GWP Architecture

Energy and Sustainability Statement

Proposal for 19 new dwellings @ Healey Lane, Batley, Kirklees.

10 June 2024

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1 Executive Summary

This Energy and Sustainability Statement has been prepared by Watt Energy on behalf of GWP Architecture to support a planning application for the development of 19 new build dwellings at Healey Lane, Batley, Kirklees. The statement specifically addresses the following Kirklees Council Policy LP26 and the National Planning Policy Framework including:

- SAP calculations to comply with building regulations Part L and predict regulated CO2 Emissions.
- Implementation of an Energy Hierarchy prioritizing energy efficiency.
- Assessing sustainable design and construction measures.

The statement details how the development will incorporate sustainable design and resource efficiency in line with the Energy Hierarchy, so to meet the policy requirements and council targets whilst reducing its overall environmental impact.

In relation to the planning documents and policies outlined above, the development is required to achieve Part L Compliance and compliance with Policy LP26 set out in Kirklees statement in carbon emissions over the residual emissions, calculated throughout the stages of the Energy Hierarchy, and through the implementation of renewable and low/zero carbon technologies.

To achieve this compliance, the development has been designed with a holistic low energy design concept involving a fabric first approach and utilising electric panel heating and an Air Source Heat Pump Hot Water Cylinder (ASHP HW) to satisfy the space heating and hot water requirements. The U-values, design air permeability and ventilation targets all aspire to achieve Part L 2022 standards along with the consideration and application of low zero carbon renewable technologies.

Following the LZC feasibility assessment, it is proposed that the development will benefit from a **1.6 kWp PV array** per dwelling that will be implemented on the main sloped roof areas for a total of 19 dwellings.

As a result of the above the predicted site wide reduction in CO_2 over Part L 2022 of the Building Regulations can be summarised as:

- **60.7%** with SAP 10.1 carbon factors (proposed improvements to Part L)

In relation to the planning target centred around carbon emission reduction, the proposed development is achieving a **22.9%** reduction over the residual emissions overall from low zero carbon technologies. This surpasses Kirklees City Council's planning targets and therefore allows compliance to be reached.

2 Planning Statement

The following statement relates to the proposed development at Healey Lane, Batley, Kirklees.

The Site and Proposed Development

The site is located to northeast of the Huddersfield. It is bound by Malham drive to the east and Linton Avenue to the northwest. A plan, with the site's extents denoted by the red outline seen in Figure 1 (shown later in this subsection).

The proposal is for a residential development consisting of 19 new two storey houses. The proposed dwellings consist of 2B3P homes, 3B4P homes both semi-detached and terraced. Also provided will be associated ancillary facilities including parking spaces.

Figure 1: Proposed Site Plan

2.1 Relevant Policies and Guidance

2.1.1 Local Planning Policy

2.1.1.1 Kirklees Core Strategy

This report is a resultant production in response to Kirklees City Council's Development Framework Core Strategy, covering Climate Change and Sustainability.

Council Plan Summary

Policy LP1

Policy LP1

Presumption in favour of sustainable development

When considering development proposals, the council will take a positive approach that reflects the presumption in favour of sustainable development contained in the National Planning Policy Framework. The council will always work pro-actively with applicants jointly to find solutions which mean that proposals can be approved wherever possible, and to secure development that improves the economic, social and environmental conditions in the area.

Proposals that accord with the policies in the Kirklees Local Plan (and, where relevant, with policies in neighbourhood plans) will be approved without delay, unless material considerations indicate otherwise.

Where there are no policies relevant to the proposal or relevant policies are out of date at the time of making the decision then the council will grant permission unless material considerations indicate otherwise – taking into account whether:

a. any adverse impacts of granting permission would significantly and demonstrably outweigh the benefits, when assessed against the policies in the National Planning Policy Framework taken as a whole; or
b. specific policies in that Framework indicate that development should be restricted.

Policy LP5

Policy LP5

Masterplanning sites

Masterplans must involve all the relevant stakeholders, including the council, landowners, developers, the local community, service providers and other interested parties. Masterplans will be developed in consultation with the council prior to the submission of a planning application. Masterplans would only be sought where feasible and appropriate.

Masterplans will be expected to achieve the following (proportionate to the scale of development):

a. an indicative development layout and phasing and implementation plan;
b. high standards of design that respect the character of the landscape, heritage, adjacent and nearby settlements and built development, reflecting the urban to rural transition with appropriate boundary treatment;
c. make effective use of the site through the application of appropriate densities in terms of scale, height and massing, and its relationship to adjoining buildings and landscape;
d. create a strong sense of place, ensuring the proposed development makes a positive contribution to local character and distinctiveness;
e. plan for integrated development, providing for a mix of housing that addresses the range of local housing needs, and encourages community cohesion;
f. reduce the need for car use and encourage sustainable modes of travel, including provision for public transport, cycle routes, footpaths and bridleways and electric charging points;
g. a network of permeable and interconnected streets and public spaces;
h. measures to mitigate the traffic impacts of the proposed development on the strategic and local road networks;

Policy LP26

Policy LP26

Renewable and low carbon energy

Renewable and low carbon energy proposals (excluding wind) will be supported and planning permission granted where the following criteria are met:

a. the proposal would not have an unacceptable impact on landscape character and visual appearance of the local area, including the urban environment;
b. the proposal would not have either individually or cumulatively an unacceptable impact on protected species, designated sites of importance for biodiversity or heritage assets;
c. the statutory protection of any area would not be compromised by the development;
d. any noise, odour, traffic or other impact of development is mitigated so as not to cause unacceptable detriment to local amenity;
e. any significant adverse effects of the proposal are mitigated by wider environmental, social and economic benefits.

Where the above criteria are met, the council encourages dialogue with local community groups promoting community renewable and low carbon energy schemes.

The creation of district heat networks is encouraged across Kirklees. Heat networks can be developed at different scales and all new developments should consider their potential. Proposals requiring a master plan should explore the potential of developing a heat network, or connecting to an existing network.

2.1.2 National Planning Policy

The NPPF (revised December 2023) sets out the Government's planning policies for England and how these are expected to be applied. The overall emphasis of the NPPF is to reiterate the Government's key objectives, including securing sustainable development.

The NPPF defines the purpose of the planning system as being to contribute to the achievement of sustainable development. It explains at Paragraph 8 that there are three dimensions to sustainable development. These are economic, social and environmental and should be pursued simultaneously through the planning system.

Paragraph 10 states that at the heart of the Framework is a presumption in favour of sustainable development.

2.2 Sustainable Design Strategy

2.2.1 Energy and Carbon Emissions

Building Services Strategy

In response to the policy requirements and climate change plan targets set out in section 2.2, developments should aim to assist and achieve the following carbon reduction targets:

- Comply with building regulations Part L and predict regulated CO2 Emissions

To achieve the most accurate calculations and estimates, the proposed dwelling has been modelled using *SAP 2010* the governments Standard Assessment Procedure for residential dwellings.

The proposed strategy for minimising energy use and carbon emissions is based on the energy hierarchy described in CIBSE Guide F 2012 (Energy efficiency in buildings). The energy hierarchy has been adopted for the development to ensure that the correct approach to design is taken to promote an energy-efficient low carbon solution (see figure 2). This has ensured that the benefits of effective methods of energy use reduction have been maximised first. The approach adopted is as follows:

Fig 2: Energy Hierarchy

Minimise energy demand – Implement passive design measures and optimise the building envelope in terms of orientation, air tightness, and insulation. For example, the proposal is targeting a low carbon classification through a holistic low energy design concept as it will be designed with a fabric first approach.

Meet demands efficiently – Specification of energy efficient decentralised plant, heating, ventilation, lighting, and system controls to facilitate efficient operation.

Particular attention is being paid to the wellbeing of occupants. The ventilation strategy has been developed to minimise noise ingress from the proposed location as far as possible while minimising the risk of overheating.

Additional Renewable Energy Measures

Opportunities for incorporating low and zero carbon technologies (LZCT) have been considered for this development. The viability of several separate technologies was examined in a LZCT study (see section 3) which helped to identify potential opportunities for the inclusion of PV panels.

Efficient and Sustainable Design Measures

In line with the above Sustainable Design Strategy, the following Energy Efficient design measures are specified.

- High levels of insulation throughout with minimal thermal bridges
- Passive solar gains and internal heat sources
- Excellent level of airtightness
- Good indoor air quality by openable windows

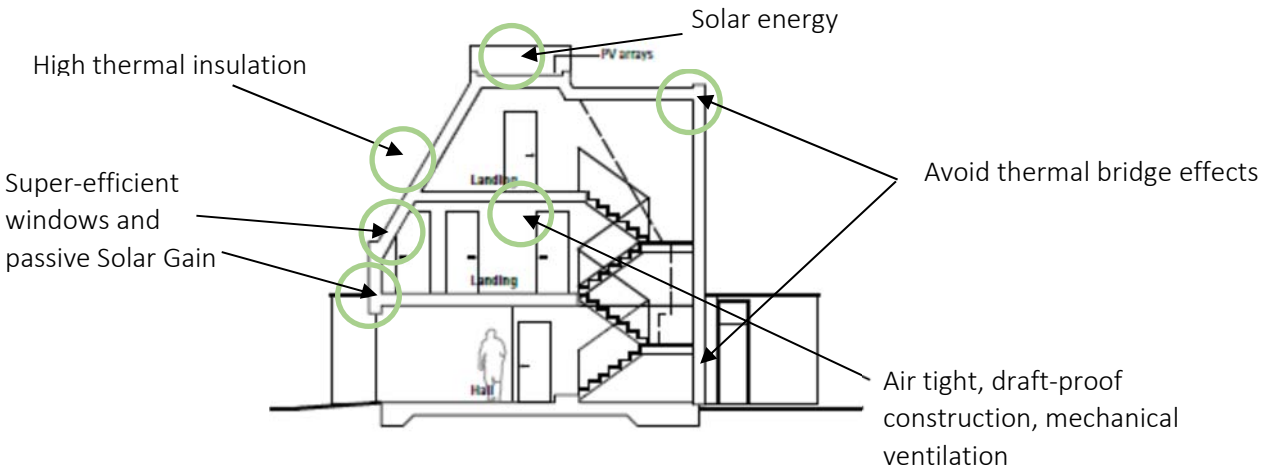


Fig 3. Efficient Design Measure examples

The Proposed specifications and key energy efficient design measures are as follows:

Residential Units:

- Ground floor U-values of 0.12 W/m²K
- External Wall U-values of 0.14 W/m²K
- Pitched Roof U-values of 0.10 W/m²K
- Low Double-Glazed Window U-values of 1.3 W/m²K
- 100% low energy lighting throughout
- Electric Panel heaters to satisfy Space Heating
- ASHP HW to satisfy the hot water heating
- Air Permeability Rate of 3m³/hm² with Centralized Mechanical Extract Ventilation
- Waste Water Heat Recovery System
- 1.6 kWp PV per dwellings implemented on the main sloped roof areas

2.2.2 Choice and Impact of Renewable Technology

All reasonable technologies were investigated for their suitability to the site and development; please refer to section 3 for details.

In addition to energy efficiency measures, it is proposed that the development will feature the following Low/Zero carbon Technologies:

- 1.6 kWp per dwelling PV Array (Approx. 4 no. 330W Panels each) implemented onto the sloped roofs

The above LZC contribution has provided an 22.9% reduction in CO2 following Energy Efficiency Measures.

- Energy Saving from onsite LZC Technologies = 15513.4 kWh/Yr
- CO2 Saving from onsite LZC Technologies = 2109.8 kgCO2/Yr

2.2.3 Energy and CO_2 Reduction Summary

A summary of all stages of the energy demand assessment from baseline figures to final carbon reduction are shown in Figures 1 & 2 below:

Summary of CO2 Emission Reductions	Total CO2 emissions (kgCO2/year)
Carbon Factors (Gas / Electric)	0.210 / 0.136
Baseline emissions	18129.9
Improved emissions (after incorporation of efficient energy supply)	9228.7
Improved emissions (after incorporation of renewable energy technology) % CO2 displaced in total	7118.9
% CO2 displaced in total	60.7%
% CO2 displaced by efficient supply of energy	49.10%
% CO2 displaced by renewable energy	22.9%

Table 1: Summary of CO2 Reductions

	Energy Demand (kWh pa)	Energy saving achieved (%)	Regulated CO_2 emissions (kg pa)	Saving achieved on resi dual CO_2 emissions (%)
Building Regulations Part L compliance ("Baseline" energy demand & emissions)	74121.7		18129.9	
Proposed scheme after clean energy supply	67858.4	8.4%	9228.7	**49.1%**
Proposed scheme after on-site renewables	52345.0	22.9%	7118.9	**22.9%**
Total savings on residual emissions				**22.9%**

Table 2. Total Energy and Carbon Emissions Savings Based on Carbon Factors

For a full Breakdown of the figures and calculations please see Appendix A – Energy Demand Assessment Spreadsheet.

Baseline energy demand

'Standard Assessment Procedure - SAP 2012' was used to produce example SAP reports to generate the figures used within the calculations.

Baseline energy demand (kWh pa)	74121.7
Regulated emissions (kg pa)	18129.9

Be Lean stage

The following table demonstrates how the development achieves the reduction in carbon dioxide emissions from energy efficiency measures.

Energy savings from energy efficiency measures (kWh pa)	---
Emission savings from energy efficiency measures (kg pa)	--
Total regulated emissions after CHP savings and energy efficiency measures (kg pa) ("residual emissions")	--

Be Clean stage

The heating and cooling hierarchy has been applied to the design process of the development. It has resulted in large focus on energy efficiency measures and as can be seen in Figure 1.

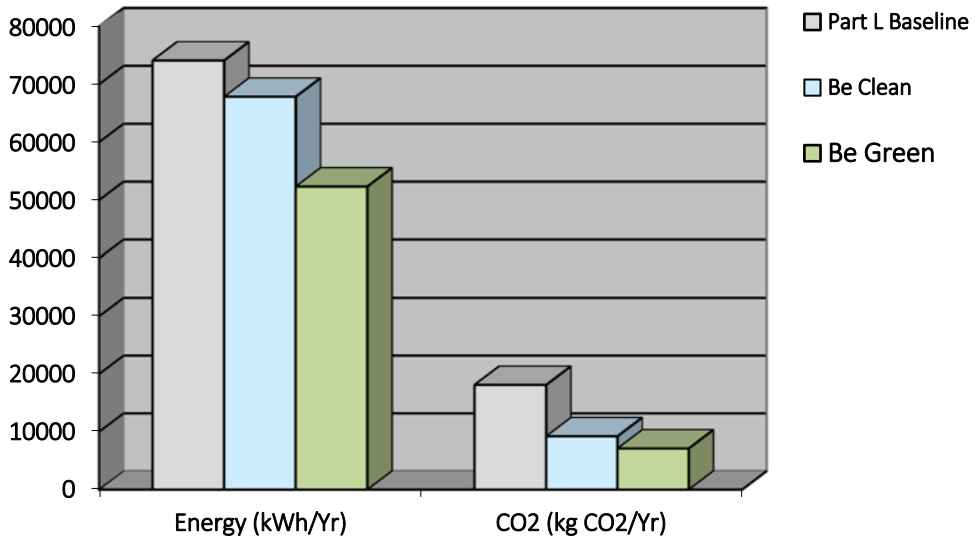
Energy savings from the use of CHP systems (kWh pa)	6263.2
Emission savings from the use of CHP systems (kg pa)	8901.2
Total regulated emissions after CHP savings (kg pa)	9228.7

On-site renewables

The following table demonstrates how the development achieves the reduction in carbon dioxide emissions from LZC technologies.

Energy saving from the use of renewables (kWh)	15513.4
Saving on residual emissions from the use of renewables (kg)	2109.8
Saving on residual emissions from the use of renewables (%)	22.9%

The chart below illustrates the improvements over the Part L Compliant Baseline:



3 Feasibility Assessment of Renewable Energy and Low Carbon Technologies

Solar Hot Water (Thermal)

Solar water heating systems are one of the more familiar renewable technologies used at the moment. They use the energy from the sun to heat water, most commonly for hot water needs. Solar heating systems use a heat collector that is usually mounted on a roof in which the sun heats a fluid. This fluid is used to heat water that is stored in either a separate hot water cylinder or in a twin-coil hot water cylinder (the second coil is used to provide additional heating from a boiler or other heat source).

Solar hot water panels could be used however, PV will provide slightly better savings and avoid the need for water storage cylinders when compared.

Renewable Technology Not Chosen.

Photovoltaic Panels (PV)

Photovoltaic modules convert sunlight directly to DC electricity. The solar cells consist of a thin piece of semiconductor material, in most cases of silicon. Through a process called doping, very small amounts of impurities are added to the semiconductor, which creates two different layers called n-type and p-type layers.

Certain wavelengths of light are able to ionize the silicon atoms, which separates some of the positive charges (holes) from the negative charges (electrons). The holes move into the positive or p-layer and the electrons into the negative or n-layer. These opposite charges are attracted to each other, but most of them can only re-combine by the electrons passing through an external circuit, due to an internal potential energy barrier. This flow of electrons produces a DC current.

A PV array can be mounted on the suitable roof space. The amount proposed at this stage is **1.6 kWp Site Wide PV Array per dwelling (Approx. 4no. 330W Panels) implemented onto the main sloped roof areas.**

Chosen Renewable Technology

Ground Source Heat pumps

A heat pump is a device that takes up heat at a certain temperature and releases it at a higher temperature. The essential components of a heat pump are heat exchangers (through which energy is extracted and emitted) and a means of pumping heat between the exchangers. The effectiveness of the heat pump is measured by the ratio of the heating capacity to the effective power input, usually known as the coefficient of performance (COP). Ground-source heat pumps (GSHP) extract heat from the ground. They are classified as either water-to-air or water-to-water units depending on whether the heat distribution system in the building uses air or water. Ground source heat pumps either use long shallow trenches or deep vertical boreholes to take low grade heat from the ground and then compress it to create higher temperatures.

Ground source heat pumps would not be suitable due to the lack of land space around the properties and the associated costs.

Renewable Technology Not Viable

Air Source Heat pumps

Air source heat pumps absorb heat from the outside air. This is usually used to heat radiators, underfloor heating systems, or warm air convectors and hot water in your home. An air source heat pump extracts heat from the outside air in the same way that a fridge extracts heat from its inside.

The system performs down to air temperatures of -20°c which means that they are more than suitable for installations within the UK. Hot water and Heating can be provided 365 days a year. The hot water is produced without the aid of electrical immersions and at 55°c is more than hot enough for baths and showers.

There are two main types of air source heat pump system:

- An air-to-water system distributes heat via your wet central heating system. Heat pumps work much more efficiently at a lower temperature than a standard boiler system would. So they are more suitable for under-floor heating systems or larger radiators, which give out heat at lower temperatures over longer periods of time.
- An air-to-air system produces warm air which is circulated by fans to heat your home. They are unlikely to provide you with hot water as well.

Air Source heat pump Hot water units are a good option to provide hot water heating demand and are a low carbon source for the proposed dwelling.

Chosen Renewable Technology

Biomass Heating

Biomass is any plant-derived organic material that renews itself over a short period.

Biomass energy systems are based on either the direct or indirect combustion of fuels derived from those plant sources. The most common form of biomass is the direct combustion of wood in treated or untreated forms. The use of biomass is becoming increasingly common in some European countries.

The environmental benefits relate to the significantly lower amounts of energy used in biomass production and processing compared to the energy released when they are burnt. This can range from a four-fold return for biodiesel to an approximate 20-fold energy return for woody biomass. Biomass-fuels can be used to produce energy on a continuous basis (unlike renewables such as wind or solar energy) and it can be an economic alternative to fossil fuels as it is a potential source of both heat and electricity.

However, Biomass systems have particular design management and maintenance requirements associated with sourcing, transportation and storage and are therefore more commonly used in commercial developments rather than domestic installations. It can be less convenient to operate than mains-supplied fuels such as natural gas and are more management intensive and require expertise in facilities management. Sources of biomass can also fluctuate, so boilers should be specified to operate on a variety of fuels without risk of overheating or tripping out.

A communal biomass system would not be feasible for this development due to the expense associated with the necessary output to heat all dwellings on the site.

Renewable Technology Not Chosen

Wind

Wind turbines convert the kinetic energy in wind into mechanical energy that is then converted to electricity. Turbines are available in a range of sizes and designs and can either be free-standing, mounted on a building or integrated into a building structure.

The wind speed in the area is under the advised minimum and the built-up area means that a wind turbine wouldn't be feasible.

Renewable Technology Not Viable

4 Conclusion

This statement has assessed the proposed development at the Healey Lane, Batley, Kirklees site against the relevant climate change and sustainability policies and targets, as outlined within the Kirklees City Council Core Strategy and building regulations Part L and predict regulated CO2 Emissions, through the following of the energy hierarchy, the modelling of the dwelling in the Elmhurst software and addressing all aspects of a sustainable development. In addition, the proposal has been assessed against national sustainable design definitions to determine how it can be classified.

As part of this process, the development was designed with a fabric first approach; with U-values, design air permeability and ventilation targets all aspiring to exceeding Building Regulations Part L 2022 standards. This approach demonstrates a holistic low energy design concept, involving very low limiting values and thus led to high-energy performance targets.

Furthermore, an LZC feasibility assessment was carried out, with all suitable technologies investigated for their suitability to the site and development. The assessment determined that a 30.4 kWp system can be proposed at this stage, which would equate to 76 No panels and would provide an additional 22.9% reduction in carbon emissions over the residual emissions: bringing the total carbon reduction to 60.7%, when using carbon factors.

The development will also be adapting to climate change by incorporating sustainable drainage measures into the design, protecting existing ecology, enhancing biodiversity where possible and providing cycle storage provision.

In addition to the following of the energy hierarchy through the efficient design and renewable technology measures mentioned and meeting all relevant Kirklees City Council carbon targets the proposal will include a large number of sustainability measures throughout construction and once completed, which will contribute heavily to the development's sustainability performance and accord with the requirements of the NPPF. The key measures to be included and therefore can be taken from this report include:

- The proposal sits within Flood Risk Zone1 and therefore a flood risk assessment need not be carried out.
- A SUDs strategy will be produced to outline all measures to be incorporated that will ensure any additional surface water is collected, treated and removed.
- The development will incorporate green infrastructure in the form of extensive planting involving hedges, trees, sedum/green roofs and ornamental planting that will instil a sense of wellbeing whilst also assisting with offsetting carbon dioxide and balancing local temperatures through evapotranspiration.
- Internal water efficiency will be prioritised by ensuring that efficient water fixtures are proposed so that each dwelling achieves less than 110L per person per day and 'A' rated appliances will be specified where possible.

- Waste minimisation will be targeted from throughout construction and occupational phase. It is targeted that at least 90% of construction waste will be diverted from landfill. Whilst tri-separator refuse shoots will be installed on each floor to promote recycling.
- In addition to targeting Secure by Design accreditation through adoption crime prevention measures, the site layout promotes busy spaces and routes and facilitates natural surveillance. These will therefore reduce the fear of crime and subsequently improving mental health of residents, visitors and workers.
- Prioritising reusing existing materials and locally sourced materials for construction to reduce waste and transportation to landfill in addition and promote a low embodied carbon development.
- When new materials are specified that are not locally attainable then only those that score well on the BRE: The Green Guide to Specification are to be used; to further encourage the use of sustainable materials and reductions in embodied carbon.
- The buildings will have a daylight and sunlight analysis carried out and will aim to achieve high pass rates.
- The proximity of Batley City Centre to the proposed site is highly sustainable in terms of transport and local amenities as it is near a number of public transport nodes including Bedminster Train Station and multiple bus stops providing services to the centre of Batley, as well as a multitude of shops and other local amenities.

As a result of all the above, the proposed sustainable design and energy strategy allows the development to comply with Kirklees City Council's planning policy requirement and building regulations Part L and predict regulated CO2 Emissions and is in line with all targets put forward in their planning documents.

House Type / Name	Mid terrace - 2B3P	Semi-Detached - 2B3P	Semi-Detached - 2B3P	Semi-Detached - 3B4P	Semi-Detached - 3B4P	Mid Terraced - 4B6P	End Terraced - 4B6P	TOTAL (kWh/yr)	SAP 10.2	TOTAL (kgCO2/yr)
Frequency	1	1	1	6	7	1	2	19		
BASELINE Dwelling Emission Rate (TER)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
Main Heating Fuel Requirement (TER)	3,277.35	2,150.15	2,533.58	2,668.37	2,846.88	3,260.99	3,859.32	54879.09	0.210	11524.6
Secondary Main Heating Fuel Requirement (TER)								0	0.136	0.0
Secondary Heating Fuel Requirement (TER)								0	0.136	0.0
Water Fuel Requirement (TER)	2,889.26	2,699.16	2,691.63	2,826.83	2,817.55	2,982.94	2,974.89	53896.6	0.210	11318.3
Electricity Pumps Fans Requirement (TER)	86.00	86.00	86.00	86.00	86.00	86.00	86.00	1634	0.136	222.2
Electricity Lighting Requirement (TER)	235.00	179.95	178.27	196.08	203.22	258.64	258.64	3968.16	0.136	539.7
PV Energy Produced (TER)	-2,351.27	-1,783.34	-1,789.77	-2,107.09	-2,090.78	-2,351.27	-2,351.27	-40256.2	0.136	-5474.8
TOTAL PER DEVELOPMENT								74121.7		18129.9

FINAL Dwelling Emission Rate (DER)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
Main Heating Fuel Requirement (DER)	2,987.11	1,932.46	2,257.61	2,349.62	2,521.38	2,861.85	3,306.28	48398.97	0.136	6582.3
Secondary Main Heating Fuel Requirement (DER)								0	0.136	0.0
Secondary Heating Fuel Requirement (DER)								0	0.136	0.0
Water Fuel Requirement (DER)	741.39	682.66	683.56	721.24	719.63	766.75	766.75	13772.71	0.136	1873.1
Electricity Pumps Fans Requirement (DER)	104.57	67.79	69.53	80.09	79.47	112.65	112.65	1616.67	0.136	219.9
Electricity Lighting Requirement (DER)	263.13	190.05	165.08	192.38	199.68	299.93	299.93	4070.09	0.136	553.5
TOTAL PER DEVELOPMENT								67858.4		9228.7

PV Energy Produced (DER)	-663.52	-619.05	-1,381.79	-756.75	-759.56	-1,381.79	-804.93	-15513.4	0.136	-2109.8
TOTAL PER DEVELOPMENT								52345.0		7118.9

watt

Energy & Consulting Engineers

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 07 Jun 2024 15:45:57

Project Information			
Assessed By	Daniel Watt	Building Type	House, Semi-detached
OCDEA Registration	EES/027301	Assessment Date	2024-06-07

Dwelling Details			
Assessment Type	As designed	Total Floor Area	85 m^2
Site Reference	3B4P (Plot 4)	Plot Reference	Semi-Detached - 3B4P
Address	Healey Lane Healey Lane, Batley, N/A		

Client Details	
Name	GWP Architecture
Company	GWP Architecture
Address	GWP Architecture, g, tbc

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	*11.35 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	5.17 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*59.27 kWh_{PE}/m^2*	
Dwelling primary energy	52.42 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*37.8 kWh/m^2*	
Dwelling fabric energy efficiency	36.9 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*	0.14	Walls (1) (0.14)	OK
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.12	Heatloss Floor 1 (0.12)	OK
Roofs	*0.16*	0.1	Roof (1) (0.1)	OK
Windows, doors, and roof windows	*1.6*	1.3	Opening (1.3)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

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)	75.05	0.14 **(!)**
Ground floor: Heatloss Floor 1, Heatloss Floor 1	42.63	0.12
Exposed roof: Roof (1)	42.3	0.1 **(!)**

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, Window	5.87	North West	0.7	1.3
Opening, Door	2.14	North West	N/A	1.3
Opening, Window	7.23	South East	0.7	1.3
Opening, Half Glazed Door	2.21	South East	N/A	1.3

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	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.03 **(!)**	
External wall	E3: Sill	Calculated by person with suitable expertise	0.04	

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E4: Jamb	Calculated by person with suitable expertise	0.05	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.07	
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.24	
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.09	
External wall	E18: Party wall between dwellings	Calculated by person with suitable expertise	0.06	
Party wall	P1: Ground floor	Calculated by person with suitable expertise	0.16	
Party wall	P4: Roof (insulation at ceiling level)	Calculated by person with suitable expertise	0.24	

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: Room heaters - Electricity	
Efficiency	100.0%
Emitter type	
Flow temperature	
System type	Panel, convector or radiant heaters
Manufacturer	
Model	
Commissioning	
Main heating system 2: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	0.0%
Emitter type	
Flow temperature	
System type	Heat Pump
Manufacturer	Auer
Model	EDL170-520RF
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: N/A	
Capacity	N/A
Declared heat loss	N/A
Primary pipework insulated	N/A
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: Instantaneous	
Efficiency	0.0%
Manufacturer	ITHO UK Ltd
Model	SHRU 50

6 Controls		
Main heating 1 - type: Programmer and room thermostats		
Function		
Ecodesign class		
Manufacturer		
Model		
Main heating 2 - type: Not applicable		
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	120 lm/W	**OK**
External lights control	N/A	

8 Mechanical ventilation		
System type: Centralised mechanical extract		
Maximum permitted specific fan power	*0.7 W/(l/s)*	
Specific fan power	0.22 W/(l/s)	**OK**
Minimum permitted heat recovery efficiency	*N/A*	
Heat recovery efficiency	N/A	**N/A**
Manufacturer/Model	Sentinel Multivent Plus	
Commissioning		

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	1.6 kWp
Orientation	South
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	3B4P (Plot 4)	**Issued on Date**	07/06/2024
Assessment Reference	Semi-Detached - 3B4P	**Prop Type Ref**	Healey lane
Property	Healey Lane, Healey Lane, Batley, England, N/A		

SAP Rating	80 C	**DER**	5.17	**TER**	11.35
Environmental	96 A	**% DER < TER**			54.45
CO_2 Emissions (t/year)	0.45	**DFEE**	36.85	**TFEE**	37.78
Compliance Check	See BREL	**% DFEE < TFEE**			2.45
% DPER < TPER	11.55	**DPER**	52.42	**TPER**	59.27

Assessor Details	Mr. Daniel Watt	**Assessor ID**	AV75-0001
Client			

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	42.3000 (1b)	x	2.4000 (2b)	=	101.5200	(1b) - (3b)
First floor	42.3000 (1c)	x	2.6000 (2c)	=	109.9800	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	84.6000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	211.5000	(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			0	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.1500	(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	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762	(22b)

Mechanical extract ventilation - centralised

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Door			2.1400	1.3000	2.7820			(26)
Window (Uw = 1.30)			13.1000	1.2357	16.1882			(27)
Half Glazed Door			2.2100	1.3000	2.8730			(26a)
Heatloss Floor 1			42.6300	0.1200	5.1156	110.0000	4689.3000	(28a)
External Wall 1	92.5000	17.4500	75.0500	0.1400	10.5070	60.0000	4503.0000	(29a)
Flat roof	42.3000		42.3000	0.1000	4.2300	9.0000	380.7000	(30)
Total net area of external elements Aum(A, m2)			177.4300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.6958			(33)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		9573.0000	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							113.1560	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	9.2000	0.0300	0.2760
E3 Sill	7.1800	0.0400	0.2872

E4 Jamb	38.7000	0.0500	1.9350	
E5 Ground floor (normal)	18.5000	0.1600	2.9600	
E6 Intermediate floor within a dwelling	18.5000	0.0700	1.2950	
E12 Gable (insulation at ceiling level)	8.3000	0.2400	1.9920	
E10 Eaves (insulation at ceiling level)	10.2000	0.0600	0.6120	
E16 Corner (normal)	10.1400	0.0900	0.9126	
E18 Party wall between dwellings	10.1400	0.0600	0.6084	
P1 Party wall - Ground floor	8.3000	0.1600	1.3280	
P4 Party wall - Roof (insulation at ceiling level)	8.3000	0.2400	1.9920	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 14.1982 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 55.8940 (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	34.8975	34.8975	34.8975	34.8975	34.8975	34.8975	34.8975	34.8975	34.8975	34.8975	34.8975	34.8975	(38)
Heat transfer coeff	90.7915	90.7915	90.7915	90.7915	90.7915	90.7915	90.7915	90.7915	90.7915	90.7915	90.7915	90.7915	(39)

Average = Sum(39)m / 12 = 90.7915

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0732	1.0732	1.0732	1.0732	1.0732	1.0732	1.0732	1.0732	1.0732	1.0732	1.0732	1.0732	(40)
HLP (average)												1.0732	
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 2.5444 (42)

Hot water usage for mixer showers

66.8805	65.8754	64.4108	61.6086	59.5406	57.2344	55.9235	57.3770	58.9703	61.4465	64.3090	66.6243	(42a)

Hot water usage for baths

28.8840	28.4551	27.8510	26.7372	25.9032	24.9784	24.4789	25.0787	25.7318	26.7214	27.8581	28.7864	(42b)

Hot water usage for other uses

40.6869	39.2074	37.7279	36.2483	34.7688	33.2893	33.2893	34.7688	36.2483	37.7279	39.2074	40.6869	(42c)

Average daily hot water use (litres/day) 125.4297 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	136.4514	133.5379	129.9897	124.5941	120.2125	115.5020	113.6917	117.2246	120.9505	125.8958	131.3745	136.0976	(44)
Energy conte	216.1057	190.1561	199.7893	170.5631	161.8292	142.0232	137.5002	145.1485	149.1441	170.8394	187.1671	213.0959	(45)

Energy content (annual) Total = Sum(45)m = 2083.3618

Distribution loss (46)m = 0.15 x (45)m

32.4159	28.5234	29.9684	25.5845	24.2744	21.3035	20.6250	21.7723	22.3716	25.6259	28.0751	31.9644	(46)

Water storage loss:

Store volume 173.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.9200 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 1.0368 (55)

Total storage loss

32.1408	29.0304	32.1408	31.1040	32.1408	31.1040	32.1408	32.1408	31.1040	32.1408	31.1040	32.1408	(56)

If cylinder contains dedicated solar storage

32.1408	29.0304	32.1408	31.1040	32.1408	31.1040	32.1408	32.1408	31.1040	32.1408	31.1040	32.1408	(57)
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)
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)

Primary loss / Combi loss

Total heat required for water heating calculated for each month

248.2465	219.1865	231.9301	201.6671	193.9700	173.1272	169.6410	177.2893	180.2481	202.9802	218.2711	245.2367	(62)
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)
-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)
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)
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)

WWHRS / PV diverter / Solar input / FGHRS

Output from w/h

248.2465	219.1865	231.9301	201.6671	193.9700	173.1272	169.6410	177.2893	180.2481	202.9802	218.2711	245.2367	(64)

Total per year (kWh/year) = Sum(64)m = 2461.7938 (64)

12Total per year (kWh/year) 2462 (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

71.8552	63.2269	66.4299	56.7122	53.8082	47.2227	45.7188	48.2619	49.5904	56.8041	62.2330	70.8544	(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	127.2186	127.2186	127.2186	127.2186	127.2186	127.2186	127.2186	127.2186	127.2186	127.2186	127.2186	127.2186	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	121.1846	134.1687	121.1846	125.2241	121.1846	125.2241	121.1846	121.1846	125.2241	121.1846	125.2241	121.1846	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	228.7856	231.1596	225.1770	212.4408	196.3636	181.2532	171.1586	168.7845	174.7671	187.5034	203.5806	218.6909	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.7219	35.7219	35.7219	35.7219	35.7219	35.7219	35.7219	35.7219	35.7219	35.7219	35.7219	35.7219	(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)	-101.7749	-101.7749	-101.7749	-101.7749	-101.7749	-101.7749	-101.7749	-101.7749	-101.7749	-101.7749	-101.7749	-101.7749	(71)
Water heating gains (Table 5)	96.5795	94.0877	89.2875	78.7670	72.3229	65.5871	61.4500	64.8681	68.8756	76.3496	86.4348	95.2344	(72)
Total internal gains	507.7153	520.5816	496.8148	477.5975	451.0367	433.2301	414.9589	416.0029	430.0324	446.2032	476.4051	496.2755	(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	
Southeast	7.2300	36.7938	0.7200	0.7000	0.7700	92.9131	(77)
Northwest	5.8700	11.2829	0.7200	0.7000	0.7700	23.1326	(81)

Solar gains	116.0457	205.3525	301.3816	407.6355	487.8102	498.0172	474.4260	412.5123	337.8470	232.4611	140.3953	98.4055	(83)
Total gains	623.7610	725.9341	798.1964	885.2330	938.8469	931.2473	889.3849	828.5152	767.8795	678.6643	616.8004	594.6811	(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	29.2887	29.2887	29.2887	29.2887	29.2887	29.2887	29.2887	29.2887	29.2887	29.2887	29.2887	29.2887	
alpha	2.9526	2.9526	2.9526	2.9526	2.9526	2.9526	2.9526	2.9526	2.9526	2.9526	2.9526	2.9526	
util living area	0.9559	0.9320	0.8957	0.8212	0.7061	0.5550	0.4249	0.4686	0.6668	0.8545	0.9344	0.9613	(86)
MIT	18.8932	19.2018	19.6224	20.1489	20.5845	20.8529	20.9505	20.9328	20.7379	20.1656	19.4297	18.8160	(87)
Th 2	20.0228	20.0228	20.0228	20.0228	20.0228	20.0228	20.0228	20.0228	20.0228	20.0228	20.0228	20.0228	(88)
util rest of house	0.9492	0.9219	0.8800	0.7939	0.6612	0.4874	0.3391	0.3809	0.6032	0.8260	0.9229	0.9553	(89)
MIT 2	17.5678	17.9546	18.4790	19.1204	19.6265	19.9098	19.9957	19.9837	19.8038	19.1561	18.2477	17.4706	(90)
Living area fraction										fLA = Living area / (4) =		0.2004	(91)
MIT	17.8333	18.2045	18.7081	19.3265	19.8185	20.0988	20.1870	20.1738	19.9910	19.3583	18.4845	17.7402	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.8333	18.2045	18.7081	19.3265	19.8185	20.0988	20.1870	20.1738	19.9910	19.3583	18.4845	17.7402	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9286	0.8976	0.8539	0.7715	0.6510	0.4930	0.3540	0.3951	0.6010	0.8028	0.8991	0.9359	(94)
Useful gains	579.2148	651.5906	681.6150	682.9351	611.1509	459.0698	314.8369	327.3461	461.4852	544.8299	554.5458	556.5489	(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	1228.7129	1207.9380	1108.3892	946.6340	737.0865	499.2424	325.6705	342.6314	534.8487	795.1828	1033.6180	1229.3307	(97)
Space heating kWh	483.2266	373.8654	317.5200	189.8632	93.6961	0.0000	0.0000	0.0000	0.0000	186.2625	344.9320	500.5496	(98a)
Space heating requirement - total per year (kWh/year)												2489.9153	
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	483.2266	373.8654	317.5200	189.8632	93.6961	0.0000	0.0000	0.0000	0.0000	186.2625	344.9320	500.5496	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2489.9153	
Space heating per m2											(98c) / (4) =	29.4316	(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)
Fraction of main heating from main system 2 0.0000 (203)
Fraction of total heating from main system 1 1.0000 (204)
Fraction of total heating from main system 2 0.0000 (205)
Efficiency of main space heating system 1 (in %) 100.0000 (206)
Efficiency of main space heating system 2 (in %) 0.0000 (207)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	483.2266	373.8654	317.5200	189.8632	93.6961	0.0000	0.0000	0.0000	0.0000	186.2625	344.9320	500.5496	(98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)	483.2266	373.8654	317.5200	189.8632	93.6961	0.0000	0.0000	0.0000	0.0000	186.2625	344.9320	500.5496	(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)
Space heating fuel used, main system 2												0.0000	(213)
Water heating													
Water heating requirement	248.2465	219.1865	231.9301	201.6671	193.9700	173.1272	169.6410	177.2893	180.2481	202.9802	218.2711	245.2367	(64)
Efficiency of water heater												302.9550	(216)
(217)m	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	(217)
Fuel for water heating, kWh/month	81.9417	72.3495	76.5559	66.5667	64.0260	57.1462	55.9954	58.5200	59.4967	67.0001	72.0474	80.9482	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	6.2677	5.6611	6.2677	6.0655	6.2677	6.0655	6.2677	6.2677	6.0655	6.2677	6.0655	6.2677	(231)
Lighting	24.7422	19.8491	17.8719	13.0938	10.1140	8.2632	9.2263	11.9927	15.5774	20.4383	23.0851	25.4299	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-32.3707	-49.2856	-75.5509	-88.1899	-94.5034	-81.0900	-79.9720	-74.1096	-63.8451	-56.4990	-36.5252	-27.6146	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year
Space heating fuel - main system 1 2489.9153 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 302.9550
Water heating fuel used 812.5939 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:

(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2860)		
mechanical ventilation fans (SFP = 0.2860)	73.7966	(230a)
Total electricity for the above, kWh/year	73.7966	(231)
Electricity for lighting (calculated in Appendix L)	199.6840	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-759.5560	(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	2816.4338	(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	2489.9153	0.1549	385.6893	(261)
Space heating - main system 2	0.0000	0.0000	0.0000	(262)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	812.5939	0.1411	114.6875	(264)
Space and water heating			500.3768	(265)
Pumps, fans and electric keep-hot	73.7966	0.1387	10.2365	(267)
Energy for lighting	199.6840	0.1443	28.8206	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-759.5560	0.1346	-102.2044	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-102.2044	(269)
Total CO2, kg/year			437.2295	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			5.1700	(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	2489.9153	1.5735	3917.8091	(275)
Space heating - main system 2	0.0000	0.0000	0.0000	(276)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	812.5939	1.5219	1236.6764	(278)
Space and water heating			5154.4855	(279)
Pumps, fans and electric keep-hot	73.7966	1.5128	111.6395	(281)
Energy for lighting	199.6840	1.5338	306.2820	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-759.5560	1.4973	-1137.3049	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-1137.3049	(283)
Total Primary energy kWh/year			4435.1020	(286)
Dwelling Primary energy Rate (DPER)			52.4200	(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	42.3000 (1b)	x	2.4000 (2b)	=	101.5200	(1b) - (3b)
First floor	42.3000 (1c)	x	2.6000 (2c)	=	109.9800	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 84.6000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	211.5000	(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	3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1418	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3918	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3918	(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	0.4996	0.4898	0.4800	0.4310	0.4212	0.3723	0.3723	0.3625	0.3918	0.4212	0.4408	0.4604	(22b)
Effective ac	0.6248	0.6200	0.6152	0.5929	0.5887	0.5693	0.5693	0.5657	0.5768	0.5887	0.5972	0.6060	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Semi-glazed door			2.2100	1.0000	2.2100			(26a)
TER Opening Type (Uw = 1.20)			13.1000	1.1450	15.0000			(27)
Heatloss Floor 1			42.6300	0.1300	5.5419			(28a)
External Wall 1	92.5000	17.4500	75.0500	0.1800	13.5090			(29a)
Flat roof	42.3000		42.3000	0.1100	4.6530			(30)
Total net area of external elements Aum(A, m2)			177.4300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.0539			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 113.1560 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	9.2000	0.0500	0.4600
E3 Sill	7.1800	0.0500	0.3590
E4 Jamb	38.7000	0.0500	1.9350
E5 Ground floor (normal)	18.5000	0.1600	2.9600
E6 Intermediate floor within a dwelling	18.5000	0.0000	0.0000
E12 Gable (insulation at ceiling level)	8.3000	0.0600	0.4980
E10 Eaves (insulation at ceiling level)	10.2000	0.0600	0.6120
E16 Corner (normal)	10.1400	0.0900	0.9126
E18 Party wall between dwellings	10.1400	0.0600	0.6084
P1 Party wall - Ground floor	8.3000	0.0800	0.6640
P4 Party wall - Roof (insulation at ceiling level)	8.3000	0.1200	0.9960

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.0050 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 53.0589 (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	43.6080	43.2697	42.9382	41.3809	41.0896	39.7333	39.7333	39.4821	40.2557	41.0896	41.6790	42.2952	(38)
Heat transfer coeff	96.6669	96.3286	95.9971	94.4398	94.1485	92.7922	92.7922	92.5410	93.3146	94.1485	94.7379	95.3541	(39)
Average = Sum(39)m / 12 =												94.4385	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1426	1.1386	1.1347	1.1163	1.1129	1.0968	1.0968	1.0939	1.1030	1.1129	1.1198	1.1271	(40)
HLP (average)												1.1163	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.5444 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	66.8805	65.8754	64.4108	61.6086	59.5406	57.2344	55.9235	57.3770	58.9703	61.4465	64.3090	66.6243	(42a)
Hot water usage for baths	28.8840	28.4551	27.8510	26.7372	25.9032	24.9784	24.4789	25.0787	25.7318	26.7214	27.8581	28.7864	(42b)
Hot water usage for other uses	40.6869	39.2074	37.7279	36.2483	34.7688	33.2893	33.2893	34.7688	36.2483	37.7279	39.2074	40.6869	(42c)
Average daily hot water use (litres/day)												125.4297	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	136.4514	133.5379	129.9897	124.5941	120.2125	115.5020	113.6917	117.2246	120.9505	125.8958	131.3745	136.0976	(44)
Energy conte	216.1057	190.1561	199.7893	170.5631	161.8292	142.0232	137.5002	145.1485	149.1441	170.8394	187.1671	213.0959	(45)
Energy content (annual)										Total = Sum(45)m =		2083.3618	
Distribution loss (46)m = 0.15 x (45)m	32.4159	28.5234	29.9684	25.5845	24.2744	21.3035	20.6250	21.7723	22.3716	25.6259	28.0751	31.9644	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7527	(55)
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(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	262.7006	232.2419	246.3842	215.6549	208.4241	187.1151	184.0951	191.7434	194.2359	217.4343	232.2589	259.6908	(62)
WWHRS	-30.5750	-27.0408	-28.3155	-23.4464	-21.8512	-18.6982	-17.5266	-18.6378	-19.3459	-22.8067	-25.8372	-30.0088	(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	232.1257	205.2011	218.0687	192.2085	186.5729	168.4169	166.5685	173.1056	174.8901	194.6276	206.4217	229.6820	(64)
										Total per year (kWh/year) = Sum(64)m =		2347.8893	(64)
12Total per year (kWh/year)												2348	(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	109.1311	96.8955	103.7059	92.7857	91.0841	83.2962	82.9947	85.5378	85.6639	94.0800	98.3065	108.1303	(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	127.2186	127.2186	127.2186	127.2186	127.2186	127.2186	127.2186	127.2186	127.2186	127.2186	127.2186	127.2186	(66)

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

	121.1846	134.1687	121.1846	125.2241	121.1846	125.2241	121.1846	121.1846	125.2241	121.1846	125.2241	121.1846 (67)

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

	228.7856	231.1596	225.1770	212.4408	196.3636	181.2532	171.1586	168.7845	174.7671	187.5034	203.5806	218.6909 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	35.7219	35.7219	35.7219	35.7219	35.7219	35.7219	35.7219	35.7219	35.7219	35.7219	35.7219	35.7219 (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)

	-101.7749	-101.7749	-101.7749	-101.7749	-101.7749	-101.7749	-101.7749	-101.7749	-101.7749	-101.7749	-101.7749	-101.7749 (71)

Water heating gains (Table 5)

	146.6816	144.1897	139.3896	128.8690	122.4249	115.6892	111.5521	114.9702	118.9776	126.4516	136.5368	145.3364 (72)

Total internal gains

	560.8173	573.6837	549.9169	530.6995	504.1387	483.3321	465.0609	466.1049	480.1345	499.3052	529.5072	549.3776 (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	
Southeast	7.2300	36.7938	0.6300	0.7000	0.7700	81.2990	(77)
Northwest	5.8700	11.2829	0.6300	0.7000	0.7700	20.2410	(81)

Solar gains	101.5400	179.6834	263.7089	356.6810	426.8339	435.7651	415.1228	360.9483	295.6161	203.4035	122.8459	86.1048	(83)
Total gains	662.3574	753.3671	813.6257	887.3806	930.9726	919.0972	880.1837	827.0532	775.7506	702.7087	652.3530	635.4824	(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	27.5086	27.6052	27.7005	28.1573	28.2444	28.6572	28.6572	28.7350	28.4968	28.2444	28.0687	27.8873	
alpha	2.8339	2.8403	2.8467	2.8772	2.8830	2.9105	2.9105	2.9157	2.8998	2.8830	2.8712	2.8592	
util living area	0.9512	0.9294	0.8968	0.8273	0.7193	0.5678	0.4359	0.4758	0.6708	0.8502	0.9281	0.9559	(86)
MIT	18.7961	19.0929	19.5134	20.0773	20.5344	20.8364	20.9440	20.9268	20.7200	20.1371	19.3954	18.7621	(87)
Th 2	19.9662	19.9694	19.9726	19.9875	19.9903	20.0034	20.0034	20.0058	19.9984	19.9903	19.9847	19.9787	(88)
util rest of house	0.9436	0.9188	0.8808	0.7999	0.6739	0.4987	0.3469	0.3859	0.6062	0.8206	0.9155	0.9490	(89)
MIT 2	17.4110	17.7848	18.3116	19.0103	19.5462	19.8778	19.9730	19.9634	19.7652	19.0986	18.1803	17.3758	(90)
Living area fraction									fLA = Living area / (4) =			0.2004	(91)
MIT	17.6885	18.0469	18.5524	19.2241	19.7442	20.0698	20.1675	20.1565	19.9565	19.3066	18.4237	17.6536	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6885	18.0469	18.5524	19.2241	19.7442	20.0698	20.1675	20.1565	19.9565	19.3066	18.4237	17.6536	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9208	0.8927	0.8532	0.7759	0.6617	0.5035	0.3622	0.4002	0.6033	0.7966	0.8900	0.9275	(94)
Useful gains	609.8861	672.5677	694.1607	688.5361	616.0544	462.8052	318.7781	330.9682	467.9876	559.7634	580.6036	589.3821	(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	1294.2252	1266.4196	1156.9913	975.0072	757.3495	507.5586	331.0388	347.6259	546.4984	819.7175	1072.7877	1282.8528	(97)
Space heating kWh	509.1483	399.0685	344.3460	206.2592	105.1236	0.0000	0.0000	0.0000	0.0000	193.4058	354.3726	515.9422	(98a)
Space heating requirement - total per year (kWh/year)												2627.6661	
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	509.1483	399.0685	344.3460	206.2592	105.1236	0.0000	0.0000	0.0000	0.0000	193.4058	354.3726	515.9422	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2627.6661	
Space heating per m2										(98c) / (4) =		31.0599	(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	509.1483	399.0685	344.3460	206.2592	105.1236	0.0000	0.0000	0.0000	0.0000	193.4058	354.3726	515.9422	(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)	551.6233	432.3602	373.0726	223.4660	113.8933	0.0000	0.0000	0.0000	0.0000	209.5405	383.9356	558.9840	(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	232.1257	205.2011	218.0687	192.2085	186.5729	168.4169	166.5685	173.1056	174.8901	194.6276	206.4217	229.6820	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.7708	85.5245	85.0795	84.2183	82.8252	79.8000	79.8000	79.8000	79.8000	84.0457	85.2605	85.8185	(217)
Fuel for water heating, kWh/month	270.6347	239.9326	256.3116	228.2265	225.2609	211.0487	208.7325	216.9243	219.1605	231.5737	242.1070	267.6368	(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	25.1798	20.2001	18.1880	13.3253	10.2928	8.4093	9.3895	12.2048	15.8528	20.7998	23.4933	25.8796	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-39.2807	-55.2236	-79.1548	-88.7327	-95.4483	-88.9947	-87.8830	-83.0759	-74.5620	-63.0139	-43.1254	-33.9777	(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	-22.6548	-47.6096	-94.5456	-141.8881	-187.5110	-188.3805	-186.1740	-157.6865	-115.6436	-68.0601	-30.2379	-17.9193	(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	2846.8755	(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	2817.5499	(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)	203.2152	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2090.7835	(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	3862.8571	(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	2846.8755	0.2100	597.8439	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2817.5499	0.2100	591.6855	(264)
Space and water heating			1189.5293	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	203.2152	0.1443	29.3302	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-832.4726	0.1347	-112.0928	
PV Unit electricity exported	-1258.3109	0.1259	-158.4440	
Total			-270.5368	(269)
Total CO2, kg/year			960.2520	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.3500	(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	2846.8755	1.1300	3216.9693	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2817.5499	1.1300	3183.8314	(278)
Space and water heating			6400.8007	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	203.2152	1.5338	311.6982	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-832.4726	1.4976	-1246.7516	
PV Unit electricity exported	-1258.3109	0.4622	-581.5996	
Total			-1828.3512	(283)
Total Primary energy kWh/year			5014.2486	(286)
Target Primary Energy Rate (TPER)			59.2700	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 07 Jun 2024 15:45:57

Project Information			
Assessed By	Daniel Watt	Building Type	House, Semi-detached
OCDEA Registration	EES/027301	Assessment Date	2024-06-07

Dwelling Details			
Assessment Type	As designed	Total Floor Area	95 m^2
Site Reference	2B3P (Plot 11)	Plot Reference	Mid terrace - 2B3P
Address	Healey Lane Healey Lane, Batley, N/A		

Client Details	
Name	GWP Architecture
Company	GWP Architecture
Address	GWP Architecture, g, tbc

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	*10.9 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	5.45 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*56.96 kWh_{PE}/m^2*	
Dwelling primary energy	55.54 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*38.0 kWh/m^2*	
Dwelling fabric energy efficiency	36.7 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*	0.14	Walls (1) (0.14)	OK
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.12	Heatloss Floor 1 (0.12)	OK
Roofs	*0.16*	0.1	Roof (1) (0.1)	OK
Windows, doors, and roof windows	*1.6*	1.3	Opening (1.3)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

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)	75.18	0.14 **(!)**
Ground floor: Heatloss Floor 1, Heatloss Floor 1	36.98	0.12
Exposed roof: Roof (1)	36.98	0.1 **(!)**

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, Window	5.88	North East	0.7	1.3
Opening, Door	2.14	North East	N/A	1.3
Opening, Window	5.11	South West	0.7	1.3
Opening, Half Glazed Door	2.21	South West	N/A	1.3

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	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.03 **(!)**	
External wall	E3: Sill	Calculated by person with suitable expertise	0.04	

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E4: Jamb	Calculated by person with suitable expertise	0.05	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.07	
External wall	E13: Gable (insulation at rafter level)	Calculated by person with suitable expertise	0.24	
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	
External wall	E18: Party wall between dwellings	Calculated by person with suitable expertise	0.06	

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: Room heaters - Electricity	
Efficiency	100.0%
Emitter type	
Flow temperature	
System type	Panel, convector or radiant heaters
Manufacturer	
Model	
Commissioning	
Main heating system 2: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	0.0%
Emitter type	
Flow temperature	
System type	Heat Pump
Manufacturer	Auer
Model	EDL170-520RF
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: N/A	
Capacity	N/A
Declared heat loss	N/A
Primary pipework insulated	N/A
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: Instantaneous	
Efficiency	0.0%
Manufacturer	ITHO UK Ltd
Model	SHRU 50

6 Controls	
Main heating 1 - type: Programmer and room thermostats	
Function	
Ecodesign class	
Manufacturer	
Model	
Main heating 2 - type: Not applicable	
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	120 lm/W	**OK**
External lights control	N/A	

8 Mechanical ventilation		
System type: Centralised mechanical extract		
Maximum permitted specific fan power	*0.7 W/(l/s)*	
Specific fan power	0.18 W/(l/s)	**OK**
Minimum permitted heat recovery efficiency	*N/A*	
Heat recovery efficiency	N/A	**N/A**
Manufacturer/Model	Sentinel Multivent Plus H, 407849A	
Commissioning		

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	1.6 kWp
Orientation	South
Pitch	30°
Overshading	Modest
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	2B3P (Plot 11)	**Issued on Date**	07/06/2024
Assessment Reference	Mid terrace - 2B3P	**Prop Type Ref**	Healey lane
Property	Healey Lane, Healey Lane, Batley, England, N/A		

SAP Rating	78 C	**DER**	5.45	**TER**	10.90
Environmental	95 A	**% DER < TER**			50.00
CO_2 Emissions (t/year)	0.54	**DFEE**	36.67	**TFEE**	37.99
Compliance Check	See BREL	**% DFEE < TFEE**			3.46
% DPER < TPER	2.50	**DPER**	55.54	**TPER**	56.96

Assessor Details	Mr. Daniel Watt	**Assessor ID**	AV75-0001
Client			

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	47.5700 (1b)	x	2.7000 (2b)	=	128.4390	(1b) - (3b)
First floor	47.5700 (1c)	x	3.1500 (2c)	=	149.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.1400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	278.2845	(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		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1500	(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	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762	(22b)

Mechanical extract ventilation - centralised

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Door			2.1400	1.3000	2.7820			(26)
Window (Uw = 1.30)			10.9900	1.2357	13.5808			(27)
Half Glazed Door			2.2100	1.3000	2.8730			(26a)
Heatloss Floor 1			36.9800	0.1200	4.4376	110.0000	4067.8000	(28a)
External Wall 1	90.5200	15.3400	75.1800	0.1400	10.5252	60.0000	4510.8000	(29a)
Flat roof	36.9800		36.9800	0.1000	3.6980	9.0000	332.8200	(30)
Total net area of external elements Aum(A, m2)			164.4800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		37.8966			(33)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	8911.4200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		93.6664	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	9.2000	0.0300	0.2760
E3 Sill	6.8200	0.0400	0.2728

E4 Jamb	38.7000	0.0500	1.9350	
E5 Ground floor (normal)	36.9800	0.1600	5.9168	
E6 Intermediate floor within a dwelling	36.9800	0.0700	2.5886	
E13 Gable (insulation at rafter level)	8.1700	0.2400	1.9608	
E10 Eaves (insulation at ceiling level)	8.8600	0.0600	0.5316	
E18 Party wall between dwellings	20.4400	0.0600	1.2264	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				14.7080 (36)
Point Thermal bridges			(36a) =	0.0000
Total fabric heat loss			(33) + (36) + (36a) =	52.6046 (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	45.9169	45.9169	45.9169	45.9169	45.9169	45.9169	45.9169	45.9169	45.9169	45.9169	45.9169	45.9169	(38)
Heat transfer coeff	98.5215	98.5215	98.5215	98.5215	98.5215	98.5215	98.5215	98.5215	98.5215	98.5215	98.5215	98.5215	(39)
Average = Sum(39)m / 12 =												98.5215	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0355	1.0355	1.0355	1.0355	1.0355	1.0355	1.0355	1.0355	1.0355	1.0355	1.0355	1.0355	(40)
HLP (average)												1.0355	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6898 (42)

Hot water usage for mixer showers

69.3181	68.2763	66.7584	63.8540	61.7106	59.3203	57.9617	59.4682	61.1196	63.6860	66.6528	69.0525	(42a)

Hot water usage for baths

29.9323	29.4877	28.8617	27.7075	26.8432	25.8849	25.3672	25.9888	26.6657	27.6911	28.8691	29.8311	(42b)

Hot water usage for other uses

42.1757	40.6421	39.1084	37.5748	36.0411	34.5074	34.5074	36.0411	37.5748	39.1084	40.6421	42.1757	(42c)

Average daily hot water use (litres/day) 130.0024 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	141.4261	138.4062	134.7285	129.1362	124.5949	119.7126	117.8364	121.4982	125.3600	130.4856	136.1640	141.0593	(44)
Energy conte	223.9843	197.0885	207.0727	176.7810	167.7287	147.2007	142.5129	150.4401	154.5815	177.0677	193.9906	220.8648	(45)
Energy content (annual)										Total = Sum(45)m =		2159.3135	
Distribution loss (46)m = 0.15 x (45)m	33.5976	29.5633	31.0609	26.5172	25.1593	22.0801	21.3769	22.5660	23.1872	26.5602	29.0986	33.1297	(46)

Water storage loss:

Store volume 173.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.9200 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 1.0368 (55)

Total storage loss	32.1408	29.0304	32.1408	31.1040	32.1408	31.1040	32.1408	32.1408	31.1040	32.1408	31.1040	32.1408	(56)
If cylinder contains dedicated solar storage	32.1408	29.0304	32.1408	31.1040	32.1408	31.1040	32.1408	32.1408	31.1040	32.1408	31.1040	32.1408	(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	256.1251	226.1189	239.2135	207.8850	199.8695	178.3047	174.6537	182.5809	185.6855	209.2085	225.0946	253.0056	(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	256.1251	226.1189	239.2135	207.8850	199.8695	178.3047	174.6537	182.5809	185.6855	209.2085	225.0946	253.0056	(64)
										Total per year (kWh/year) = Sum(64)m =		2537.7455	(64)
12Total per year (kWh/year)												2538	(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	74.4748	65.5319	68.8517	58.7797	55.7698	48.9442	47.3855	50.0213	51.3983	58.8750	64.5019	73.4375	(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	134.4876	134.4876	134.4876	134.4876	134.4876	134.4876	134.4876	134.4876	134.4876	134.4876	134.4876	134.4876	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	140.1416	155.1568	140.1416	144.8130	140.1416	144.8130	140.1416	140.1416	144.8130	140.1416	144.8130	140.1416	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	248.2231	250.7989	244.3080	230.4897	213.0465	196.6524	185.7002	183.1244	189.6153	203.4336	220.8767	237.2708	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.4488	36.4488	36.4488	36.4488	36.4488	36.4488	36.4488	36.4488	36.4488	36.4488	36.4488	36.4488	(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)	-107.5901	-107.5901	-107.5901	-107.5901	-107.5901	-107.5901	-107.5901	-107.5901	-107.5901	-107.5901	-107.5901	-107.5901	(71)
Water heating gains (Table 5)	100.1005	97.5178	92.5426	81.6385	74.9594	67.9781	63.6902	67.2330	71.3866	79.1331	89.5859	98.7064	(72)
Total internal gains	551.8115	566.8197	540.3385	520.2874	491.4938	472.7898	452.8783	453.8453	469.1612	486.0546	518.6220	539.4651	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.8800	11.2829	0.7200	0.7000	0.7700	23.1720	(75)
Southwest	5.1100	36.7938	0.7200	0.7000	0.7700	65.6689	(79)

Solar gains	88.8409	159.0257	238.0300	329.1981	400.0070	410.8724	390.3993	335.4694	269.2703	181.2695	107.8126	75.1223	(83)
Total gains	640.6524	725.8454	778.3684	849.4855	891.5008	883.6622	843.2777	789.3146	738.4314	667.3241	626.4345	614.5874	(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	25.1254	25.1254	25.1254	25.1254	25.1254	25.1254	25.1254	25.1254	25.1254	25.1254	25.1254	25.1254	
alpha	2.6750	2.6750	2.6750	2.6750	2.6750	2.6750	2.6750	2.6750	2.6750	2.6750	2.6750	2.6750	
util living area	0.9494	0.9290	0.8995	0.8370	0.7378	0.5970	0.4679	0.5105	0.6971	0.8604	0.9290	0.9544	(86)
MIT	18.5898	18.8806	19.3071	19.8818	20.3992	20.7605	20.9096	20.8831	20.6165	19.9531	19.1698	18.5165	(87)
Th 2	20.0538	20.0538	20.0538	20.0538	20.0538	20.0538	20.0538	20.0538	20.0538	20.0538	20.0538	20.0538	(88)
util rest of house	0.9427	0.9197	0.8859	0.8137	0.6982	0.5330	0.3815	0.4239	0.6398	0.8355	0.9181	0.9483	(89)
MIT 2	17.2262	17.5922	18.1278	18.8379	19.4556	19.8561	19.9984	19.9781	19.7134	18.9388	17.9630	17.1338	(90)
Living area fraction										fLA = Living area / (4) =		0.1843	(91)
MIT	17.4775	17.8296	18.3451	19.0303	19.6295	20.0227	20.1663	20.1449	19.8798	19.1257	18.1854	17.3885	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.4775	17.8296	18.3451	19.0303	19.6295	20.0227	20.1663	20.1449	19.8798	19.1257	18.1854	17.3885	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9173	0.8906	0.8544	0.7836	0.6783	0.5308	0.3923	0.4328	0.6280	0.8054	0.8892	0.9240	(94)
Useful gains	587.6425	646.4419	665.0579	665.6565	604.6710	469.0090	330.8322	341.5824	463.7396	537.4505	557.0505	567.8916	(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	1298.2665	1273.8431	1166.9974	998.0502	781.2250	534.2547	351.3596	368.9486	569.4379	839.9659	1092.1485	1299.3560	(97)
Space heating kWh	528.7042	421.6136	373.4430	239.3234	131.3562	0.0000	0.0000	0.0000	0.0000	225.0715	385.2706	544.2096	(98a)
Space heating requirement - total per year (kWh/year)												2848.9921	
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	528.7042	421.6136	373.4430	239.3234	131.3562	0.0000	0.0000	0.0000	0.0000	225.0715	385.2706	544.2096	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2848.9921	
Space heating per m2											(98c) / (4) =	29.9453	(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)
Fraction of main heating from main system 2	0.0000	(203)
Fraction of total heating from main system 1	1.0000	(204)
Fraction of total heating from main system 2	0.0000	(205)
Efficiency of main space heating system 1 (in %)	100.0000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	528.7042	421.6136	373.4430	239.3234	131.3562	0.0000	0.0000	0.0000	0.0000	225.0715	385.2706	544.2096	(98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)	528.7042	421.6136	373.4430	239.3234	131.3562	0.0000	0.0000	0.0000	0.0000	225.0715	385.2706	544.2096	(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)
Space heating fuel used, main system 2												0.0000	(213)
Water heating													
Water heating requirement	256.1251	226.1189	239.2135	207.8850	199.8695	178.3047	174.6537	182.5809	185.6855	209.2085	225.0946	253.0056	(64)
Efficiency of water heater												302.9550	(216)
(217)m	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	(217)
Fuel for water heating, kWh/month	84.5423	74.6378	78.9601	68.6191	65.9733	58.8552	57.6500	60.2667	61.2914	69.0560	74.2997	83.5126	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	6.7474	6.0944	6.7474	6.5297	6.7474	6.5297	6.7474	6.7474	6.5297	6.7474	6.5297	6.7474	(231)
Lighting	32.6033	26.1556	23.5502	17.2539	13.3274	10.8886	12.1577	15.8031	20.5266	26.9320	30.4197	33.5095	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-26.7177	-41.3099	-64.5434	-77.3459	-85.0151	-72.8778	-71.8957	-66.1141	-56.2389	-48.3319	-30.4039	-22.7218	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year

Space heating fuel - main system 1	2848.9921	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	302.9550	
Water heating fuel used	837.6642	(219)
Space cooling fuel	0.0000	(221)

Electricity for pumps and fans:

(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2340)

mechanical ventilation fans (SFP = 0.2340) 79.4447 (230a)

Total electricity for the above, kWh/year 79.4447 (231)

Electricity for lighting (calculated in Appendix L)	263.1277	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-663.5162	(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	3365.7125	(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	2848.9921	0.1544	439.8278	(261)
Space heating - main system 2	0.0000	0.0000	0.0000	(262)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	837.6642	0.1412	118.2370	(264)
Space and water heating			558.0647	(265)
Pumps, fans and electric keep-hot	79.4447	0.1387	11.0200	(267)
Energy for lighting	263.1277	0.1443	37.9775	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-663.5162	0.1341	-88.9816	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-88.9816	(269)
Total CO2, kg/year			518.0805	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			5.4500	(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	2848.9921	1.5716	4477.3361	(275)
Space heating - main system 2	0.0000	0.0000	0.0000	(276)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	837.6642	1.5219	1274.8720	(278)
Space and water heating			5752.2080	(279)
Pumps, fans and electric keep-hot	79.4447	1.5128	120.1839	(281)
Energy for lighting	263.1277	1.5338	403.5941	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-663.5162	1.4956	-992.3747	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-992.3747	(283)
Total Primary energy kWh/year			5283.6112	(286)
Dwelling Primary energy Rate (DPER)			55.5400	(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	47.5700	(1b)	x 2.7000	(2b) =	128.4390	(1b) - (3b)
First floor	47.5700	(1c)	x 3.1500	(2c) =	149.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.1400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		278.2845	(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	3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1078	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3578	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3578	(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	0.4562	0.4473	0.4383	0.3936	0.3846	0.3399	0.3399	0.3310	0.3578	0.3846	0.4025	0.4204	(22b)
Effective ac	0.6041	0.6000	0.5961	0.5775	0.5740	0.5578	0.5578	0.5548	0.5640	0.5740	0.5810	0.5884	(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	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Semi-glazed door			2.2100	1.0000	2.2100			(26a)
TER Opening Type (Uw = 1.20)			10.9900	1.1450	12.5840			(27)
Heatloss Floor 1			36.9800	0.1300	4.8074			(28a)
External Wall 1	90.5200	15.3400	75.1800	0.1800	13.5324			(29a)
Flat roof	36.9800		36.9800	0.1100	4.0678			(30)
Total net area of external elements Aum(A, m2)			164.4800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		39.3416			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 93.6664 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	9.2000	0.0500	0.4600
E3 Sill	6.8200	0.0500	0.3410
E4 Jamb	38.7000	0.0500	1.9350
E5 Ground floor (normal)	36.9800	0.1600	5.9168
E6 Intermediate floor within a dwelling	36.9800	0.0000	0.0000
E13 Gable (insulation at rafter level)	8.1700	0.0800	0.6536
E10 Eaves (insulation at ceiling level)	8.8600	0.0600	0.5316
E18 Party wall between dwellings	20.4400	0.0600	1.2264

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 11.0644 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 50.4060 (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	55.4731	55.1020	54.7383	53.0298	52.7102	51.2222	51.2222	50.9467	51.7954	52.7102	53.3568	54.0329	(38)
Heat transfer coeff	105.8790	105.5080	105.1442	103.4358	103.1162	101.6282	101.6282	101.3526	102.2013	103.1162	103.7628	104.4388	(39)

Average = Sum(39)m / 12 = 103.4343

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1129	1.1090	1.1052	1.0872	1.0838	1.0682	1.0682	1.0653	1.0742	1.0838	1.0906	1.0977	(40)
HLP (average)												1.0872	
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 2.6898 (42)

Hot water usage for mixer showers	69.3181	68.2763	66.7584	63.8540	61.7106	59.3203	57.9617	59.4682	61.1196	63.6860	66.6528	69.0525 (42a)
Hot water usage for baths	29.9323	29.4877	28.8617	27.7075	26.8432	25.8849	25.3672	25.9888	26.6657	27.6911	28.8691	29.8311 (42b)
Hot water usage for other uses	42.1757	40.6421	39.1084	37.5748	36.0411	34.5074	34.5074	36.0411	37.5748	39.1084	40.6421	42.1757 (42c)

Average daily hot water use (litres/day) 130.0024 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	141.4261	138.4062	134.7285	129.1362	124.5949	119.7126	117.8364	121.4982	125.3600	130.4856	136.1640	141.0593	(44)
Energy conte	223.9843	197.0885	207.0727	176.7810	167.7287	147.2007	142.5129	150.4401	154.5815	177.0677	193.9906	220.8648	(45)
Energy content (annual)										Total = Sum(45)m =		2159.3135	
Distribution loss (46)m = 0.15 x (45)m	33.5976	29.5633	31.0609	26.5172	25.1593	22.0801	21.3769	22.5660	23.1872	26.5602	29.0986	33.1297	(46)

Water storage loss:

Store volume 150.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.3938 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.7527 (55)

Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (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	270.5792	239.1742	253.6676	221.8729	214.3236	192.2925	189.1078	197.0350	199.6733	223.6626	239.0825	267.4597 (62)
WWHRS	-31.6893	-28.0263	-29.3475	-24.3009	-22.6476	-19.3797	-18.1654	-19.3170	-20.0510	-23.6379	-26.7789	-31.1025 (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	238.8899	211.1479	224.3201	197.5720	191.6760	172.9128	170.9424	177.7179	179.6223	200.0247	212.3036	236.3572 (64)
									Total per year (kWh/year) = Sum(64)m =			2413.4869 (64)
12Total per year (kWh/year)												2413 (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	111.7507	99.2005	106.1276	94.8532	93.0457	85.0177	84.6615	87.2973	87.4718	96.1509	100.5754	110.7135 (65)

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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	134.4876	134.4876	134.4876	134.4876	134.4876	134.4876	134.4876	134.4876	134.4876	134.4876	134.4876	134.4876	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	140.1416	155.1568	140.1416	144.8130	140.1416	144.8130	140.1416	140.1416	144.8130	140.1416	144.8130	140.1416	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	248.2231	250.7989	244.3080	230.4897	213.0465	196.6524	185.7002	183.1244	189.6153	203.4336	220.8767	237.2708	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.4488	36.4488	36.4488	36.4488	36.4488	36.4488	36.4488	36.4488	36.4488	36.4488	36.4488	36.4488	(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)	-107.5901	-107.5901	-107.5901	-107.5901	-107.5901	-107.5901	-107.5901	-107.5901	-107.5901	-107.5901	-107.5901	-107.5901	(71)
Water heating gains (Table 5)	150.2026	147.6198	142.6446	131.7405	125.0614	118.0801	113.7923	117.3350	121.4886	129.2351	139.6880	148.8084	(72)
Total internal gains	604.9136	619.9217	593.4405	573.3895	544.5959	522.8919	502.9804	503.9473	519.2632	539.1566	571.7240	592.5671	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.8800	11.2829	0.6300	0.7000	0.7700	20.2755	(75)
Southwest	5.1100	36.7938	0.6300	0.7000	0.7700	57.4603	(79)

Solar gains	77.7358	139.1475	208.2762	288.0483	350.0061	359.5133	341.5994	293.5357	235.6115	158.6108	94.3360	65.7320	(83)
Total gains	682.6493	759.0692	801.7167	861.4378	894.6020	882.4052	844.5798	797.4830	754.8747	697.7675	666.0600	658.2992	(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	23.3795	23.4617	23.5428	23.9317	24.0059	24.3574	24.3574	24.4236	24.2208	24.0059	23.8563	23.7019	
alpha	2.5586	2.5641	2.5695	2.5954	2.6004	2.6238	2.6238	2.6282	2.6147	2.6004	2.5904	2.5801	
util living area	0.9443	0.9257	0.8989	0.8400	0.7469	0.6070	0.4773	0.5155	0.6983	0.8549	0.9224	0.9487	(86)
MIT	18.4625	18.7473	19.1792	19.7963	20.3361	20.7364	20.8988	20.8734	20.5921	19.9136	19.1149	18.4336	(87)
Th 2	19.9903	19.9935	19.9966	20.0113	20.0141	20.0269	20.0269	20.0293	20.0219	20.0141	20.0085	20.0027	(88)
util rest of house	0.9368	0.9157	0.8847	0.8164	0.7067	0.5415	0.3877	0.4266	0.6396	0.8286	0.9104	0.9417	(89)
MIT 2	17.0292	17.3891	17.9337	18.7063	19.3547	19.8098	19.9654	19.9479	19.6621	18.8643	17.8667	16.9997	(90)
Living area fraction									fLA = Living area / (4) =			0.1843	(91)
MIT	17.2933	17.6393	18.1632	18.9072	19.5356	19.9805	20.1374	20.1184	19.8335	19.0576	18.0967	17.2639	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.2933	17.6393	18.1632	18.9072	19.5356	19.9805	20.1374	20.1184	19.8335	19.0576	18.0967	17.2639	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9086	0.8843	0.8512	0.7845	0.6846	0.5381	0.3984	0.4354	0.6269	0.7972	0.8793	0.9148	(94)
Useful gains	620.2450	671.2749	682.4127	675.7789	612.4074	474.8631	336.5010	347.1957	473.2268	556.2818	585.6742	602.2069	(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	1375.7179	1344.1013	1226.3136	1035.1000	807.9731	546.8148	359.4996	376.8709	585.9691	872.1160	1141.0482	1364.3771	(97)
Space heating kWh	562.0719	452.1393	404.6623	258.7112	145.5009	0.0000	0.0000	0.0000	0.0000	234.9806	399.8693	567.0546	(98a)
Space heating requirement - total per year (kWh/year)												3024.9900	
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	562.0719	452.1393	404.6623	258.7112	145.5009	0.0000	0.0000	0.0000	0.0000	234.9806	399.8693	567.0546	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3024.9900	
Space heating per m2										(98c) / (4) =		31.7951	(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	562.0719	452.1393	404.6623	258.7112	145.5009	0.0000	0.0000	0.0000	0.0000	234.9806	399.8693	567.0546	(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)	608.9619	489.8584	438.4207	280.2938	157.6391	0.0000	0.0000	0.0000	0.0000	254.5836	433.2278	614.3604	(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	238.8899	211.1479	224.3201	197.5720	191.6760	172.9128	170.9424	177.7179	179.6223	200.0247	212.3036	236.3572	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.9102	85.7224	85.3664	84.6654	83.4497	79.8000	79.8000	79.8000	79.8000	84.4219	85.4575	85.9483	(217)
Fuel for water heating, kWh/month	278.0694	246.3161	262.7734	233.3563	229.6904	216.6827	214.2136	222.7042	225.0907	236.9346	248.4318	274.9993	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	29.1187	23.3601	21.0332	15.4098	11.9030	9.7248	10.8583	14.1140	18.3327	24.0535	27.1684	29.9280	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-43.8044	-61.3823	-87.6768	-97.9088	-104.9760	-97.7343	-96.5119	-91.4147	-82.3146	-69.8820	-48.0216	-37.9143	(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	-25.8474	-54.2625	-107.6642	-161.4443	-213.2361	-214.1980	-211.6888	-179.3433	-131.5880	-77.5220	-34.4817	-20.4484	(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	3277.3456	(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	2889.2624	(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)	235.0043	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2351.2664	(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	4136.3459	(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	3277.3456	0.2100	688.2426	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2889.2624	0.2100	606.7451	(264)
Space and water heating			1294.9877	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	235.0043	0.1443	33.9184	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-919.5416	0.1347	-123.8906	
PV Unit electricity exported	-1431.7248	0.1259	-180.3134	
Total			-304.2040	(269)
Total CO2, kg/year			1036.6313	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.9000	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3277.3456	1.1300	3703.4006	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2889.2624	1.1300	3264.8665	(278)
Space and water heating			6968.2671	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	235.0043	1.5338	360.4574	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-919.5416	1.4980	-1377.4280	
PV Unit electricity exported	-1431.7248	0.4623	-661.8767	
Total			-2039.3047	(283)
Total Primary energy kWh/year			5419.5206	(286)
Target Primary Energy Rate (TPER)			56.9600	(287)