800	2.7200				
R4 Ridge (vaulted ceiling)	28.1500	0.0800	2.2520				
R8 Roof to wall (rafter)	18.3200	0.0600	1.0992				
R10 All other roof or room-in-roof junctions	6.5000	0.0800	0.5200				
R11 Upstands or kerbs of rooflights	18.0000	0.0800	1.4400				
E20 Exposed floor (normal)	22.2500	0.3200	7.1200				
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							53.3550 (36)
Point Thermal bridges							(36a) = 0.0000
Total fabric heat loss							(33) + (36) + (36a) = 406.3579 (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	198.9097	197.8216	196.7551	191.7458	190.8086	186.4457	186.4457	185.6377	188.1262	190.8086	192.7046	194.6868
Average = Sum(39)m / 12 =	605.2676	604.1796	603.1131	598.1038	597.1666	592.8036	592.8036	591.9957	594.4842	597.1666	599.0626	601.0447
	598.0993											
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.6650	1.6620	1.6591	1.6453	1.6427	1.6307	1.6307	1.6285	1.6354	1.6427	1.6479	1.6534
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

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Assumed occupancy												3.2145 (42)
Hot water usage for mixer showers												106.9988 (42a)
Hot water usage for baths	107.4104	105.7962	103.4440	98.9436	95.6224	91.9186	89.8134	92.1477	94.7066	98.6834	103.2805	106.9988 (42a)
Hot water usage for other uses	35.4904	34.9634	34.2211	32.8526	31.8278	30.6915	30.0777	30.8148	31.6173	32.8332	34.2299	35.3705 (42b)
Average daily hot water use (litres/day)	50.0524	48.2323	46.4122	44.5921	42.7720	40.9519	40.9519	42.7720	44.5921	46.4122	48.2323	50.0524 (42c)
												177.4361 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content (annual)	192.9532	188.9918	184.0773	176.3883	170.2222	163.5620	160.8430	165.7345	170.9160	177.9287	185.7427	192.4217 (44)
Distribution loss (46)m = 0.15 x (45)m	305.5907	269.1219	282.9200	241.4667	229.1518	201.1186	194.5257	205.2140	210.7565	241.4476	264.6245	301.2858 (45)
												2947.2238
Water storage loss:	45.8386	40.3683	42.4380	36.2200	34.3728	30.1678	29.1789	30.7821	31.6135	36.2171	39.6937	45.1929 (46)
Store volume												300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												3.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.6200 (55)
Total storage loss	50.2200	45.3600	50.2200	48.6000	50.2200	48.6000	50.2200	50.2200	48.6000	50.2200	48.6000	50.2200 (56)
If cylinder contains dedicated solar storage	50.2200	45.3600	50.2200	48.6000	50.2200	48.6000	50.2200	50.2200	48.6000	50.2200	48.6000	50.2200 (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	379.0731	335.4931	356.4024	312.5787	302.6342	272.2306	268.0081	278.6964	281.8685	314.9300	335.7365	374.7682 (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	379.0731	335.4931	356.4024	312.5787	302.6342	272.2306	268.0081	278.6964	281.8685	314.9300	335.7365	374.7682 (64)
												3812.4198 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
												0.0000 (64a)
Heat gains from water heating, kWh/month	120.2188	106.2920	112.6808	98.2973	94.8029	84.8815	83.2897	86.8436	88.0862	98.8912	105.9972	118.7875 (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	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	59.5670	52.9069	43.0268	32.5740	24.3495	20.5569	22.2124	28.8725	38.7527	49.2054	57.4300	61.2226 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	758.0317	765.8977	746.0756	703.8768	650.6084	600.5436	567.0972	559.2312	579.0533	621.2521	674.5205	724.5853 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802 (71)
Water heating gains (Table 5)	161.5844	158.1726	151.4527	136.5240	127.4232	117.8910	111.9485	116.7252	122.3419	132.9183	147.2184	159.6606 (72)
Total internal gains	1100.9748	1098.7689	1062.3468	994.7665	924.1728	860.7831	823.0498	826.6206	861.9395	925.1675	1000.9605	1067.2601 (73)

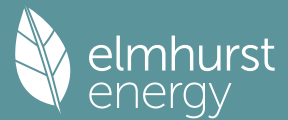
6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast					48.4100	11.2829		0.6300	0.7000	0.7700	166.9280 (75)	
Southeast					56.9700	36.7938		0.6300	0.7000	0.7700	640.6091 (77)	
Southwest					14.4000	36.7938		0.6300	0.7000	0.7700	161.9233 (79)	
Northwest					54.0400	11.2829		0.6300	0.7000	0.7700	186.3415 (81)	
Southeast					5.2800	39.9751		0.6300	0.7000	1.0000	83.7732 (82)	
Northwest					8.7700	16.3666		0.6300	0.7000	1.0000	56.9690 (82)	
Horizontal					6.0000	26.0000		0.6300	0.7000	1.0000	61.9164 (82)	
Solar gains	1358.4604	2485.9388	3845.7913	5489.8088	6795.8612	7027.3204	6658.6006	5643.9142	4410.1225	2868.5157	1658.7415	1141.9366 (83)
Total gains	2459.4352	3584.7076	4908.1381	6484.5753	7720.0340	7888.1036	7481.6505	6470.5349	5272.0620	3793.6832	2659.7020	2209.1967 (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	41.7079	41.7830	41.8569	42.2075	42.2737	42.5848	42.5848	42.6430	42.4645	42.2737	42.1399	42.0009
alpha	3.7805	3.7855	3.7905	3.8138	3.8182	3.8390	3.8390	3.8429	3.8310	3.8182	3.8093	3.8001
util living area	0.9964	0.9855	0.9476	0.8334	0.6472	0.4655	0.3446	0.4120	0.6841	0.9347	0.9912	0.9976 (86)
MIT	20.2391	20.3378	20.4796	20.6334	20.7199	20.7506	20.7569	20.7552	20.7248	20.5773	20.3724	20.2234 (87)
Th 2	19.5660	19.5682	19.5703	19.5803	19.5821	19.5909	19.5909	19.5925	19.5875	19.5821	19.5784	19.5744 (88)
util rest of house	0.9951	0.9804	0.9301	0.7863	0.5701	0.3696	0.2363	0.2903	0.5772	0.9039	0.9873	0.9967 (89)
MIT 2	18.6645	18.7918	18.9698	19.1570	19.2446	19.2777	19.2810	19.2824	19.2584	19.1032	18.8460	18.6520 (90)
Living area fraction	18.8369	18.9611	19.1352	19.3187	19.4062	19.4391	19.4427	19.4437	19.4191	19.2646	19.0132	18.8241 (91)
MIT	18.8369	18.9611	19.1352	19.3187	19.4062	19.4391	19.4427	19.4437	19.4191	19.2646	19.0132	18.8241 (92)
Temperature adjustment	18.8369	18.9611	19.1352	19.3187	19.4062	19.4391	19.4427	19.4437	19.4191	19.2646	19.0132	18.8241 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9942	0.9776	0.9235	0.7762	0.5597	0.3589	0.2247	0.2770	0.5628	0.8949	0.9853	0.9961	(94)
Useful gains	2445.0937	3504.3734	4532.8774	5033.3827	4320.8109	2830.7633	1680.8822	1792.2947	2967.0343	3394.7895	2620.5124	2200.4863	(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	8798.7396	8495.4364	7620.4530	6231.4884	4601.8653	2868.6213	1685.1572	1801.8721	3162.0985	5174.2327	7136.7667	8789.7452	(97)
Space heating kWh	4727.1125	3353.9943	2297.1562	862.6361	209.1044	0.0000	0.0000	0.0000	0.0000	1323.9058	3251.7031	4902.4086	(98a)
Space heating requirement - total per year (kWh/year)												20928.0211	
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	4727.1125	3353.9943	2297.1562	862.6361	209.1044	0.0000	0.0000	0.0000	0.0000	1323.9058	3251.7031	4902.4086	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												20928.0211	
Space heating per m2										(98c) / (4) =		57.5705	(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 %)													249.9000	(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	4727.1125	3353.9943	2297.1562	862.6361	209.1044	0.0000	0.0000	0.0000	0.0000	1323.9058	3251.7031	4902.4086	(98)	
Space heating efficiency (main heating system 1)	249.9000	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000	(210)	
Space heating fuel (main heating system)	1891.6017	1342.1346	919.2302	345.1925	83.6752	0.0000	0.0000	0.0000	0.0000	529.7742	1301.2017	1961.7481	(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	379.0731	335.4931	356.4024	312.5787	302.6342	272.2306	268.0081	278.6964	281.8685	314.9300	335.7365	374.7682	(64)	
Efficiency of water heater	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(216)	
Fuel for water heating, kWh/month	216.4895	191.6008	203.5422	178.5144	172.8351	155.4715	153.0600	159.1641	160.9758	179.8572	191.7398	214.0310	(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	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	52.1387	41.8276	37.6611	27.5921	21.3130	17.4129	19.4424	25.2720	32.8258	43.0692	48.6466	53.5878	(232)	
Electricity generated by PVs (Appendix M) (negative quantity)	-49.3549	-92.0568	-178.4969	-259.0578	-321.9750	-312.5298	-305.5924	-262.1368	-194.0882	-122.8275	-60.4706	-39.8938	(233a)	
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)	
Electricity generated by PVs (Appendix M) (negative quantity)	-0.1657	-0.8404	-4.3485	-17.4222	-43.7159	-56.1102	-54.3846	-36.8917	-17.8798	-2.8787	-0.3550	-0.1036	(233b)	
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)	
Annual totals kWh/year														
Space heating fuel - main system 1													8374.5583	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													175.1000	
Water heating fuel used													2177.2814	(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)													420.7890	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-2433.5770	(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													8539.0517	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	8374.5583	16.4900	1380.9647	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2177.2814	16.4900	359.0337	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Energy for lighting	420.7890	16.4900	69.3881	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2198.4806	16.4900	-362.5295	
PV Unit electricity exported	-235.0963	5.5900	-13.1419	

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Total -375.6713 (252)
Total energy cost 1433.7151 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.3600 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 1.2634 (257)
SAP value 79.5198
SAP rating (Section 12) 80 (258)
SAP band C

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	8374.5583	0.1567	1312.4182 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2177.2814	0.1409	306.8397 (264)
Space and water heating			1619.2579 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	420.7890	0.1443	60.7329 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2198.4806	0.1303	-286.4307
PV Unit electricity exported	-235.0963	0.1110	-26.0845
Total			-312.5152 (269)
Total CO2, kg/year			1367.4755 (272)
CO2 emissions per m2			3.7600 (273)
EI value			95.5145
EI rating			96 (274)
EI band			A

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Ground floor	196.7600 (1b)	x 2.9500 (2b)	= 580.4420 (1b) - (3b)
First floor	166.7600 (1c)	x 2.7300 (2c)	= 455.2548 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	363.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1035.6968 (5)

2. Ventilation rate

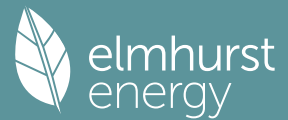
	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	7 * 10 = 70.0000 (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) =	70.0000 / (5) = 0.0676 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3176 (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) = 0.3176 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.8000	4.5000	4.4000	3.9000	3.9000	3.6000	3.7000	3.5000	3.7000	4.0000	4.1000	4.4000 (22)
Wind factor	1.2000	1.1250	1.1000	0.9750	0.9750	0.9000	0.9250	0.8750	0.9250	1.0000	1.0250	1.1000 (22a)
Adj infilt rate	0.3811	0.3573	0.3493	0.3096	0.3096	0.2858	0.2938	0.2779	0.2938	0.3176	0.3255	0.3493 (22b)
Effective ac	0.5726	0.5638	0.5610	0.5479	0.5479	0.5408	0.5431	0.5386	0.5431	0.5504	0.5530	0.5610 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Main dwelling							
Solid doors			3.2400	1.2000	3.8880		(26)
Windows Dbl LowE			173.8200	1.1450	199.0305		(27)
Rooflights Dbl LowE			20.0500	1.1450	22.9580		(27a)
FT01 GF			196.7600	0.1300	25.5788		(28a)

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FT02 FF Exposed				50.0000	0.1300	6.5000	(28b)
WT01 GF	164.0800	76.5400	87.5400	0.1800	15.7572		(29a)
WT02 Glazed corridor	32.6400	28.8000	3.8400	0.1800	0.6912		(29a)
WT03 Annex	68.4000	20.7700	47.6300	0.1800	8.5734		(29a)
WT04 FF	251.1400	45.2700	205.8700	0.1800	37.0566		(29a)
WT05 Dormer	21.9600	5.6800	16.2800	0.1800	2.9304		(29a)
RT01 Main roof	177.3200	14.0500	163.2700	0.1100	17.9597		(30)
RT02 Flat dormer	24.5100		24.5100	0.1100	2.6961		(30)
RT03 Flat annex	86.1800	6.0000	80.1800	0.1100	8.8198		(30)
RT04 Balcony	5.1200		5.1200	0.1100	0.5632		(30)
Total net area of external elements Aum(A, m2)			1078.1100				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		353.0029		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	49.2300	0.0500	2.4615
E2 Other lintels (including other steel lintels)	17.3900	0.0500	0.8695
E3 Sill	17.7300	0.0500	0.8865
E4 Jamb	97.6800	0.0500	4.8840
E5 Ground floor (normal)	96.0000	0.1600	15.3600
E19 Ground floor (inverted)	6.7800	0.0700	0.4746
E6 Intermediate floor within a dwelling	43.4800	0.0000	0.0000
E8 Balcony within a dwelling, wall insulation continuous	6.7500	0.0000	0.0000
E11 Eaves (insulation at rafter level)	42.9500	0.0400	1.7180
E13 Gable (insulation at rafter level)	24.5200	0.0800	1.9616
E14 Flat roof	51.8400	0.0800	4.1472
E15 Flat roof with parapet	36.5900	0.0900	3.2931
E16 Corner (normal)	27.2000	0.0900	2.4480
E17 Corner (inverted - internal area greater than external area)	16.2000	-0.0900	-1.4580
R1 Head of roof window	8.2700	0.0800	0.6616
R2 Sill of roof window	8.2700	0.0600	0.4962
R3 Jamb of roof window	34.0000	0.0800	2.7200
R4 Ridge (vaulted ceiling)	28.1500	0.0800	2.2520
R8 Roof to wall (rafter)	18.3200	0.0600	1.0992
R10 All other roof or room-in-roof junctions	6.5000	0.0800	0.5200
R11 Upstands or kerbs of rooflights	18.0000	0.0800	1.4400
E20 Exposed floor (normal)	22.2500	0.3200	7.1200

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 53.3550 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 406.3579 (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	195.7102	192.7046	191.7458	187.2752	187.2752	184.8513	185.6377	184.0865	185.6377	188.1262	188.9988	191.7458	(38)
Heat transfer coeff	602.0681	599.0626	598.1038	593.6331	593.6331	591.2093	591.9957	590.4444	591.9957	594.4842	595.3568	598.1038	(39)
Average = Sum(39)m / 12 =												595.0076	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.6562	1.6479	1.6453	1.6330	1.6330	1.6263	1.6285	1.6242	1.6285	1.6354	1.6378	1.6453	(40)
HLP (average)												1.6368	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

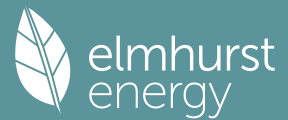
4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.2145 (42)
Hot water usage for mixer showers													
107.4104	105.7962	103.4440	98.9436	95.6224	91.9186	89.8134	92.1477	94.7066	98.6834	103.2805	106.9988	106.9988	(42a)
Hot water usage for baths													
35.4904	34.9634	34.2211	32.8526	31.8278	30.6915	30.0777	30.8148	31.6173	32.8332	34.2299	35.3705	35.3705	(42b)
Hot water usage for other uses													
50.0524	48.2323	46.4122	44.5921	42.7720	40.9519	40.9519	42.7720	44.5921	46.4122	48.2323	50.0524	50.0524	(42c)
Average daily hot water use (litres/day)												177.4361	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	192.9532	188.9918	184.0773	176.3883	170.2222	163.5620	160.8430	165.7345	170.9160	177.9287	185.7427	192.4217	(44)
Energy conte	305.5907	269.1219	282.9200	241.4667	229.1518	201.1186	194.5257	205.2140	210.7565	241.4476	264.6245	301.2858	(45)
Energy content (annual)										Total = Sum(45)m =		2947.2238	
Distribution loss (46)m = 0.15 x (45)m													
45.8386	40.3683	42.4380	36.2200	34.3728	30.1678	29.1789	30.7821	31.6135	36.2171	39.6937	45.1929	45.1929	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												3.0000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.6200	(55)
Total storage loss													
50.2200	45.3600	50.2200	48.6000	50.2200	48.6000	50.2200	50.2200	48.6000	50.2200	48.6000	50.2200	50.2200	(56)
If cylinder contains dedicated solar storage													
50.2200	45.3600	50.2200	48.6000	50.2200	48.6000	50.2200	50.2200	48.6000	50.2200	48.6000	50.2200	50.2200	(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													
379.0731	335.4931	356.4024	312.5787	302.6342	272.2306	268.0081	278.6964	281.8685	314.9300	335.7365	374.7682	374.7682	(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	379.0731	335.4931	356.4024	312.5787	302.6342	272.2306	268.0081	278.6964	281.8685	314.9300	335.7365	374.7682	(64)
								Total per year (kWh/year) = Sum(64)m =				3812.4198	(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	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month													
120.2188	106.2920	112.6808	98.2973	94.8029	84.8815	83.2897	86.8436	88.0862	98.8912	105.9972	118.7875	118.7875	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	192.8704	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
59.5670	52.9069	43.0268	32.5740	24.3495	20.5569	22.2124	28.8725	38.7527	49.2054	57.4300	61.2226	61.2226	(67)

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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	758.0317	765.8977	746.0756	703.8768	650.6084	600.5436	567.0972	559.2312	579.0533	621.2521	674.5205	724.5853 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015	57.5015 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802	-128.5802 (71)
Water heating gains (Table 5)	161.5844	158.1726	151.4527	136.5240	127.4232	117.8910	111.9485	116.7252	122.3419	132.9183	147.2184	159.6606 (72)
Total internal gains	1100.9748	1098.7689	1062.3468	994.7665	924.1728	860.7831	823.0498	826.6206	861.9395	925.1675	1000.9605	1067.2601 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
Northeast				48.4100	13.7622		0.6300		0.7000		0.7700		203.6078 (75)
Southeast				56.9700	42.6275		0.6300		0.7000		0.7700		742.1785 (77)
Southwest				14.4000	42.6275		0.6300		0.7000		0.7700		187.5965 (79)
Northwest				54.0400	13.7622		0.6300		0.7000		0.7700		227.2870 (81)
Southeast				5.2800	47.3724		0.6300		0.7000		1.0000		99.2751 (82)
Northwest				8.7700	20.0162		0.6300		0.7000		1.0000		69.6726 (82)
Horizontal				6.0000	32.0000		0.6300		0.7000		1.0000		76.2048 (82)
Solar gains	1605.8222	2624.1628	4069.4387	6149.3962	7327.9838	8098.1190	7585.1841	6488.3453	5006.7019	3245.6585	1982.3186	1303.9802	(83)
Total gains	2706.7970	3722.9317	5131.7855	7144.1628	8252.1566	8958.9022	8408.2339	7314.9659	5868.6414	4170.8260	2983.2791	2371.2403	(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	41.9295	42.1399	42.2075	42.5253	42.5253	42.6997	42.6430	42.7550	42.6430	42.4645	42.4022	42.2075
alpha	3.7953	3.8093	3.8138	3.8350	3.8350	3.8466	3.8429	3.8503	3.8429	3.8310	3.8268	3.8138
util living area	0.9942	0.9817	0.9326	0.7748	0.5663	0.3644	0.2525	0.2809	0.5672	0.8878	0.9834	0.9962 (86)
MIT	20.2876	20.3724	20.5188	20.6711	20.7374	20.7563	20.7586	20.7588	20.7440	20.6347	20.4368	20.2780 (87)
Th 2	19.5724	19.5784	19.5803	19.5892	19.5892	19.5941	19.5925	19.5956	19.5925	19.5875	19.5858	19.5803 (88)
util rest of house	0.9920	0.9753	0.9104	0.7182	0.4842	0.2753	0.1543	0.1690	0.4500	0.8367	0.9760	0.9947 (89)
MIT 2	18.7322	18.8448	19.0266	19.2049	19.2662	19.2842	19.2833	19.2870	19.2767	19.1733	18.9343	18.7272 (90)
Living area fraction	fLA = Living area / (4) = 0.1095 (91)											
MIT	18.9025	19.0122	19.1900	19.3655	19.4274	19.4454	19.4449	19.4482	19.4374	19.3333	19.0989	18.8971 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.9025	19.0122	19.1900	19.3655	19.4274	19.4454	19.4449	19.4482	19.4374	19.3333	19.0989	18.8971 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9906	0.9719	0.9029	0.7081	0.4742	0.2657	0.1439	0.1572	0.4361	0.8250	0.9725	0.9937 (94)
Ext temp.	2681.4480	3618.4512	4633.2974	5058.7474	3913.5296	2380.7739	1209.9947	1149.5484	2559.4443	3441.1227	2901.2613	2356.3054 (95)
Heat loss rate W	5.0000	5.4000	7.1000	9.5000	12.6000	15.4000	17.4000	17.5000	15.0000	11.7000	8.1000	5.2000 (96)
Space heating kWh	8370.2763	8154.5462	7231.0941	5856.4900	4052.9460	2391.6962	1210.5986	1150.3305	2626.9159	4537.9027	6548.2504	8192.2980 (97)
Space heating requirement - total per year (kWh/year)	4232.4883	3048.2558	1932.7607	574.3747	103.7258	0.0000	0.0000	0.0000	0.0000	816.0044	2625.8322	4341.9785 (98a)
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (98b)
Solar heating contribution - total per year (kWh/year)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	4232.4883	3048.2558	1932.7607	574.3747	103.7258	0.0000	0.0000	0.0000	0.0000	816.0044	2625.8322	4341.9785 (98c)
Space heating per m2	(98c) / (4) = 48.6230 (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 %)	249.9000 (206)											
Efficiency of main space heating system 2 (in %)	0.0000 (207)											
Efficiency of secondary/supplementary heating system, %	0.0000 (208)											
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating efficiency (main heating system 1)	4232.4883	3048.2558	1932.7607	574.3747	103.7258	0.0000	0.0000	0.0000	0.0000	816.0044	2625.8322	4341.9785 (98)
Space heating fuel (main heating system)	249.9000	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000 (210)
Space heating efficiency (main heating system 2)	1693.6728	1219.7903	773.4136	229.8418	41.5069	0.0000	0.0000	0.0000	0.0000	326.5324	1050.7532	1737.4864 (211)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Water heating requirement	379.0731	335.4931	356.4024	312.5787	302.6342	272.2306	268.0081	278.6964	281.8685	314.9300	335.7365	374.7682 (64)
Efficiency of water heater (217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000 (216)
Fuel for water heating, kWh/month	216.4895	191.6008	203.5422	178.5144	172.8351	155.4715	153.0600	159.1641	160.9758	179.8572	191.7398	214.0310 (219)

Full SAP Calculation Printout



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	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	0.0000	(231)
Lighting	52.1387	41.8276	37.6611	27.5921	21.3130	17.4129	19.4424	25.2720	32.8258	43.0692	48.6466	53.5878		(232)
Electricity generated by PVs (Appendix M) (negative quantity)														
(233a)m	-60.6690	-100.4160	-192.4141	-287.8226	-341.6215	-350.7095	-340.1657	-296.7809	-221.0049	-141.8047	-74.9217	-47.4515		(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	-0.2795	-1.0829	-5.6685	-25.5214	-54.5436	-75.0697	-71.2366	-49.8636	-24.1407	-4.8525	-0.6495	-0.1645		(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													7072.9973	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													175.1000	
Water heating fuel used													2177.2814	(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)													420.7890	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-2768.8550	(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													6902.2127	(238)

10a. Fuel costs - using BEDF prices (567)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	7072.9973	26.0600	1843.2231	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2177.2814	26.0600	567.3995	(247)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Energy for lighting	420.7890	26.0600	109.6576	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2455.7821	26.0600	-639.9768	
PV Unit electricity exported	-313.0729	5.8100	-18.1895	
Total			-658.1664	(252)
Total energy cost			1862.1139	(255)

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	7072.9973	0.1575	1114.1961	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2177.2814	0.1409	306.8397	(264)
Space and water heating			1421.0358	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	420.7890	0.1443	60.7329	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2455.7821	0.1303	-320.0264	
PV Unit electricity exported	-313.0729	0.1112	-34.8092	
Total			-354.8356	(269)
Total CO2, kg/year			1126.9330	(272)

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	7072.9973	1.5831	11197.5873	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2177.2814	1.5211	3311.8667	(278)
Space and water heating			14509.4540	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	420.7890	1.5338	645.4202	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2455.7821	1.4814	-3637.9276	
PV Unit electricity exported	-313.0729	0.4070	-127.4066	
Total			-3765.3342	(283)
Total Primary energy kWh/year			11389.5399	(286)

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