MSUSTAINABILITY

Energy and Sustainability Statement
8 Druid Stoke Avenue,
Bristol,
BS9 1DD

For Kathryn Ashby

Completed by Laura Meehan
Issue 07

M Sustainability
[redacted]

Issued by	M Sustainability [redacted]

Client	Kathryn Ashby
Project	8 Druid Stoke Avenue
Title	Energy and Sustainability Statement
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P01	01/02/2024	Preliminary draft for comment
P02	08/02/2024	With inclusions from client
P03	15/02/2024	Edited contents page
P07	20/12/2024	Revision of SAPs based on new drawings

Table of Contents

1. Introduction

This report has been prepared by M Sustainability in consideration of the Bristol City Council Policies and the Sustainability and Practice note which details the relevant issues for the local authority. The application is for outline approval for a total of 1 new build dwellings.

It assesses expected energy demand for the site showing how energy and carbon dioxide emissions will be reduced through designing for minimum energy use and installing on-site renewable and low carbon energy sources.

It will outline the sustainable construction principles that will be incorporated into the design and outline the proposed developments energy requirements and subsequent CO_2 emissions

Bristol City Council BCS 15 requires residential developments of more than 10 dwellings to provide evidence of energy efficient design and that 20% of predicted energy demand is met through renewable and low carbon sources. A final energy strategy, to outline how the 20% reduction can be met can be finalised through a suitably worded condition.

The development design proposes a 20% reduction on the total CO_2 emissions as outlined within Bristol's Climate Change and Sustainability Practice Note BCS14. The table on page 18 shows that there is proposed a significant improvement on the energy usage and CO2 emissions from Baseline measures.

2. National Policy Requirements

The Climate Change Act 2008

Under the Climate Change Act the UK government is committed by law to reducing greenhouse gas emission by at least 100% of 1990 levels (net zero) by 2050 compared to 1990 levels. The government has set five-yearly carbon budgets which currently run until 2032. Through Climate Change Act the government has set a target to significantly reduce UK greenhouse gas emission by 2050 and a path to get there.

The construction and operation of UK buildings account for approximately 60% of national carbon dioxide emissions. Therefore, planning legislation seeks to mitigate the impact (in particular) of new construction in order to minimise these emissions and to meet the national targets.

National Planning Policy Framework

The National Planning Policy Framework (NPPF) sets out the overarching planning policies on the delivery of sustainable development through the planning system. The NPPF was published in early 2012 – updated in early 2019, with limited changes affecting the environmental sustainability requirements. It sets out the Government's planning policies for England and how these are expected to be applied, moreover it compels planning authorities to facilitate and promote good quality and sustainable development.

Para 154

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

(a) not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and

(b) approve the application if its impacts are (or can be made) acceptable 49 . Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas.[1]National Policy Requirements

[1]https://www.gov.uk/guidance/national-planning-policy-framework/14-meeting-the-challenge-of-climate-change-flooding-and-coastal-change

3. Bristol Core Strategy 14 - Sustainable Energy

In Bristol City Council published their "Bristol Development Framework, Core Strategy". This Core Strategy has set out a strong commitment to promote sustainable development and high quality urban design. This publication clearly outlines the objectives and strategy for sustainable communities in Bristol, tackling the causes and effects of climate change, and maximising energy savings and energy efficiency within new buildings.

BCS14 - Sustainable Energy

This sets out the criteria for assessing new renewable energy schemes, with a presumption in favour of large-scale renewable energy installations. BCS14 requires new development to minimise its energy requirements and then incorporate an element of renewable energy to reduce its CO_2 emissions by a further 20%.

From the Bristol Core Strategy:

"Development in Bristol should include measures to reduce carbon dioxide emissions from energy use in accordance with the following energy hierarchy:

1. Minimising energy requirements;

2. Incorporating renewable energy sources;

3. Incorporating low-carbon energy sources.

Heat Hierarchy

Consistent with stage two of the above energy hierarchy, development will be expected to provide sufficient renewable energy generation to reduce carbon dioxide emissions from residual energy use in the buildings by at least 20%. An exception will only be made in the case where a development is appropriate and necessary but where it is demonstrated that meeting the required standard would not be feasible or viable. The use of combined heat and power (CHP), combined cooling, heat and power (CCHP) and district heating will be encouraged. Within Heat Priority Areas, major development will be expected to incorporate, where feasible, infrastructure for district heating, and will be expected to connect to existing systems where available. New development will be expected to demonstrate that the heating and cooling systems have been selected according to the following heat hierarchy:

1. Connection to existing CHP/CCHP distribution networks

2. Site-wide renewable CHP/CCHP

3. Site-wide gas-fired CHP/CCHP

4. Site-wide renewable community heating/cooling

5. Site-wide gas-fired community heating/cooling

6. Individual building renewable heating"

How to comply

Compliance with the requirements of Policy BCS14 can be shown through following the guidance outlined in the Bristol City Council's Climate Change and Sustainability Practice Note, dated July 2020 with addendum July 2023. The Climate Change and Sustainability Practice Note states the following requirements:

"As such, the policy has four main strands:

- *To encourage major freestanding renewable and low carbon energy installations;*
- *To reduce energy demand through the use of energy efficiency and conservation measures, including improvements in fabric efficiency and air permeability and use of passive design principles in new development;*
- *To secure at least a 20% saving in CO2 emissions from energy use in new development through on-site generation of renewable energy; and*
- *To ensure that heating and hot water systems are designed and specified in accordance with the heat hierarchy including, where appropriate, connection to a heat network. "*

In general terms, policy BCS14 aims to push developments towards energy efficiency measures, connection into district CHP systems and/or installing low and zero carbon technologies on site. An exception will only be made in cases where a development is appropriate and necessary but where it is demonstrated that meeting the required standard would not be feasible or viable.

Bristol City council are committed to achieving their goal as part of the climate emergency protocol. Currently all planning applications large or small are required to meet the heat hierarchy. In conjunction with energy efficiency in design, this will lead us towards the goal of carbon neutrality.

BCS15 - Sustainable Design and Construction

- Requires all development to engage with issues around sustainable design and construction.
- Requires larger developments to be assessed against BREEAM and super major developments to be assessed using BREEAM Communities.
- Contains additional policy content relating to refuse storage and broadband provision.

BCS16 - Flood Risk and Water Management

Principally addresses the issues around development in flood risk areas but also requires all development to include water management measures to reduce surface water run-off, including sustainable drainage systems (SUDS). There will be a green roof installed on the first floor roof that will reduce run off and increase biodiversity.

4. The Proposed Site

This report has been structured to demonstrate how the proposed development responds to both the local sustainability policies of Bristol City Council and the principles of sustainable development set out in the National Planing Policy Framework (NPFF)

Site and Surroundings

The application site comprises of proposed new building

Figure 1 Site

Proposed development

The client seeks to create a 2 storey dwelling. This house is to be situated behind the existing house at no. 8 Druid Stoke Avenue

5. Sustainability at 8 Druid Stoke Avenue

Sustainability has been considered for the development under the following chapter headings which reflect the Sustainable Development Themes of the NPPF and the guidance of the Core Strategy from Bristol City Council.

Climate Change

One of the main challenges facing the UK and new development is the need to mitigate and adapt to a changing climate. The government is committed to tackling climate change and has an ambitious long-term goal to reduce carbon emissions by 100% by 2050.

Policies BCS13 through to 16 requires new developments to contribute to both mitigation of and adaption to the impacts of climate change and meet targets to reduce carbon dioxide emissions.

Mitigation

Climate Change Mitigation refers to efforts to reduce or prevent emission of greenhouse gases. Mitigation measures are incorporated throughout this section under various different headings as follows:

- Energy and Carbon - including outline detail on super insulated, air tight and highly efficient services including outline design measures to passively reduce energy demand and finally the use of renewable and low carbon energy systems to meet the lower demand.
- Sustainable Design and Construction - includes the efficient use of natural resources and ensuring that methods of reducing waste are identified at early stages and materials with low embodied carbon are identified
- Sustainable Transport - includes measures to encourage cycling, walking, the use of public transport and use of electric cars instead of journeys by private car.

Adaptation

Policy BCS16 states that developments should be designed to be resilient to extreme weather events including flood risk, rising temperatures and changes in rainfall. The following features will be considered:

- Spacing of the development to allow free air flow for ventilation and comfort
- Use of trees to provide shade, buffer wind and help mitigate against flooding (retaining soil and acting as a natural water retainer)
- Openable windows to allow for cross ventilation whilst keeping dwellings secure.

- Larger capacity building gutters, downpipes and drainage to cope with additional rainfall
- Green roof systems to reduce overheating in the summer months, buffer rainfall and increase biodiversity.
- Water butts to buffer additional rainfall

6. Energy and CO_2 emissions reductions

BCS14 Reducing energy demand and CO2 emissions

Provides criteria for assessing new renewable energy schemes, with a presumption in favour of large-scale renewable energy installations. Requires development to minimise its energy requirements and then incorporate an element of renewable energy to reduce its energy by a further 20%.

The strategy will be considered in line with the energy hierarchy below considering options to demonstrate sufficient renewable energy generation to reduce energy emissions by 20%.

Baseline Energy Use and Carbon Emissions

The exact requirements of the development will be outlined at detailed design stage and then confirmed through energy modelling. The energy performance of the proposed development is therefore a pro rata calculation based on benchmark design stage Part L (SAP) data for dwellings. Therefore at this stage all elements of the energy strategy are preliminary, pending further design work prior to any reserved matters submission.

The proposed new dwellings will be designed and constructed in accordance with the energy hierarchy, aiming to minimise energy use and carbon emissions before considering low carbon energy and renewable energy technologies.

	Fabric energy efficiency (kWh/ yr)	Target Primary Energy Rate (kWh/ yr)	Energy saving (%)	Total Regulated CO_2 emissions (kg CO_2/yr)	Saving achieved on residual CO_2 emissions (%)
Baseline energy demand – "Baseline"	12418	12553	0%	2346.96	0%
Baseline energy efficiency demand (kWh/ yr)			12418		
TPER			12553		
Regulated emissions (kg/yr)			2346.96		

The energy baseline (Part L 2020[2]) is shown in table 1.

These figures are based on building regulations minimum standards, however the part of Bristol City Councils requirement is to provide *"designs that are energy efficient and designed to reduce their energy demands"* this is also in line with government policy to reduce residual emissions.

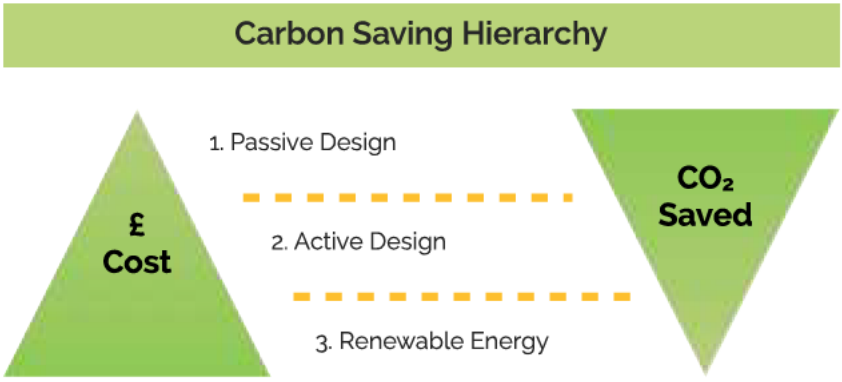
This approach has a number of benefits including:

[2] http://www.zerocarbonhub.org/zero-carbon-policy/fabric-energy-efficiency-standard

- Carbon savings delivered are 'locked-in' for the lifetime of the homes (60 years or more) rather than the much shorter lifespan (around 25 years) of a renewable energy technology;
- There are virtually no maintenance and/or replacement costs to maintain carbon reductions through improved fabric; and
- No reliance on an occupier's behaviour to deliver carbon reductions. In contrast, achieving carbon savings from renewable energy technologies requires education, awareness and often, behavioural changes from occupants.

7. Reducing Energy Demand

There are two complementary parts, passive design and provision of efficient building services. The section below outlines our proposal for the measures included for the proposed development.



If we assume that all dwellings will be built to a highly efficient fabric standard the estimated energy demand can be significantly reduced above and beyond our current calculations.

Currently to meet building regulations we assume a specification of:

- Minimal thermal bridges
- Walls at 0.17 w/m²K
- Floors and roofs at 0.12 w/m²K
- Windows at 1.1 w/m²K
- Air pressure test at 3

Building Services

In addition to building fabric, the building services (i.e. lighting, plumbing and wiring) will be highly efficient. Building services are generally installed in buildings to provide comfort conditions. The services that provide comfort conditions are most efficient when they are accurately sized to match the load that they need to provide. Therefore both the efficiency of the items of equipment and their level of control affects overall CO_2 emissions performance.

The following items have been used to show that in conjunction with insulating building fabric, the building's energy use can be reduced by:

- Mechanical Ventilation
- Low energy lighting such as LEDs throughout
- Highly efficient Air Source Heat Pump for heating and hot water

- Programmers and room thermostats

This will mean a reduction in CO_2 emissions and reduced running and maintenance costs. The client proposes the use of thermodynamic panels, although not included here it is thought they will be used for reduced the energy required for hot water in the dwelling.

	Fabric Energy Efficiency (kWh/yr)	Primary Energy Rate (kWh/ yr)	Energy saving (%)	Total Regulated CO_2 emissions (kg CO_2/yr)	Saving achieved on residual CO_2 emissions (%)
Baseline energy demand – "Baseline"	12418	12553	0%	2346.96	0%
Proposed scheme after energy efficiency measures better than Building Part L1A standards – "Residual"	12098	7648	39.07%	731.52	68.83%

Baseline energy demand (kWh/yr)		12418
Regulated emissions (kg/yr)		2346.96
Energy savings from energy efficiency measures (kWh)		320
Emission savings from energy efficiency measures		68.83%
Total regulated emissions after energy efficiency measures		731.52

8. Renewable Energy Generation on Site

Of the technologies considered: (PV, Solar Thermal, Air Source Heat Pumps, Wind, District Heating and CHP), Air Source Heat Pumps and PVs were considered the most appropriate option for the site. This was due to the nature of the site in terms of planning restrictions, financial investment required.

CHP

Bristol City Council has plans for mixed use district heating and CHP schemes.

Gas-fired combined heat and power (CHP) schemes in high-density urban areas are the most popular because the costs are viable, the technology is mature and heat networks benefit many users.

CHP systems requires a significant infrastructure, and a substantial heat demand to be viable and therefore has been discounted within development, as the infrastructure is not yet available.

Wind

The first consideration for this technology is local wind speed. The Energy Saving Trust has established the wind speed at Druid Stoke Avenue to be 4.5 metres per second at 10 metres above ground[3]. Wind speeds of less than 5 metres per second are unlikely to provide a cost effective source of electricity (based on current technologies) and considering the neighbouring buildings and suburban environment it may not be the best placed to provide wind power.

A solution may be to mount the turbine beyond the zone of turbulence which may be 15m or more in the air – there may be planning concerns from both an aesthetic and noise perspective. Turbines also carry high capital costs upwards of £35,000 for a 12 kW turbine.

Solar hot water systems

Solar water heating systems use the energy from the sun to heat water stored in a hot water cylinder inside the building.

Typical cost for 4m^2 of flat plate solar hot water is approximately £2,800 with a payback period of around 6-10 years. This could also benefit from the Renewable Heat Incentive.

There is west facing roof space so it could accommodate both PV and Solar thermal and if the buildings have a low heat demand it will be suited to solar thermal to supplement the hot water demand. This is a suitable technology.

[3] http://www.rensmart.com/Weather/BERR

Biomass heating

Biomass boilers such as Woodchip-fed systems remain very costly and the requirements for siting both the boiler and the fuel source were considered impractical for this development.

Therefore use of this technology for the main heating system was considered to be inappropriate for this development.

Heat pumps

Heat pumps take in heat at a certain temperature and release it at a higher temperature, using the same process as a refrigerator. Fluid is circulated through pipes buried in the ground and passes through a heat exchanger in the heat pump that extracts heat from the fluid.

The heat pump raises the temperature of the fluid via the compression cycle to supply hot water to the building as from a normal boiler. Air source heat pumps work in the same way but use the air as the heat source rather than the ground.

Ground-source heat pumps are used to extract heat from the ground to provide space and water heating. The ground pipe system can be horizontal or vertical.

Ground Source heat pumps have a high capital cost and would be very disruptive to install, therefore they are not advised for this site.

Air Source Heat Pumps can deliver up to four units of electricity from one unit, they can be sized to provide heating and hot water and work best with highly insulated and air tight properties with underfloor heating. They are best sited on a South or West facing wall with good air flow.

As general guidance ASHPs require:

- Ample supply of ambient (outdoor) air, enclosed courtyards or alleyways are usually unsuitable. Manufacturers vary but as a guide 350mm gap behind units, 4m space in front of unit and ample air flow at sides
- Easy access for servicing schedule
- Some drainage below outside unit (small 400mm depth soakaway sufficient) to prevent ice build up from condensation dripping in cold weather, if the unit is wall mounted a tray connected to a waste pipe may be needed.

Heat pumps work very well on low energy houses.

Photovoltaic Panels

Photovoltaic Panel systems convert energy from the sun into electricity through semi-conductor cells mounted in collector panels. The panels are connected to an inverter to turn the DC output into AC for use in the building to which they are attached and to be fed back into the grid when not required.

The current Feed in Tariff scheme yields guaranteed payments for 25 years for all electricity generated by the system and payment for electricity exported back to the grid. Typical cost for around 3kWp array is around £5,000 with a payback period of around 12 years.

Photovoltaic arrays provide a quiet and effective renewable energy source with a relatively low aesthetic impact. The major benefit of PV systems is the significant reductions they can achieve in comparison to other technologies, in terms of CO_2 and energy use.

PV are suitable in conjunction with ASHP, PV is a very complementary technology providing electricity to power the air source heat pump.

Air Source Heat Pump and Photovoltaics, chosen strategy

An Air Source Heat Pump for hot water and space heating is appropriate for dwellings with a low energy demand and this house will be well insulated, air tight. Air Source Heat Pump can provide low temperature hot water and heating. This is well suited as it can provide highly efficient heating and hot water heating in conjunction with around 6 kWp of photovoltaics for the dwelling. The client proposes use of thermo dynamic panels which should further reduce the energy use in the dwelling.

9. Table 1, Proposed renewables and Emissions Reductions for the House[4]

	Primary Energy Rate (kWh/yr)	Energy saving (%)	Total Regulated CO_2 emissions (kg CO_2/yr)	Saving achieved on residual CO_2 emissions (%)
Baseline energy demand – "Baseline"	12553	0%	2346.96	0%
Proposed scheme after energy efficiency measures to achieve pass were it required to comply with Building Part L1A standards – "Residual"	7648	39.07%	731.52	68.83%
Proposed scheme after on-site renewables (compared to strict definition of BCS14 residual)	3010	61%	304.8	58.33%
Proposed scheme offset for financial contribution or other allowable solution	N/A	N/A	N/A	N/A

Baseline energy demand (kWh/yr)	12553
Regulated emissions (kg/yr)	2346.96

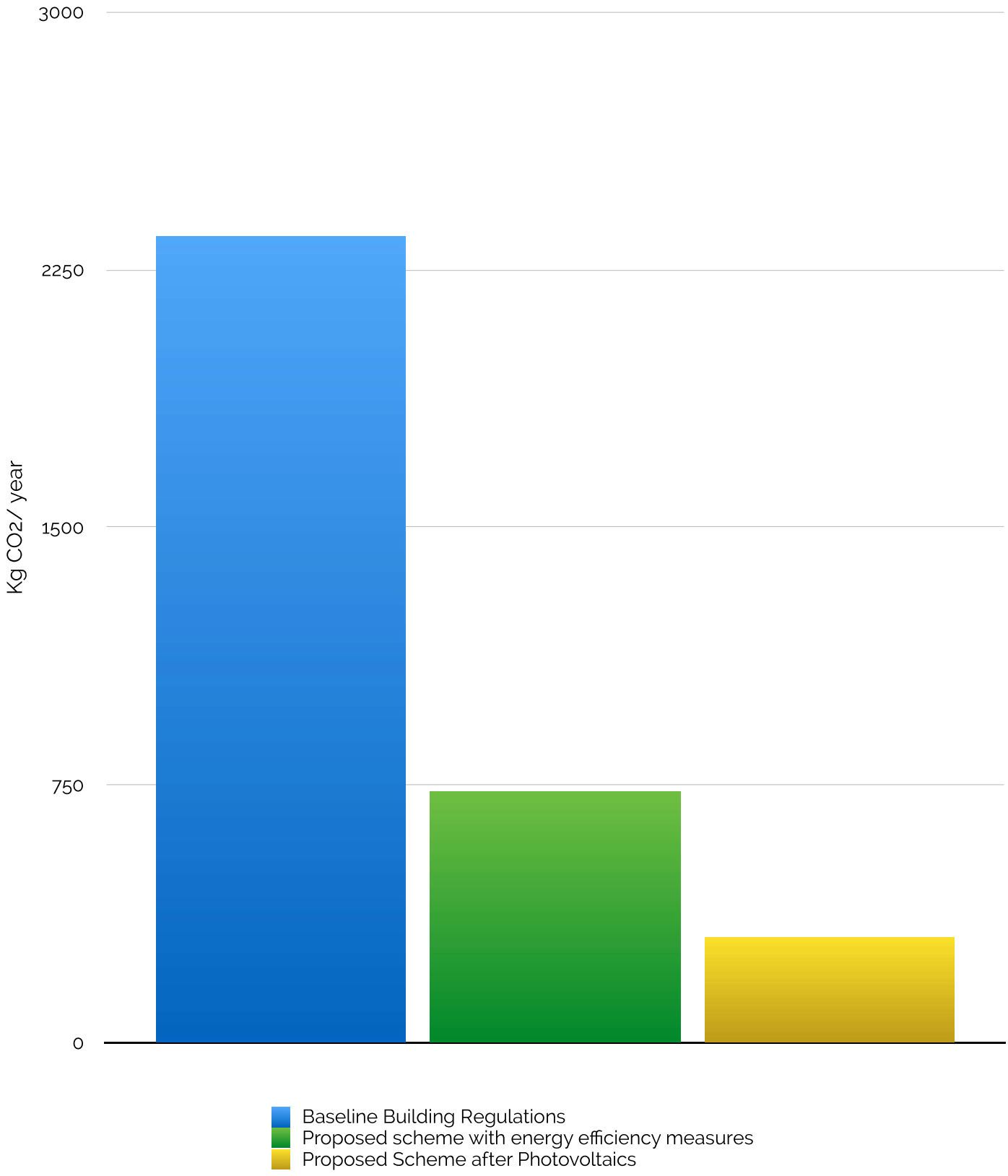
Energy savings from energy efficiency measures (kWh)	4905
Emission savings from energy efficiency measures	68.83%
Total regulated emissions after energy efficiency measures	731.52

Generated Power (kWh)	4638
Saving on residual emissions from use of renewables (kg/yr)	1312.89

Saving on residual emissions from use of renewables (kg/yr)	**1312.89**
Saving on residual emissions from the use of renewables (%)	**58.33%**

4 As the development has reached the 20% the financial contribution is not needed. Information on Photovoltaic generation accessed http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php

10. Graph to Show CO2 reduction in Emissions



11. Water

Water

The BCS15 states that the water resources should be conserved. The appliances onsite will be low water use in line with the requirements of planning and Part G, full calculations in appendix A.

The potable water demand will be designed to be less than 125l/person/day as prescribed by Part G of the Building Regulations, this could be achieved by:

Dual flush toilets (6 full flush and 3 part flush)

Basin taps with 5 l/minute flow

Bath capacity of approximately 240 litres

Flow restrictors to bathroom taps of 3 litres per minute

Aerated shower heads for up to 9 litres per minute

Lower water usage dishwashers and washing machines

Water butts will be fitted to drainpipes for watering plants and general cleaning onsite.

Water Efficiency Measures on site

Water is a valuable resource and water conservation is key to environmental and sustainable design. It is proposed that low water usage fittings will be utilised throughout the development to minimise water consumption as well as within the site cabins. This will assist with keeping low usage throughout the construction phase.

Monitoring of water consumption through water metering will take place. Any inefficiency in the water distribution system should be detected in the unlikely event of leakage.

It would be recommended that the site workforce will have tool box talks to cover 'Energy and Fuel Efficiency' as well as being made aware of the standard Environment Agency PPGs for pollution prevention guidance and groundwater pollution prevention. Whilst on site, energy and water consumption could be recorded and monitored.

12. Materials use

Materials will be considered for embodied impact and preferred materials will be locally and responsibly sourced, such as FSC timber, and BES certified roof tiles. Any replaced materials will be increasing efficiency overall for the lifecycle of the building.

Proposed Measures

A number of methods for maximising green infrastructure and procuring responsibly sourced materials will assist with the overall design. A number of methods are being used to assist with having minimal environment impacts including:

- Materials Specification - The building fabric and materials specified will have a low environmental impact. Where appropriate materials may be reviewed using the BRE 'Green Guide to Specification' aiming to maximise the proportion of A+ or A rated materials. Materials may include reclaimed or recycled materials where appropriate.
- Maximise Recycled Content of Materials – A number of materials used commercially in the UK construction industry are manufactured using materials recycled from post consumer waste. A detailed analysis of the materials available in the UK is outlined on the government WRAP website and the National Building Specification (NBS) Greenspec website. The proposed development will be designed to give preference to natural materials and materials with a high percentage of recycled content.
- Responsible Sourcing of Materials: Where possible materials will be responsibly sourced. The green guide will also assist with the materials selection. 100% of the timber used including the timber products will be legally and responsibly sourced.
- FSC Certified Timber – Certain timber products and materials available in the UK use tropical hardwoods from endangered or illegal sources. The development will endeavour to use timber from a temperate, well-managed source or manufactured from recycled timber waste. Timber will as far as possible be certified by the Forest Stewardship Council (FSC), which provides a product- specific chain of custody number confirming that the timber used in the manufacture of the product originates from a sustainably managed source.
- Low solvent / low VOC paints – Certain paints contain high levels of solvents or Volatile Organic Compounds (VOCs). High VOC paints emit the chemical contained in the paint into the internal air of a building, long after the building has been completed. These chemicals that are inhaled by the building occupants are considered to be a contributing factor in sick building syndrome. Low VOC products also have a benefit to construction workers in terms of health and safety. As far as reasonably possible, internal paints which have a low solvent / low VOC content will be used.
- Zero Formaldehyde MDF – Medium Density Fibreboard (MDF) is a timber panel product, which can be manufactured with new or recycled timber. Typically MDF is manufactured using formaldehyde, which is hazardous to health and is emitted into

the internal air of a building, long after the building has been completed. MDF can be manufactured without the use of formaldehyde. The proposed development will seek to use zero formaldehyde MDF for internal skirting within the building. The potential for the use of MDF manufactured using recycled materials will also be assessed.

- Zero ODP and GWP Insulation – Certain foamed plastic insulation materials available in the UK are manufactured with substances, which deplete the ozone layer and/or contribute to global warming. The proposed development will give preference to insulation materials such as rock wool and mineral wool, which are manufactured with no ozone depletion potential (ODP) and low global warming potential (GWP), while still giving consideration to thermal performance and fitness for purpose.
- Flexibility – the internal partitions should allow for adaptation which allows for alternative layout and reconfiguration should any future occupants wish to make changes. This would be subject to the practicalities associated with the choice of building material.
- Construction Site Impacts - The main contractor will have an environmental material policy used for sourcing of construction materials to be used on site.

13. Waste

Waste and recycling

The development will follow the waste management hierarchy (England Waste Strategy 2007 at www.defra.gov.uk), above.

This site will implement measures during the construction phase which aim to reduce substantial environmental impacts as advised in the NPPF (National Planning Policy Framework). Waste impacts will be mitigated through the following means:

Site Waste Management Plan

A SWMP will be used to help benchmarking, procedures and commitments for the minimising of and diversion of the site waste from landfill, as well as target benchmarks for resource efficiency, procedures and commitments to minimise non-hazardous construction waste and procedures for minimising hazardous waste as applicable

There are many opportunities to reduce waste on the site, such as careful storage of site materials, offsite construction where possible, consideration given to sizing in the design stage such as using manufacturers set sizes to reduce waste, take back systems such as those offered by plasterboard manufacturers, and re use of materials where appropriate.

14. Pollution

On site and during construction, the following measures have been recommended:

- Pollution prevention measures and environmental controls to be included in the site specific induction, as well as delivery of relevant tool box talks
- Provision of site specific inductions
- Controls in place to control construction dust

Air Quality Management

During the construction phase of the development there is the potential for air quality impacts as a result of fugitive dust emissions from the site. Good practice dust control measures will be implemented and therefore the residual significance of potential air quality impacts from dust generated by demolition, earthworks, construction and track out activities is predicted to be negligible.

Internal and External Lighting

All fluorescent and compact fluorescent lamps will be fitted with high frequency ballasts to reduce the risk of health problems related to the flicker of fluorescent lighting. All internal fittings will be energy efficient (e.g. LED), and all external fittings will be low energy and controlled to avoid their use during hours throughout the day. The use of time clocks and PIR sensors may be considered where appropriate.

During construction works, any lighting will be kept to a minimum. Task specific lighting will be reviewed and detailed within a Construction Management Plan and monitored accordingly.

Flooding and Surface Water Runoff

The government's flood map shows that there is a low risk of flooding in zone 1. There will be measures in place to reduce the surface water run off, there will be a green roof and attenuation tanks. The green roof should increase the biodiversity onsite.

ICT/Broadband

Broadband is available locally and the house will be designed to incorporate necessary wiring.

Appendix A SAP Calculations

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Mon 23 Dec 2024 12:08:24

Project Information			
Assessed By	Laura Meehan	Building Type	House, Detached
OCDEA Registration	EES/024602	Assessment Date	2024-12-23

Dwelling Details			
Assessment Type	As designed	Total Floor Area	254 m^2
Site Reference	8 Druid Stoke Avenue rev B	Plot Reference	8 Druid Stoke with PV
Address	8 Druid Stoke Avenue, Bristol, BS9 1DD		

Client Details	
Name	Kathy Ashby
Company	Kathy Ashby
Address	8 Druid Stoke Avenue, Bristol, BS9 1DD

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*9.24 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	1.2 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*49.42 kWh_{PE}/m^2*	
Dwelling primary energy	11.85 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*48.9 kWh/m^2*	
Dwelling fabric energy efficiency	47.6 kWh/m^2	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.17	Walls (1) (0.17)	OK
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.13	Heatloss Floor 1 (0.13)	OK
Roofs	*0.16*	0.12	Roof (2) (0.13)	OK
Windows, doors, and roof windows	*1.6*	1.1	Opening (1.1)	OK
Rooflights	*2.2*	1	Opening, North West (1)	OK

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	200.5	0.17
Ground floor: Heatloss Floor 1, Heatloss Floor 1	144	0.13
Exposed roof: Roof (1)	31.96	0.1 **(!)**
Exposed roof: Roof (2)	110	0.13

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
Opening, Opening Type 2	21.61	South West	0.7	1.1 **(!)**
Opening, Opening Type 2	14.5	North East	0.7	1.1 **(!)**
Opening, Opening Type 2	34.39	South East	0.7	1.1 **(!)**
Opening, Opening Type 3	1.02	North West	0.7	1
Opening, Opening Type 3	1.02	North East	0.7	1
Opening, Opening Type 2	12.5	North West	0.7	1.1 **(!)**

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1 - Main Dwelling**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E5: Ground floor (normal)	Government-approved scheme	0.08	
External wall	E6: Intermediate floor within a	Government-approved scheme	0.1	

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
	dwelling			
External wall	E16: Corner (normal)	Government-approved scheme	0.02 **(!)**	
External wall	E2: Other lintels (including other steel lintels)	Government-approved scheme	0.044	
External wall	E3: Sill	Government-approved scheme	0.044	
External wall	E4: Jamb	Government-approved scheme	0.044	
External wall	E10: Eaves (insulation at ceiling level)	Government-approved scheme	0.09	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))		
Maximum permitted air permeability at 50Pa	*8 m^3/hm^2*	
Dwelling air permeability at 50Pa	3 m^3/hm^2, Design value **(!)**	OK
Air permeability test certificate reference		

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	351.6%
Emitter type	Both radiators and underfloor
Flow temperature	35°C
System type	Heat Pump
Manufacturer	Mitsubishi Electric Europe B.V.
Model	Ecodan 6.0 kW
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	200 litres
Declared heat loss	1.4 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: Instantaneous	
Efficiency	73.7%
Manufacturer	RenewABILITY Energy Inc.
Model	R4-120

6 Controls	
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	93.75 lm/W	OK
External lights control	N/A	

8 Mechanical ventilation		
System type: Balanced whole-house mechanical ventilation with heat recovery		
Maximum permitted specific fan power	*1.5 W/(l/s)*	
Specific fan power	0.71 W/(l/s)	OK
Minimum permitted heat recovery efficiency	*73%*	
Heat recovery efficiency	88%	OK
Manufacturer/Model	ComfoAir 350	
Commissioning		

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	4 kWp
Orientation	South West
Pitch	30°
Overshading	1 (overshading factor calculated according to MCS)
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

12 Declarations	
a. Assessor Declaration	
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.	
Signed: Name:	Assessor ID: Date:
b. Client Declaration	
N/A	

Full SAP Calculation Printout

Property Reference	8 Druid Stoke Avenue rev B	Issued on Date	23/12/2024
Assessment Reference	8 Druid Stoke with PV	Prop Type Ref	
Property	8, Druid Stoke Avenue, Bristol, Avon, BS9 1DD		

SAP Rating	94 A	DER	1.20	TER	9.24
Environmental	99 A	% DER < TER			87.01
CO_2 Emissions (t/year)	0.18	DFEE	47.63	TFEE	48.89
Compliance Check	See BREL	% DFEE < TFEE			2.58
% DPER < TPER	76.02	DPER	11.85	TPER	49.42

Assessor Details	Ms. Laura Meehan	Assessor ID	Z762-0001
Client	Kathy Ashby, Kathy Ashby		

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	144.0000	(1b)	x 3.2000	(2b) =	460.8000	(1b) - (3b)
First floor	110.0000	(1c)	x 2.5000	(2c) =	275.0000	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	254.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		735.8000	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1162	(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	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1162	0.1250	0.1308	0.1366	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.2000 (23c)

Effective ac	0.2522	0.2493	0.2464	0.2319	0.2290	0.2144	0.2144	0.2115	0.2202	0.2290	0.2348	0.2406	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 2 (Uw = 1.10)			83.0000	1.0536	87.4521			(27)
Opening			1.0200	0.9615	0.9808			(27a)
Opening			1.0200	0.9615	0.9808			(27a)
Heatloss Floor 1			144.0000	0.1300	18.7200	110.0000	15840.0000	(28a)
External Wall 1	283.5000	83.0000	200.5000	0.1700	34.0850	190.0000	38095.0000	(29a)
External Roof 1	34.0000	2.0400	31.9600	0.1000	3.1960	9.0000	287.6400	(30)
External Roof 2	110.0000		110.0000	0.1300	14.3000	9.0000	990.0000	(30)
Total net area of external elements Aum(A, m2)			571.5000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		159.7146			(33)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	55212.6400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		217.3726 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E5 Ground floor (normal)	67.0000	0.0800	5.3600	
E6 Intermediate floor within a dwelling	60.0000	0.1000	6.0000	
E16 Corner (normal)	22.4000	0.0200	0.4480	
E2 Other lintels (including other steel lintels)	48.0500	0.0440	2.1142	
E3 Sill	48.0500	0.0440	2.1142	
E4 Jamb	124.0000	0.0440	5.4560	
E10 Eaves (insulation at ceiling level)	67.0000	0.0900	6.0300	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 27.5224 (36)
Point Thermal bridges (36a) = 12.0000 (36a)
Total fabric heat loss (33) + (36) + (36a) = 199.2370 (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	61.2422	60.5366	59.8309	56.3025	55.5968	52.0684	52.0684	51.3627	53.4798	55.5968	57.0082	58.4195	(38)
Heat transfer coeff	260.4793	259.7736	259.0679	255.5395	254.8339	251.3055	251.3055	250.5998	252.7168	254.8339	256.2452	257.6566	(39)
Average = Sum(39)m / 12 =												255.3631	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0255	1.0227	1.0200	1.0061	1.0033	0.9894	0.9894	0.9866	0.9949	1.0033	1.0088	1.0144	(40)
HLP (average)												1.0054	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0721 (42)
Hot water usage for mixer showers

	94.6618	93.2392	91.1662	87.1999	84.2729	81.0087	79.1534	81.2107	83.4658	86.9706	91.0220	94.2991 (42a)

Hot water usage for baths

	32.6893	32.2039	31.5202	30.2596	29.3158	28.2691	27.7038	28.3827	29.1219	30.2418	31.5283	32.5788 (42b)

Hot water usage for other uses

	46.0917	44.4156	42.7396	41.0635	39.3874	37.7114	37.7114	39.3874	41.0635	42.7396	44.4156	46.0917 (42c)

Average daily hot water use (litres/day) 159.4847 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	173.4428	169.8587	165.4259	158.5231	152.9761	146.9893	144.5686	148.9808	153.6512	159.9519	166.9660	172.9696	(44)
Energy conte	274.6910	241.8765	254.2535	217.0102	205.9352	180.7404	174.8431	184.4693	189.4673	217.0532	237.8736	270.8286	(45)
Energy content (annual)										Total = Sum(45)m =		2649.0420	
Distribution loss (46)m = 0.15 x (45)m	41.2036	36.2815	38.1380	32.5515	30.8903	27.1111	26.2265	27.6704	28.4201	32.5580	35.6810	40.6243	(46)

Water storage loss:
Store volume 200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.4000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.7560 (55)
Total storage loss

	23.4360	21.1680	23.4360	22.6800	23.4360	22.6800	23.4360	23.4360	22.6800	23.4360	22.6800	23.4360 (56)

If cylinder contains dedicated solar storage

	23.4360	21.1680	23.4360	22.6800	23.4360	22.6800	23.4360	23.4360	22.6800	23.4360	22.6800	23.4360 (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	321.3894	284.0557	300.9519	262.2022	252.6336	225.9324	221.5415	231.1677	234.6593	263.7516	283.0656	317.5270 (62)
WWHRS	-79.4098	-70.2307	-73.5415	-60.8953	-56.7522	-48.5633	-45.5203	-48.4063	-50.2454	-59.2338	-67.1047	-77.9393 (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	241.9796	213.8250	227.4104	201.3069	195.8814	177.3692	176.0212	182.7614	184.4139	204.5178	215.9609	239.5877 (64)
									Total per year (kWh/year) = Sum(64)m =			2461.0352 (64)
12Total per year (kWh/year)												2461 (64)

Electric shower(s)

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

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

	128.6935	114.1673	121.8980	108.3095	105.8322	96.2498	95.4941	98.6948	99.1515	109.5289	115.2466	127.4092 (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	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	211.7656	234.4548	211.7656	218.8245	211.7656	218.8245	211.7656	211.7656	218.8245	211.7656	218.8245	211.7656	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	419.8490	424.2057	413.2269	389.8544	360.3507	332.6215	314.0966	309.7399	320.7187	344.0912	373.5949	401.3241	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	(71)
Water heating gains (Table 5)	172.9751	169.8918	163.8414	150.4298	142.2476	133.6803	128.3522	132.6543	137.7104	147.2163	160.0647	171.2489	(72)
Total internal gains	873.6716	897.6342	857.9159	828.1906	783.4458	754.2081	723.2964	723.2417	746.3355	772.1551	821.5660	853.4206	(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	14.5000	11.2829	0.5700	0.7000	0.7700	45.2373	(75)
Southeast	34.3900	36.7938	0.5700	0.7000	0.7700	349.8753	(77)
Southwest	21.6100	36.7938	0.5700	0.7000	0.7700	219.8548	(79)
Northwest	12.5000	11.2829	0.5700	0.7000	0.7700	38.9977	(81)
Northeast	1.0200	18.0708	0.6400	0.7000	1.0000	7.4319	(82)
Northwest	1.0200	18.0708	0.6400	0.7000	1.0000	7.4319	(82)

Solar gains	668.8288	1173.1494	1695.1649	2251.2667	2659.3208	2700.6667	2578.5216	2264.8334	1886.2882	1320.8490	807.2738	568.3850	(83)
Total gains	1542.5005	2070.7836	2553.0808	3079.4573	3442.7666	3454.8748	3301.8180	2988.0751	2632.6237	2093.0041	1628.8397	1421.8057	(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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.8793	59.0393	59.2001	60.0175	60.1837	61.0287	61.0287	61.2005	60.6879	60.1837	59.8522	59.5244	
alpha	4.9253	4.9360	4.9467	5.0012	5.0122	5.0686	5.0686	5.0800	5.0459	5.0122	4.9901	4.9683	
util living area	0.9961	0.9840	0.9473	0.8351	0.6515	0.4603	0.3340	0.3839	0.6319	0.9150	0.9890	0.9973	(86)
Living	20.4718	20.5528	20.6505	20.7511	20.7992	20.8144	20.8163	20.8164	20.8061	20.7255	20.5775	20.4609	
Non living	19.4219	19.5268	19.6504	19.7790	19.8305	19.8556	19.8568	19.8595	19.8448	19.7557	19.5697	19.4165	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	17	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	14	28	22	0	0	0	0	0	0	0	0	31	
MIT	20.8649	20.7467	20.7580	20.7511	20.7992	20.8144	20.8163	20.8164	20.8061	20.7255	20.5775	20.6946	(87)
Th 2	20.0621	20.0644	20.0667	20.0783	20.0806	20.0922	20.0922	20.0945	20.0875	20.0806	20.0760	20.0714	(88)
util rest of house	0.9950	0.9797	0.9338	0.8006	0.5975	0.3972	0.2656	0.3093	0.5593	0.8873	0.9853	0.9966	(89)
MIT 2	19.9345	19.8271	19.8155	19.7790	19.8305	19.8556	19.8568	19.8595	19.8448	19.7557	19.5697	19.7823	(90)
Living area fraction										fLA = Living area / (4) =		0.3547	(91)
MIT	20.2645	20.1533	20.1498	20.1238	20.1741	20.1957	20.1971	20.1989	20.1858	20.0997	19.9272	20.1059	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2645	20.1533	20.1498	20.1238	20.1741	20.1957	20.1971	20.1989	20.1858	20.0997	19.9272	20.1059	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9952	0.9802	0.9352	0.8024	0.6032	0.4045	0.2735	0.3179	0.5674	0.8880	0.9846	0.9966	(94)
Useful gains	1535.1418	2029.7387	2387.5459	2470.9783	2076.7633	1397.4456	903.0525	950.0576	1493.8160	1858.5972	1603.7394	1416.9710	(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	4158.4312	3962.4129	3536.2299	2868.1354	2159.4869	1406.2423	903.9768	952.0027	1537.9859	2420.8515	3286.9021	4098.2701	(97)
Space heating kWh	1951.7274	1298.7570	854.6209	285.9532	61.5463	0.0000	0.0000	0.0000	0.0000	418.3172	1211.8771	1994.8865	(98a)
Space heating requirement - total per year (kWh/year)												8077.6856	
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	1951.7274	1298.7570	854.6209	285.9532	61.5463	0.0000	0.0000	0.0000	0.0000	418.3172	1211.8771	1994.8865	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8077.6856	
Space heating per m2											(98c) / (4) =	31.8019	(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 %)												351.6397	(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	1951.7274	1298.7570	854.6209	285.9532	61.5463	0.0000	0.0000	0.0000	0.0000	418.3172	1211.8771	1994.8865	(98)
Space heating efficiency (main heating system 1)	351.6397	351.6397	351.6397	351.6397	351.6397	0.0000	0.0000	0.0000	0.0000	351.6397	351.6397	351.6397	(210)
Space heating fuel (main heating system)	555.0362	369.3432	243.0388	81.3199	17.5027	0.0000	0.0000	0.0000	0.0000	118.9619	344.6361	567.3099	(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	241.9796	213.8250	227.4104	201.3069	195.8814	177.3692	176.0212	182.7614	184.4139	204.5178	215.9609	239.5877	(64)
Efficiency of water heater												186.7367	(216)
(217)m	186.7367	186.7367	186.7367	186.7367	186.7367	186.7367	186.7367	186.7367	186.7367	186.7367	186.7367	186.7367	(217)
Fuel for water heating, kWh/month	129.5833	114.5062	121.7813	107.8025	104.8971	94.9836	94.2617	97.8712	98.7561	109.5220	115.6500	128.3024	(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	75.7835	68.4496	75.7835	73.3389	75.7835	73.3389	75.7835	75.7835	73.3389	75.7835	73.3389	75.7835	(231)
Lighting	53.1923	42.6729	38.4222	28.1497	21.7437	17.7648	19.8353	25.7827	33.4891	43.9396	49.6296	54.6707	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-87.7845	-149.3370	-258.8345	-344.5043	-415.4059	-403.3597	-397.7199	-351.5706	-277.4018	-190.7319	-104.5961	-72.9448	(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	-0.3784	-1.8009	-7.5073	-22.5809	-44.8016	-51.3240	-50.0527	-35.5844	-19.0406	-5.0768	-0.8120	-0.2469	(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	2297.1487	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	186.7367	
Water heating fuel used	1317.9175	(219)

Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.9940)		
mechanical ventilation fans (SFP = 0.9940)	892.2899	(230a)
Total electricity for the above, kWh/year	892.2899	(231)
Electricity for lighting (calculated in Appendix L)	429.2924	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3293.3975	(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	1643.2511	(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	2297.1487	0.1573	361.3802	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1317.9175	0.1407	185.4801	(264)
Space and water heating			546.8604	(265)
Pumps, fans and electric keep-hot	892.2899	0.1387	123.7716	(267)
Energy for lighting	429.2924	0.1443	61.9602	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3054.1910	0.1314	-401.2947	
PV Unit electricity exported	-239.2065	0.1141	-27.2999	
Total			-428.5946	(269)
Total CO2, kg/year			303.9976	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.2000	(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	2297.1487	1.5823	3634.8893	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1317.9175	1.5204	2003.7447	(278)
Space and water heating			5638.6340	(279)
Pumps, fans and electric keep-hot	892.2899	1.5128	1349.8562	(281)
Energy for lighting	429.2924	1.5338	658.4631	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3054.1910	1.4854	-4536.7531	
PV Unit electricity exported	-239.2065	0.4182	-100.0243	
Total			-4636.7774	(283)
Total Primary energy kWh/year			3010.1759	(286)
Dwelling Primary energy Rate (DPER)			11.8500	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	144.0000	(1b)	x 3.2000	(2b) =	460.8000	(1b) - (3b)
First floor	110.0000	(1c)	x 2.5000	(2c) =	275.0000	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	254.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		735.8000	(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) =	0.0544	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3044	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2359	(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	0.3007	0.2949	0.2890	0.2595	0.2536	0.2241	0.2241	0.2182	0.2359	0.2536	0.2654	0.2772	(22b)
Effective ac	0.5452	0.5435	0.5417	0.5337	0.5321	0.5251	0.5251	0.5238	0.5278	0.5321	0.5352	0.5384	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			61.9800	1.1450	70.9695			(27)
Opening			0.7600	2.0221	1.5368			(27a)
Opening			0.7600	2.0221	1.5368			(27a)
Heatloss Floor 1			144.0000	0.1300	18.7200			(28a)
External Wall 1	283.5000	61.9800	221.5200	0.1800	39.8736			(29a)
External Roof 1	34.0000	1.5200	32.4800	0.1100	3.5728			(30)
External Roof 2	110.0000		110.0000	0.1100	12.1000			(30)
Total net area of external elements Aum(A, m2)			571.5000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		148.3094			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 217.3726 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E5 Ground floor (normal)	67.0000	0.1600	10.7200
E6 Intermediate floor within a dwelling	60.0000	0.0000	0.0000
E16 Corner (normal)	22.4000	0.0900	2.0160
E2 Other lintels (including other steel lintels)	48.0500	0.0500	2.4025
E3 Sill	48.0500	0.0500	2.4025
E4 Jamb	124.0000	0.0500	6.2000
E10 Eaves (insulation at ceiling level)	67.0000	0.0600	4.0200

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 27.7610 (36)

Point Thermal bridges (36a) = 12.0000 (36a)

Total fabric heat loss (33) + (36) + (36a) = 188.0704 (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	132.3882	131.9618	131.5438	129.5806	129.2133	127.5034	127.5034	127.1868	128.1621	129.2133	129.9564	130.7332	(38)
Heat transfer coeff	320.4586	320.0322	319.6142	317.6510	317.2837	315.5738	315.5738	315.2572	316.2325	317.2837	318.0268	318.8036	(39)
Average = Sum(39)m / 12 =												317.6493	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2616	1.2600	1.2583	1.2506	1.2491	1.2424	1.2424	1.2412	1.2450	1.2491	1.2521	1.2551	(40)
HLP (average)												1.2506	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0721 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	75.7294	74.5913	72.9330	69.7599	67.4183	64.8070	63.3227	64.9685	66.7727	69.5765	72.8176	75.4393	(42a)
Hot water usage for baths	32.6893	32.2039	31.5202	30.2596	29.3158	28.2691	27.7038	28.3827	29.1219	30.2418	31.5283	32.5788	(42b)
Hot water usage for other uses	46.0917	44.4156	42.7396	41.0635	39.3874	37.7114	37.7114	39.3874	41.0635	42.7396	44.4156	46.0917	(42c)
Average daily hot water use (litres/day)												142.0297	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	154.5104	151.2108	147.1927	141.0831	136.1215	130.7875	128.7379	132.7387	136.9580	142.5578	148.7615	154.1098	(44)
Energy conte	244.7067	215.3222	226.2297	193.1357	183.2457	160.8185	155.6973	164.3582	168.8830	193.4496	211.9381	241.2986	(45)
Energy content (annual)										Total = Sum(45)m =		2359.0834	
Distribution loss (46)m = 0.15 x (45)m	36.7060	32.2983	33.9345	28.9704	27.4869	24.1228	23.3546	24.6537	25.3324	29.0174	31.7907	36.1948	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6525	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8924	(55)
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(56)
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	295.6328	261.3199	277.1558	242.4190	234.1718	210.1018	206.6234	215.2843	218.1663	244.3757	261.2214	292.2247	(62)
WWHRS	-34.6203	-30.6185	-32.0619	-26.5485	-24.7423	-21.1721	-19.8455	-21.1037	-21.9055	-25.8242	-29.2557	-33.9792	(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	261.0125	230.7014	245.0939	215.8704	209.4295	188.9296	186.7779	194.1806	196.2607	218.5515	231.9657	258.2455	(64)
										Total per year (kWh/year) = Sum(64)m =		2637.0193	(64)
12Total per year (kWh/year)												2637	(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	122.1059	108.3928	115.9622	103.6443	101.6701	92.8988	92.5102	95.3900	95.5802	105.0628	109.8961	120.9727	(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	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	211.7656	234.4548	211.7656	218.8245	211.7656	218.8245	211.7656	211.7656	218.8245	211.7656	218.8245	211.7656	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	419.8490	424.2057	413.2269	389.8544	360.3507	332.6215	314.0966	309.7399	320.7187	344.0912	373.5949	401.3241	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	(71)
Water heating gains (Table 5)													
	164.1208	161.2988	155.8632	143.9504	136.6533	129.0261	124.3417	128.2123	132.7503	141.2135	152.6334	162.5977	(72)
Total internal gains													
	867.8173	892.0413	852.9377	824.7111	780.8516	749.5540	719.2859	718.7998	741.3754	769.1523	817.1347	847.7693	(73)

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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	10.8300	11.2829	0.6300	0.7000	0.7700	37.3442	(75)
Southeast	25.6800	36.7938	0.6300	0.7000	0.7700	288.7632	(77)
Southwest	16.1400	36.7938	0.6300	0.7000	0.7700	181.4890	(79)
Northwest	9.3300	11.2829	0.6300	0.7000	0.7700	32.1718	(81)
Northeast	0.7600	18.0708	0.6300	0.7000	1.0000	5.4510	(82)
Northwest	0.7600	18.0708	0.6300	0.7000	1.0000	5.4510	(82)

Solar gains	550.6702	965.4179	1393.7688	1849.0438	2182.5292	2215.7682	2115.8362	1859.5463	1550.2534	1086.6324	664.5699	468.0275	(83)
Total gains	1418.4875	1857.4592	2246.7065	2673.7549	2963.3808	2965.3221	2835.1221	2578.3460	2291.6288	1855.7847	1481.7045	1315.7968	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	47.8591	47.9228	47.9855	48.2821	48.3379	48.5999	48.5999	48.6487	48.4986	48.3379	48.2250	48.1075	
alpha	4.1906	4.1949	4.1990	4.2188	4.2225	4.2400	4.2400	4.2432	4.2332	4.2225	4.2150	4.2072	
util living area													
	0.9972	0.9911	0.9748	0.9225	0.8068	0.6319	0.4773	0.5399	0.7886	0.9595	0.9933	0.9979	(86)
MIT	19.1883	19.4757	19.8745	20.3650	20.7417	20.9326	20.9837	20.9732	20.8269	20.2992	19.6405	19.1373	(87)
Th 2	19.8710	19.8723	19.8736	19.8797	19.8809	19.8862	19.8862	19.8872	19.8842	19.8809	19.8786	19.8761	(88)
util rest of house													
	0.9963	0.9884	0.9670	0.8986	0.7515	0.5400	0.3625	0.4197	0.7086	0.9422	0.9909	0.9973	(89)
MIT 2	17.7592	18.1265	18.6317	19.2376	19.6627	19.8465	19.8807	19.8770	19.7626	19.1728	18.3430	17.6973	(90)
Living area fraction									fLA = Living area / (4) =			0.3547	(91)
MIT	18.2661	18.6051	19.0726	19.6375	20.0454	20.2318	20.2720	20.2659	20.1401	19.5724	18.8033	18.2081	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2661	18.6051	19.0726	19.6375	20.0454	20.2318	20.2720	20.2659	20.1401	19.5724	18.8033	18.2081	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9944	0.9841	0.9597	0.8924	0.7605	0.5699	0.4032	0.4621	0.7290	0.9360	0.9875	0.9959	(94)
Useful gains	1410.6134	1827.9864	2156.0759	2386.1745	2253.6082	1690.0218	1143.2122	1191.4706	1670.6633	1737.0032	1463.1767	1310.3574	(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													
	4475.5583	4386.0713	4018.3668	3410.7893	2647.8734	1777.2454	1158.7816	1218.7437	1910.0827	2846.7886	3721.9522	4465.8242	(97)
Space heating kWh													
	2280.3190	1719.0331	1385.5445	737.7227	293.3333	0.0000	0.0000	0.0000	0.0000	825.6803	1626.3184	2347.6673	(98a)
Space heating requirement - total per year (kWh/year)												11215.6186	
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													
	2280.3190	1719.0331	1385.5445	737.7227	293.3333	0.0000	0.0000	0.0000	0.0000	825.6803	1626.3184	2347.6673	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												11215.6186	
Space heating per m2											(98c) / (4) =	44.1560	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												92.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2280.3190	1719.0331	1385.5445	737.7227	293.3333	0.0000	0.0000	0.0000	0.0000	825.6803	1626.3184	2347.6673	(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)													
	2470.5514	1862.4411	1501.1316	799.2662	317.8043	0.0000	0.0000	0.0000	0.0000	894.5616	1761.9917	2543.5182	(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													
	261.0125	230.7014	245.0939	215.8704	209.4295	188.9296	186.7779	194.1806	196.2607	218.5515	231.9657	258.2455	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.7832	87.6306	87.3198	86.5893	84.8154	79.8000	79.8000	79.8000	79.8000	86.7522	87.5672	87.8185	(217)
Fuel for water heating, kWh/month													
	297.3378	263.2659	280.6854	249.3039	246.9240	236.7539	234.0575	243.3340	245.9408	251.9260	264.9002	294.0674	(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	44.0007	35.2990	31.7828	23.2855	17.9864	14.6950	16.4078	21.3274	27.7022	36.3468	41.0537	45.2236	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-111.4743	-146.6675	-196.7975	-205.8979	-209.6073	-191.0136	-188.2033	-183.2191	-173.4078	-159.4786	-118.5403	-97.6115	(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	-99.3700	-203.4029	-394.5227	-579.1944	-753.6583	-753.2422	-744.7565	-636.3974	-474.1004	-286.7308	-131.2070	-79.0592	(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	12151.2661	(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	3108.4969	(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)	355.1109	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-7117.5608	(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	8583.3131	(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	12151.2661	0.2100	2551.7659	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3108.4969	0.2100	652.7843	(264)
Space and water heating			3204.5502	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	355.1109	0.1443	51.2535	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1981.9187	0.1362	-269.8465	
PV Unit electricity exported	-5135.6421	0.1266	-650.0180	
Total			-919.8646	(269)
Total CO2, kg/year			2347.8684	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.2400	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	12151.2661	1.1300	13730.9307	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3108.4969	1.1300	3512.6014	(278)
Space and water heating			17243.5321	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	355.1109	1.5338	544.6810	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1981.9187	1.5033	-2979.3957	
PV Unit electricity exported	-5135.6421	0.4646	-2386.1610	
Total			-5365.5567	(283)
Total Primary energy kWh/year			12552.7573	(286)
Target Primary Energy Rate (TPER)			49.4200	(287)

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

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		144.0000 (1b)	x	3.2000 (2b)	=	460.8000 (1b) - (3b)	
First floor		110.0000 (1c)	x	2.5000 (2c)	=	275.0000 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	254.0000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	735.8000	(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	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) =	0.0544	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.2044	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1584	(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	0.2019	0.1980	0.1940	0.1742	0.1703	0.1505	0.1505	0.1465	0.1584	0.1703	0.1782	0.1861	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5204	0.5196	0.5188	0.5152	0.5145	0.5113	0.5113	0.5107	0.5125	0.5145	0.5159	0.5173	(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	
Opening Type 2 (Uw = 1.10)			83.0000	1.0536	87.4521			(27)
Opening			1.0200	0.9615	0.9808			(27a)
Opening			1.0200	0.9615	0.9808			(27a)
Heatloss Floor 1			144.0000	0.1300	18.7200	110.0000	15840.0000	(28a)
External Wall 1	283.5000	83.0000	200.5000	0.1700	34.0850	190.0000	38095.0000	(29a)
External Roof 1	34.0000	2.0400	31.9600	0.1000	3.1960	9.0000	287.6400	(30)
External Roof 2	110.0000		110.0000	0.1300	14.3000	9.0000	990.0000	(30)
Total net area of external elements Aum(A, m2)			571.5000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		159.7146			(33)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	55212.6400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		217.3726 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E5 Ground floor (normal)	67.0000	0.0800	5.3600
E6 Intermediate floor within a dwelling	60.0000	0.1000	6.0000
E16 Corner (normal)	22.4000	0.0200	0.4480
E2 Other lintels (including other steel lintels)	48.0500	0.0440	2.1142
E3 Sill	48.0500	0.0440	2.1142
E4 Jamb	124.0000	0.0440	5.4560
E10 Eaves (insulation at ceiling level)	67.0000	0.0900	6.0300

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		27.5224 (36)
Point Thermal bridges	(36a) =	12.0000 (36a)
Total fabric heat loss	(33) + (36) + (36a) =	199.2370 (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	126.3577	126.1655	125.9771	125.0920	124.9264	124.1555	124.1555	124.0128	124.4524	124.9264	125.2614	125.6116	(38)
Heat transfer coeff	325.5948	325.4025	325.2141	324.3290	324.1634	323.3926	323.3926	323.2498	323.6895	324.1634	324.4984	324.8487	(39)
Average = Sum(39)m / 12 =												324.3282	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2819	1.2811	1.2804	1.2769	1.2762	1.2732	1.2732	1.2726	1.2744	1.2762	1.2776	1.2789	(40)
HLP (average)												1.2769	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy		3.0721 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	(42a)
Hot water usage for baths	32.6893	32.2039	31.5202	30.2596	29.3158	28.2691	27.7038	28.3827	29.1219	30.2418	31.5283	32.5788	(42b)
Hot water usage for other uses	46.0917	44.4156	42.7396	41.0635	39.3874	37.7114	37.7114	39.3874	41.0635	42.7396	44.4156	46.0917	(42c)
Average daily hot water use (litres/day)												72.2097	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	78.7810	76.6195	74.2598	71.3231	68.7032	65.9805	65.4152	67.7701	70.1854	72.9813	75.9439	78.6705	(44)
Energy conte	124.7699	109.1051	114.1345	97.6378	92.4877	81.1308	79.1140	83.9136	86.5456	99.0350	108.1960	123.1790	(45)
Energy content (annual)										Total = Sum(45)m =		1199.2490	
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	(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	(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	106.0544	92.7394	97.0143	82.9922	78.6146	68.9611	67.2469	71.3265	73.5637	84.1798	91.9666	104.7022	(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													
	106.0544	92.7394	97.0143	82.9922	78.6146	68.9611	67.2469	71.3265	73.5637	84.1798	91.9666	104.7022	(64)
										Total per year (kWh/year) = Sum(64)m =		1019.3617	(64)
12Total per year (kWh/year)												1019	(64)
Electric shower(s)													
	60.6466	54.0366	59.0059	56.3087	57.3653	54.7209	56.5449	57.3653	56.3087	59.0059	57.8964	60.6466	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		689.8519	(64a)
Heat gains from water heating, kWh/month													
	41.6753	36.6940	39.0051	34.8252	33.9950	30.9205	30.9480	32.1730	32.4681	35.7964	37.4658	41.3372	(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	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	211.7656	234.4548	211.7656	218.8245	211.7656	218.8245	211.7656	211.7656	218.8245	211.7656	218.8245	211.7656	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	419.8490	424.2057	413.2269	389.8544	360.3507	332.6215	314.0966	309.7399	320.7187	344.0912	373.5949	401.3241	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	(71)
Water heating gains (Table 5)													
	56.0151	54.6042	52.4262	48.3683	45.6921	42.9452	41.5967	43.2432	45.0946	48.1135	52.0358	55.5607	(72)
Total internal gains													
	756.7117	782.3466	746.5006	726.1291	686.8904	663.4730	636.5409	633.8307	653.7197	673.0523	713.5371	737.7324	(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	14.5000	11.2829	0.5700	0.7000	0.7700	45.2373	(75)
Southeast	34.3900	36.7938	0.5700	0.7000	0.7700	349.8753	(77)
Southwest	21.6100	36.7938	0.5700	0.7000	0.7700	219.8548	(79)
Northwest	12.5000	11.2829	0.5700	0.7000	0.7700	38.9977	(81)
Northeast	1.0200	18.0708	0.6400	0.7000	1.0000	7.4319	(82)
Northwest	1.0200	18.0708	0.6400	0.7000	1.0000	7.4319	(82)

Solar gains	668.8288	1173.1494	1695.1649	2251.2667	2659.3208	2700.6667	2578.5216	2264.8334	1886.2882	1320.8490	807.2738	568.3850	(83)
Total gains	1425.5405	1955.4960	2441.6655	2977.3958	3346.2112	3364.1397	3215.0624	2898.6640	2540.0079	1993.9013	1520.8108	1306.1175	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	47.1041	47.1319	47.1592	47.2879	47.3121	47.4249	47.4249	47.4458	47.3813	47.3121	47.2632	47.2123	
alpha	4.1403	4.1421	4.1439	4.1525	4.1541	4.1617	4.1617	4.1631	4.1588	4.1541	4.1509	4.1475	
util living area													
	0.9971	0.9894	0.9674	0.8990	0.7618	0.5811	0.4342	0.4970	0.7511	0.9506	0.9927	0.9980	(86)
MIT	19.1594	19.4854	19.9210	20.4276	20.7864	20.9473	20.9876	20.9787	20.8506	20.3228	19.6235	19.0951	(87)
Th 2	19.8551	19.8557	19.8562	19.8590	19.8595	19.8619	19.8619	19.8623	19.8610	19.8595	19.8585	19.8574	(88)
util rest of house													
	0.9962	0.9862	0.9576	0.8700	0.7017	0.4907	0.3260	0.3816	0.6664	0.9301	0.9900	0.9974	(89)
MIT 2	18.1847	18.5089	18.9368	19.4168	19.7232	19.8386	19.8587	19.8563	19.7820	19.3332	18.6500	18.1223	(90)
Living area fraction									fLA = Living area / (4) =			0.3547	(91)
MIT	18.5305	18.8553	19.2859	19.7753	20.1003	20.2318	20.2592	20.2544	20.1610	19.6843	18.9953	18.4674	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5305	18.8553	19.2859	19.7753	20.1003	20.2318	20.2592	20.2544	20.1610	19.6843	18.9953	18.4674	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9947	0.9824	0.9514	0.8676	0.7154	0.5212	0.3644	0.4224	0.6908	0.9262	0.9872	0.9962	(94)
Useful gains	1418.0272	1921.0778	2323.0023	2583.0916	2393.8002	1753.4617	1171.5999	1224.5367	1754.6625	1846.7505	1501.3545	1301.2019	(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													
	4633.3701	4541.0755	4158.1570	3527.1876	2723.0805	1821.2982	1183.3436	1245.9407	1961.8953	2944.7863	3860.0216	4634.7311	(97)
Space heating kWh													
	2392.2152	1760.6384	1365.3551	679.7491	244.9846	0.0000	0.0000	0.0000	0.0000	816.9386	1698.2403	2480.1457	(98a)
Space heating requirement - total per year (kWh/year)												11438.2669	
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													
	2392.2152	1760.6384	1365.3551	679.7491	244.9846	0.0000	0.0000	0.0000	0.0000	816.9386	1698.2403	2480.1457	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												11438.2669	
Space heating per m2											(98c) / (4) =	45.0325	(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	3039.8900	2393.1049	2456.6985	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8851	0.9324	0.9027	0.0000	0.0000	0.0000	0.0000	(101)

Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	2690.6246	2231.3684	2217.6236	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3808.1590	3639.5024	3278.7909	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	804.6248	1047.6517	789.5084	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	201.1562	261.9129	197.3771	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												660.4462	(107)
Energy for space heating												45.0325	(99)
Energy for space cooling												2.6002	(108)
Total												47.6327	(109)
Fabric Energy Efficiency (DFEE)												47.6	(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)	
Ground floor	144.0000	(1b)	x 3.2000	(2b) =	460.8000	(1b) - (3b)
First floor	110.0000	(1c)	x 2.5000	(2c) =	275.0000	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	254.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		735.8000	(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) =	0.0544	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3044	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2359	(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													
	0.3007	0.2949	0.2890	0.2595	0.2536	0.2241	0.2241	0.2182	0.2359	0.2536	0.2654	0.2772	(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	0.5452	0.5435	0.5417	0.5337	0.5321	0.5251	0.5251	0.5238	0.5278	0.5321	0.5352	0.5384	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			61.9800	1.1450	70.9695			(27)
Opening			0.7600	2.0221	1.5368			(27a)
Opening			0.7600	2.0221	1.5368			(27a)
Heatloss Floor 1			144.0000	0.1300	18.7200			(28a)
External Wall 1	283.5000	61.9800	221.5200	0.1800	39.8736			(29a)
External Roof 1	34.0000	1.5200	32.4800	0.1100	3.5728			(30)
External Roof 2	110.0000		110.0000	0.1100	12.1000			(30)
Total net area of external elements Aum(A, m2)			571.5000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		148.3094			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K			217.3726 (35)
List of Thermal Bridges			
K1 Element	Length	Psi-value	Total
E5 Ground floor (normal)	67.0000	0.1600	10.7200
E6 Intermediate floor within a dwelling	60.0000	0.0000	0.0000
E16 Corner (normal)	22.4000	0.0900	2.0160
E2 Other lintels (including other steel lintels)	48.0500	0.0500	2.4025
E3 Sill	48.0500	0.0500	2.4025
E4 Jamb	124.0000	0.0500	6.2000
E10 Eaves (insulation at ceiling level)	67.0000	0.0600	4.0200
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			27.7610 (36)
Point Thermal bridges		(36a) =	12.0000 (36a)
Total fabric heat loss	(33) + (36) + (36a) =		188.0704 (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	132.3882	131.9618	131.5438	129.5806	129.2133	127.5034	127.5034	127.1868	128.1621	129.2133	129.9564	130.7332	(38)
Heat transfer coeff													
	320.4586	320.0322	319.6142	317.6510	317.2837	315.5738	315.5738	315.2572	316.2325	317.2837	318.0268	318.8036	(39)
Average = Sum(39)m / 12 =												317.6493	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2616	1.2600	1.2583	1.2506	1.2491	1.2424	1.2424	1.2412	1.2450	1.2491	1.2521	1.2551	(40)
HLP (average)												1.2506	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.0721	(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	(42a)
Hot water usage for baths													
	32.6893	32.2039	31.5202	30.2596	29.3158	28.2691	27.7038	28.3827	29.1219	30.2418	31.5283	32.5788	(42b)
Hot water usage for other uses													
	46.0917	44.4156	42.7396	41.0635	39.3874	37.7114	37.7114	39.3874	41.0635	42.7396	44.4156	46.0917	(42c)
Average daily hot water use (litres/day)												72.2097	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	78.7810	76.6195	74.2598	71.3231	68.7032	65.9805	65.4152	67.7701	70.1854	72.9813	75.9439	78.6705	(44)
Energy conte	124.7699	109.1051	114.1345	97.6378	92.4877	81.1308	79.1140	83.9136	86.5456	99.0350	108.1960	123.1790	(45)
Energy content (annual)										Total = Sum(45)m =		1199.2490	
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	(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	(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													
	106.0544	92.7394	97.0143	82.9922	78.6146	68.9611	67.2469	71.3265	73.5637	84.1798	91.9666	104.7022	(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													
	106.0544	92.7394	97.0143	82.9922	78.6146	68.9611	67.2469	71.3265	73.5637	84.1798	91.9666	104.7022	(64)
									Total per year (kWh/year) = Sum(64)m =			1019.3617	(64)
12Total per year (kWh/year)												1019	(64)
Electric shower(s)													
	60.6466	54.0366	59.0059	56.3087	57.3653	54.7209	56.5449	57.3653	56.3087	59.0059	57.8964	60.6466	(64a)
					Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =							689.8519	(64a)
Heat gains from water heating, kWh/month													
	41.6753	36.6940	39.0051	34.8252	33.9950	30.9205	30.9480	32.1730	32.4681	35.7964	37.4658	41.3372	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	153.6065	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	211.7656	234.4548	211.7656	218.8245	211.7656	218.8245	211.7656	211.7656	218.8245	211.7656	218.8245	211.7656	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	419.8490	424.2057	413.2269	389.8544	360.3507	332.6215	314.0966	309.7399	320.7187	344.0912	373.5949	401.3241	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	38.3606	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	(71)
Water heating gains (Table 5)													
	56.0151	54.6042	52.4262	48.3683	45.6921	42.9452	41.5967	43.2432	45.0946	48.1135	52.0358	55.5607	(72)
Total internal gains													
	756.7117	782.3466	746.5006	726.1291	686.8904	663.4730	636.5409	633.8307	653.7197	673.0523	713.5371	737.7324	(73)

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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	10.8300	11.2829	0.6300	0.7000	0.7700	37.3442	(75)
Southeast	25.6800	36.7938	0.6300	0.7000	0.7700	288.7632	(77)
Southwest	16.1400	36.7938	0.6300	0.7000	0.7700	181.4890	(79)
Northwest	9.3300	11.2829	0.6300	0.7000	0.7700	32.1718	(81)
Northeast	0.7600	18.0708	0.6300	0.7000	1.0000	5.4510	(82)
Northwest	0.7600	18.0708	0.6300	0.7000	1.0000	5.4510	(82)

Solar gains	550.6702	965.4179	1393.7688	1849.0438	2182.5292	2215.7682	2115.8362	1859.5463	1550.2534	1086.6324	664.5699	468.0275	(83)
Total gains	1307.3818	1747.7645	2140.2694	2575.1729	2869.4196	2879.2412	2752.3771	2493.3769	2203.9731	1759.6846	1378.1069	1205.7599	(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	47.8591	47.9228	47.9855	48.2821	48.3379	48.5999	48.5999	48.6487	48.4986	48.3379	48.2250	48.1075	
alpha	4.1906	4.1949	4.1990	4.2188	4.2225	4.2400	4.2400	4.2432	4.2332	4.2225	4.2150	4.2072	
util living area													
	0.9979	0.9929	0.9786	0.9305	0.8196	0.6463	0.4904	0.5557	0.8048	0.9659	0.9949	0.9985	(86)
MIT	19.1378	19.4270	19.8305	20.3325	20.7238	20.9266	20.9820	20.9701	20.8116	20.2619	19.5941	19.0870	(87)

Th 2	19.8710	19.8723	19.8736	19.8797	19.8809	19.8862	19.8862	19.8872	19.8842	19.8809	19.8786	19.8761	(88)
util rest of house	0.9973	0.9907	0.9719	0.9084	0.7660	0.5538	0.3730	0.4332	0.7270	0.9509	0.9930	0.9981	(89)
MIT 2	18.1749	18.4637	18.8632	19.3501	19.6974	19.8522	19.8814	19.8783	19.7794	19.2944	18.6359	18.1280	(90)
Living area fraction									fLA = Living area / (4) =			0.3547	(91)
MIT	18.5164	18.8054	19.2063	19.6986	20.0615	20.2333	20.2718	20.2656	20.1456	19.6376	18.9758	18.4682	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5164	18.8054	19.2063	19.6986	20.0615	20.2333	20.2718	20.2656	20.1456	19.6376	18.9758	18.4682	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9879	0.9667	0.9042	0.7756	0.5842	0.4147	0.4765	0.7475	0.9467	0.9909	0.9972	(94)
Useful gains	1302.3907	1726.5526	2068.9734	2328.4009	2225.3831	1682.0491	1141.4265	1188.0687	1647.3607	1665.8760	1365.5498	1202.4337	(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	4555.7790	4450.1913	4061.1283	3430.1902	2652.9558	1777.7363	1158.7365	1218.6569	1911.8038	2867.4798	3776.8239	4548.7463	(97)
Space heating kWh	2420.5209	1830.2852	1482.1632	793.2883	318.1141	0.0000	0.0000	0.0000	0.0000	893.9932	1736.1174	2489.6566	(98a)
Space heating requirement – total per year (kWh/year)												11964.1389	
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	2420.5209	1830.2852	1482.1632	793.2883	318.1141	0.0000	0.0000	0.0000	0.0000	893.9932	1736.1174	2489.6566	(98c)
Space heating requirement after solar contribution – total per year (kWh/year)												11964.1389	
Space heating per m2											(98c) / (4) =	47.1029	(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	2966.3941	2335.2464	2395.9547	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8439	0.9044	0.8677	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	2503.4758	2112.0675	2079.0347	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3247.8810	3104.7573	2809.8578	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	535.9718	738.5612	543.7324	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	133.9929	184.6403	135.9331	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												454.5663	(107)
Energy for space heating												47.1029	(99)
Energy for space cooling												1.7896	(108)
Total												48.8925	(109)
Fabric Energy Efficiency (TFEE)												48.9	(109)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	144.0000	(1b)	x 3.2000	(2b) =	460.8000	(1b) – (3b)
First floor	110.0000	(1c)	x 2.5000	(2c) =	275.0000	(1c) – (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	254.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		735.8000	(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	0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 – [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1162	(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	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1162	0.1250	0.1308	0.1366	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation 0.5000 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0.5000 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.2000 (23c)

Effective ac	0.2522	0.2493	0.2464	0.2319	0.2290	0.2144	0.2144	0.2115	0.2202	0.2290	0.2348	0.2406	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 2 (Uw = 1.10)			83.0000	1.0536	87.4521			(27)
Opening			1.0200	0.9615	0.9808			(27a)
Opening			1.0200	0.9615	0.9808			(27a)
Heatloss Floor 1			144.0000	0.1300	18.7200	110.0000	15840.0000	(28a)
External Wall 1	283.5000	83.0000	200.5000	0.1700	34.0850	190.0000	38095.0000	(29a)
External Roof 1	34.0000	2.0400	31.9600	0.1000	3.1960	9.0000	287.6400	(30)
External Roof 2	110.0000		110.0000	0.1300	14.3000	9.0000	990.0000	(30)
Total net area of external elements Aum(A, m2)			571.5000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	159.7146			(33)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 55212.6400 (34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 217.3726 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E5 Ground floor (normal)	67.0000	0.0800	5.3600
E6 Intermediate floor within a dwelling	60.0000	0.1000	6.0000
E16 Corner (normal)	22.4000	0.0200	0.4480
E2 Other lintels (including other steel lintels)	48.0500	0.0440	2.1142
E3 Sill	48.0500	0.0440	2.1142
E4 Jamb	124.0000	0.0440	5.4560
E10 Eaves (insulation at ceiling level)	67.0000	0.0900	6.0300

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 27.5224 (36)

Point Thermal bridges (36a) = 12.0000 (36a)

Total fabric heat loss (33) + (36) + (36a) = 199.2370 (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	61.2422	60.5366	59.8309	56.3025	55.5968	52.0684	52.0684	51.3627	53.4798	55.5968	57.0082	58.4195	(38)
Heat transfer coeff	260.4793	259.7736	259.0679	255.5395	254.8339	251.3055	251.3055	250.5998	252.7168	254.8339	256.2452	257.6566	(39)
Average = Sum(39)m / 12 =												255.3631	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0255	1.0227	1.0200	1.0061	1.0033	0.9894	0.9894	0.9866	0.9949	1.0033	1.0088	1.0144	(40)
HLP (average)												1.0054	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0721 (42)

Hot water usage for mixer showers

94.6618	93.2392	91.1662	87.1999	84.2729	81.0087	79.1534	81.2107	83.4658	86.9706	91.0220	94.2991	(42a)

Hot water usage for baths

32.6893	32.2039	31.5202	30.2596	29.3158	28.2691	27.7038	28.3827	29.1219	30.2418	31.5283	32.5788	(42b)

Hot water usage for other uses

46.0917	44.4156	42.7396	41.0635	39.3874	37.7114	37.7114	39.3874	41.0635	42.7396	44.4156	46.0917	(42c)

Average daily hot water use (litres/day) 159.4847 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	173.4428	169.8587	165.4259	158.5231	152.9761	146.9893	144.5686	148.9808	153.6512	159.9519	166.9660	172.9696	(44)
Energy conte	274.6910	241.8765	254.2535	217.0102	205.9352	180.7404	174.8431	184.4693	189.4673	217.0532	237.8736	270.8286	(45)
Energy content (annual)										Total = Sum(45)m =		2649.0420	
Distribution loss (46)m = 0.15 x (45)m	41.2036	36.2815	38.1380	32.5515	30.8903	27.1111	26.2265	27.6704	28.4201	32.5580	35.6810	40.6243	(46)

Water storage loss:

Store volume 200.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.4000 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.7560 (55)

Total storage loss

23.4360	21.1680	23.4360	22.6800	23.4360	22.6800	23.4360	23.4360	22.6800	23.4360	22.6800	23.4360	(56)

If cylinder contains dedicated solar storage

23.4360	21.1680	23.4360	22.6800	23.4360	22.6800	23.4360	23.4360	22.6800	23.4360	22.6800	23.4360	(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

321.3894	284.0557	300.9519	262.2022	252.6336	225.9324	221.5415	231.1677	234.6593	263.7516	283.0656	317.5270	(62)
WWHRS -79.4098	-70.2307	-73.5415	-60.8953	-56.7522	-48.5633	-45.5203	-48.4063	-50.2454	-59.2338	-67.1047	-77.9393	(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	241.9796	213.8250	227.4104	201.3069	195.8814	177.3692	176.0212	182.7614	184.4139	204.5178	215.9609	239.5877	(64)
									Total per year (kWh/year) = Sum(64)m =			2461.0352	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			0.0000	(64a)

Heat gains from water heating, kWh/month

128.6935	114.1673	121.8980	108.3095	105.8322	96.2498	95.4941	98.6948	99.1515	109.5289	115.2466	127.4092	(65)

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

Metabolic gains (Table 5), Watts

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(66)m	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	60.7708	53.9761	43.8963	33.2323	24.8415	20.9723	22.6613	29.4560	39.5358	50.1998	58.5905	62.4598	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	626.6403	633.1428	616.7566	581.8722	537.8369	496.4499	468.8009	462.2984	478.6846	513.5690	557.6043	598.9912	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	(71)
Water heating gains (Table 5)													
	172.9751	169.8918	163.8414	150.4298	142.2476	133.6803	128.3522	132.6543	137.7104	147.2163	160.0647	171.2489	(72)
Total internal gains													
	978.3337	974.9582	942.4418	883.4818	822.8735	769.0500	737.7620	742.3561	773.8783	828.9326	894.2070	950.6475	(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	14.5000	11.2829	0.5700	0.7000	0.7700	45.2373	(75)
Southeast	34.3900	36.7938	0.5700	0.7000	0.7700	349.8753	(77)
Southwest	21.6100	36.7938	0.5700	0.7000	0.7700	219.8548	(79)
Northwest	12.5000	11.2829	0.5700	0.7000	0.7700	38.9977	(81)
Northeast	1.0200	18.0708	0.6400	0.7000	1.0000	7.4319	(82)
Northwest	1.0200	18.0708	0.6400	0.7000	1.0000	7.4319	(82)

Solar gains	668.8288	1173.1494	1695.1649	2251.2667	2659.3208	2700.6667	2578.5216	2264.8334	1886.2882	1320.8490	807.2738	568.3850	(83)
Total gains	1647.1625	2148.1076	2637.6067	3134.7486	3482.1943	3469.7167	3316.2835	3007.1895	2660.1665	2149.7816	1701.4808	1519.0325	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.8793	59.0393	59.2001	60.0175	60.1837	61.0287	61.0287	61.2005	60.6879	60.1837	59.8522	59.5244	
alpha	4.9253	4.9360	4.9467	5.0012	5.0122	5.0686	5.0686	5.0800	5.0459	5.0122	4.9901	4.9683	
util living area													
	0.9948	0.9815	0.9410	0.8276	0.6455	0.4584	0.3326	0.3815	0.6264	0.9076	0.9868	0.9964	(86)
Living	20.4841	20.5613	20.6582	20.7539	20.7998	20.8145	20.8163	20.8164	20.8064	20.7298	20.5857	20.4724	
Non living	19.4376	19.5375	19.6596	19.7819	19.8310	19.8557	19.8568	19.8595	19.8451	19.7606	19.5800	19.4313	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	17	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	14	28	22	0	0	0	0	0	0	0	0	31	
MIT	20.8680	20.7515	20.7634	20.7539	20.7998	20.8145	20.8163	20.8164	20.8064	20.7298	20.5857	20.7012	(87)
Th 2	20.0621	20.0644	20.0667	20.0783	20.0806	20.0922	20.0922	20.0945	20.0875	20.0806	20.0760	20.0714	(88)
util rest of house													
	0.9933	0.9766	0.9263	0.7924	0.5917	0.3955	0.2644	0.3073	0.5541	0.8783	0.9824	0.9954	(89)
MIT 2	19.9376	19.8319	19.8210	19.7819	19.8310	19.8557	19.8568	19.8595	19.8451	19.7606	19.5800	19.7888	(90)
Living area fraction										fLA = Living area / (4) =		0.3547	(91)
MIT	20.2677	20.1581	20.1553	20.1267	20.1746	20.1958	20.1971	20.1989	20.1861	20.1044	19.9368	20.1125	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2677	20.1581	20.1553	20.1267	20.1746	20.1958	20.1971	20.1989	20.1861	20.1044	19.9368	20.1125	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9937	0.9771	0.9279	0.7944	0.5974	0.4028	0.2723	0.3159	0.5622	0.8792	0.9817	0.9955	(94)
Useful gains	1636.7341	2098.9706	2447.3613	2490.1995	2080.3168	1397.6174	903.0723	950.1170	1495.6344	1890.0227	1670.2643	1512.1248	(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													
	4159.2488	3963.6492	3537.6435	2868.8639	2159.6257	1406.2496	903.9779	952.0056	1538.0599	2422.0374	3289.3656	4099.9522	(97)
Space heating kWh													
	1876.7509	1253.0640	811.1700	272.6384	59.0059	0.0000	0.0000	0.0000	0.0000	395.8189	1165.7530	1925.3436	(98a)
Space heating requirement - total per year (kWh/year)												7759.5446	
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													
	1876.7509	1253.0640	811.1700	272.6384	59.0059	0.0000	0.0000	0.0000	0.0000	395.8189	1165.7530	1925.3436	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7759.5446	
Space heating per m2											(98c) / (4) =	30.5494	(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 %)												351.6397	(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													
	1876.7509	1253.0640	811.1700	272.6384	59.0059	0.0000	0.0000	0.0000	0.0000	395.8189	1165.7530	1925.3436	(98)
Space heating efficiency (main heating system 1)													
	351.6397	351.6397	351.6397	351.6397	351.6397	0.0000	0.0000	0.0000	0.0000	351.6397	351.6397	351.6397	(210)
Space heating fuel (main heating system)													
	533.7143	356.3489	230.6822	77.5335	16.7802	0.0000	0.0000	0.0000	0.0000	112.5638	331.5192	547.5331	(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												
	241.9796	213.8250	227.4104	201.3069	195.8814	177.3692	176.0212	182.7614	184.4139	204.5178	215.9609	239.5877 (64)
Efficiency of water heater												186.7367 (216)
(217)m	186.7367	186.7367	186.7367	186.7367	186.7367	186.7367	186.7367	186.7367	186.7367	186.7367	186.7367	186.7367 (217)
Fuel for water heating, kWh/month												
	129.5833	114.5062	121.7813	107.8025	104.8971	94.9836	94.2617	97.8712	98.7561	109.5220	115.6500	128.3024 (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	75.7835	68.4496	75.7835	73.3389	75.7835	73.3389	75.7835	75.7835	73.3389	75.7835	73.3389	75.7835 (231)
Lighting	53.1923	42.6729	38.4222	28.1497	21.7437	17.7648	19.8353	25.7827	33.4891	43.9396	49.6296	54.6707 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-87.7761	-149.3065	-258.7043	-344.3507	-415.3413	-403.3597	-397.7199	-351.5706	-277.4018	-190.6739	-104.5817	-72.9397 (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	-0.3869	-1.8315	-7.6375	-22.7345	-44.8662	-51.3240	-50.0527	-35.5844	-19.0406	-5.1348	-0.8264	-0.2520 (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	2206.6751 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	186.7367
Water heating fuel used	1317.9175 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.9940)	
mechanical ventilation fans (SFP = 0.9940)	892.2899 (230a)
Total electricity for the above, kWh/year	892.2899 (231)
Electricity for lighting (calculated in Appendix L)	429.2924 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-3293.3975 (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	1552.7776 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2206.6751	16.4900	363.8807	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1317.9175	16.4900	217.3246	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	892.2899	16.4900	147.1386	(249)
Energy for lighting	429.2924	16.4900	70.7903	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3053.7260	16.4900	-503.5594	
PV Unit electricity exported	-239.6715	5.5900	-13.3976	
Total			-516.9571	(252)
Total energy cost			282.1772	(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] =	0.3397 (257)
SAP value		94.4927
SAP rating (Section 12)		94 (258)
SAP band		A

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	2206.6751	0.1574	347.2239	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1317.9175	0.1407	185.4801	(264)
Space and water heating			532.7040	(265)
Pumps, fans and electric keep-hot	892.2899	0.1387	123.7716	(267)
Energy for lighting	429.2924	0.1443	61.9602	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3053.7260	0.1314	-401.2271	
PV Unit electricity exported	-239.6715	0.1142	-27.3734	
Total			-428.6005	(269)
Total CO2, kg/year			289.8352	(272)
CO2 emissions per m2			1.1400	(273)
EI value			98.7011	
EI rating			99	(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)	
Ground floor	144.0000 (1b)	x	3.2000 (2b)	=	460.8000 (1b)	- (3b)
First floor	110.0000 (1c)	x	2.5000 (2c)	=	275.0000 (1c)	- (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	254.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	735.8000	(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	0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1162	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.7000	4.4000	4.4000	4.1000	4.2000	3.8000	3.9000	3.7000	3.7000	4.0000	4.0000	4.3000	(22)
Wind factor	1.1750	1.1000	1.1000	1.0250	1.0500	0.9500	0.9750	0.9250	0.9250	1.0000	1.0000	1.0750	(22a)
Adj infilt rate	0.1366	0.1279	0.1279	0.1192	0.1221	0.1104	0.1133	0.1075	0.1075	0.1162	0.1162	0.1250	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.2000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2406	0.2319	0.2319	0.2232	0.2261	0.2144	0.2173	0.2115	0.2115	0.2202	0.2202	0.2290	(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	
Opening Type 2 (Uw = 1.10)			83.0000	1.0536	87.4521			(27)
Opening			1.0200	0.9615	0.9808			(27a)
Opening			1.0200	0.9615	0.9808			(27a)
Heatloss Floor 1			144.0000	0.1300	18.7200	110.0000	15840.0000	(28a)
External Wall 1	283.5000	83.0000	200.5000	0.1700	34.0850	190.0000	38095.0000	(29a)
External Roof 1	34.0000	2.0400	31.9600	0.1000	3.1960	9.0000	287.6400	(30)
External Roof 2	110.0000		110.0000	0.1300	14.3000	9.0000	990.0000	(30)
Total net area of external elements Aum(A, m2)			571.5000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		159.7146			(33)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 55212.6400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	217.3726 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E5 Ground floor (normal)	67.0000	0.0800	5.3600
E6 Intermediate floor within a dwelling	60.0000	0.1000	6.0000
E16 Corner (normal)	22.4000	0.0200	0.4480
E2 Other lintels (including other steel lintels)	48.0500	0.0440	2.1142
E3 Sill	48.0500	0.0440	2.1142
E4 Jamb	124.0000	0.0440	5.4560
E10 Eaves (insulation at ceiling level)	67.0000	0.0900	6.0300

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	27.5224 (36)
Point Thermal bridges	(36a) = 12.0000 (36a)
Total fabric heat loss	(33) + (36) + (36a) = 199.2370 (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	58.4195	56.3025	56.3025	54.1855	54.8911	52.0684	52.7741	51.3627	51.3627	53.4798	53.4798	55.5968	(38)
Heat transfer coeff	257.6566	255.5395	255.5395	253.4225	254.1282	251.3055	252.0112	250.5998	250.5998	252.7168	252.7168	254.8339	(39)
Average = Sum(39)m / 12 =												253.4225	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0144	1.0061	1.0061	0.9977	1.0005	0.9894	0.9922	0.9866	0.9866	0.9949	0.9949	1.0033	(40)
HLP (average)												0.9977	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.0721	(42)
Hot water usage for mixer showers													
	94.6618	93.2392	91.1662	87.1999	84.2729	81.0087	79.1534	81.2107	83.4658	86.9706	91.0220	94.2991	(42a)
Hot water usage for baths													
	32.6893	32.2039	31.5202	30.2596	29.3158	28.2691	27.7038	28.3827	29.1219	30.2418	31.5283	32.5788	(42b)
Hot water usage for other uses													
	46.0917	44.4156	42.7396	41.0635	39.3874	37.7114	37.7114	39.3874	41.0635	42.7396	44.4156	46.0917	(42c)
Average daily hot water use (litres/day)												159.4847	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	173.4428	169.8587	165.4259	158.5231	152.9761	146.9893	144.5686	148.9808	153.6512	159.9519	166.9660	172.9696	(44)
Energy conte	274.6910	241.8765	254.2535	217.0102	205.9352	180.7404	174.8431	184.4693	189.4673	217.0532	237.8736	270.8286	(45)
Energy content (annual)										Total = Sum(45)m =		2649.0420	
Distribution loss (46)m = 0.15 x (45)m													
	41.2036	36.2815	38.1380	32.5515	30.8903	27.1111	26.2265	27.6704	28.4201	32.5580	35.6810	40.6243	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7560	(55)
Total storage loss													
	23.4360	21.1680	23.4360	22.6800	23.4360	22.6800	23.4360	23.4360	22.6800	23.4360	22.6800	23.4360	(56)
If cylinder contains dedicated solar storage													
	23.4360	21.1680	23.4360	22.6800	23.4360	22.6800	23.4360	23.4360	22.6800	23.4360	22.6800	23.4360	(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													
	321.3894	284.0557	300.9519	262.2022	252.6336	225.9324	221.5415	231.1677	234.6593	263.7516	283.0656	317.5270	(62)
WWHRS	−79.4098	−70.2307	−73.5415	−60.8953	−56.7522	−48.5633	−45.5203	−48.4063	−50.2454	−59.2338	−67.1047	−77.9393	(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													
	241.9796	213.8250	227.4104	201.3069	195.8814	177.3692	176.0212	182.7614	184.4139	204.5178	215.9609	239.5877	(64)
										Total per year (kWh/year) = Sum(64)m =		2461.0352	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month													
	128.6935	114.1673	121.8980	108.3095	105.8322	96.2498	95.4941	98.6948	99.1515	109.5289	115.2466	127.4092	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	60.7708	53.9761	43.8963	33.2323	24.8415	20.9723	22.6613	29.4560	39.5358	50.1998	58.5905	62.4598	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	626.6403	633.1428	616.7566	581.8722	537.8369	496.4499	468.8009	462.2984	478.6846	513.5690	557.6043	598.9912	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	−122.8852	−122.8852	−122.8852	−122.8852	−122.8852	−122.8852	−122.8852	−122.8852	−122.8852	−122.8852	−122.8852	−122.8852	(71)
Water heating gains (Table 5)													
	172.9751	169.8918	163.8414	150.4298	142.2476	133.6803	128.3522	132.6543	137.7104	147.2163	160.0647	171.2489	(72)
Total internal gains													
	978.3337	974.9582	942.4418	883.4818	822.8735	769.0500	737.7620	742.3561	773.8783	828.9326	894.2070	950.6475	(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	14.5000	13.7804	0.5700	0.7000	0.7700	55.2505	(75)
Southeast	34.3900	43.0593	0.5700	0.7000	0.7700	409.4539	(77)
Southwest	21.6100	43.0593	0.5700	0.7000	0.7700	257.2928	(79)
Northwest	12.5000	13.7804	0.5700	0.7000	0.7700	47.6298	(81)
Northeast	1.0200	22.2520	0.6400	0.7000	1.0000	9.1515	(82)
Northwest	1.0200	22.2520	0.6400	0.7000	1.0000	9.1515	(82)

Solar gains	787.9300	1209.8559	1743.2923	2453.6919	2748.6884	3050.0951	2807.2818	2495.1120	2088.9880	1425.5463	913.8142	647.3659	(83)
Total gains	1766.2637	2184.8141	2685.7341	3337.1737	3571.5619	3819.1451	3545.0438	3237.4681	2862.8663	2254.4788	1808.0212	1598.0134	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	59.5244	60.0175	60.0175	60.5189	60.3508	61.0287	60.8578	61.2005	61.2005	60.6879	60.6879	60.1837	
alpha	4.9683	5.0012	5.0012	5.0346	5.0234	5.0686	5.0572	5.0800	5.0800	5.0459	5.0459	5.0122	
util living area													
	0.9905	0.9739	0.9185	0.7559	0.5666	0.3477	0.2557	0.2784	0.5156	0.8515	0.9751	0.9938	(86)
Living	20.5384	20.6044	20.6951	20.7801	20.8077	20.8161	20.8161	20.8169	20.8137	20.7635	20.6401	20.5251	
Non living	19.5154	19.6049	19.7153	19.8166	19.8403	19.8567	19.8540	19.8597	19.8579	19.8047	19.6593	19.5072	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	17	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	14	28	21	0	0	0	0	0	0	0	0	31	
MIT	20.8819	20.7760	20.7847	20.7801	20.8077	20.8161	20.8161	20.8169	20.8137	20.7635	20.6401	20.7310	(87)
Th 2	20.0714	20.0783	20.0783	20.0852	20.0829	20.0922	20.0899	20.0945	20.0945	20.0875	20.0875	20.0806	(88)
util rest of house													
	0.9877	0.9668	0.8985	0.7124	0.5088	0.2886	0.1912	0.2085	0.4418	0.8078	0.9667	0.9919	(89)
MIT 2	19.9605	19.8693	19.8526	19.8166	19.8403	19.8567	19.8540	19.8597	19.8579	19.8047	19.6593	19.8275	(90)
Living area fraction										fLA = Living area / (4) =		0.3547	(91)
MIT	20.2874	20.1909	20.1833	20.1584	20.1835	20.1970	20.1953	20.1992	20.1969	20.1448	20.0072	20.1480	(92)
Temperature adjustment												0.0000	

adjusted MIT	20.2874	20.1909	20.1833	20.1584	20.1835	20.1970	20.1953	20.1992	20.1969	20.1448	20.0072	20.1480	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9884	0.9678	0.9010	0.7161	0.5153	0.2955	0.1987	0.2166	0.4503	0.8109	0.9659	0.9920	(94)
Useful gains	1745.8462	2114.3543	2419.9234	2389.7935	1840.4948	1128.4590	704.2886	701.2581	1289.2545	1828.1377	1746.2903	1585.3063	(95)
Ext temp.	5.4000	5.9000	7.5000	9.9000	12.8000	15.7000	17.4000	17.4000	15.0000	11.7000	8.3000	5.4000	(96)
Heat loss rate W	3835.8282	3651.9004	3241.0721	2599.7125	1876.3460	1130.1207	704.4480	701.4903	1302.3487	2134.1428	2958.6124	3758.2934	(97)
Space heating kWh	1554.9466	1033.2309	610.9347	151.1417	26.6733	0.0000	0.0000	0.0000	0.0000	227.6678	872.8719	1616.7024	(98a)
Space heating requirement - total per year (kWh/year)												6094.1693	
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	1554.9466	1033.2309	610.9347	151.1417	26.6733	0.0000	0.0000	0.0000	0.0000	227.6678	872.8719	1616.7024	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6094.1693	
Space heating per m2											(98c) / (4) =	23.9928	(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 %)	351.6174	(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	1554.9466	1033.2309	610.9347	151.1417	26.6733	0.0000	0.0000	0.0000	0.0000	227.6678	872.8719	1616.7024	(98)
Space heating efficiency (main heating system 1)	351.6174	351.6174	351.6174	351.6174	351.6174	0.0000	0.0000	0.0000	0.0000	351.6174	351.6174	351.6174	(210)
Space heating fuel (main heating system)	442.2268	293.8509	173.7498	42.9847	7.5859	0.0000	0.0000	0.0000	0.0000	64.7487	248.2448	459.7902	(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	241.9796	213.8250	227.4104	201.3069	195.8814	177.3692	176.0212	182.7614	184.4139	204.5178	215.9609	239.5877	(64)
Efficiency of water heater												186.7327	(216)
(217)m	186.7327	186.7327	186.7327	186.7327	186.7327	186.7327	186.7327	186.7327	186.7327	186.7327	186.7327	186.7327	(217)
Fuel for water heating, kWh/month	129.5861	114.5086	121.7839	107.8049	104.8994	94.9856	94.2638	97.8733	98.7582	109.5244	115.6524	128.3052	(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	75.7835	68.4496	75.7835	73.3389	75.7835	73.3389	75.7835	75.7835	73.3389	75.7835	73.3389	75.7835	(231)
Pumps and Fa	53.1923	42.6729	38.4222	28.1497	21.7437	17.7648	19.8353	25.7827	33.4891	43.9396	49.6296	54.6707	(232)
Lighting	-105.3325	-156.6366	-268.8267	-373.2352	-427.4907	-446.3841	-427.5118	-384.0178	-307.5683	-208.1598	-120.4409	-84.6796	(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													
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													
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	(235c)
(235a)m													
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	-0.6574	-2.2379	-9.1573	-30.0591	-49.6013	-67.7170	-60.9127	-44.9255	-24.7470	-6.9773	-1.3012	-0.3944	(233b)
(235c)m													
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	(234b)
(233b)m													
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	(235b)
(234b)m													
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	(235d)
(235b)m													
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m													

Annual totals kWh/year		
Space heating fuel - main system 1	1733.1818	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	186.7327	
Water heating fuel used	1317.9458	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.9940)		
mechanical ventilation fans (SFP = 0.9940)	892.2899	(230a)
Total electricity for the above, kWh/year	892.2899	(231)
Electricity for lighting (calculated in Appendix L)	429.2924	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3608.9723	(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	763.7377	(238)

10a. Fuel costs - using BEDF prices (556)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1733.1818	26.0600	451.6672	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1317.9458	26.0600	343.4567	(247)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000	(247a)

Pumps, fans and electric keep-hot	892.2899	26.0600	232.5308	(249)
Energy for lighting	429.2924	26.0600	111.8736	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3310.2841	26.0600	-862.6600	
PV Unit electricity exported	-298.6882	5.8100	-17.3538	
Total			-880.0138	(252)
Total energy cost			259.5144	(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	1733.1818	0.1581	274.0676	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1317.9458	0.1407	185.4841	(264)
Space and water heating			459.5517	(265)
Pumps, fans and electric keep-hot	892.2899	0.1387	123.7716	(267)
Energy for lighting	429.2924	0.1443	61.9602	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3310.2841	0.1314	-435.0153	
PV Unit electricity exported	-298.6882	0.1142	-34.0969	
Total			-469.1122	(269)
Total CO2, kg/year			176.1713	(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	1733.1818	1.5853	2747.6892	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1317.9458	1.5204	2003.7877	(278)
Space and water heating			4751.4770	(279)
Pumps, fans and electric keep-hot	892.2899	1.5128	1349.8562	(281)
Energy for lighting	429.2924	1.5338	658.4631	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3310.2841	1.4855	-4917.3739	
PV Unit electricity exported	-298.6882	0.4182	-124.9231	
Total			-5042.2969	(283)
Total Primary energy kWh/year			1717.4993	(286)

SAP 10 EPC IMPROVEMENTS

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8 Druid Stoke with PV

Current energy efficiency rating: A 94
Current environmental impact rating: A 99

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	-£ 77	-40 kg (22.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
(none)				
Total Savings	£0	0.00 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 99

Fuel prices for cost data on this page from database revision number 556 TEST (29 Nov 2024)
Recommendation texts revision number 6.1 (11 Jun 2019)

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

	Current	Potential	Saving
Electricity	£1140	£1140	£0
Space heating	£684	£684	£0
Water heating	£343	£343	£0
Lighting	£112	£112	£0
Generated (PV)	-£880	-£880	£0
Total cost of fuels	£260	£260	£0
Total cost of uses	£259	£259	£0
Delivered energy	3 kWh/m²	3 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.2 tonnes	0.2 tonnes	0.0 tonnes
CO2 emissions per m²	1 kg/m²	1 kg/m²	0 kg/m²
Primary energy	7 kWh/m²	7 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)	
Ground floor	144.0000	(1b)	x 3.2000	(2b)	=	460.8000	(1b) - (3b)
First floor	110.0000	(1c)	x 2.5000	(2c)	=	275.0000	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	254.0000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	735.8000	(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	0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1162	(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	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1162	0.1250	0.1308	0.1366	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.2000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2522	0.2493	0.2464	0.2319	0.2290	0.2144	0.2144	0.2115	0.2202	0.2290	0.2348	0.2406	(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	
Opening Type 2 (Uw = 1.10)			83.0000	1.0536	87.4521			(27)
Opening			1.0200	0.9615	0.9808			(27a)
Opening			1.0200	0.9615	0.9808			(27a)
Heatloss Floor 1			144.0000	0.1300	18.7200	110.0000	15840.0000	(28a)
External Wall 1	283.5000	83.0000	200.5000	0.1700	34.0850	190.0000	38095.0000	(29a)
External Roof 1	34.0000	2.0400	31.9600	0.1000	3.1960	9.0000	287.6400	(30)
External Roof 2	110.0000		110.0000	0.1300	14.3000	9.0000	990.0000	(30)
Total net area of external elements Aum(A, m2)			571.5000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	159.7146			(33)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 55212.6400	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	217.3726	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E5 Ground floor (normal)	67.0000	0.0800	5.3600
E6 Intermediate floor within a dwelling	60.0000	0.1000	6.0000
E16 Corner (normal)	22.4000	0.0200	0.4480
E2 Other lintels (including other steel lintels)	48.0500	0.0440	2.1142
E3 Sill	48.0500	0.0440	2.1142
E4 Jamb	124.0000	0.0440	5.4560
E10 Eaves (insulation at ceiling level)	67.0000	0.0900	6.0300

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	27.5224	(36)
Point Thermal bridges	(36a) = 12.0000	(36a)
Total fabric heat loss	(33) + (36) + (36a) = 199.2370	(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	61.2422	60.5366	59.8309	56.3025	55.5968	52.0684	52.0684	51.3627	53.4798	55.5968	57.0082	58.4195	(38)
Heat transfer coeff	260.4793	259.7736	259.0679	255.5395	254.8339	251.3055	251.3055	250.5998	252.7168	254.8339	256.2452	257.6566	(39)
Average = Sum(39)m / 12 =												255.3631	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0255	1.0227	1.0200	1.0061	1.0033	0.9894	0.9894	0.9866	0.9949	1.0033	1.0088	1.0144	(40)
HLP (average)												1.0054	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.0721 (42)
Hot water usage for mixer showers	

	94.6618	93.2392	91.1662	87.1999	84.2729	81.0087	79.1534	81.2107	83.4658	86.9706	91.0220	94.2991	(42a)
Hot water usage for baths													
	32.6893	32.2039	31.5202	30.2596	29.3158	28.2691	27.7038	28.3827	29.1219	30.2418	31.5283	32.5788	(42b)
Hot water usage for other uses													
	46.0917	44.4156	42.7396	41.0635	39.3874	37.7114	37.7114	39.3874	41.0635	42.7396	44.4156	46.0917	(42c)
Average daily hot water use (litres/day)												159.4847	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	173.4428	169.8587	165.4259	158.5231	152.9761	146.9893	144.5686	148.9808	153.6512	159.9519	166.9660	172.9696	(44)
Energy conte	274.6910	241.8765	254.2535	217.0102	205.9352	180.7404	174.8431	184.4693	189.4673	217.0532	237.8736	270.8286	(45)
Energy content (annual)										Total = Sum(45)m =		2649.0420	
Distribution loss (46)m = 0.15 x (45)m													
	41.2036	36.2815	38.1380	32.5515	30.8903	27.1111	26.2265	27.6704	28.4201	32.5580	35.6810	40.6243	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7560	(55)
Total storage loss													
	23.4360	21.1680	23.4360	22.6800	23.4360	22.6800	23.4360	23.4360	22.6800	23.4360	22.6800	23.4360	(56)
If cylinder contains dedicated solar storage													
	23.4360	21.1680	23.4360	22.6800	23.4360	22.6800	23.4360	23.4360	22.6800	23.4360	22.6800	23.4360	(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													
	321.3894	284.0557	300.9519	262.2022	252.6336	225.9324	221.5415	231.1677	234.6593	263.7516	283.0656	317.5270	(62)
WWHRS	-79.4098	-70.2307	-73.5415	-60.8953	-56.7522	-48.5633	-45.5203	-48.4063	-50.2454	-59.2338	-67.1047	-77.9393	(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													
	241.9796	213.8250	227.4104	201.3069	195.8814	177.3692	176.0212	182.7614	184.4139	204.5178	215.9609	239.5877	(64)
										Total per year (kWh/year) = Sum(64)m =		2461.0352	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month													
	128.6935	114.1673	121.8980	108.3095	105.8322	96.2498	95.4941	98.6948	99.1515	109.5289	115.2466	127.4092	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	60.7708	53.9761	43.8963	33.2323	24.8415	20.9723	22.6613	29.4560	39.5358	50.1998	58.5905	62.4598	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	626.6403	633.1428	616.7566	581.8722	537.8369	496.4499	468.8009	462.2984	478.6846	513.5690	557.6043	598.9912	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	(71)
Water heating gains (Table 5)													
	172.9751	169.8918	163.8414	150.4298	142.2476	133.6803	128.3522	132.6543	137.7104	147.2163	160.0647	171.2489	(72)
Total internal gains													
	978.3337	974.9582	942.4418	883.4818	822.8735	769.0500	737.7620	742.3561	773.8783	828.9326	894.2070	950.6475	(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	14.5000	11.2829	0.5700	0.7000	0.7700	45.2373	(75)
Southeast	34.3900	36.7938	0.5700	0.7000	0.7700	349.8753	(77)
Southwest	21.6100	36.7938	0.5700	0.7000	0.7700	219.8548	(79)
Northwest	12.5000	11.2829	0.5700	0.7000	0.7700	38.9977	(81)
Northeast	1.0200	18.0708	0.6400	0.7000	1.0000	7.4319	(82)
Northwest	1.0200	18.0708	0.6400	0.7000	1.0000	7.4319	(82)

Solar gains	668.8288	1173.1494	1695.1649	2251.2667	2659.3208	2700.6667	2578.5216	2264.8334	1886.2882	1320.8490	807.2738	568.3850	(83)
Total gains	1647.1625	2148.1076	2637.6067	3134.7486	3482.1943	3469.7167	3316.2835	3007.1895	2660.1665	2149.7816	1701.4808	1519.0325	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.8793	59.0393	59.2001	60.0175	60.1837	61.0287	61.0287	61.2005	60.6879	60.1837	59.8522	59.5244	
alpha	4.9253	4.9360	4.9467	5.0012	5.0122	5.0686	5.0686	5.0800	5.0459	5.0122	4.9901	4.9683	
util living area													
	0.9948	0.9815	0.9410	0.8276	0.6455	0.4584	0.3326	0.3815	0.6264	0.9076	0.9868	0.9964	(86)
Living	20.4841	20.5613	20.6582	20.7539	20.7998	20.8145	20.8163	20.8164	20.8064	20.7298	20.5857	20.4724	
Non living	19.4376	19.5375	19.6596	19.7819	19.8310	19.8557	19.8568	19.8595	19.8451	19.7606	19.5800	19.4313	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	17	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	14	28	22	0	0	0	0	0	0	0	0	31	
MIT	20.8680	20.7515	20.7634	20.7539	20.7998	20.8145	20.8163	20.8164	20.8064	20.7298	20.5857	20.7012	(87)
Th 2	20.0621	20.0644	20.0667	20.0783	20.0806	20.0922	20.0922	20.0945	20.0875	20.0806	20.0760	20.0714	(88)
util rest of house													
	0.9933	0.9766	0.9263	0.7924	0.5917	0.3955	0.2644	0.3073	0.5541	0.8783	0.9824	0.9954	(89)
MIT 2	19.9376	19.8319	19.8210	19.7819	19.8310	19.8557	19.8568	19.8595	19.8451	19.7606	19.5800	19.7888	(90)
Living area fraction									fLA = Living area / (4) =			0.3547	(91)
MIT	20.2677	20.1581	20.1553	20.1267	20.1746	20.1958	20.1971	20.1989	20.1861	20.1044	19.9368	20.1125	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2677	20.1581	20.1553	20.1267	20.1746	20.1958	20.1971	20.1989	20.1861	20.1044	19.9368	20.1125	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9937	0.9771	0.9279	0.7944	0.5974	0.4028	0.2723	0.3159	0.5622	0.8792	0.9817	0.9955	(94)
Useful gains	1636.7341	2098.9706	2447.3613	2490.1995	2080.3168	1397.6174	903.0723	950.1170	1495.6344	1890.0227	1670.2643	1512.1248	(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	4159.2488	3963.6492	3537.6435	2868.8639	2159.6257	1406.2496	903.9779	952.0056	1538.0599	2422.0374	3289.3656	4099.9522	(97)
Space heating kWh	1876.7509	1253.0640	811.1700	272.6384	59.0059	0.0000	0.0000	0.0000	0.0000	395.8189	1165.7530	1925.3436	(98a)
Space heating requirement - total per year (kWh/year)												7759.5446	
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	1876.7509	1253.0640	811.1700	272.6384	59.0059	0.0000	0.0000	0.0000	0.0000	395.8189	1165.7530	1925.3436	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7759.5446	
Space heating per m2											(98c) / (4) =	30.5494	(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 %)												351.6397	(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	1876.7509	1253.0640	811.1700	272.6384	59.0059	0.0000	0.0000	0.0000	0.0000	395.8189	1165.7530	1925.3436	(98)
Space heating efficiency (main heating system 1)	351.6397	351.6397	351.6397	351.6397	351.6397	0.0000	0.0000	0.0000	0.0000	351.6397	351.6397	351.6397	(210)
Space heating fuel (main heating system)	533.7143	356.3489	230.6822	77.5335	16.7802	0.0000	0.0000	0.0000	0.0000	112.5638	331.5192	547.5331	(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	241.9796	213.8250	227.4104	201.3069	195.8814	177.3692	176.0212	182.7614	184.4139	204.5178	215.9609	239.5877	(64)
Efficiency of water heater												186.7367	(216)
(217)m	186.7367	186.7367	186.7367	186.7367	186.7367	186.7367	186.7367	186.7367	186.7367	186.7367	186.7367	186.7367	(217)
Fuel for water heating, kWh/month	129.5833	114.5062	121.7813	107.8025	104.8971	94.9836	94.2617	97.8712	98.7561	109.5220	115.6500	128.3024	(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	75.7835	68.4496	75.7835	73.3389	75.7835	73.3389	75.7835	75.7835	73.3389	75.7835	73.3389	75.7835	(231)
Lighting	53.1923	42.6729	38.4222	28.1497	21.7437	17.7648	19.8353	25.7827	33.4891	43.9396	49.6296	54.6707	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-87.7761	-149.3065	-258.7043	-344.3507	-415.3413	-403.3597	-397.7199	-351.5706	-277.4018	-190.6739	-104.5817	-72.9397	(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	-0.3869	-1.8315	-7.6375	-22.7345	-44.8662	-51.3240	-50.0527	-35.5844	-19.0406	-5.1348	-0.8264	-0.2520	(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												2206.6751	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												186.7367	
Water heating fuel used												1317.9175	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.9940)													
mechanical ventilation fans (SFP = 0.9940)												892.2899	(230a)
Total electricity for the above, kWh/year												892.2899	(231)
Electricity for lighting (calculated in Appendix L)												429.2924	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-3293.3975	(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												1552.7776	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2206.6751	16.4900	363.8807	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1317.9175	16.4900	217.3246	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	892.2899	16.4900	147.1386	(249)
Energy for lighting	429.2924	16.4900	70.7903	(250)
Additional standing charges			0.0000	(251)

Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3053.7260	16.4900	-503.5594	
PV Unit electricity exported	-239.6715	5.5900	-13.3976	
Total			-516.9571	(252)
Total energy cost			282.1772	(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] =	0.3397	(257)
SAP value		94.4927	
SAP rating (Section 12)		94	(258)
SAP band		A	

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	2206.6751	0.1574	347.2239	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1317.9175	0.1407	185.4801	(264)
Space and water heating			532.7040	(265)
Pumps, fans and electric keep-hot	892.2899	0.1387	123.7716	(267)
Energy for lighting	429.2924	0.1443	61.9602	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3053.7260	0.1314	-401.2271	
PV Unit electricity exported	-239.6715	0.1142	-27.3734	
Total			-428.6005	(269)
Total CO2, kg/year			289.8352	(272)
CO2 emissions per m2			1.1400	(273)
EI value			98.7011	
EI rating			99	(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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	144.0000	(1b)	x 3.2000	(2b) =	460.8000	(1b) - (3b)
First floor	110.0000	(1c)	x 2.5000	(2c) =	275.0000	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	254.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		735.8000	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1162	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.7000	4.4000	4.4000	4.1000	4.2000	3.8000	3.9000	3.7000	3.7000	4.0000	4.0000	4.3000	(22)
Wind factor	1.1750	1.1000	1.1000	1.0250	1.0500	0.9500	0.9750	0.9250	0.9250	1.0000	1.0000	1.0750	(22a)
Adj infilt rate	0.1366	0.1279	0.1279	0.1192	0.1221	0.1104	0.1133	0.1075	0.1075	0.1162	0.1162	0.1250	(22b)
Balanced mechanical ventilation with heat recovery													
If mechanical ventilation												0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												79.2000	(23c)
Effective ac	0.2406	0.2319	0.2319	0.2232	0.2261	0.2144	0.2173	0.2115	0.2115	0.2202	0.2202	0.2290	(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	
Opening Type 2 (Uw = 1.10)			83.0000	1.0536	87.4521			(27)
Opening			1.0200	0.9615	0.9808			(27a)
Opening			1.0200	0.9615	0.9808			(27a)
Heatloss Floor 1			144.0000	0.1300	18.7200	110.0000	15840.0000	(28a)
External Wall 1	283.5000	83.0000	200.5000	0.1700	34.0850	190.0000	38095.0000	(29a)
External Roof 1	34.0000	2.0400	31.9600	0.1000	3.1960	9.0000	287.6400	(30)
External Roof 2	110.0000		110.0000	0.1300	14.3000	9.0000	990.0000	(30)
Total net area of external elements Aum(A, m2)			571.5000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	159.7146			(33)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	55212.6400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		217.3726 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E5 Ground floor (normal)	67.0000	0.0800	5.3600
E6 Intermediate floor within a dwelling	60.0000	0.1000	6.0000
E16 Corner (normal)	22.4000	0.0200	0.4480
E2 Other lintels (including other steel lintels)	48.0500	0.0440	2.1142
E3 Sill	48.0500	0.0440	2.1142
E4 Jamb	124.0000	0.0440	5.4560
E10 Eaves (insulation at ceiling level)	67.0000	0.0900	6.0300

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		27.5224 (36)
Point Thermal bridges	(36a) =	12.0000 (36a)
Total fabric heat loss	(33) + (36) + (36a) =	199.2370 (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	58.4195	56.3025	56.3025	54.1855	54.8911	52.0684	52.7741	51.3627	51.3627	53.4798	53.4798	55.5968	(38)
Heat transfer coeff	257.6566	255.5395	255.5395	253.4225	254.1282	251.3055	252.0112	250.5998	250.5998	252.7168	252.7168	254.8339	(39)
Average = Sum(39)m / 12 =												253.4225	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0144	1.0061	1.0061	0.9977	1.0005	0.9894	0.9922	0.9866	0.9866	0.9949	0.9949	1.0033	(40)
HLP (average)												0.9977	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy		3.0721 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	94.6618	93.2392	91.1662	87.1999	84.2729	81.0087	79.1534	81.2107	83.4658	86.9706	91.0220	94.2991	(42a)
Hot water usage for baths	32.6893	32.2039	31.5202	30.2596	29.3158	28.2691	27.7038	28.3827	29.1219	30.2418	31.5283	32.5788	(42b)
Hot water usage for other uses	46.0917	44.4156	42.7396	41.0635	39.3874	37.7114	37.7114	39.3874	41.0635	42.7396	44.4156	46.0917	(42c)
Average daily hot water use (litres/day)												159.4847	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	173.4428	169.8587	165.4259	158.5231	152.9761	146.9893	144.5686	148.9808	153.6512	159.9519	166.9660	172.9696	(44)
Energy conte	274.6910	241.8765	254.2535	217.0102	205.9352	180.7404	174.8431	184.4693	189.4673	217.0532	237.8736	270.8286	(45)
Energy content (annual)										Total = Sum(45)m =		2649.0420	
Distribution loss (46)m = 0.15 x (45)m	41.2036	36.2815	38.1380	32.5515	30.8903	27.1111	26.2265	27.6704	28.4201	32.5580	35.6810	40.6243	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7560	(55)
Total storage loss	23.4360	21.1680	23.4360	22.6800	23.4360	22.6800	23.4360	23.4360	22.6800	23.4360	22.6800	23.4360	(56)
If cylinder contains dedicated solar storage	23.4360	21.1680	23.4360	22.6800	23.4360	22.6800	23.4360	23.4360	22.6800	23.4360	22.6800	23.4360	(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	321.3894	284.0557	300.9519	262.2022	252.6336	225.9324	221.5415	231.1677	234.6593	263.7516	283.0656	317.5270	(62)
WWHRS	-79.4098	-70.2307	-73.5415	-60.8953	-56.7522	-48.5633	-45.5203	-48.4063	-50.2454	-59.2338	-67.1047	-77.9393	(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	241.9796	213.8250	227.4104	201.3069	195.8814	177.3692	176.0212	182.7614	184.4139	204.5178	215.9609	239.5877	(64)
										Total per year (kWh/year) = Sum(64)m =		2461.0352	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	128.6935	114.1673	121.8980	108.3095	105.8322	96.2498	95.4941	98.6948	99.1515	109.5289	115.2466	127.4092	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	184.3278	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	60.7708	53.9761	43.8963	33.2323	24.8415	20.9723	22.6613	29.4560	39.5358	50.1998	58.5905	62.4598	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	626.6403	633.1428	616.7566	581.8722	537.8369	496.4499	468.8009	462.2984	478.6846	513.5690	557.6043	598.9912	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	56.5049	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	-122.8852	(71)
Water heating gains (Table 5)	172.9751	169.8918	163.8414	150.4298	142.2476	133.6803	128.3522	132.6543	137.7104	147.2163	160.0647	171.2489	(72)
Total internal gains	978.3337	974.9582	942.4418	883.4818	822.8735	769.0500	737.7620	742.3561	773.8783	828.9326	894.2070	950.6475	(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	14.5000	13.7804	0.5700	0.7000	0.7700	55.2505	(75)
Southeast	34.3900	43.0593	0.5700	0.7000	0.7700	409.4539	(77)
Southwest	21.6100	43.0593	0.5700	0.7000	0.7700	257.2928	(79)
Northwest	12.5000	13.7804	0.5700	0.7000	0.7700	47.6298	(81)
Northeast	1.0200	22.2520	0.6400	0.7000	1.0000	9.1515	(82)
Northwest	1.0200	22.2520	0.6400	0.7000	1.0000	9.1515	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	787.9300	1209.8559	1743.2923	2453.6919	2748.6884	3050.0951	2807.2818	2495.1120	2088.9880	1425.5463	913.8142	647.3659	(83)
Total gains	1766.2637	2184.8141	2685.7341	3337.1737	3571.5619	3819.1451	3545.0438	3237.4681	2862.8663	2254.4788	1808.0212	1598.0134	(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	59.5244	60.0175	60.0175	60.5189	60.3508	61.0287	60.8578	61.2005	61.2005	60.6879	60.6879	60.1837	
alpha	4.9683	5.0012	5.0012	5.0346	5.0234	5.0686	5.0572	5.0800	5.0800	5.0459	5.0459	5.0122	
util living area	0.9905	0.9739	0.9185	0.7559	0.5666	0.3477	0.2557	0.2784	0.5156	0.8515	0.9751	0.9938	(86)
Living	20.5384	20.6044	20.6951	20.7801	20.8077	20.8161	20.8161	20.8169	20.8137	20.7635	20.6401	20.5251	
Non living	19.5154	19.6049	19.7153	19.8166	19.8403	19.8567	19.8540	19.8597	19.8579	19.8047	19.6593	19.5072	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	17	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	14	28	21	0	0	0	0	0	0	0	0	31	
MIT	20.8819	20.7760	20.7847	20.7801	20.8077	20.8161	20.8161	20.8169	20.8137	20.7635	20.6401	20.7310	(87)
Th 2	20.0714	20.0783	20.0783	20.0852	20.0829	20.0922	20.0899	20.0945	20.0945	20.0875	20.0875	20.0806	(88)
util rest of house	0.9877	0.9668	0.8985	0.7124	0.5088	0.2886	0.1912	0.2085	0.4418	0.8078	0.9667	0.9919	(89)
MIT 2	19.9605	19.8693	19.8526	19.8166	19.8403	19.8567	19.8540	19.8597	19.8579	19.8047	19.6593	19.8275	(90)
Living area fraction										fLA = Living area / (4) =		0.3547	(91)
MIT	20.2874	20.1909	20.1833	20.1584	20.1835	20.1970	20.1953	20.1992	20.1969	20.1448	20.0072	20.1480	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2874	20.1909	20.1833	20.1584	20.1835	20.1970	20.1953	20.1992	20.1969	20.1448	20.0072	20.1480	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9884	0.9678	0.9010	0.7161	0.5153	0.2955	0.1987	0.2166	0.4503	0.8109	0.9659	0.9920	(94)
Useful gains	1745.8462	2114.3543	2419.9234	2389.7935	1840.4948	1128.4590	704.2886	701.2581	1289.2545	1828.1377	1746.2903	1585.3063	(95)
Ext temp.	5.4000	5.9000	7.5000	9.9000	12.8000	15.7000	17.4000	17.4000	15.0000	11.7000	8.3000	5.4000	(96)
Heat loss rate W	3835.8282	3651.9004	3241.0721	2599.7125	1876.3460	1130.1207	704.4480	701.4903	1302.3487	2134.1428	2958.6124	3758.2934	(97)
Space heating kWh	1554.9466	1033.2309	610.9347	151.1417	26.6733	0.0000	0.0000	0.0000	0.0000	227.6678	872.8719	1616.7024	(98a)
Space heating requirement - total per year (kWh/year)												6094.1693	
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	1554.9466	1033.2309	610.9347	151.1417	26.6733	0.0000	0.0000	0.0000	0.0000	227.6678	872.8719	1616.7024	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6094.1693	
Space heating per m2											(98c) / (4) =	23.9928	(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 %)	351.6174 (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	1554.9466	1033.2309	610.9347	151.1417	26.6733	0.0000	0.0000	0.0000	0.0000	227.6678	872.8719	1616.7024	(98)
Space heating efficiency (main heating system 1)	351.6174	351.6174	351.6174	351.6174	351.6174	0.0000	0.0000	0.0000	0.0000	351.6174	351.6174	351.6174	(210)
Space heating fuel (main heating system)	442.2268	293.8509	173.7498	42.9847	7.5859	0.0000	0.0000	0.0000	0.0000	64.7487	248.2448	459.7902	(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	241.9796	213.8250	227.4104	201.3069	195.8814	177.3692	176.0212	182.7614	184.4139	204.5178	215.9609	239.5877	(64)
Efficiency of water heater												186.7327	(216)
(217)m	186.7327	186.7327	186.7327	186.7327	186.7327	186.7327	186.7327	186.7327	186.7327	186.7327	186.7327	186.7327	(217)
Fuel for water heating, kWh/month	129.5861	114.5086	121.7839	107.8049	104.8994	94.9856	94.2638	97.8733	98.7582	109.5244	115.6524	128.3052	(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	75.7835	68.4496	75.7835	73.3389	75.7835	73.3389	75.7835	75.7835	73.3389	75.7835	73.3389	75.7835	(231)
Lighting	53.1923	42.6729	38.4222	28.1497	21.7437	17.7648	19.8353	25.7827	33.4891	43.9396	49.6296	54.6707	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-105.3325	-156.6366	-268.8267	-373.2352	-427.4907	-446.3841	-427.5118	-384.0178	-307.5683	-208.1598	-120.4409	-84.6796	(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	-0.6574	-2.2379	-9.1573	-30.0591	-49.6013	-67.7170	-60.9127	-44.9255	-24.7470	-6.9773	-1.3012	-0.3944	(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	1733.1818	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	186.7327	
Water heating fuel used	1317.9458	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.9940)		
mechanical ventilation fans (SFP = 0.9940)	892.2899	(230a)
Total electricity for the above, kWh/year	892.2899	(231)
Electricity for lighting (calculated in Appendix L)	429.2924	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3608.9723	(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	763.7377	(238)

10a. Fuel costs - using BEDF prices (556)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1733.1818	26.0600	451.6672	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1317.9458	26.0600	343.4567	(247)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000	(247a)
Pumps, fans and electric keep-hot	892.2899	26.0600	232.5308	(249)
Energy for lighting	429.2924	26.0600	111.8736	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3310.2841	26.0600	-862.6600	
PV Unit electricity exported	-298.6882	5.8100	-17.3538	
Total			-880.0138	(252)
Total energy cost			259.5144	(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	1733.1818	0.1581	274.0676	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1317.9458	0.1407	185.4841	(264)
Space and water heating			459.5517	(265)
Pumps, fans and electric keep-hot	892.2899	0.1387	123.7716	(267)
Energy for lighting	429.2924	0.1443	61.9602	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3310.2841	0.1314	-435.0153	
PV Unit electricity exported	-298.6882	0.1142	-34.0969	
Total			-469.1122	(269)
Total CO2, kg/year			176.1713	(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	1733.1818	1.5853	2747.6892	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1317.9458	1.5204	2003.7877	(278)
Space and water heating			4751.4770	(279)
Pumps, fans and electric keep-hot	892.2899	1.5128	1349.8562	(281)
Energy for lighting	429.2924	1.5338	658.4631	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3310.2841	1.4855	-4917.3739	
PV Unit electricity exported	-298.6882	0.4182	-124.9231	
Total			-5042.2969	(283)
Total Primary energy kWh/year			1717.4993	(286)

Predicted Energy Assessment

elmhurst energy

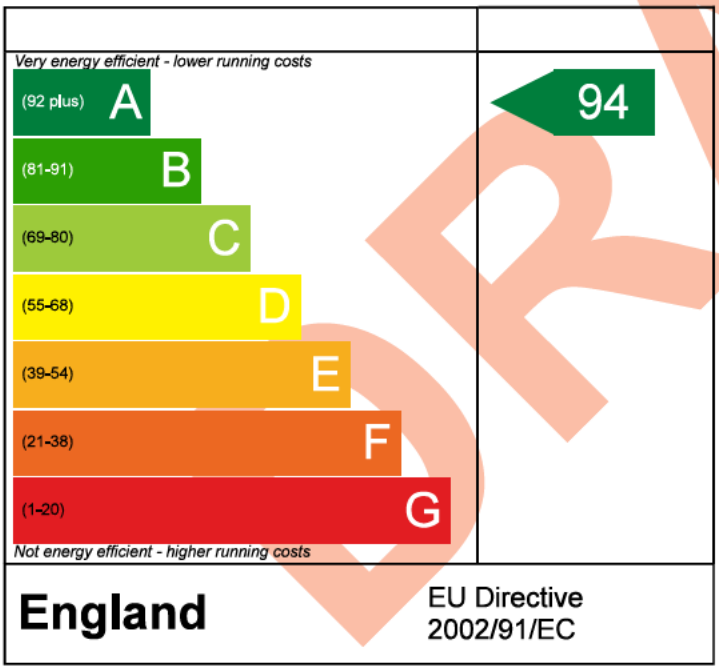
8, Druid Stoke Avenue, Bristol, Avon, BS9 1DD

Dwelling type:	House, Detached
Date of assessment:	23/12/2024
Produced by:	Laura Meehan
Total floor area:	254 m²
DRRN:	

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

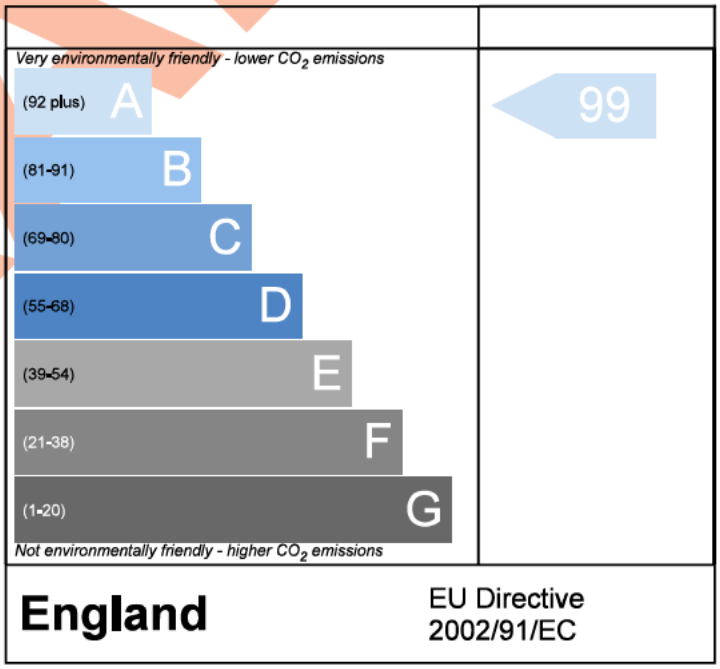
The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

Environmental Impact (CO_2) Rating



The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating the less impact it has on the environment.

DRAFT

Summary for Input Data

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Property Reference	8 Druid Stoke Avenue rev B	Issued on Date	23/12/2024
Assessment Reference	8 Druid Stoke with PV	Prop Type Ref	
Property	8, Druid Stoke Avenue, Bristol, Avon, BS9 1DD		

SAP Rating	94 A	DER	1.20	TER	9.24
Environmental	99 A	% DER < TER			87.01
CO_2 Emissions (t/year)	0.18	DFEE	47.63	TFEE	48.89
Compliance Check	See BREL	% DFEE < TFEE			2.58
% DPER < TPER	76.02	DPER	11.85	TPER	49.42

Assessor Details	Ms. Laura Meehan	Assessor ID	Z762-0001
Client	Kathy Ashby, Kathy Ashby		

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	Southeast	
Property Tenture	ND	
Transaction Type	6	
Terrain Type	Urban	
1.0 Property Type	House, Detached	
2.0 Number of Storeys	2	
3.0 Date Built	2025	
4.0 Sheltered Sides	3	
5.0 Sunlight/Shade	Average or unknown	
6.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	217.37	kJ/m²K
7.0 Electricity Tariff	Standard	
Smart electricity meter fitted	Yes	
Smart gas meter fitted	Yes	

7.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground floor:	67.30 m	144.00 m²	3.20 m
1st Storey:	60.00 m	110.00 m²	2.50 m

8.0 Living Area 90.10 m²

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area(m²)	Nett Area (m²)	Shelter Res	Shelter	Openings	Area Calculation Type
External Wall 1	Cavity Wall	Cavity wall : dense plaster, dense block, filled cavity, any outside structure	0.17	190.00	283.50	200.50	0.00	None	83.00	Enter Gross Area

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area(m²)	Nett Area (m²)	Shelter Code	Shelter Factor	Calculation Type	Openings
External Roof 1	External Plane Roof	Plasterboard, insulated at ceiling level	0.10	9.00	34.00	31.96	None	0.00	Enter Gross Area	2.04
External Roof 2	External Flat Roof	Plasterboard, insulated flat roof	0.13	9.00	110.00	110.00	None	0.00	Enter Gross Area	0.00

11.0 Heat Loss Floors

Description	Type	Storey Index	Construction	U-Value (W/m²K)	Shelter Code	Shelter Factor	Kappa (kJ/m²K)	Area (m²)
Heatloss Floor 1	Ground Floor - Solid	Lowest occupied	Slab on ground, screed over insulation	0.13	None	0.00	110.00	144.00

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Filling Type	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Opening Type 1	Manufacturer	Solid Door				0.00			0.79
Opening Type 2	Manufacturer	Window	Triple Low-E Soft 0.05			0.57		0.70	1.10
Opening Type 3	Manufacturer	Roof Light	Triple Low-E Hard 0.2			0.64		0.70	1.00

13.0 Openings

Name	Opening Type	Location	Orientation	Area (m²)	Pitch
Opening	Opening Type 2	External Wall 1	South West	21.61	
Opening	Opening Type 2	External Wall 1	North East	14.50	

Summary for Input Data

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Opening	Opening Type 2	External Wall 1	South East	34.39	
Opening	Opening Type 3	External Roof 1	North West	1.02	30
Opening	Opening Type 3	External Roof 1	North East	1.02	30
Opening	Opening Type 2	External Wall 1	North West	12.50	

14.0 Conservatory	None	
15.0 Draught Proofing	100	%
16.0 Draught Lobby	No	

17.0 Thermal Bridging	Calculate Bridges	

17.1 List of Bridges

Bridge Type	Source Type	Length	Psi	Adjusted Reference:	Imported
E5 Ground floor (normal)	Gov Approved Scheme	67.00	0.08	0.08	No
E6 Intermediate floor within a dwelling	Gov Approved Scheme	60.00	0.10	0.10	No
E16 Corner (normal)	Gov Approved Scheme	22.40	0.02	0.02	No
E2 Other lintels (including other steel lintels)	Gov Approved Scheme	48.05	0.04	0.04	No
E3 Sill	Gov Approved Scheme	48.05	0.04	0.04	No
E4 Jamb	Gov Approved Scheme	124.00	0.04	0.04	No
E10 Eaves (insulation at ceiling level)	Gov Approved Scheme	67.00	0.09	0.09	No

Y-value	0.05	W/m²K

19.0 Mechanical Ventilation

Mechanical Ventilation

Mechanical Ventilation System Present	Yes
Approved Installation	No
Mechanical Ventilation data Type	Database
Type	Balanced mechanical ventilation with heat recovery
MV Reference Number	500142
Configuration	2
Manufacturer SFP	0.71
Duct Type	Rigid
MVHR Efficiency	88.00
Wet Rooms	2
SFP from Installer Commissioning Certificate	No
MVHR System Location	Inside heated envelope (installed exclusively)
Duct Installation Specification	Level 1

20.0 Fans, Open Fireplaces, Flues

Number of open chimneys	0
Number of open flues	0
Number of chimneys/flues attached to closed fire	0
Number of flues attached to solid fuel boiler	0
Number of flues attached to other heater	0
Number of blocked chimneys	0
Number of intermittent extract fans	0
Number of passive vents	0
Number of flueless gas fires	0

21.0 Fixed Cooling System	No	

22.0 Pressure Testing	Yes	
Designed AP_{50}	3.00	m³/(h.m²) @ 50 Pa
Test Method	Blower Door	

22.0 Lighting

No Fixed Lighting	No

Name	Efficacy	Power	Capacity	Count
Lighting 1	93.75	8.00	750.00	15

24.0 Main Heating 1	Database	

Summary for Input Data

elmhurst energy

Percentage of Heat	100.00	%
Database Ref. No.	104638	
Fuel Type	Electricity	
In Winter	351.64	
In Summer	186.74	
Model Name	Ecodan 6.0 kW	
Manufacturer	Mitsubishi Electric Europe B.V.	
System Type	Heat Pump	
Controls SAP Code	2207	
Is MHS Pumped	Pump in heated space	
Heating Pump Age	2013 or later	
Heat Emitter	Radiators and Underfloor	
Underfloor Heating	Yes - Pipes in Concrete	
Flow Temperature	Enter value	
Flow Temperature Value	35.00	

25.0 Main Heating 2 — None

26.0 Heat Networks — None

	Heat Source	Fuel Type	Heating Use	Efficiency	Percentage Of Heat	Heat	Heat Power Ratio	Electrical	Fuel Factor	Efficiency type
Heat source 1	None									
Heat source 2	None									
Heat source 3	None									
Heat source 4	None									
Heat source 5	None									

27.0 Secondary Heating — None

28.0 Water Heating

Water Heating	Main Heating 1
SAP Code	901
Flue Gas Heat Recovery System	No
Waste Water Heat Recovery Instantaneous System 1	Yes
Waste Water Heat Recovery Instantaneous System 2	No
Waste Water Heat Recovery Storage System	No
Solar Panel	No
Water use <= 125 litres/person/day	Yes
Cold Water Source	From mains
Bath Count	1
Immersion Only Heating Hot Water	No

28.1 Showers

Description	Shower Type	Flow Rate [l/min]	Rated Power [kW]	Connected	Connected To
shower	Vented hot water system	10.00		Yes	Instantaneous System 1

28.3 Waste Water Heat Recovery System Instantaneous System 1

Database ID	80047
Brand Model	Power-pipe, R4-120
Details	Year: 2011 + current Efficiency: 73.65 Utilisation factor: 0.879

29.0 Hot Water Cylinder — Hot Water Cylinder

Cylinder Stat	Yes
Cylinder In Heated Space	Yes
Independent Time Control	Yes

Summary for Input Data

elmhurst energy

Insulation Type	Measured Loss	
Cylinder Volume	200.00	L
Loss	1.40	kWh/day
Pipes insulation	Fully insulated primary pipework	
In Airing Cupboard	No	

31.0 Thermal Store — None

32.0 Photovoltaic Unit — One Dwelling

Export Capable Meter?	Yes
Connected To Dwelling	Yes
Diverter	No
Battery Capacity [kWh]	9.60

PV Cells kWp	Orientation	Elevation	Overshading	FGHRS	MCS Certificate	Overshading Factor	MCS Certificate Reference	Panel Manufacturer
4.00	South West	30°			Yes	1.00		

34.0 Small-scale Hydro — None

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

	Typical Cost	Typical savings per year	Ratings after improvement	
			SAP rating	Environmental Impact
			A 95	A 99
			0	0
			0	0

Appendix B Flood Risk

Flood map for planning

Your reference	Location (easting/northing)	Created
<Unspecified>	**355956/176215**	**2 Feb 2024 13:30**

Your selected location is in flood zone 1, an area with a low probability of flooding.

You will need to do a flood risk assessment if your site is **any of the following:**

- bigger that 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

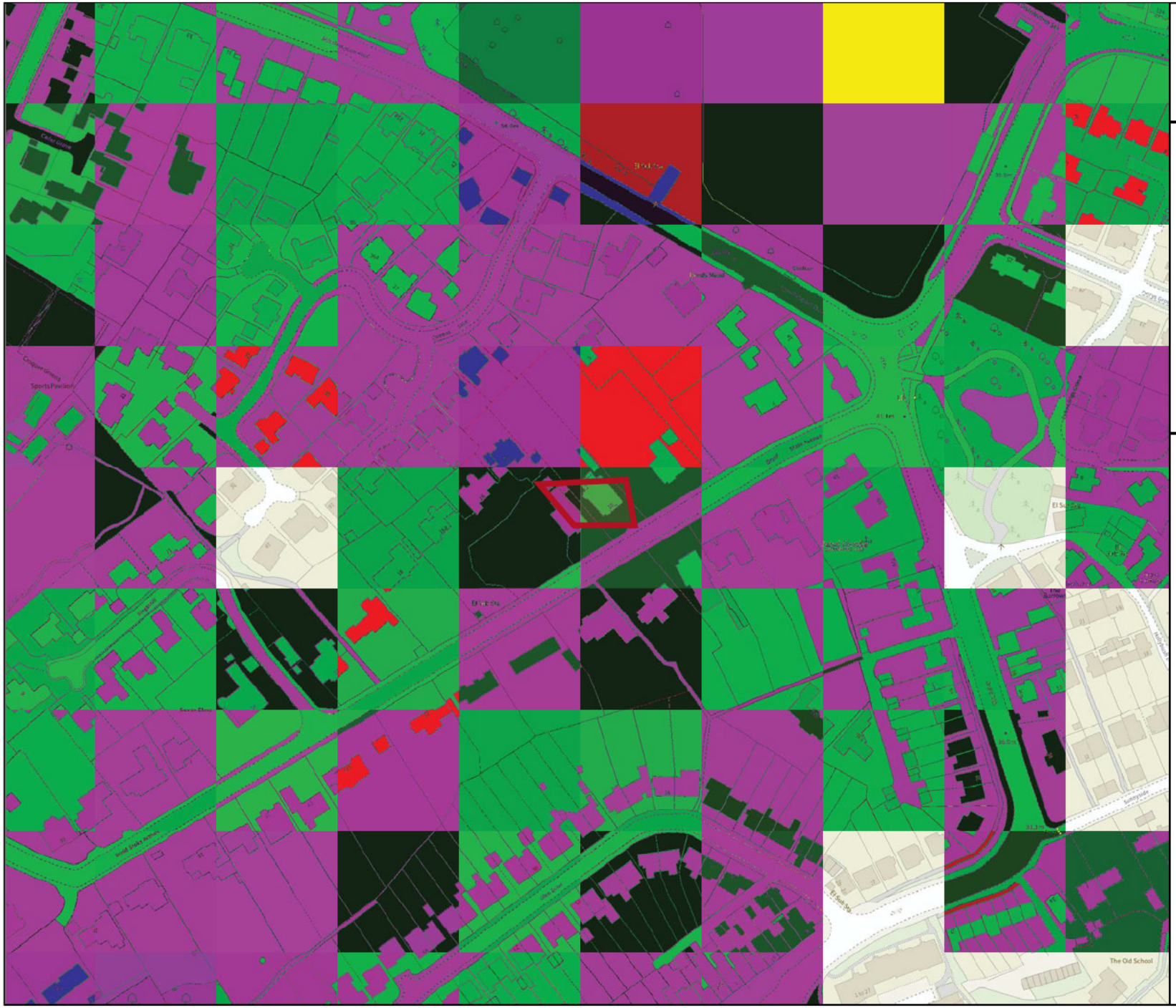
Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Flood risk data is covered by the Open Government Licence **which** sets out the terms and conditions for using government data. https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/

Use of the address and mapping data is subject to Ordnance Survey public viewing terms under Crown copyright and database rights 2022 OS 100024198. https://flood-map-for-planning.service.gov.uk/os-terms



Environment Agency

Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
355956/176215

Scale
1:2500

Created
2 Feb 2024 13:30

- Selected area
- Flood zone 3
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Water storage area

0 20 40 60m

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Appendix C Broadband

Ofcom (https://www.ofcom.org.uk/)
making communications work for everyone

Mobile and broadband checker English (/en-gb/broadband-coverage) | Cymraeg (/cy-gb/broadband-coverage)

View broadband availability

Use of this checker is subject to Ofcom's terms of use (https://www.ofcom.org.uk/about-ofcom/website/terms-of-use)

Please enter your postcode to see the broadband services that are present at your location, or click the button to enable the site to find your location

BS91DD

Change Location

8, DRUID STOKE AVENUE

The speeds indicated on the checker are the fastest estimated speeds predicted by the network operator(s) providing services in this area. Actual service availability at a property or speeds received may be different. More information (https://checker.ofcom.org.uk/en-gb/about-checker).

The table shows the predicted broadband services in your area.

Broadband type	Highest available download speed	Highest available upload speed	Availability
Standard	19 Mbps (Megabits per second)	1 Mbps (Megabits per second)	✓
Superfast	80 Mbps (Megabits per second)	20 Mbps (Megabits per second)	✓

Broadband type	Highest available download speed	Highest available upload speed	Availability
Ultrafast	1000 Mbps (Megabits per second)	100 Mbps (Megabits per second)	✓

Networks in your area - Virgin Media (https://www.virginmedia.com/), Openreach (https://www.openreach.com)

Click on a network's name to be directed to a website where you can find out about service availability and how to request a service from them or one of their partners.

You may be able to obtain broadband service from these Fixed Wireless Access providers covering your area.

EE (https://ee.co.uk/), Three (https://www.three.co.uk/)

Find out what these results mean

About this broadband checker

Feedback

Accessibility Statement (https://www.ofcom.org.uk/about-ofcom/website/accessibility-checker)

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