QODA

Parnall Road, Harlow, Essex, CM18 7PP

Energy Statement

LN1040-QODA-XX-XX-RP-YS-0001-01

QODA

Revision Summary

Issue	Document prepared			Document checked		
	Name	Signature	Date	Name	Signature	Date
First	D.Karnik	[redacted]	07.03.2024	L.Patti	[redacted]	07.03.2024

QODA

Contents

QODA

1 Executive Summary

This Energy Statement has been prepared by QODA Consulting as part of the of the planning application for the proposed residential development at Parnall Road, Harlow, Essex, CM18 7PP. This is a development by Harlow District Council, to provide residential units in the form of construction of 5 townhouses and 5 flats with a total GIA of 926.00 m^2.

The Harlow Local Development Plan Adopted December 2020 set out sustainability requirements for residential developments. The key policy is Policy PL03 Sustainable Design, Construction and Energy Usage which encourages new-build residential developments to follow the energy hierarchy and to achieve a minimum of 19% carbon reduction over building regulations baseline.

This report shows how the reduction of energy consumption has been considered by reducing CO_2 emissions following be lean, be clean, be green energy hierarchy. In this case overall 60% reduction is achieved on site. A Standard Assessment Procedure (SAP) calculation has been performed to calculate the development's expected carbon emissions against the Approved Document L baseline, following the Part L 2021 methodology and GLA Guidance 2022.

The excellent energy performance of the proposed residential development is mainly driven by the following key factors based on the fabric first approach methodology:

- High levels of insulation.
- Airtight construction.
- Energy efficient building services and controls.
- Mechanical ventilation with heat recovery
- The inclusion of low or zero carbon technology (LZCT) in the form of external air hot water tanks for domestic hot water generation in flats and an air source heat pump for space heating and domestic hot water in the townhouses.

Results show that 60% carbon reduction for the domestic development compared to the baseline case, which for domestic areas exceeds the requirements set by the Adopted Local Plan and represents a high-performance and low-carbon development.

Table 1-1 Domestic carbon reduction from proposed measures

	Carbon Emissions (tonnes CO_2/yr)	
	Baseline	Proposed
Domestic Carbon Emissions	11.5	4.6
% Saving over baseline		60 %

2 Introduction

The report demonstrates how the proposed design is in accordance with relevant national, regional and local planning policies in terms of energy and carbon reductions. It has been produced to document the steps taken to reduce the energy consumption and associated carbon emissions relating to the development. Improvement measures identified in this report relate to the architectural design and construction of the development as well as the proposed building services.

In addition to low carbon design, all proposals for the scheme have been considered with respect to their in-use operation and the effect they may have to users operating and maintaining the building.

2.1 Aims and Objectives

The purpose of this energy statement is to demonstrate that the Proposed Development incorporates climate change mitigation measures in order to comply with applicable energy policies set out below.

This report aims to:

Address the planning requirements associated with energy in Policy PL 03 Sustainable Design. Construction, and Energy Usage.
Provide information relating to the detailed energy assessment for residential areas.
Demonstrate that the "Be Lean, Be Clean, Be Green" energy hierarchy has been followed.
The report also shows compliance with Part O Overheating.

2.2 Site Context

The site is in a central part of Harlow to the South of the town centre, within the Staple Tye neighbourhood. Boarding to the North is Kingdom Hall, with Staple Tye Shopping Mews and a collection of small shops to the very North end of Parnall Road. The main thoroughfare through Harlow is the A1169 Southern Way, providing access to the Staple Tye Shopping Mews and connecting to Parnall Road. The A1169 also provides a main route through Harlow with connection to the A414 and M11 to the east. To the North of the site, the typologies vary from civic, religious to retail. Towards the South, East and West of the site, the typologies are predominantly residential.

The L shape building consists of 5 two-storey terrace houses along the Parnall Roadside and another five flats located over ground plus two floors along the Pinceybrook Road.

Table 2-1 Type and number of properties in the Proposed Development

Property Type	Units
Flats	5
Townhouses	5
Development Total	10

Figure 2-1 Proposed Site plan

3 Planning Policy Requirements

The Proposed Development will be designed in line with current national, regional, and local policy. The policies that have been considered for this energy assessment include National Planning Policy Framework 2021; The Harlow Local Development Plan Adopted December 2020; Harlow Design Guide (SPD) Adopted October 2011 and the Energy Assessment Guidance by GLA – 2022.

3.1 National Planning Policy Framework (2021)

The National Planning Policy Framework sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally prepared plans for housing and other development can be produced. At the heart of the NPPF is a presumption in favour of sustainable development. Achieving sustainable development means that the planning system has three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways (so that opportunities can be taken to secure net gains across each of the different objectives).

> An economic objective – to help build a strong, responsive, and competitive economy, by ensuring that sufficient land of the right type is available in the right places and at the right time to support growth, innovation and improved productivity; by identifying and coordinating the provision of infrastructure.

A social objective – to support strong, vibrant, and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations: To foster a well-designed and safe built environment, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being.
An environmental objective – to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution and mitigating and adapting to climate change, including moving to a low carbon economy.

3.2 Harlow Local Development Plan Adopted December 2020

Policy PL3 Sustainable Design, Construction and Energy Usage

New development will be expected to deliver high standards of sustainable design and construction and efficient energy usage, taking account of predicted changes to heating and cooling requirements as a result of climate change.

13.18 The Building Regulations set out the minimum requirements for the conservation of fuel and power. Development will be encouraged to exceed the minimum standards required by Building Regulations. Where exceeded, the amount by which the minimum standards should be exceeded is preferably at least 19%. The Council supports development that follows the principles of sustainable construction and encourages developers to deliver schemes which adopt a fabric-first approach to development and meet the performance and quality set by appropriate standards, such as Passivhaus, Home Quality Mark (HQM) and BREEAM UK New Construction 2018.

13.19 Development proposals must demonstrate how the reduction of energy consumption and carbon dioxide emissions is being considered. The wellbeing of building occupants must also be addressed within the design and layout, by minimising risks of overheating and providing adequate daylight and ventilation.

13.20 Where a low-carbon district heating scheme is proposed, the Council will expect the scheme to demonstrate that any proposed heating and cooling systems have been selected in line with the following order of preference:

(a) if possible, connection with heat distribution networks which exist at the time

(b) site-wide heat network fuelled by renewable energy sources.

(c) communal network fuelled by renewable energy sources.

(d) individual Air Source Heat Pump.

Details of the base case and performance against this criterion mentioned in 13.8 are detailed within later sections of the report.

3.3 Energy Assessment Guidance June 2022 by GLA

The guidance document explains how to prepare an energy assessment to accompany strategic planning applications referred to the Mayor, as set out in London Plan. It is for anyone involved in, or with an interest in developing energy assessments including developers, energy consultants and local government officials. Although primarily aimed at strategic planning applications, Local boroughs in England are encouraged to apply the same structure for energy assessments related to non-referable applications and adapt it for relevant scales of development.

The guidance explains how the energy assessment should be carried out to achieve compliance with policies using energy hierarch. It provides detailed guidance on the following:

- Requirements for different types of planning application.
- Integration with other supporting documents for planning applications.
- Structure and contents of the energy assessment.
- Usage of carbon emission factors for reporting CO_2 emissions.
- The methodology for establishing CO_2 emissions for the development.
- Application of Be Lean, Be Clean and Be Green measures and associated calculations.
- Evaluation and mitigation of overheating and reducing active cooling requirements.
- Managing peak demand and incorporate energy flexibility into developments.

3.4 Climate Crisis

The Proposed Development comes at a time when there is international consensus on the effects of human-made carbon emissions on the global climate. The International Panel for Climate Change (IPCC) in their 2018 and 2022 reports have identified the effects on the planet of various climate change scenarios.

It is now widely accepted that a 1.5degC rise in global average temperatures is a 'least bad' limit to global warming, although this will still result in significant impacts to humans and the natural environment. To avoid exceeding the 1.5degC temperature rise, global climate emissions must stop increasing by around 2030, and become zero by 2050.

Currently, around 40% of the UK's carbon emissions come from the built environment, and there is a responsibility on designers to develop buildings with drastically lower carbon emissions.

4 Energy and Carbon Strategy

4.1 General Approach

The energy strategy for the site can be summarised as:

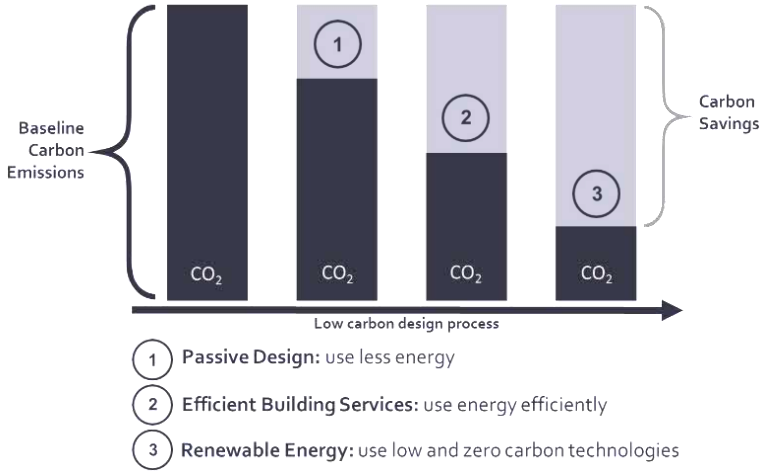
- Efficient passive design utilising high levels of insulation to minimise heat losses.
- Airtight construction to minimise heat losses via air infiltration.
- Mechanical ventilation with heat recovery

Direct electric panel radiators to provide space heating in flats.
Energy efficient building services and controls.
The inclusion of low or zero carbon technology (LZCT) in the form of external air hot water tanks for domestic hot water generation in flats and an air source heat pump for space heating and domestic hot water in the townhouses.

Passive Design

A 'fabric first' approach has been taken, with the aim of reducing the buildings energy demands through a high performing building envelope. The key point is that such measures are extremely difficult to implement later.

Figure 4-1 Energy Hierarchy



Efficient Building Services

Heat, ventilation, and light will be provided efficiently through appropriate selection of products, good design practices and controls. Minimising distribution and storage losses from space heat and hot water systems is a significant element of this, particularly for a multi-residential scheme. Technologies such as LED lighting, and mechanical ventilation with heat recovery will be adopted as part of the design.

Renewable Energy

The final stage of carbon reduction is to utilise renewable energy (or low carbon) technology which supplies heat or power from a low (or zero) carbon source. It is far easier to retrofit such technologies compared to building envelope measures. In the context of Parnall Road this takes the form of an external air hot water tank for domestic hot water generation in flats and an air source heat pump for domestic hot water and space heating in the townhouses.

5 Proposed Design Specification

5.1 Building Fabric

The table below outlines target U-values and air permeability compared to the minimum standards required by Part L1 2021.

Table 5-1 : Proposed fabric standards compared to minimum Part L 2021 standards

Building Fabric	Minimum Standard (Building Regs 2021)	Targeted Standard Flats	Targeted Standard Townhouses
External Walls	0.26 W/m².K	0.18 W/m².K	0.18 W/m².K
Roofs	0.16 W/m².K	0.10 W/m².K	0.10 W/m².K
Ground Floors	0.18 W/m².K	0.12 W/m².K	0.12 W/m².K
External Glazing	1.60 W/m².K	1.20 W/m².K	1.20 W/m².K
Air Permeability	Minimum Standard	Targeted Standard (Domestic)	Targeted Standard (Domestic)
Airtightness Standard	8 m³/h.m² @50Pa L1	3 m³/h.m² @50Pa	3 m³/h.m² @50Pa

5.2 Building Services

The building services strategy has been based on the following key elements:

Flats:

Direct electric panel radiators for space heating.
Domestic hot water is to be provided via external air hot water tank.
Mechanical ventilation with heat recovery.
LED Lighting throughout.

Townhouses:

Space heating and domestic hot water via air source heat pump.
Mechanical ventilation with heat recovery.
LED Lighting throughout.

5.3 Building Energy Systems Summary

The table below provides a summary of the proposed building specification for all the units which have been modelled in SAP for energy and carbon calculations.

Table 5-2 Proposed building fabric and services specification for residential units.

Parnall Road	Flats	Townhouses
Fabric Specification		
External wall U-value	0.18 W/m^{2}K	0.18 W/m^{2}K
Roof U-value	0.10 W/m^{2}K	0.10 W/m^{2}K
Ground Floor U-value	0.12 W/m^{2}K	0.12 W/m^{2}K
Glazing	U-Value = 1.20 W/m^{2}K (Double glazing, argon filled, low-e coating)	U-Value = 1.20 W/m^{2}K (Double glazing, argon filled, low-e coating)
	g-value 0.42	g-value 0.42
Door U-value	1.0 W/m^{2}K	1.0 W/m^{2}K
Thermal Mass Parameter	Medium Thermal Mass Construction	Medium Thermal Mass Construction
Thermal Bridging Y-value target	FHH recognised construction details	FHH recognised construction details
Building Air Permeability		
Air-tightness standard	3 m^3/h.m^2 @50Pa	3 m^3/h.m^2 @50Pa
Space Heating and Hot water		
Heating System	Direct Electric Panel Heaters	ASHP Heating using water: Radiators
Heating Controls	7 Day Programmer	7 Day Programmer
DHW System	External Air Hot Water Tank	ASHP + Local Hot water cylinder with supplementary immersion
	Cylinder in heated space	Cylinder in heated space
	Heat Loss 1.61 kWh/24hr	Heat Loss 1.88 kWh/24hr
	COP 3.19	COP 1.67
	Cylinder with stat	Cylinder with stat
Cylinder Volume	200l	150l
Cylinder Insulation	80mm, factory insulated	80mm, factory insulated
Pipework Insulation	Fully insulated primary network	Fully insulated primary network
Cooling	N/A	N/A
Ventilation		
System Type	MVHR	MVHR
Heat Recovery %	85%	85%
Specific Fan Power	0.97 W/l/s	0.97 W/l/s
Lighting		
% energy efficient LED lighting	100%	100%

6 Energy and Carbon Analysis

A SAP assessment has been conducted to calculate the development's performance in terms of energy demand and carbon emissions. The Elmhurst Energy Design SAP10 software has been used for this assessment, following the SAP 10.2 assessment procedure together with the proposed building specifications from Table 5-2.

6.1 Calculation Methodology

6.1.1 Carbon Factors

SAP 10.2 was published by BRE in December 2021. The SAP 10.2 carbon factors were produced by the government to be a closer representation of the carbon intensity of the grid today. The factors are also published in the GLA Energy Assessment Guidance 2022.

Table 6-1 SAP 10.2 carbon factor

	SAP 10.2 ($kgCO_2/kWh$)
Natural Gas	0.210
Grid Electricity	0.136

6.1.2 Base Case - Domestic

The Adopted Local Plan urges that a new residential development should reduce at least 19% of carbon emissions against a building regulations compliant base case. In the Part L methodology, the carbon emissions reduction is calculated against the "notional building", which consists of a standard specification for fabric, lighting etc, but more crucially, matches the proposed building in terms of heating and ventilation systems. While this may be appropriate for standardising compliance with building regulations, it is problematic for assessing real building performance as the 'goal posts' are effectively moved when the designer seeks to implement low energy systems in the building. One consequence of this is that it can often be easier to achieve a % carbon reduction using inferior systems (in carbon terms), because these may offer a greater margin for improvement than low carbon systems. The actual building's carbon emissions, in absolute terms, would be much higher.

The GLA's London Plan recognises this fact, and, for example, requires that a separate "baseline" model should be created which incorporates gas boilers and no renewable energy systems. This means that alternative heating systems such as heat pumps are then rightly compared against a true 'minimum' standard. Following this approach, the baseline specification has been based on the Approved Document L1 Notional standard (2021), of a building that has the following:

The exact specification details of the baseline model, measured against the proposed specification, can be found in Appendix B.

7 Baseline Emissions

Regulated CO_2 emissions for a Part L 2021 of the Building Regulations compliant development was calculated to establish the baseline CO_2 emissions for the Proposed Development. In establishing TER for the development, a Gas Boiler system for heating and hot water generation was modelled in line with the Limiting Coefficient of Performance of Part L 2021 for domestic assessment.

Table 7-1 Regulated baseline CO2 emissions Domestic (Part L 2021 carbon factors)

Parnall Road	Baseline
Carbon Emissions ($KgCO_2/ m^2 yr$)	12.4
Carbon Emissions (Tonnes CO_2 /year)	11.5

8 Be Lean

This section outlines the demand reduction measures incorporated in order to exceed the requirements of Building regulation Part L 2021 requirements.

8.1.1 Fabric First Approach

In the construction industry, there is significant evidence to suggest that buildings do not perform as well when they are completed as was anticipated when they were being designed. The difference between anticipated and actual performance is known as the performance gap. Recent studies have suggested that in-use energy consumption can be 5 to 10 times higher than compliance calculations carried out during design stage.

8.1.2 Proposed Fabric First Measures

High levels of thermal insulation to reduce heating demand, and continuity of insulation to avoid cold bridges which create heat loss and cold surfaces.
Air-tight construction to avoid cold draughts, reduce heat losses and protect the fabric against moisture egress.
High performance double glazing to reduce heating demand and provide warm internal surfaces to improve occupant comfort.
Mechanical ventilation with heat recovery system to provide improved indoor air quality while minimizing energy use.
Detailed calculations at design stage to ensure that all energy demands are understood and incorporated in the design.
High levels of quality control during construction to ensure that the required air tightness can be achieved, insulation is installed properly, and services commissioned correctly.

8.1.3 Passive Be Lean Design Measures

Consideration has been given to the building fabric in order to reduce the energy demand and associated CO_2 emissions of the development. Passive design measures considered include the following:

- Optimising building form, orientation, and site layout.
- Use of natural ventilation.
- Maximising day lighting.
- Use of high-performance glazing.
- Optimising glazing ratio and use of solar shading.
- Use of enhanced thermal insulation and improvements to U-Values.
- Improvements to fabric air permeability.
- Minimising thermal bridging.

Proposed building fabric performance and services set for the development are shown in Table 5-1.

8.1.4 Active Be Lean Design Measures

Following the application of passive design measures, active design measures have been applied to further reduce the energy demand and CO_2 emissions. Active design measures considered include the following:

- Installation of low energy LED lighting.
- Mechanical ventilation with heat recovery.
- Use of smart meters for heat and electricity networks.
- Use of programmable heating controls with individual zone control for heating and hot water.

9 Be Clean

Following the reduction of energy demand in the Be Lean stage, the Local Plan requires the development to demonstrate how the energy systems will supply energy efficiently and cleanly to reduce CO_2 emissions in the Be Clean stage of the energy hierarchy. This section is concluded to have no change from the "Be Lean" results.

9.1 Heating Hierarchy

Connecting to a local or planned heat network

Potential to connect to an existing heat network was investigated, however there is currently no existing heat network within the surrounding area which is close enough to connect to.

Zero emission and/or local secondary heat sources

Availability of secondary heat sources locally was investigated in order to minimise primary energy demand and CO_2 emissions. No waste heat sources were identified on or adjacent to the site. Analysis

showing the feasibility of the renewable technologies considered feasible on site can be found in Be Green section of the report.

Low emission Combined Heat and Power (CHP)

Due to the rapid decarbonisation of the electricity grid resulting in reduced CO_2 savings and air quality concerns associated with combustion-based systems, gas-fired CHP was not considered a viable option compared to the possibility of using renewable technologies identified above.

Ultra-low NOx boilers

Gas boilers are not proposed for the development. The energy strategy proposal is 100% electric with all space heating and domestic hot water generated by electric Air Source Heat Pumps for the townhouses and direct electric heating coupled with external air heat pump hot water tank for domestic hot water for the flats.

9.2 The Cooling Hierarchy

Measures to reduce the cooling demand have been considered under the following categories:

1. Reduce the amount of heat entering the building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure.
2. Minimise internal heat generation through energy efficient design.
3. Manage the heat within the building through exposed internal thermal mass and high ceilings.
4. Passive ventilation.
5. Mechanical ventilation.
6. Active cooling systems.

Reduce the amount of heat entering the building

High efficiency building fabric with low U-values incorporated in design will reduce the heat transfer from outside during summer months. The g-value and glazing ratio of windows has been selected to optimise the amount of solar heat gains and natural daylight levels throughout the year.

Minimise internal heat generation

The heat distribution infrastructure and building services within the building have been designed to minimise heat losses to spaces and improve system efficiencies. All electric heating system and localised EAHP for domestic hot water generation is proposed in flats, which has minimal heat loss (and therefore minimal unwanted heat gains in summer) when compared to a standard communal heat network. All necessary pipework and ductwork are insulated to exceed the requirements of Building Regulations to further reduce heat losses into spaces. High efficiency LED lighting is used to reduce the heat gains from lighting with optimised lighting control in communal areas.

Manage the heat within the building through exposed internal thermal mass and high ceilings

Ceiling heights are in line with the Housing Design Guide. Exposed thermal mass in not incorporated in this scheme.

Passive ventilation

High levels of passive ventilation have been considered to reduce the likelihood of the dwellings overheating. The dwelling and window designs are provided to maximise the operable area available to each occupied space. Most of the dwellings are dual aspect allowing higher levels of natural ventilation through opening windows compared to single sided ventilation. The dwelling floor plates are relatively shallow and so occupied spaces are provided close to the façade openings.

Mechanical Ventilation

Mechanical ventilation with heat recovery is provided in all dwellings.

10 Be Green

Following the reduction of energy demand in the Be Lean stage, opportunities to use renewable energy on-site were considered as required by the Be Green stage of energy hierarchy.

10.1 LZCT Feasibility Analysis

The following renewable technologies were considered feasible for the site:

- External air hot water tanks for domestic hot water (Flats)
- Air Source Heat Pumps for space heating and domestic hot water production (Townhouses)

Site specific analysis carried out to investigate which technologies are best suited to the developments is shown in Table 10-2.

Table 10-2 LZCT Feasibility Analysis

Technology	How it works	Key Considerations	Viability for ONE YMCA
External Air Heat Pump (EAHP)	The heat pump comprises of a stainless-steel inner vessel with a hot water heat pump mounted on top. The heat pump produces hot water by extracting heat from external air supplied via insulated ductwork. The heat pump is provided with an integral backup heater (immersion) and all necessary controls including domestic hot water temperature control and time clock.	Building fabric should very thermally efficient to reduce space heating demand, which will reduce occupants' heating costs. Larger ductworks required to be accommodated within apartment ceiling void and greater extent of louvres to be incorporated as part of the external façade design. Decentralised heating equipment placed within apartment. Decentralised domestic hot water production plant located within apartments. Decentralised whole house ventilation equipment located within apartment. Domestic hot water recovery time varies between 7 to 10 hours depending on the unit selected. This is not in line with CIBSE's guidance which recommends a minimum of 2-hour recovery period. No centralised plant on roof making space available for PV panels. Low capital cost Low embodied carbon Low distribution losses Low impact on overheating Requires only 1 no. water meter and 1 no. electricity meter	✓
Air-source Heat Pump (air to water ASHP) 	Heat pumps and exchangers extract heat from outside air to provide space heating and/or hot water. ASHPs are less efficient than GSHP due to the lower average temperature of outside air and greater variance across the year.	Requires a suitable location for the external unit to the building – planning permission may be required. The noise generated by the external unit must be considered. Like GSHPs, air to water ASHPs are most effective when providing space heating via under-floor heating systems designed to operate at temperatures of around 30°C-40°C. ASHPs are easier and cheaper to install than GSHPs however GHSPs are more efficient. The increasingly decarbonizing electrical grid combined with high efficiency heat pumps results in a low carbon source of heat.	✓

Technology	How it works	Key Considerations	Viability for ONE YMCA
Ground-source Heat Pump (GSHP) 	GSHPs transfer heat from the ground into a building to provide space heating and/or hot water. The ground tends to be at a constant temperature of around 12°C throughout the year and, through the use of a refrigerant cycle this constant low-grade heat can be harnessed to provide a useful level of heat for a building.	Feasibility depends on space for the piping circuit and whether the geology is suitable for either boreholes or trenches. Heat pumps are most suitable for low temperature heating systems such as underfloor heating. The capital cost of GSHPs are significantly higher that fossil-fuel boiler. Greatest carbon savings when combined with renewable electricity-generating technologies. The increasingly decarbonizing electrical grid combined with high efficiency heat pumps results in a low carbon source of heat.	✗
Biomass 	Energy by burning solid organic matter in the form of wood chips or sawdust pellets. Biomass boilers can provide energy for heating and hot water systems. A carbon neutral energy source.	Best suited for relatively continuous operation. Require store facilities to accommodate the fuel. Ideally, biomass fuel should be sourced locally to reduce transport costs and associated carbon emissions. Use may be limited in Smoke Control Zones.	✗
Cobined Heat and Power (CHP) 	CHP is the simultaneous generation of both usable heat and electrical power from the same source. Fuel (usually mains gas or oil) is combusted in an engine where the mechanical power produced is used to generate electricity while the heat emitted provides space heating or hot water.	CHP requires predictable and fairly constant electricity and heating loads for best performance. CHP units are best suited for hotels, residential homes, student accommodations, hospitals and schools. The unit should be sized on heat demands, rather than electrical requirements – units are usually sized on the building's hot water load as this is continuous throughout the year.	✗

Technology	How it works	Key Considerations	Viability for ONE YMCA
Solar Thermal 	Solar thermal panels generate hot water from the sun's energy through the use of solar collectors. A mixture of water and anti-freeze is circulated through the solar collectors and a heat exchanger within the water storage cylinder to heat the water in the tank.	Most effective in a south-facing position on an incline of 30-40 degrees. Panel locations should be clear of obstructions and over shading. Requires space for a hot water cylinder close to the collectors. Most economically viable in buildings with a high hot water demand or where a building is not on the national gas grid.	✗
Photovolatics (PV) 	PV arrays are made up of semi-conductor solar cells which convert sunlight into electricity. Energy from sunlight causes an electrical current to flow between difference atomic energy levels within the solar cells. PV panels are made of solar cells, and several panels create a PV array.	The position of the PV array will affect the energy generation and, consequently the carbon and financial savings. PV panels may require regular cleaning to avoid a reduction in efficiency PV panels should be free from shading from adjacent buildings/trees. Permission is required from the DNO (Distribution Network Operator) to connect the array to the grid (the cost of this grid connection is dependent on the size of the array and its location on the grid).	✗
Wind 	Wind turbines produce energy by using wind power to drive a generator. Turbines can either be free-standing or roof mounted. Roof-mounted wind turbines require an average wind speed of 3 m/s to be viable whereas larger, stand-alone turbines require greater speeds of approximately 6 m/s to be viable.	Rural areas are better suited than urban areas as the wind speeds are higher and less turbulent. Pay-back periods are strongly dependent on wind conditions plus the length of cabling required to connect the turbine to the building. Planning permission is required and is often a contentious issue	✗

The Adopted Local Plan expects all residential development proposals to maximise on-site renewable energy generation. In line with this, Air Source Heat Pump for space heating and domestic hot water generation was considered for the town houses and EAHP hot water tanks for the flats in order to maximise CO_2 reductions achieved on site.

11 Conserving Water and Maximising Water Efficiency

As a design team we have made initial selections of sanitaryware and appliances to demonstrate that the target of 110 litres/person/day will be achieved. The table below shows the performance of each appliance and fitting.

Table 11-1: Proposed standards for water fittings and appliances

Appliance/Fitting	Targeted Standard
WCs	6/4 litres dual flush
Wash basins	3 litres/min
Showers	8 litres/min
Baths	157 litres
Kitchen sink taps	9 litres/min
Washing machines	7.5 litres/kg
Dishwasher	0.79 litres/place setting

12 Using Recycled and Recyclable Material and Sourcing them Responsibly

The project will follow the “reduce, reuse, recycle” principle, which will limit virgin material use, reducing extraction, waste, and pollution.

The structural specification will consider the use of recycled materials, and recyclability at end of life. Simple measures such as low or no cement content mortars facilitate the easy re-use of masonry and there is a myriad of masonry products available with high recycled content.

On a physical level, the use of non-toxic and non-volatile finishes reduces the build-up of airborne compounds which can be harmful in elevated concentrations. Durable self- finished materials also require less maintenance and remove the need for re-application of applied finishes. Where possible the design will consider the use of self- finished materials and limited use of paint systems in interior environments.

13 Minimising Waste and Maximising Recycling During Construction and Operation

During construction, the site will operate an avoid, prevent, and minimise strategy to waste and will aim to achieve a 90% diversion from landfill approach. During operation, properties will be provided with suitable space for recycling and food waste in line with the Council's waste guidance.

The buildings will be designed to be low maintenance, avoiding additional finishes and use of harmful products. The team will look to reuse the building materials where possible, such as excavated material being reused for landscaping, and the reuse of tiles or bricks to form the architecture/structure.

Certifications will be required for all structural materials supplied on the project to guarantee it is of legal origin.

Structures will be designed in accordance with Eurocodes and have a design life of at least 60 years.

14 Minimising Flood Risk Including Floor Resilient Construction

The site is located in Flood risk zone 1 and has low probability of flooding from rivers and the sea.

15 Part O Overheating Assessment

15.1 Thermal Comfort Assessment

An Overheating Assessment has been conducted to investigate whether the development is likely to overheat during summertime periods. CIBSE TM59 Design Methodology for the Assessment of Overheating Risk in Homes (2017) has been used as a guide for what is regarded as acceptable thermal conditions. TM59 is used to assess the dwellings and has specific modelling instructions for bedrooms, kitchens and living areas.

TM59 uses an "adaptive thermal comfort" approach and provides time and temperature limits for the operative temperature to define the risk of overheating; a temperature limit is set in bedrooms during the night. The methodology also calculates the hourly operative temperature (T_{op}) within each room accounting for both air temperature and other room factors. CIBSE TM59 provides time and temperature limits for the operative temperature to define the risk of overheating.

For homes that are predominantly naturally or mechanically ventilated, compliance with TM59 is based on passing both of the following criteria:

Criterion 1: for living rooms, kitchens and bedrooms.

T_{op} should not exceed T_{max} by more than 1 degree for more than 3% of occupied hours during the months of May to September.

Criterion 1 will show which rooms frequently overheat. This is likely to happen in rooms where heat gains are not dissipated sufficiently, and heat accumulates over several days. This is often the case for rooms which don't have a night cooling/ventilation strategy.

Criterion 2: For bedrooms only.

T_{op} should not exceed 26°C for more than 1% of occupied hours from 10pm to 7am. 1% of annual hours between 10pm and 7am is 32 hours, so 33 or more hours above 26°C will be recorded as a fail.

The TM59 methodology is prescriptive so that it is consistently applied. It uses defined internal gain and window opening profiles, and specific weather files with clearly defined thresholds to provide a clear pass/fail result. It provides a set of profiles that represent reasonable usage patterns for a home; the profiles have been developed to test the building design against overheating risk, not to cover all usage modes.

As stated in CIBSE TM59 this methodology will; Allow different designs to be compared with a common approach, based on reasonable assumptions, support design decisions that improve comfort without cooling, and Provide consistency across the industry as all consultants will be using the same methodology for overheating risk prediction.

15.2 Part O - Overheating Assessment

In 2021 the government introduced a new approved document Part O which aims to protect the health and welfare of occupants of a building by reducing the occurrences of high indoor temperatures. The regulations in Part O are intended to mitigate the future risks of global temperature increase and the increased frequency of extreme events such as heat waves. It is a response to buildings where occupants have experienced high temperatures that impact their quality of life. It also addresses the changing methods of construction with lightweight structures or modern methods of construction becoming more popular.

There are two routes to compliance contained within the approved Part O document:

Simplified Method
Dynamic Thermal Modelling

For this report, dynamic thermal modelling has been used to achieve Part O compliance. Part O guidance requires adopting the CIBSE TM59 methodology for the assessment with the following limits. Usually, the CIBSE's TM59 method requires the modeller to make choices however Part O limits these choices, which are detailed below –

a. When a room is occupied during the day (8am to 11pm), openings should be modelled to do all of the following.

i. Start to open when the internal temperature exceeds 22°C.

ii. Be fully open when the internal temperature exceeds 26°C.

iii. Start to close when the internal temperature falls below 26°C.

iv. Be fully closed when the internal temperature falls below 22°C.

b. At night (11pm to 8am), openings should be modelled as fully open if both of the following apply.

i. The opening is on the first floor or above and not easily accessible.

ii. The internal temperature exceeds 23°C at 11pm.

c. When a ground floor or easily accessible room is unoccupied, both of the following apply.

i. In the day, windows, patio doors and balcony doors should be modelled as open, if this can be done securely.

ii. At night, windows, patio doors and balcony doors should be modelled as closed.

d. An entrance door should be included, which should be shut all the time.

15.3 Site context

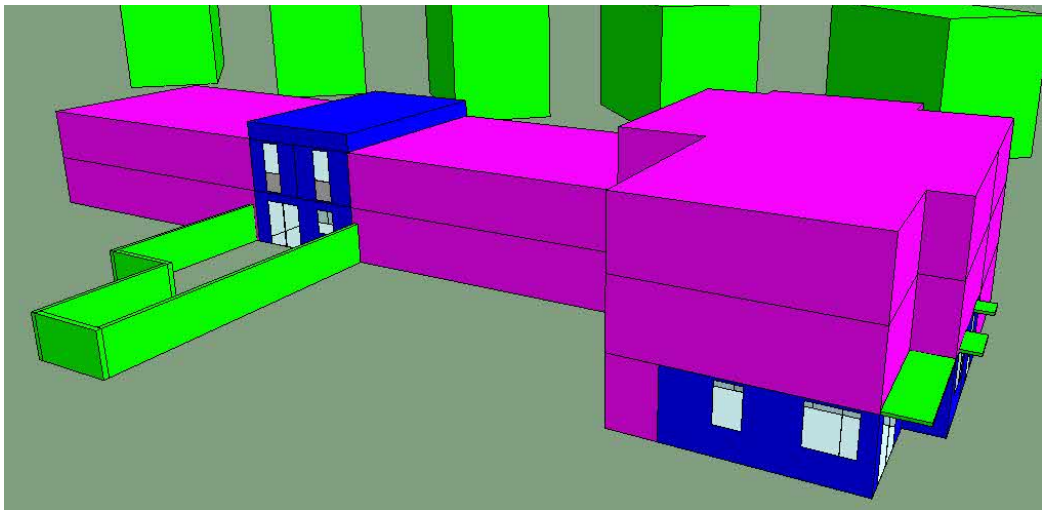
This Overheating Risk Assessment has been prepared in support of the residential project at Parnall Road, hereafter referred to as the Proposed Development. The proposed development includes the construction of two-storey rows of terraced homes and a block of flats located at Parnall Road, Harlow, Essex, CM18 7PP.

Figure 15-1 Ground Floor – Parnall Road development

16 Overheating Assessment Methodology

A dynamic thermal modelling method has been used to assess overheating risk. The modelling has been conducted using the dynamic simulation modelling software IES Virtual Environment (VE). IES VE is a CIBSE AM 11 Building Energy and Performance Modelling accredited software. Buildings have been zoned into separate rooms including kitchens, living rooms, bedrooms, bathrooms and circulation areas.

Figure 16-1 Sample Dwellings chosen, right to left, Unit 03 and Unit 06



In accordance with TM59 methodology, a sample of units within the development has been selected for the overheating assessment. The sample units and respective IES model geometries are indicated by Figure below. Refer to the Architect's drawings for internal layouts.

Figure 16-2 Sample units selected for overheating assessment

The sample dwellings were selected due to exhibiting the following features:

Larger, sun-facing windows, which increase solar heat gains.
Lower external shading than others, and therefore, reduced protection from unwanted solar heat gains in summer.
South-facing kitchens and living rooms, which are more prone to daytime overheating (TM 59 Criterion a)).
west-facing bedrooms, which are more prone to night-time overheating (TM 59 Criterion b)).
bedrooms with windows in non-secure locations (ground floors and above porch roofs).

This sample is deemed to represent a worst-case overheating scenario for the proposed development. Other dwellings within the development have a lower proportion of large, sun-facing windows, benefit more from shading, and benefit from a similar amount of natural ventilation openings and opportunities for cross-ventilation as the sample dwellings. Therefore, if the sample dwellings comply with the overheating requirements, all other dwellings can be reasonably expected to also comply.

16.1 Weather files

The weather file selected for the assessment has a substantial impact on the overheating results, therefore the latest DSY weather files are used for Parnall Road to assess the overheating risk.

However, as there is no dedicated weather file for the location of Harlow, the weather data that has been used for the assessment is based on the CIBSE DSY1 2020 High 50 file, for the location of Norwich. This is not the closest location to the site but is a representative weather file based on the topography and geographical conditions applicable to Harlow.

16.2 Building Fabric

The thermal model replicates the geometry based on the architectural drawings. Modelling parameters including U-value fabric standards, window openings and usage profiles (TM59 Guidelines) were applied to the model.

Table 16-1: Fabric standards

Building Fabric	
External Walls	0.18 W/m².K
Roof	0.10 W/m².K
Ground Floor	0.12 W/m².K
External Glazing	1.2 W/m².K
Glazing G-value	0.42
Doors	1.0 W/m².K
Airtightness	
Airtightness	3 m³/m².h

The table below outlines the U-values and air permeability for this site.

16.2.1 Internal Heat Gains

The internal heat gains have been based on the TM59 recommendations for each property type and are detailed in the table below.

Table 16-2: Internal heat gains per house type

Occupied areas	Lighting Gain (W/m²)	Nr People	Sensible Gain (W/person)	Equipment Gain (W)	Lights, Occupancy and Equipment Profiles (W)
Double Bedroom	2	2	75	80	Based on CIBSE TM59 Guide Profiles
2 Bedroom Property Living/Kitchen	2	2	75	450	
3 Bedroom Property Living/Kitchen	2	4	75	450	

16.2.2 Ventilation

Table 16-3: Ventilation specification

	Specification	
Opening window types	side-hung	
Mechanical ventilation system	MVHR	
	Kitchen Living Dining – 2 Bedroom	14/ls
	Living Dining – 3 Bedroom	14/ls
	Kitchen	7 l/s
	Double Bedroom	10l/s
	Single Bedroom	7l/s

The dwellings are proposed to have a hybrid ventilation strategy, with natural ventilation via openable windows and background ventilation via MVHR unit. Building Regulation Part F parameters have been applied.

16.3 Dynamic thermal modelling method (Part O input)

Table 16-4: Modelling specification

2b.1 Modelling details	
Dynamic software name and version	IES-VE 2023
Weather file location used	Norwich _DSY1_2020 High 50
2b.2 Modelled occupancy	
Has the project passed the assessment described in CIBSE's TM59, taking into account the limits detailed in paragraphs 2.5 and 2.6?(1)	Yes
Details of the occupancy profiles used	Based on TM59 Occupancy profiles
Details of the equipment profiles used	Based on TM59 Occupancy profiles
Details of the opening profiles used	Based on Part O limits detailed in paragraphs 2.5 and 2.6
Window g-value	0.42
Shading strategy	75mm reveal
Mechanical cooling	-

16.4 Window Openings

The acoustic constraints at Parnall Road have meant that the natural ventilation strategy has been tested with bedroom windows open during the day only to satisfy this risk. Ground floor apartments incorporate louvred shutters to provide secure ventilation to these spaces. Additional spandrel panels have been incorporated on all first-floor windows on the East Elevation to reduce overheating risk.

The results below demonstrate that Part O constraints are met, and the sample dwellings assessed pass with acoustic and security constraints taken into account.

16.5 Overheating Assessment Results

The assessment results showed that with the proposed dwelling specification, there is a low risk of overheating under current climatic conditions.

The ground floor bedrooms have no value at present but have been shown to pass once ventilation louvres have been incorporated to reduce security risk. This will be finalised in further stages.

Table 16-5: Overheating Assessment Results

Room Name			TM59 Criterion 1	TM59 Criterion 2	TM59 Result
	Ground Floor	Kitchen Living Dining	0.9	NA	Pass
	Ground Floor	Bedroom 1	0.2	-	Pass
Unit 03	Ground Floor	Bedroom 2	0.2	-	Pass
	First Floor	Living Dining	1.1	NA	Pass
	First Floor	Kitchen	0.5	NA	Pass
	First Floor	Bedroom 1	0.3	13	Pass
	First Floor	Bedroom 2	0.4	30	Pass
Unit 06	First Floor	Bedroom 3	0.5	23	Pass

17 Overheating Assessment Conclusions

The main conclusions from the overheating risk assessment are:

- The suggested strategy performs well overall and the risk of overheating under current climate conditions is low.
- All areas comply with the CIBSE TM59 criteria and Part O guidance under the 2020 weather data.
- Mechanical ventilation is vital in maintaining the night-time temperature in bedrooms below 26°C, especially for south/west facing rooms.
- The design achieves very good performance in terms of thermal comfort, ensuring that it will meet the occupiers' needs.

The overheating risk assessment demonstrates that, under current climate conditions as represented by the Norwich CIBSE DSY1 2020 High 50 weather data, there is a low risk of overheating in all occupied spaces in the sample dwellings, as defined in TM59. The proposed building design allows internal temperatures in all occupied spaces to be maintained in line with the TM59/Part O recommended levels.

18 Conclusions

This Energy Assessment Report demonstrates that the Proposed Development at Parnall Road, Harlow, Essex, CM18 7PP incorporates passive and active measures to comply with applicable energy policies. The assessment involved establishing applicable policies and applying CO_2 reduction measures to the development in accordance with the Harlow Local Development Plan.

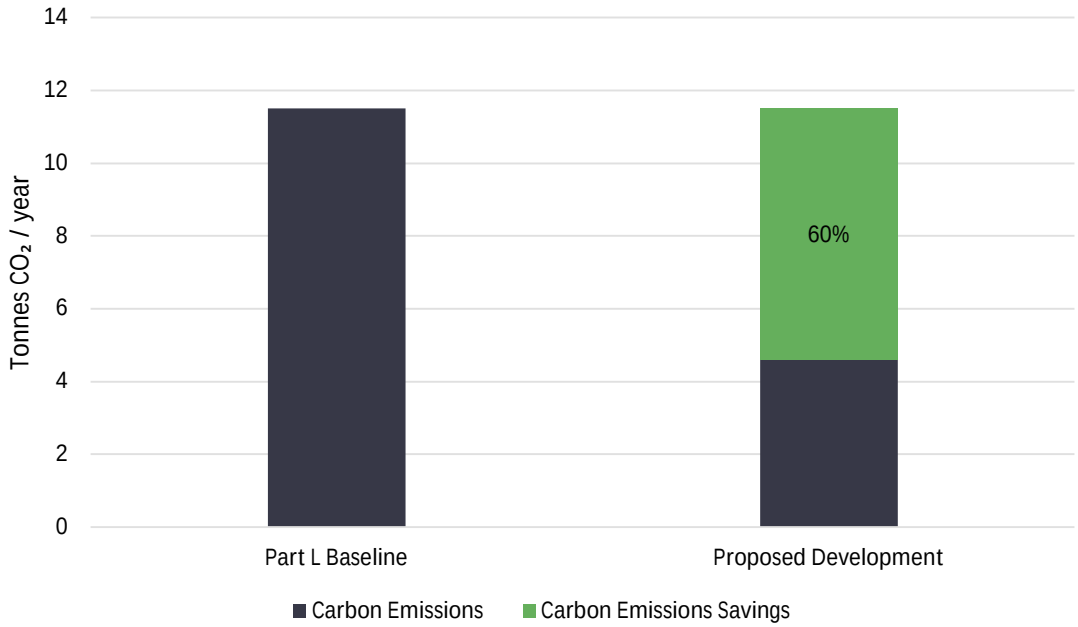
During the Be Lean phase of the hierarchy, passive and active demand reduction measures were prioritised. Following the reduction of energy demand in the Be Lean stage, methods of supplying energy efficiently and cleanly to reduce CO_2 emissions further were investigated at the Be Clean stage of the

energy hierarchy. No opportunities to connect to existing or planned district heating networks were identified.

Opportunities to use renewable energy on-site were considered in the Be Green stage of the energy hierarchy. An Air Source Heat Pump was identified as the most suitable strategy for heating and hot water generation for townhouses and EAHP domestic hot water tanks for flats to achieve the necessary carbon targets to meet the client's ambitious energy criteria and provide flexibility for the future.

The results of modelling done using the SAP 10.2 software demonstrates approx. 60% reduction of CO_2 emissions over Building Regulations Part L 2021 for the domestic building.

Figure 18-1 Carbon emissions reduction over Part L 2021



The results show that the Proposed Developments complies with the energy policies of Harlow District Council and National Planning Policy Framework as a result of climate change mitigation measures incorporated into the development. The energy assessment demonstrates energy remains an integral part of the development's design and evolution in order to address the climate change emergency declared by the UK.

QODA

Appendix A: Fabric Efficiency and Primary Energy

Table 18-1 Fabric Energy Efficiency

	Target Fabric Energy Efficiency (kWh/m²)	Dwelling Fabric Energy Efficiency (kWh/m²)	Improvement (%)
Development total	41.71	40.27	3%

Table 18-2 Primary Energy

	Target Primary Energy Efficiency (kWh/m²)	Dwelling Primary Energy Efficiency (kWh/m²)	Improvement (%)
Development total	67.34	53.26	20.5%

Appendix B: Baseline Building Specification

Table 18-3 Baseline Building Specification

	Baseline (Part L 2021) Residential
	Fabric Specification
External wall U-value	0.18 W/m2K
Roof U-value	0.13 W/m2K
Ground Floor U-value	0.13 W/m2K
Glazing	U-Value = 1.4 W/m2K (Double glazing)
	g-value 0.63
Door U-value	1.0 W/m2K
	Building Air Permeability
Air-tightness standard	5 m³/h.m² @50Pa
	Space Heating
System	Mains Gas 89.5% efficient
Heating Controls	Time and Temperature zone control
	Hot Water System
System	Natural Gas Combi Boiler
	Cylinder in heated space
	Cylinder with stat
Cylinder Volume	150l
Cylinder Insulation	Better than 0.85x(0.2+0.051)kWh/day
Pipework Insulation	Fully insulated primary network
	Ventilation
System Type	Natural Ventilation via openable windows. Local extract fans in wet rooms
Ductwork Insulated?	-
Ducting Type	-
Specific Fan Power	-
Heat Exchanger Efficiency	-
Cooling Efficiency	N/A
	Lighting
% Energy efficient LED lighting	100%
	PV Panels
PV	For flats: kWp = 40% of dwelling floor area / (6.5 ´ number of storeys in block)

QODA

Appendix C Part O Window Openings

Description	Openable Area %	Height (mm)	Width (mm)	Restrictor	Degree of Opening
Window 1	66%	1.100	0.880	No	ADO.Section_26ab, a and c
Window 2	68%	1.400	0.880	No	ADO.Section_26ab, a and c
Window 3	70%	1.400	1.030	No	ADO.Section_26ab, a and c
Patio 1	69%	2.110	0.905	No	ADO.Section_26ab, a and c
Window 2 Apartment	71%	2.150	1.100	No	ADO.Section_26ab, a and c

QODA

Appendix D SAP Calculations (Sample)

Full SAP Calculation Printout

Property Reference	Parnall Road Plot 03	**Issued on Date**	06/03/2024
Assessment Reference	00001	**Prop Type Ref**	Parnall Road Plot 03
Property	Plot 03, Parnall Road, Harlow, CM18 7PP		

SAP Rating	79 C	**DER**	4.51	**TER**	10.79
Environmental	96 A	**% DER < TER**			58.20
CO Emissions (t/year)	0.46	**DFEE**	38.67	**TFEE**	39.65
Compliance Check	See BREL	**% DFEE < TFEE**			2.49
% DPER < TPER	15.11	**DPER**	47.92	**TPER**	56.45

Assessor Details	Mr. Robert Stubbings	**Assessor ID**	Y779-0001
Client			

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

---

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.3500 (1b)	x	3.0400 (2b)	=	162.1840 (1b) - (3b)	
First floor	53.3500 (1c)	x	3.3400 (2c)	=	178.1890 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.7000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	340.3730	(5)

---

2. Ventilation rate

---

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275	(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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	80.1000 (23c)

Effective ac	0.2621	0.2589	0.2557	0.2397	0.2366	0.2206	0.2206	0.2174	0.2270	0.2366	0.2429	0.2493	(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	
Solid Doors			2.1300	1.0000	2.1300			(26)
Fully Glazed Doors (Uw = 1.20)			3.8200	1.1450	4.3740			(27)
Windows (Uw = 1.20)			6.2500	1.1450	7.1565			(27)
Spandrel Panel (Uw = 0.50)			3.2400	0.4902	1.5882			(27)
Ground Floor			53.3500	0.1200	6.4020	110.0000	5868.5000	(28a)
External Wall	74.8100	15.4400	59.3700	0.1800	10.6866	60.0000	3562.2000	(29a)
Flat Roof	53.3500		53.3500	0.1000	5.3350	9.0000	480.1500	(30)
Total net area of external elements Aum(A, m2)			181.5100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.6724			(33)
Party Wall			116.1200	0.0000	0.0000	45.0000	5225.4000	(32)
Internal Walls			186.7300			9.0000	1680.5700	(32c)
First Floor			53.3500			18.0000	960.3000	(32d)
Ground Floor Ceiling			53.3500			9.0000	480.1500	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 18257.2700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 171.1084 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	8.7200	0.3610	3.1479
E3 Sill	7.7100	0.0190	0.1465
E4 Jamb	27.1200	0.0220	0.5966
E5 Ground floor (normal)	11.7300	0.0610	0.7155
E6 Intermediate floor within a dwelling	11.7300	0.0010	0.0117
E14 Flat roof	11.7300	0.0800	0.9384
E18 Party wall between dwellings	25.5200	0.0330	0.8422
P1 Party wall - Ground floor	18.2000	0.0510	0.9282
P2 Party wall - Intermediate floor within a dwelling	18.2000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	18.2000	0.1200	2.1840

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.5111 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 47.1834 (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	29.4357	29.0776	28.7196	26.9295	26.5714	24.7813	24.7813	24.4233	25.4973	26.5714	27.2875	28.0036	(38)
Heat transfer coeff	76.6191	76.2611	75.9030	74.1129	73.7549	71.9647	71.9647	71.6067	72.6808	73.7549	74.4709	75.1870	(39)

Average = Sum(39)m / 12 = 74.0234

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7181	0.7147	0.7114	0.6946	0.6912	0.6745	0.6745	0.6711	0.6812	0.6912	0.6979	0.7047	(40)
HLP (average)												0.6938	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy 2.7935 (42)
Hot water usage for mixer showers

79.9398	78.7384	76.9879	73.6384	71.1666	68.4101	66.8433	68.5806	70.4851	73.4447	76.8661	79.6335	(42a)

Hot water usage for baths

30.6803	30.2247	29.5830	28.3999	27.5141	26.5318	26.0012	26.6383	27.3321	28.3832	29.5906	30.5766	(42b)

Hot water usage for other uses

43.2382	41.6659	40.0936	38.5213	36.9490	35.3767	35.3767	36.9490	38.5213	40.0936	41.6659	43.2382	(42c)

Average daily hot water use (litres/day) 141.4547 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	153.8583	150.6290	146.6645	140.5597	135.6297	130.3186	128.2212	132.1680	136.3385	141.9215	148.1227	153.4483	(44)
Energy conte	243.6739	214.4937	225.4179	192.4192	182.5837	160.2419	155.0724	163.6516	168.1190	192.5862	211.0279	240.2630	(45)
Energy content (annual)										Total = Sum(45)m =		2349.5503	
Distribution loss (46)m = 0.15 x (45)m	36.5511	32.1741	33.8127	28.8629	27.3875	24.0363	23.2609	24.5477	25.2178	28.8879	31.6542	36.0394	(46)

Water storage loss:
Store volume 150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.8800 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.0152 (55)
Total storage loss

31.4712	28.4256	31.4712	30.4560	31.4712	30.4560	31.4712	31.4712	30.4560	31.4712	30.4560	31.4712	(56)

If cylinder contains dedicated solar storage

31.4712	28.4256	31.4712	30.4560	31.4712	30.4560	31.4712	31.4712	30.4560	31.4712	30.4560	31.4712	(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

298.4075	263.9305	280.1515	245.3872	237.3173	213.2099	209.8060	218.3852	221.0870	247.3198	263.9959	294.9966	(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

298.4075	263.9305	280.1515	245.3872	237.3173	213.2099	209.8060	218.3852	221.0870	247.3198	263.9959	294.9966	(64)

Total per year (kWh/year) = Sum(64)m = 2993.9943 (64)
12Total per year (kWh/year) 2994 (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

124.8085	110.8686	118.7383	106.3538	104.4959	95.6548	95.3485	98.2010	98.2740	107.8218	112.5412	123.6743	(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	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	148.0492	163.9116	148.0492	152.9841	148.0492	152.9841	148.0492	148.0492	152.9841	148.0492	152.9841	148.0492	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	266.7267	269.4945	262.5198	247.6714	228.9280	211.3118	199.5431	196.7753	203.7500	218.5984	237.3419	254.9580	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	(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)	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	(71)
Water heating gains (Table 5)	167.7533	164.9830	159.5945	147.7136	140.4515	132.8539	128.1565	131.9906	136.4916	144.9218	156.3072	166.2289	(72)
Total internal gains	647.4317	663.2916	635.0659	613.2716	582.3311	562.0523	540.6513	541.7176	558.1283	576.4718	611.5357	634.1386	(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	
West	3.8200	19.6403	0.4200	0.7000	0.7700	15.2859	(80)

East			4.1400	19.6403	0.4200	0.7000	0.7700				16.5664	(76)
West			2.1100	19.6403	0.4200	0.7000	0.7700				8.4433	(80)
East			1.6200	19.6403	0.0000	0.7000	0.7700				0.0000	(76)
West			1.6200	19.6403	0.0000	0.7000	0.7700				0.0000	(80)
Solar gains	40.2956	78.8267	129.8163	189.3294	232.0303	237.5243	226.1328	194.2447	150.9818	93.5345	50.2438	33.1371 (83)
Total gains	687.7273	742.1183	764.8823	802.6010	814.3614	799.5766	766.7841	735.9623	709.1100	670.0063	661.7795	667.2757 (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	66.1906	66.5013	66.8150	68.4289	68.7611	70.4715	70.4715	70.8239	69.7772	68.7611	68.0999	67.4513	
alpha	5.4127	5.4334	5.4543	5.5619	5.5841	5.6981	5.6981	5.7216	5.6518	5.5841	5.5400	5.4968	
util living area	0.9836	0.9733	0.9537	0.8904	0.7670	0.5652	0.4114	0.4451	0.6748	0.8992	0.9680	0.9856	(86)
Living	20.2664	20.3755	20.5261	20.7387	20.8752	20.9357	20.9442	20.9437	20.9190	20.7585	20.4991	20.2621	
Non living	19.4548	19.5948	19.7859	20.0568	20.2132	20.2866	20.2929	20.2957	20.2667	20.0862	19.7641	19.4592	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.6247	20.3755	20.5261	20.7387	20.8752	20.9357	20.9442	20.9437	20.9190	20.7585	20.4991	20.3653	(87)
Th 2	20.3249	20.3278	20.3308	20.3456	20.3486	20.3634	20.3634	20.3664	20.3575	20.3486	20.3426	20.3367	(88)
util rest of house	0.9804	0.9682	0.9446	0.8700	0.7290	0.5127	0.3526	0.3849	0.6217	0.8764	0.9610	0.9828	(89)
MIT 2	19.9780	19.5948	19.7859	20.0568	20.2132	20.2866	20.2929	20.2957	20.2667	20.0862	19.7641	19.6173	(90)
Living area fraction									fLA = Living area / (4) =			0.4231	(91)
MIT	20.2516	19.9251	20.0991	20.3453	20.4933	20.5612	20.5684	20.5699	20.5427	20.3706	20.0750	19.9337	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2516	19.9251	20.0991	20.3453	20.4933	20.5612	20.5684	20.5699	20.5427	20.3706	20.0750	19.9337	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9800	0.9646	0.9410	0.8700	0.7378	0.5293	0.3716	0.4043	0.6374	0.8772	0.9577	0.9808	(94)
Useful gains	674.0020	715.8262	719.7352	698.2878	600.8617	423.1839	284.9414	297.5702	451.9934	587.7436	633.8110	654.4670	(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	1222.1972	1145.8302	1032.2119	848.2451	648.5486	428.9974	285.5869	298.5899	468.2600	720.6308	966.2640	1182.9730	(97)
Space heating kWh	407.8573	288.9627	232.4826	107.9692	35.4791	0.0000	0.0000	0.0000	0.0000	98.8681	239.3662	393.2084	(98a)
Space heating requirement - total per year (kWh/year)												1804.1937	
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	407.8573	288.9627	232.4826	107.9692	35.4791	0.0000	0.0000	0.0000	0.0000	98.8681	239.3662	393.2084	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1804.1937	
Space heating per m2											(98c) / (4) =	16.9090	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	249.6592	(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	407.8573	288.9627	232.4826	107.9692	35.4791	0.0000	0.0000	0.0000	0.0000	98.8681	239.3662	393.2084	(98)
Space heating efficiency (main heating system 1)	249.6592	249.6592	249.6592	249.6592	249.6592	0.0000	0.0000	0.0000	0.0000	249.6592	249.6592	249.6592	(210)
Space heating fuel (main heating system)	163.3656	115.7429	93.1200	43.2466	14.2110	0.0000	0.0000	0.0000	0.0000	39.6012	95.8772	157.4981	(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	298.4075	263.9305	280.1515	245.3872	237.3173	213.2099	209.8060	218.3852	221.0870	247.3198	263.9959	294.9966	(64)
Efficiency of water heater												169.6132	(216)
(217)m	169.6132	169.6132	169.6132	169.6132	169.6132	169.6132	169.6132	169.6132	169.6132	169.6132	169.6132	169.6132	(217)
Fuel for water heating, kWh/month	175.9341	155.6073	165.1708	144.6746	139.9167	125.7036	123.6967	128.7548	130.3477	145.8140	155.6458	173.9231	(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	47.8943	43.2593	47.8943	46.3493	47.8943	46.3493	47.8943	47.8943	46.3493	47.8943	46.3493	47.8943	(231)
Lighting	35.0224	28.0963	25.2976	18.5341	14.3163	11.6965	13.0598	16.9756	22.0496	28.9303	32.6767	35.9958	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year

Space heating fuel - main system 1	722.6627 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	169.6132
Water heating fuel used	1765.1893 (219)
Space cooling fuel	0.0000 (221)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.3580)

mechanical ventilation fans (SFP = 1.3580)	563.9164 (230a)
Total electricity for the above, kWh/year	563.9164 (231)
Electricity for lighting (calculated in Appendix L)	282.6511 (232)

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

PV generation	0.0000 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	3334.4194 (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	722.6627	0.1564	112.9904	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1765.1893	0.1410	248.8235	(264)
Space and water heating			361.8138	(265)
Pumps, fans and electric keep-hot	563.9164	0.1387	78.2222	(267)
Energy for lighting	282.6511	0.1443	40.7953	(268)
Total CO2, kg/year			480.8312	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.5100	(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	722.6627	1.5788	1140.9653	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1765.1893	1.5212	2685.2537	(278)
Space and water heating			3826.2190	(279)
Pumps, fans and electric keep-hot	563.9164	1.5128	853.0927	(281)
Energy for lighting	282.6511	1.5338	433.5396	(282)
Total Primary energy kWh/year			5112.8514	(286)
Dwelling Primary energy Rate (DPER)			47.9200	(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	53.3500 (1b)	x	3.0400 (2b)	=	162.1840	(1b) - (3b)
First floor	53.3500 (1c)	x	3.3400 (2c)	=	178.1890	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.7000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	340.3730	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1175	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3675	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3124	(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	0.3983	0.3905	0.3827	0.3436	0.3358	0.2968	0.2968	0.2890	0.3124	0.3358	0.3514	0.3671 (22b)
Effective ac	0.5793	0.5762	0.5732	0.5590	0.5564	0.5440	0.5440	0.5417	0.5488	0.5564	0.5618	0.5674 (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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.20)			13.3100	1.1450	15.2405			(27)
Ground Floor			53.3500	0.1300	6.9355			(28a)
External Wall	74.8100	15.4400	59.3700	0.1800	10.6866			(29a)
Flat Roof	53.3500		53.3500	0.1100	5.8685			(30)
Total net area of external elements Aum(A, m2)			181.5100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.8611			(33)
Party Wall			116.1200	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 171.1084 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	8.7200	0.0500	0.4360
E3 Sill	7.7100	0.0500	0.3855
E4 Jamb	27.1200	0.0500	1.3560
E5 Ground floor (normal)	11.7300	0.1600	1.8768
E6 Intermediate floor within a dwelling	11.7300	0.0000	0.0000
E14 Flat roof	11.7300	0.0800	0.9384
E18 Party wall between dwellings	25.5200	0.0600	1.5312
P1 Party wall - Ground floor	18.2000	0.0800	1.4560
P2 Party wall - Intermediate floor within a dwelling	18.2000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	18.2000	0.1200	2.1840

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.1639 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 51.0250 (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	65.0711	64.7251	64.3860	62.7932	62.4952	61.1079	61.1079	60.8510	61.6422	62.4952	63.0980	63.7283	(38)
Heat transfer coeff	116.0960	115.7501	115.4109	113.8181	113.5201	112.1328	112.1328	111.8759	112.6672	113.5201	114.1230	114.7533	(39)
Average = Sum(39)m / 12 =												113.8167	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0881	1.0848	1.0816	1.0667	1.0639	1.0509	1.0509	1.0485	1.0559	1.0639	1.0696	1.0755	(40)
HLP (average)												1.0667	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7935 (42)

Hot water usage for mixer showers

71.0576	69.9897	68.4336	65.4564	63.2592	60.8090	59.4163	60.9606	62.6534	65.2842	68.3254	70.7853	(42a)

Hot water usage for baths

30.6803	30.2247	29.5830	28.3999	27.5141	26.5318	26.0012	26.6383	27.3321	28.3832	29.5906	30.5766	(42b)

Hot water usage for other uses

43.2382	41.6659	40.0936	38.5213	36.9490	35.3767	35.3767	36.9490	38.5213	40.0936	41.6659	43.2382	(42c)

Average daily hot water use (litres/day) 133.2657 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	144.9761	141.8803	138.1103	132.3776	127.7223	122.7175	120.7942	124.5479	128.5068	133.7610	139.5820	144.6001	(44)
Energy conte	229.6067	202.0357	212.2704	181.2184	171.9388	150.8954	146.0901	154.2163	158.4617	181.5124	198.8601	226.4089	(45)
Energy content (annual)										Total = Sum(45)m =		2213.5149	
Distribution loss (46)m = 0.15 x (45)m	34.4410	30.3053	31.8406	27.1828	25.7908	22.6343	21.9135	23.1325	23.7693	27.2269	29.8290	33.9613	(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

276.2016	244.1214	258.8653	226.3102	218.5337	195.9873	192.6850	200.8112	203.5536	228.1073	243.9520	273.0038	(62)
WWHRS -32.4846	-28.7296	-30.0840	-24.9107	-23.2159	-19.8660	-18.6212	-19.8018	-20.5541	-24.2311	-27.4509	-31.8830	(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	243.7171	215.3918	228.7813	201.3995	195.3178	176.1213	174.0638	181.0094	182.9994	203.8763	216.5011	241.1208	(64)

Total per year (kWh/year) = Sum(64)m = 2460.2994 (64)

12Total per year (kWh/year) 2460 (64)

Electric shower(s)

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

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

Heat gains from water heating, kWh/month

113.6202	100.8454	107.8558	96.3286	94.4456	86.2462	85.8509	88.5529	88.7620	97.6288	102.1945	112.5569	(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	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	148.0492	163.9116	148.0492	152.9841	148.0492	152.9841	148.0492	148.0492	152.9841	148.0492	152.9841	148.0492	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	266.7267	269.4945	262.5198	247.6714	228.9280	211.3118	199.5431	196.7753	203.7500	218.5984	237.3419	254.9580	(68)

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

	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	(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)												
	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399 (71)
Water heating gains (Table 5)												
	152.7153	150.0676	144.9675	133.7897	126.9430	119.7864	115.3910	119.0227	123.2806	131.2215	141.9368	151.2861 (72)
Total internal gains												
	635.3936	651.3762	623.4389	602.3477	571.8226	548.9848	527.8857	528.7496	544.9172	565.7716	600.1652	622.1958 (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	
East	5.7600	19.6403	0.6300	0.7000	0.7700	34.5734	(76)
West	7.5500	19.6403	0.6300	0.7000	0.7700	45.3175	(80)

Solar gains	79.8909	156.2835	257.3767	375.3685	460.0282	470.9208	448.3358	385.1138	299.3397	185.4435	99.6145	65.6984 (83)
Total gains	715.2845	807.6597	880.8156	977.7162	1031.8508	1019.9055	976.2214	913.8634	844.2569	751.2151	699.7798	687.8942 (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	43.6834	43.8139	43.9427	44.5576	44.6746	45.2273	45.2273	45.3312	45.0128	44.6746	44.4386	44.1945	
alpha	3.9122	3.9209	3.9295	3.9705	3.9783	4.0152	4.0152	4.0221	4.0009	3.9783	3.9626	3.9463	
util living area													
	0.9871	0.9783	0.9603	0.9090	0.8082	0.6423	0.4887	0.5373	0.7658	0.9327	0.9778	0.9889	(86)
MIT	19.3247	19.5400	19.8735	20.3327	20.6967	20.9141	20.9777	20.9675	20.8207	20.3438	19.7685	19.2992	(87)
Th 2	20.0106	20.0133	20.0159	20.0281	20.0304	20.0411	20.0411	20.0431	20.0370	20.0304	20.0258	20.0209	(88)
util rest of house													
	0.9842	0.9734	0.9510	0.8873	0.7629	0.5652	0.3895	0.4362	0.6980	0.9120	0.9719	0.9864	(89)
MIT 2	18.0576	18.3322	18.7544	19.3285	19.7523	19.9818	20.0311	20.0274	19.8971	19.3543	18.6331	18.0320	(90)
Living area fraction										fLA = Living area / (4) =		0.4231	(91)
MIT	18.5936	18.8432	19.2278	19.7533	20.1519	20.3762	20.4316	20.4251	20.2878	19.7729	19.1134	18.5681	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5936	18.8432	19.2278	19.7533	20.1519	20.3762	20.4316	20.4251	20.2878	19.7729	19.1134	18.5681	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9785	0.9658	0.9417	0.8801	0.7691	0.5933	0.4308	0.4778	0.7172	0.9054	0.9647	0.9812	(94)
Useful gains	699.9126	780.0146	829.4202	860.4968	793.5635	605.1558	420.5832	436.6656	605.5048	680.1418	675.0556	674.9927	(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													
	1659.4352	1613.9247	1468.9290	1235.3014	959.4569	647.7040	429.6447	450.3141	697.1651	1041.3113	1371.0045	1648.7887	(97)
Space heating kWh													
	713.8849	560.3876	475.7946	269.8593	123.4247	0.0000	0.0000	0.0000	0.0000	268.7101	501.0832	724.5042	(98a)
Space heating requirement - total per year (kWh/year)												3637.6485	
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													
	713.8849	560.3876	475.7946	269.8593	123.4247	0.0000	0.0000	0.0000	0.0000	268.7101	501.0832	724.5042	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3637.6485	
Space heating per m2											(98c) / (4) =	34.0923	(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													
	713.8849	560.3876	475.7946	269.8593	123.4247	0.0000	0.0000	0.0000	0.0000	268.7101	501.0832	724.5042	(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)													
	773.4397	607.1372	515.4871	292.3720	133.7212	0.0000	0.0000	0.0000	0.0000	291.1268	542.8854	784.9450	(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													
	243.7171	215.3918	228.7813	201.3995	195.3178	176.1213	174.0638	181.0094	182.9994	203.8763	216.5011	241.1208	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.3222	86.1038	85.6629	84.7167	83.0597	79.8000	79.8000	79.8000	79.8000	84.6799	85.8778	86.3677	(217)
Fuel for water heating, kWh/month													
	282.3341	250.1536	267.0715	237.7328	235.1534	220.7033	218.1250	226.8289	229.3226	240.7610	252.1036	279.1793	(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	30.7617	24.6782	22.2200	16.2793	12.5746	10.2736	11.4710	14.9104	19.3671	25.4107	28.7014	31.6167	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-48.5535	-67.7491	-96.3635	-107.1341	-114.4583	-106.3983	-105.0422	-99.6758	-90.0594	-76.8785	-53.1148	-42.0568	(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	-29.5614	-61.9472	-122.7124	-183.7317	-242.4183	-243.4354	-240.6065	-203.9807	-149.8334	-88.4359	-39.4131	-23.3973	(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	3941.1143	(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	2939.4693	(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)	248.2645	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2636.9574	(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	4577.8906	(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	3941.1143	0.2100	827.6340	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2939.4693	0.2100	617.2885	(264)
Space and water heating			1444.9225	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	248.2645	0.1443	35.8322	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1007.4841	0.1348	-135.8358	
PV Unit electricity exported	-1629.4733	0.1260	-205.2876	
Total			-341.1235	(269)
Total CO2, kg/year			1151.5606	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.7900	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3941.1143	1.1300	4453.4592	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2939.4693	1.1300	3321.6003	(278)
Space and water heating			7775.0594	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	248.2645	1.5338	380.7964	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1007.4841	1.4983	-1509.5240	
PV Unit electricity exported	-1629.4733	0.4625	-753.5527	
Total			-2263.0767	(283)
Total Primary energy kWh/year			6022.8799	(286)
Target Primary Energy Rate (TPER)			56.4500	(287)

Full SAP Calculation Printout

Property Reference	Parnall Road Plot 03	**Issued on Date**	06/03/2024
Assessment Reference	00001	**Prop Type Ref**	Parnall Road Plot 03
Property	Plot 03, Parnall Road, Harlow, CM18 7PP		

SAP Rating	79 C	**DER**	4.51	**TER**	10.79
Environmental	96 A	**% DER < TER**			58.20
CO Emissions (t/year)	0.46	**DFEE**	38.67	**TFEE**	39.65
Compliance Check	See BREL	**% DFEE < TFEE**			2.49
% DPER < TPER	15.11	**DPER**	47.92	**TPER**	56.45

Assessor Details	Mr. Robert Stubbings	**Assessor ID**	Y779-0001
Client			

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

---

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.3500 (1b)	x	3.0400 (2b)	=	162.1840	(1b) - (3b)
First floor	53.3500 (1c)	x	3.3400 (2c)	=	178.1890	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.7000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	340.3730	(5)

---

2. Ventilation rate

---

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1175	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.2675	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2274	(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	0.2899	0.2842	0.2786	0.2501	0.2444	0.2160	0.2160	0.2103	0.2274	0.2444	0.2558	0.2672	(22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0.0000	(23c)

Effective ac	0.5420	0.5404	0.5388	0.5313	0.5299	0.5233	0.5233	0.5221	0.5259	0.5299	0.5327	0.5357	(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	
Solid Doors			2.1300	1.0000	2.1300			(26)
Fully Glazed Doors (Uw = 1.20)			3.8200	1.1450	4.3740			(27)
Windows (Uw = 1.20)			6.2500	1.1450	7.1565			(27)
Spandrel Panel (Uw = 0.50)			3.2400	0.4902	1.5882			(27)
Ground Floor			53.3500	0.1200	6.4020	110.0000	5868.5000	(28a)
External Wall	74.8100	15.4400	59.3700	0.1800	10.6866	60.0000	3562.2000	(29a)
Flat Roof	53.3500		53.3500	0.1000	5.3350	9.0000	480.1500	(30)
Total net area of external elements Aum(A, m2)			181.5100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		37.6724			(33)
Party Wall			116.1200	0.0000	0.0000	45.0000	5225.4000	(32)
Internal Walls			186.7300			9.0000	1680.5700	(32c)
First Floor			53.3500			18.0000	960.3000	(32d)
Ground Floor Ceiling			53.3500			9.0000	480.1500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	18257.2700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		171.1084 (35)
List of Thermal Bridges		

	Length	Psi-value	Total	
K1 Element				
E1 Steel lintel with perforated steel base plate	8.7200	0.3610	3.1479	
E3 Sill	7.7100	0.0190	0.1465	
E4 Jamb	27.1200	0.0220	0.5966	
E5 Ground floor (normal)	11.7300	0.0610	0.7155	
E6 Intermediate floor within a dwelling	11.7300	0.0010	0.0117	
E14 Flat roof	11.7300	0.0800	0.9384	
E18 Party wall between dwellings	25.5200	0.0330	0.8422	
P1 Party wall - Ground floor	18.2000	0.0510	0.9282	
P2 Party wall - Intermediate floor within a dwelling	18.2000	0.0000	0.0000	
P4 Party wall - Roof (insulation at ceiling level)	18.2000	0.1200	2.1840	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			9.5111	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	47.1834	(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	60.8822	60.6989	60.5192	59.6753	59.5174	58.7823	58.7823	58.6462	59.0655	59.5174	59.8368	60.1708	(38)
Heat transfer coeff	108.0657	107.8823	107.7027	106.8587	106.7008	105.9658	105.9658	105.8296	106.2489	106.7008	107.0202	107.3542	(39)
Average = Sum(39)m / 12 =												106.8580	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0128	1.0111	1.0094	1.0015	1.0000	0.9931	0.9931	0.9918	0.9958	1.0000	1.0030	1.0061	(40)
HLP (average)												1.0015	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7935 (42)

Hot water usage for mixer showers

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

30.6803	30.2247	29.5830	28.3999	27.5141	26.5318	26.0012	26.6383	27.3321	28.3832	29.5906	30.5766	(42b)

Hot water usage for other uses

43.2382	41.6659	40.0936	38.5213	36.9490	35.3767	35.3767	36.9490	38.5213	40.0936	41.6659	43.2382	(42c)

Average daily hot water use (litres/day) 67.7529 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	73.9185	71.8906	69.6766	66.9213	64.4631	61.9085	61.3779	63.5874	65.8534	68.4768	71.2565	73.8148	(44)
Energy conte	117.0689	102.3712	107.0904	91.6119	86.7797	76.1237	74.2313	78.7344	81.2038	92.9224	101.5180	115.5761	(45)
Energy content (annual)										Total = Sum(45)m =		1125.2318	
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	99.5085	87.0155	91.0268	77.8701	73.7627	64.7052	63.0966	66.9243	69.0233	78.9840	86.2903	98.2397	(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	99.5085	87.0155	91.0268	77.8701	73.7627	64.7052	63.0966	66.9243	69.0233	78.9840	86.2903	98.2397	(64)
									Total per year (kWh/year) = Sum(64)m =			956.4470	(64)
12Total per year (kWh/year)												956	(64)
Electric shower(s)	56.9053	50.7031	55.3658	52.8349	53.8263	51.3451	53.0566	53.8263	52.8349	55.3658	54.3247	56.9053	(64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			647.2943	(64a)
Heat gains from water heating, kWh/month	39.1035	34.4297	36.5982	32.6762	31.8973	29.0126	29.0383	30.1877	30.4645	33.5875	35.1538	38.7863	(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	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	148.0492	163.9116	148.0492	152.9841	148.0492	152.9841	148.0492	148.0492	152.9841	148.0492	152.9841	148.0492	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	266.7267	269.4945	262.5198	247.6714	228.9280	211.3118	199.5431	196.7753	203.7500	218.5984	237.3419	254.9580	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	(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)	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	(71)
Water heating gains (Table 5)	52.5584	51.2346	49.1911	45.3837	42.8727	40.2952	39.0300	40.5748	42.3119	45.1444	48.8247	52.1321	(72)
Total internal gains	532.2368	549.5432	524.6625	510.9417	484.7523	469.4936	451.5247	450.3017	463.9485	476.6945	504.0531	520.0417	(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	
West	3.8200	19.6403	0.4200	0.7000	0.7700	15.2859	(80)
East	4.1400	19.6403	0.4200	0.7000	0.7700	16.5664	(76)
West	2.1100	19.6403	0.4200	0.7000	0.7700	8.4433	(80)
East	1.6200	19.6403	0.0000	0.7000	0.7700	0.0000	(76)
West	1.6200	19.6403	0.0000	0.7000	0.7700	0.0000	(80)

Solar gains	40.2956	78.8267	129.8163	189.3294	232.0303	237.5243	226.1328	194.2447	150.9818	93.5345	50.2438	33.1371	(83)

Total gains	572.5324	628.3699	654.4788	700.2711	716.7825	707.0179	677.6575	644.5465	614.9303	570.2290	554.2970	553.1789	(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	46.9295	47.0092	47.0876	47.4595	47.5298	47.8595	47.8595	47.9210	47.7319	47.5298	47.3879	47.2405	
alpha	4.1286	4.1339	4.1392	4.1640	4.1687	4.1906	4.1906	4.1947	4.1821	4.1687	4.1592	4.1494	
util living area	0.9940	0.9904	0.9839	0.9628	0.9121	0.7902	0.6357	0.6811	0.8707	0.9687	0.9896	0.9948	(86)
MIT	19.2891	19.4560	19.7281	20.1407	20.5297	20.8337	20.9507	20.9334	20.7251	20.2258	19.6965	19.2618	(87)
Th 2	20.0727	20.0741	20.0755	20.0821	20.0833	20.0891	20.0891	20.0901	20.0869	20.0833	20.0808	20.0782	(88)
util rest of house	0.9926	0.9881	0.9798	0.9522	0.8842	0.7216	0.5251	0.5744	0.8204	0.9579	0.9867	0.9936	(89)
MIT 2	18.4994	18.6665	18.9379	19.3488	19.7212	19.9896	20.0698	20.0619	19.9039	19.4364	18.9117	18.4763	(90)
Living area fraction										fLA = Living area / (4) =		0.4231	(91)
MIT	18.8335	19.0005	19.2722	19.6838	20.0632	20.3467	20.4425	20.4306	20.2513	19.7704	19.2437	18.8086	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8335	19.0005	19.2722	19.6838	20.0632	20.3467	20.4425	20.4306	20.2513	19.7704	19.2437	18.8086	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9901	0.9847	0.9752	0.9466	0.8835	0.7428	0.5703	0.6169	0.8308	0.9532	0.9832	0.9914	(94)
Useful gains	566.8576	618.7282	638.2690	662.8890	633.3024	525.1859	386.4761	397.6314	510.8804	543.5383	544.9978	548.4130	(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	1570.5712	1521.1961	1375.6042	1152.3446	892.3627	608.9542	407.1684	426.5537	653.5683	978.4872	1299.6206	1568.2945	(97)
Space heating kWh	746.7629	606.4584	548.5774	352.4081	192.7409	0.0000	0.0000	0.0000	0.0000	323.6020	543.3284	758.7918	(98a)
Space heating requirement - total per year (kWh/year)												4072.6698	
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	746.7629	606.4584	548.5774	352.4081	192.7409	0.0000	0.0000	0.0000	0.0000	323.6020	543.3284	758.7918	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4072.6698	
Space heating per m2											(98c) / (4) =	38.1694	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	996.0782	784.1467	804.3053	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6837	0.7748	0.7411	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	681.0581	607.5508	596.0597	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	756.6899	725.5879	689.9268	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	54.4548	87.8196	69.8371	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	13.6137	21.9549	17.4593	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												53.0279	(107)
Energy for space heating												38.1694	(99)
Energy for space cooling												0.4970	(108)
Total												38.6663	(109)
Fabric Energy Efficiency (DFEE)												38.7	(109)

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

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY

---

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.3500 (1b)	x	3.0400 (2b)	=	162.1840	(1b) - (3b)
First floor	53.3500 (1c)	x	3.3400 (2c)	=	178.1890	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 106.7000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		340.3730	(5)

---

2. Ventilation rate

---

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)

Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1175 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3675 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3124 (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	0.3983	0.3905	0.3827	0.3436	0.3358	0.2968	0.2968	0.2890	0.3124	0.3358	0.3514	0.3671	(22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		0.0000 (23c)

Effective ac	0.5793	0.5762	0.5732	0.5590	0.5564	0.5440	0.5440	0.5417	0.5488	0.5564	0.5618	0.5674	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.20)			13.3100	1.1450	15.2405			(27)
Ground Floor			53.3500	0.1300	6.9355			(28a)
External Wall	74.8100	15.4400	59.3700	0.1800	10.6866			(29a)
Flat Roof	53.3500		53.3500	0.1100	5.8685			(30)
Total net area of external elements Aum(A, m2)			181.5100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.8611			(33)
Party Wall			116.1200	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		171.1084 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	8.7200	0.0500	0.4360
E3 Sill	7.7100	0.0500	0.3855
E4 Jamb	27.1200	0.0500	1.3560
E5 Ground floor (normal)	11.7300	0.1600	1.8768
E6 Intermediate floor within a dwelling	11.7300	0.0000	0.0000
E14 Flat roof	11.7300	0.0800	0.9384
E18 Party wall between dwellings	25.5200	0.0600	1.5312
P1 Party wall - Ground floor	18.2000	0.0800	1.4560
P2 Party wall - Intermediate floor within a dwelling	18.2000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	18.2000	0.1200	2.1840

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.1639 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	51.0250 (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	65.0711	64.7251	64.3860	62.7932	62.4952	61.1079	61.1079	60.8510	61.6422	62.4952	63.0980	63.7283	(38)
Heat transfer coeff	116.0960	115.7501	115.4109	113.8181	113.5201	112.1328	112.1328	111.8759	112.6672	113.5201	114.1230	114.7533	(39)
Average = Sum(39)m / 12 =												113.8167	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0881	1.0848	1.0816	1.0667	1.0639	1.0509	1.0509	1.0485	1.0559	1.0639	1.0696	1.0755	(40)
HLP (average)												1.0667	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7935 (42)

Hot water usage for mixer showers

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

30.6803	30.2247	29.5830	28.3999	27.5141	26.5318	26.0012	26.6383	27.3321	28.3832	29.5906	30.5766	(42b)

Hot water usage for other uses

43.2382	41.6659	40.0936	38.5213	36.9490	35.3767	35.3767	36.9490	38.5213	40.0936	41.6659	43.2382	(42c)

Average daily hot water use (litres/day)		67.7529 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	73.9185	71.8906	69.6766	66.9213	64.4631	61.9085	61.3779	63.5874	65.8534	68.4768	71.2565	73.8148	(44)
Energy conte	117.0689	102.3712	107.0904	91.6119	86.7797	76.1237	74.2313	78.7344	81.2038	92.9224	101.5180	115.5761	(45)
Energy content (annual)										Total = Sum(45)m =		1125.2318	
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	99.5085	87.0155	91.0268	77.8701	73.7627	64.7052	63.0966	66.9243	69.0233	78.9840	86.2903	98.2397	(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	99.5085	87.0155	91.0268	77.8701	73.7627	64.7052	63.0966	66.9243	69.0233	78.9840	86.2903	98.2397	(64)
									Total per year (kWh/year) = Sum(64)m =			956.4470	(64)
12Total per year (kWh/year)												956	(64)
Electric shower(s)	56.9053	50.7031	55.3658	52.8349	53.8263	51.3451	53.0566	53.8263	52.8349	55.3658	54.3247	56.9053	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 647.2943 (64a)

Heat gains from water heating, kWh/month

	39.1035	34.4297	36.5982	32.6762	31.8973	29.0126	29.0383	30.1877	30.4645	33.5875	35.1538	38.7863 (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	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	(66)

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

	148.0492	163.9116	148.0492	152.9841	148.0492	152.9841	148.0492	148.0492	152.9841	148.0492	152.9841	148.0492 (67)

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

	266.7267	269.4945	262.5198	247.6714	228.9280	211.3118	199.5431	196.7753	203.7500	218.5984	237.3419	254.9580 (68)

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

	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675 (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)

	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399 (71)

Water heating gains (Table 5)

	52.5584	51.2346	49.1911	45.3837	42.8727	40.2952	39.0300	40.5748	42.3119	45.1444	48.8247	52.1321 (72)

Total internal gains

	532.2368	549.5432	524.6625	510.9417	484.7523	469.4936	451.5247	450.3017	463.9485	476.6945	504.0531	520.0417 (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	
East	5.7600	19.6403	0.6300	0.7000	0.7700	34.5734	(76)
West	7.5500	19.6403	0.6300	0.7000	0.7700	45.3175	(80)

Solar gains	79.8909	156.2835	257.3767	375.3685	460.0282	470.9208	448.3358	385.1138	299.3397	185.4435	99.6145	65.6984	(83)
Total gains	612.1277	705.8267	782.0392	886.3102	944.7805	940.4144	899.8605	835.4155	763.2882	662.1381	603.6677	585.7401	(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	43.6834	43.8139	43.9427	44.5576	44.6746	45.2273	45.2273	45.3312	45.0128	44.6746	44.4386	44.1945	
alpha	3.9122	3.9209	3.9295	3.9705	3.9783	4.0152	4.0152	4.0221	4.0009	3.9783	3.9626	3.9463	
util living area	0.9925	0.9861	0.9725	0.9303	0.8409	0.6809	0.5250	0.5791	0.8073	0.9534	0.9864	0.9937	(86)
MIT	19.1907	19.4120	19.7574	20.2449	20.6428	20.8939	20.9712	20.9576	20.7792	20.2490	19.6473	19.1653	(87)
Th 2	20.0106	20.0133	20.0159	20.0281	20.0304	20.0411	20.0411	20.0431	20.0370	20.0304	20.0258	20.0209	(88)
util rest of house	0.9907	0.9828	0.9658	0.9124	0.7995	0.6035	0.4205	0.4735	0.7441	0.9379	0.9827	0.9922	(89)
MIT 2	18.3560	18.5774	18.9207	19.4025	19.7702	19.9827	20.0309	20.0267	19.8987	19.4158	18.8217	18.3382	(90)
Living area fraction										fLA = Living area / (4) =		0.4231	(91)
MIT	18.7091	18.9305	19.2746	19.7589	20.1394	20.3682	20.4287	20.4205	20.2712	19.7683	19.1710	18.6881	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7091	18.9305	19.2746	19.7589	20.1394	20.3682	20.4287	20.4205	20.2712	19.7683	19.1710	18.6881	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9875	0.9781	0.9593	0.9066	0.8047	0.6314	0.4640	0.5169	0.7611	0.9327	0.9783	0.9894	(94)
Useful gains	604.4720	690.3625	750.2436	803.4894	760.2245	593.7509	417.5322	431.7857	580.9276	617.6005	590.5514	579.5226	(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	1672.8417	1624.0302	1474.3344	1235.9373	958.0377	646.8044	429.3222	449.8007	695.2905	1040.7870	1377.5752	1662.5571	(97)
Space heating kWh	794.8670	627.4247	538.7235	311.3625	147.1730	0.0000	0.0000	0.0000	0.0000	314.8507	566.6572	805.7776	(98a)
Space heating requirement - total per year (kWh/year)												4106.8363	
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	794.8670	627.4247	538.7235	311.3625	147.1730	0.0000	0.0000	0.0000	0.0000	314.8507	566.6572	805.7776	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4106.8363	
Space heating per m2											(98c) / (4) =	38.4896	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1054.0485	829.7828	850.2569	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7911	0.8629	0.8283	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	833.8130	715.9975	704.2935	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1029.4910	985.3057	913.0205	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	140.8881	200.3653	155.2929	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	35.2220	50.0913	38.8232	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												124.1366	(107)
Energy for space heating												38.4896	(99)
Energy for space cooling												1.1634	(108)

Total	39.6530 (109)
Fabric Energy Efficiency (TFEE)	39.7 (109)

Full SAP Calculation Printout

Property Reference	Parnall Road Plot 03	**Issued on Date**	06/03/2024
Assessment Reference	00001	**Prop Type Ref**	Parnall Road Plot 03
Property	Plot 03, Parnall Road, Harlow, CM18 7PP		

SAP Rating	79 C	**DER**	4.51	**TER**	10.79
Environmental	96 A	**% DER < TER**			58.20
CO Emissions (t/year)	0.46	**DFEE**	38.67	**TFEE**	39.65
Compliance Check	See BREL	**% DFEE < TFEE**			2.49
% DPER < TPER	15.11	**DPER**	47.92	**TPER**	56.45

Assessor Details	Mr. Robert Stubbings	**Assessor ID**	Y779-0001
Client			

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

---

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.3500 (1b)	x	3.0400 (2b)	=	162.1840 (1b) - (3b)	
First floor	53.3500 (1c)	x	3.3400 (2c)	=	178.1890 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.7000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	340.3730	(5)

---

2. Ventilation rate

---

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275	(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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	80.1000 (23c)

Effective ac	0.2621	0.2589	0.2557	0.2397	0.2366	0.2206	0.2206	0.2174	0.2270	0.2366	0.2429	0.2493	(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	
Solid Doors			2.1300	1.0000	2.1300			(26)
Fully Glazed Doors (Uw = 1.20)			3.8200	1.1450	4.3740			(27)
Windows (Uw = 1.20)			6.2500	1.1450	7.1565			(27)
Spandrel Panel (Uw = 0.50)			3.2400	0.4902	1.5882			(27)
Ground Floor			53.3500	0.1200	6.4020	110.0000	5868.5000	(28a)
External Wall	74.8100	15.4400	59.3700	0.1800	10.6866	60.0000	3562.2000	(29a)
Flat Roof	53.3500		53.3500	0.1000	5.3350	9.0000	480.1500	(30)
Total net area of external elements Aum(A, m2)			181.5100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.6724			(33)
Party Wall			116.1200	0.0000	0.0000	45.0000	5225.4000	(32)
Internal Walls			186.7300			9.0000	1680.5700	(32c)
First Floor			53.3500			18.0000	960.3000	(32d)
Ground Floor Ceiling			53.3500			9.0000	480.1500	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 18257.2700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 171.1084 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	8.7200	0.3610	3.1479
E3 Sill	7.7100	0.0190	0.1465
E4 Jamb	27.1200	0.0220	0.5966
E5 Ground floor (normal)	11.7300	0.0610	0.7155
E6 Intermediate floor within a dwelling	11.7300	0.0010	0.0117
E14 Flat roof	11.7300	0.0800	0.9384
E18 Party wall between dwellings	25.5200	0.0330	0.8422
P1 Party wall - Ground floor	18.2000	0.0510	0.9282
P2 Party wall - Intermediate floor within a dwelling	18.2000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	18.2000	0.1200	2.1840

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.5111 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 47.1834 (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	29.4357	29.0776	28.7196	26.9295	26.5714	24.7813	24.7813	24.4233	25.4973	26.5714	27.2875	28.0036	(38)
Heat transfer coeff	76.6191	76.2611	75.9030	74.1129	73.7549	71.9647	71.9647	71.6067	72.6808	73.7549	74.4709	75.1870	(39)

Average = Sum(39)m / 12 = 74.0234

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7181	0.7147	0.7114	0.6946	0.6912	0.6745	0.6745	0.6711	0.6812	0.6912	0.6979	0.7047	(40)
HLP (average)												0.6938	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy 2.7935 (42)
Hot water usage for mixer showers

79.9398	78.7384	76.9879	73.6384	71.1666	68.4101	66.8433	68.5806	70.4851	73.4447	76.8661	79.6335	(42a)

Hot water usage for baths

30.6803	30.2247	29.5830	28.3999	27.5141	26.5318	26.0012	26.6383	27.3321	28.3832	29.5906	30.5766	(42b)

Hot water usage for other uses

43.2382	41.6659	40.0936	38.5213	36.9490	35.3767	35.3767	36.9490	38.5213	40.0936	41.6659	43.2382	(42c)

Average daily hot water use (litres/day) 141.4547 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	153.8583	150.6290	146.6645	140.5597	135.6297	130.3186	128.2212	132.1680	136.3385	141.9215	148.1227	153.4483	(44)
Energy conte	243.6739	214.4937	225.4179	192.4192	182.5837	160.2419	155.0724	163.6516	168.1190	192.5862	211.0279	240.2630	(45)
Energy content (annual)										Total = Sum(45)m =		2349.5503	
Distribution loss (46)m = 0.15 x (45)m	36.5511	32.1741	33.8127	28.8629	27.3875	24.0363	23.2609	24.5477	25.2178	28.8879	31.6542	36.0394	(46)

Water storage loss:
Store volume 150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.8800 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.0152 (55)
Total storage loss

31.4712	28.4256	31.4712	30.4560	31.4712	30.4560	31.4712	31.4712	30.4560	31.4712	30.4560	31.4712	(56)

If cylinder contains dedicated solar storage

31.4712	28.4256	31.4712	30.4560	31.4712	30.4560	31.4712	31.4712	30.4560	31.4712	30.4560	31.4712	(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

298.4075	263.9305	280.1515	245.3872	237.3173	213.2099	209.8060	218.3852	221.0870	247.3198	263.9959	294.9966	(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

298.4075	263.9305	280.1515	245.3872	237.3173	213.2099	209.8060	218.3852	221.0870	247.3198	263.9959	294.9966	(64)

Total per year (kWh/year) = Sum(64)m = 2993.9943 (64)
12Total per year (kWh/year) 2994 (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

124.8085	110.8686	118.7383	106.3538	104.4959	95.6548	95.3485	98.2010	98.2740	107.8218	112.5412	123.6743	(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	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	148.0492	163.9116	148.0492	152.9841	148.0492	152.9841	148.0492	148.0492	152.9841	148.0492	152.9841	148.0492	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	266.7267	269.4945	262.5198	247.6714	228.9280	211.3118	199.5431	196.7753	203.7500	218.5984	237.3419	254.9580	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	(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)	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	(71)
Water heating gains (Table 5)	167.7533	164.9830	159.5945	147.7136	140.4515	132.8539	128.1565	131.9906	136.4916	144.9218	156.3072	166.2289	(72)
Total internal gains	647.4317	663.2916	635.0659	613.2716	582.3311	562.0523	540.6513	541.7176	558.1283	576.4718	611.5357	634.1386	(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	
West	3.8200	19.6403	0.4200	0.7000	0.7700	15.2859	(80)

East			4.1400	19.6403	0.4200	0.7000	0.7700				16.5664	(76)
West			2.1100	19.6403	0.4200	0.7000	0.7700				8.4433	(80)
East			1.6200	19.6403	0.0000	0.7000	0.7700				0.0000	(76)
West			1.6200	19.6403	0.0000	0.7000	0.7700				0.0000	(80)
Solar gains	40.2956	78.8267	129.8163	189.3294	232.0303	237.5243	226.1328	194.2447	150.9818	93.5345	50.2438	33.1371 (83)
Total gains	687.7273	742.1183	764.8823	802.6010	814.3614	799.5766	766.7841	735.9623	709.1100	670.0063	661.7795	667.2757 (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	66.1906	66.5013	66.8150	68.4289	68.7611	70.4715	70.4715	70.8239	69.7772	68.7611	68.0999	67.4513	
alpha	5.4127	5.4334	5.4543	5.5619	5.5841	5.6981	5.6981	5.7216	5.6518	5.5841	5.5400	5.4968	
util living area	0.9836	0.9733	0.9537	0.8904	0.7670	0.5652	0.4114	0.4451	0.6748	0.8992	0.9680	0.9856	(86)
Living	20.2664	20.3755	20.5261	20.7387	20.8752	20.9357	20.9442	20.9437	20.9190	20.7585	20.4991	20.2621	
Non living	19.4548	19.5948	19.7859	20.0568	20.2132	20.2866	20.2929	20.2957	20.2667	20.0862	19.7641	19.4592	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.6247	20.3755	20.5261	20.7387	20.8752	20.9357	20.9442	20.9437	20.9190	20.7585	20.4991	20.3653	(87)
Th 2	20.3249	20.3278	20.3308	20.3456	20.3486	20.3634	20.3634	20.3664	20.3575	20.3486	20.3426	20.3367	(88)
util rest of house	0.9804	0.9682	0.9446	0.8700	0.7290	0.5127	0.3526	0.3849	0.6217	0.8764	0.9610	0.9828	(89)
MIT 2	19.9780	19.5948	19.7859	20.0568	20.2132	20.2866	20.2929	20.2957	20.2667	20.0862	19.7641	19.6173	(90)
Living area fraction									fLA = Living area / (4) =			0.4231	(91)
MIT	20.2516	19.9251	20.0991	20.3453	20.4933	20.5612	20.5684	20.5699	20.5427	20.3706	20.0750	19.9337	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2516	19.9251	20.0991	20.3453	20.4933	20.5612	20.5684	20.5699	20.5427	20.3706	20.0750	19.9337	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9800	0.9646	0.9410	0.8700	0.7378	0.5293	0.3716	0.4043	0.6374	0.8772	0.9577	0.9808	(94)
Useful gains	674.0020	715.8262	719.7352	698.2878	600.8617	423.1839	284.9414	297.5702	451.9934	587.7436	633.8110	654.4670	(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	1222.1972	1145.8302	1032.2119	848.2451	648.5486	428.9974	285.5869	298.5899	468.2600	720.6308	966.2640	1182.9730	(97)
Space heating kWh	407.8573	288.9627	232.4826	107.9692	35.4791	0.0000	0.0000	0.0000	0.0000	98.8681	239.3662	393.2084	(98a)
Space heating requirement - total per year (kWh/year)												1804.1937	
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	407.8573	288.9627	232.4826	107.9692	35.4791	0.0000	0.0000	0.0000	0.0000	98.8681	239.3662	393.2084	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1804.1937	
Space heating per m2											(98c) / (4) =	16.9090	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	249.6592	(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	407.8573	288.9627	232.4826	107.9692	35.4791	0.0000	0.0000	0.0000	0.0000	98.8681	239.3662	393.2084	(98)
Space heating efficiency (main heating system 1)	249.6592	249.6592	249.6592	249.6592	249.6592	0.0000	0.0000	0.0000	0.0000	249.6592	249.6592	249.6592	(210)
Space heating fuel (main heating system)	163.3656	115.7429	93.1200	43.2466	14.2110	0.0000	0.0000	0.0000	0.0000	39.6012	95.8772	157.4981	(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	298.4075	263.9305	280.1515	245.3872	237.3173	213.2099	209.8060	218.3852	221.0870	247.3198	263.9959	294.9966	(64)
Efficiency of water heater												169.6132	(216)
(217)m	169.6132	169.6132	169.6132	169.6132	169.6132	169.6132	169.6132	169.6132	169.6132	169.6132	169.6132	169.6132	(217)
Fuel for water heating, kWh/month	175.9341	155.6073	165.1708	144.6746	139.9167	125.7036	123.6967	128.7548	130.3477	145.8140	155.6458	173.9231	(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	47.8943	43.2593	47.8943	46.3493	47.8943	46.3493	47.8943	47.8943	46.3493	47.8943	46.3493	47.8943	(231)
Lighting	35.0224	28.0963	25.2976	18.5341	14.3163	11.6965	13.0598	16.9756	22.0496	28.9303	32.6767	35.9958	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year

Space heating fuel - main system 1	722.6627 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	169.6132
Water heating fuel used	1765.1893 (219)
Space cooling fuel	0.0000 (221)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.3580)

mechanical ventilation fans (SFP = 1.3580)	563.9164 (230a)
Total electricity for the above, kWh/year	563.9164 (231)
Electricity for lighting (calculated in Appendix L)	282.6511 (232)

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

PV generation	0.0000 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	3334.4194 (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	722.6627	0.1564	112.9904	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1765.1893	0.1410	248.8235	(264)
Space and water heating			361.8138	(265)
Pumps, fans and electric keep-hot	563.9164	0.1387	78.2222	(267)
Energy for lighting	282.6511	0.1443	40.7953	(268)
Total CO2, kg/year			480.8312	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.5100	(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	722.6627	1.5788	1140.9653	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1765.1893	1.5212	2685.2537	(278)
Space and water heating			3826.2190	(279)
Pumps, fans and electric keep-hot	563.9164	1.5128	853.0927	(281)
Energy for lighting	282.6511	1.5338	433.5396	(282)
Total Primary energy kWh/year			5112.8514	(286)
Dwelling Primary energy Rate (DPER)			47.9200	(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	53.3500 (1b)	x	3.0400 (2b)	=	162.1840	(1b) - (3b)
First floor	53.3500 (1c)	x	3.3400 (2c)	=	178.1890	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.7000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	340.3730	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1175	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3675	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3124	(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	0.3983	0.3905	0.3827	0.3436	0.3358	0.2968	0.2968	0.2890	0.3124	0.3358	0.3514	0.3671 (22b)
Effective ac	0.5793	0.5762	0.5732	0.5590	0.5564	0.5440	0.5440	0.5417	0.5488	0.5564	0.5618	0.5674 (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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.20)			13.3100	1.1450	15.2405			(27)
Ground Floor			53.3500	0.1300	6.9355			(28a)
External Wall	74.8100	15.4400	59.3700	0.1800	10.6866			(29a)
Flat Roof	53.3500		53.3500	0.1100	5.8685			(30)
Total net area of external elements Aum(A, m2)			181.5100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.8611			(33)
Party Wall			116.1200	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 171.1084 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	8.7200	0.0500	0.4360
E3 Sill	7.7100	0.0500	0.3855
E4 Jamb	27.1200	0.0500	1.3560
E5 Ground floor (normal)	11.7300	0.1600	1.8768
E6 Intermediate floor within a dwelling	11.7300	0.0000	0.0000
E14 Flat roof	11.7300	0.0800	0.9384
E18 Party wall between dwellings	25.5200	0.0600	1.5312
P1 Party wall - Ground floor	18.2000	0.0800	1.4560
P2 Party wall - Intermediate floor within a dwelling	18.2000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	18.2000	0.1200	2.1840

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.1639 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 51.0250 (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	65.0711	64.7251	64.3860	62.7932	62.4952	61.1079	61.1079	60.8510	61.6422	62.4952	63.0980	63.7283	(38)
Heat transfer coeff	116.0960	115.7501	115.4109	113.8181	113.5201	112.1328	112.1328	111.8759	112.6672	113.5201	114.1230	114.7533	(39)
Average = Sum(39)m / 12 =												113.8167	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0881	1.0848	1.0816	1.0667	1.0639	1.0509	1.0509	1.0485	1.0559	1.0639	1.0696	1.0755	(40)
HLP (average)												1.0667	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7935 (42)

Hot water usage for mixer showers

71.0576	69.9897	68.4336	65.4564	63.2592	60.8090	59.4163	60.9606	62.6534	65.2842	68.3254	70.7853	(42a)

Hot water usage for baths

30.6803	30.2247	29.5830	28.3999	27.5141	26.5318	26.0012	26.6383	27.3321	28.3832	29.5906	30.5766	(42b)

Hot water usage for other uses

43.2382	41.6659	40.0936	38.5213	36.9490	35.3767	35.3767	36.9490	38.5213	40.0936	41.6659	43.2382	(42c)

Average daily hot water use (litres/day) 133.2657 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	144.9761	141.8803	138.1103	132.3776	127.7223	122.7175	120.7942	124.5479	128.5068	133.7610	139.5820	144.6001	(44)
Energy conte	229.6067	202.0357	212.2704	181.2184	171.9388	150.8954	146.0901	154.2163	158.4617	181.5124	198.8601	226.4089	(45)
Energy content (annual)										Total = Sum(45)m =		2213.5149	
Distribution loss (46)m = 0.15 x (45)m	34.4410	30.3053	31.8406	27.1828	25.7908	22.6343	21.9135	23.1325	23.7693	27.2269	29.8290	33.9613	(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

276.2016	244.1214	258.8653	226.3102	218.5337	195.9873	192.6850	200.8112	203.5536	228.1073	243.9520	273.0038	(62)
WWHRS -32.4846	-28.7296	-30.0840	-24.9107	-23.2159	-19.8660	-18.6212	-19.8018	-20.5541	-24.2311	-27.4509	-31.8830	(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	243.7171	215.3918	228.7813	201.3995	195.3178	176.1213	174.0638	181.0094	182.9994	203.8763	216.5011	241.1208	(64)

Total per year (kWh/year) = Sum(64)m = 2460.2994 (64)

12Total per year (kWh/year) 2460 (64)

Electric shower(s)

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

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

Heat gains from water heating, kWh/month

113.6202	100.8454	107.8558	96.3286	94.4456	86.2462	85.8509	88.5529	88.7620	97.6288	102.1945	112.5569	(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	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	139.6749	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	148.0492	163.9116	148.0492	152.9841	148.0492	152.9841	148.0492	148.0492	152.9841	148.0492	152.9841	148.0492	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	266.7267	269.4945	262.5198	247.6714	228.9280	211.3118	199.5431	196.7753	203.7500	218.5984	237.3419	254.9580	(68)

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

	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	36.9675	(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)												
	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399	-111.7399 (71)
Water heating gains (Table 5)												
	152.7153	150.0676	144.9675	133.7897	126.9430	119.7864	115.3910	119.0227	123.2806	131.2215	141.9368	151.2861 (72)
Total internal gains												
	635.3936	651.3762	623.4389	602.3477	571.8226	548.9848	527.8857	528.7496	544.9172	565.7716	600.1652	622.1958 (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	
East	5.7600	19.6403	0.6300	0.7000	0.7700	34.5734	(76)
West	7.5500	19.6403	0.6300	0.7000	0.7700	45.3175	(80)

Solar gains	79.8909	156.2835	257.3767	375.3685	460.0282	470.9208	448.3358	385.1138	299.3397	185.4435	99.6145	65.6984 (83)
Total gains	715.2845	807.6597	880.8156	977.7162	1031.8508	1019.9055	976.2214	913.8634	844.2569	751.2151	699.7798	687.8942 (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	43.6834	43.8139	43.9427	44.5576	44.6746	45.2273	45.2273	45.3312	45.0128	44.6746	44.4386	44.1945	
alpha	3.9122	3.9209	3.9295	3.9705	3.9783	4.0152	4.0152	4.0221	4.0009	3.9783	3.9626	3.9463	
util living area													
	0.9871	0.9783	0.9603	0.9090	0.8082	0.6423	0.4887	0.5373	0.7658	0.9327	0.9778	0.9889	(86)
MIT	19.3247	19.5400	19.8735	20.3327	20.6967	20.9141	20.9777	20.9675	20.8207	20.3438	19.7685	19.2992	(87)
Th 2	20.0106	20.0133	20.0159	20.0281	20.0304	20.0411	20.0411	20.0431	20.0370	20.0304	20.0258	20.0209	(88)
util rest of house													
	0.9842	0.9734	0.9510	0.8873	0.7629	0.5652	0.3895	0.4362	0.6980	0.9120	0.9719	0.9864	(89)
MIT 2	18.0576	18.3322	18.7544	19.3285	19.7523	19.9818	20.0311	20.0274	19.8971	19.3543	18.6331	18.0320	(90)
Living area fraction										fLA = Living area / (4) =		0.4231	(91)
MIT	18.5936	18.8432	19.2278	19.7533	20.1519	20.3762	20.4316	20.4251	20.2878	19.7729	19.1134	18.5681	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5936	18.8432	19.2278	19.7533	20.1519	20.3762	20.4316	20.4251	20.2878	19.7729	19.1134	18.5681	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9785	0.9658	0.9417	0.8801	0.7691	0.5933	0.4308	0.4778	0.7172	0.9054	0.9647	0.9812	(94)
Useful gains	699.9126	780.0146	829.4202	860.4968	793.5635	605.1558	420.5832	436.6656	605.5048	680.1418	675.0556	674.9927	(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													
	1659.4352	1613.9247	1468.9290	1235.3014	959.4569	647.7040	429.6447	450.3141	697.1651	1041.3113	1371.0045	1648.7887	(97)
Space heating kWh													
	713.8849	560.3876	475.7946	269.8593	123.4247	0.0000	0.0000	0.0000	0.0000	268.7101	501.0832	724.5042	(98a)
Space heating requirement - total per year (kWh/year)												3637.6485	
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													
	713.8849	560.3876	475.7946	269.8593	123.4247	0.0000	0.0000	0.0000	0.0000	268.7101	501.0832	724.5042	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3637.6485	
Space heating per m2											(98c) / (4) =	34.0923	(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													
	713.8849	560.3876	475.7946	269.8593	123.4247	0.0000	0.0000	0.0000	0.0000	268.7101	501.0832	724.5042	(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)													
	773.4397	607.1372	515.4871	292.3720	133.7212	0.0000	0.0000	0.0000	0.0000	291.1268	542.8854	784.9450	(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													
	243.7171	215.3918	228.7813	201.3995	195.3178	176.1213	174.0638	181.0094	182.9994	203.8763	216.5011	241.1208	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.3222	86.1038	85.6629	84.7167	83.0597	79.8000	79.8000	79.8000	79.8000	84.6799	85.8778	86.3677	(217)
Fuel for water heating, kWh/month													
	282.3341	250.1536	267.0715	237.7328	235.1534	220.7033	218.1250	226.8289	229.3226	240.7610	252.1036	279.1793	(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	30.7617	24.6782	22.2200	16.2793	12.5746	10.2736	11.4710	14.9104	19.3671	25.4107	28.7014	31.6167	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-48.5535	-67.7491	-96.3635	-107.1341	-114.4583	-106.3983	-105.0422	-99.6758	-90.0594	-76.8785	-53.1148	-42.0568	(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	-29.5614	-61.9472	-122.7124	-183.7317	-242.4183	-243.4354	-240.6065	-203.9807	-149.8334	-88.4359	-39.4131	-23.3973	(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	3941.1143	(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	2939.4693	(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)	248.2645	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2636.9574	(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	4577.8906	(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	3941.1143	0.2100	827.6340	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2939.4693	0.2100	617.2885	(264)
Space and water heating			1444.9225	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	248.2645	0.1443	35.8322	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1007.4841	0.1348	-135.8358	
PV Unit electricity exported	-1629.4733	0.1260	-205.2876	
Total			-341.1235	(269)
Total CO2, kg/year			1151.5606	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.7900	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3941.1143	1.1300	4453.4592	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2939.4693	1.1300	3321.6003	(278)
Space and water heating			7775.0594	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	248.2645	1.5338	380.7964	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1007.4841	1.4983	-1509.5240	
PV Unit electricity exported	-1629.4733	0.4625	-753.5527	
Total			-2263.0767	(283)
Total Primary energy kWh/year			6022.8799	(286)
Target Primary Energy Rate (TPER)			56.4500	(287)

Full SAP Calculation Printout

Property Reference	Parnall Road Plot 06	**Issued on Date**	06/03/2024
Assessment Reference	00001	**Prop Type Ref**	Parnall Road Plot 06
Property	Plot 06, Parnall Road, Harlow, CM18 7PP		

SAP Rating	79 C	**DER**	5.66	**TER**	14.82
Environmental	96 A	**% DER < TER**			61.81
CO Emissions (t/year)	0.37	**DFEE**	42.67	**TFEE**	44.80
Compliance Check	See BREL	**% DFEE < TFEE**			4.74
% DPER < TPER	25.08	**DPER**	58.61	**TPER**	78.24

Assessor Details	Mr. Robert Stubbings	**Assessor ID**	Y779-0001
Client			

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

---

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	72.8000 (1b)	x	3.0500 (2b)	=	222.0400	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.8000					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	222.0400	(5)

---

2. Ventilation rate

---

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	0 * 10 =	0.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275 (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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)
Effective ac	0.2576	0.2544	0.2512	0.2352	0.2321	0.2161	0.2161	0.2129	0.2225	0.2321	0.2384	0.2448	(25)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	81.0000 (23c)

---

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	
Solid Doors			2.1300	1.0000	2.1300			(26)
Fully Glazed Doors (Uw = 1.20)			4.6400	1.1450	5.3130			(27)
Windows (Uw = 1.20)			6.4400	1.1450	7.3740			(27)
Spandrel Panels (Uw = 0.30)			0.8100	0.2964	0.2401			(27)
Ground Floor			72.8000	0.1200	8.7360	110.0000	8008.0000	(28a)
External Wall	54.6600	11.8900	42.7700	0.1800	7.6986	60.0000	2566.2000	(29a)
Sheltered	54.6600	2.1300	52.5300	0.1700	8.9301	60.0000	3151.8000	(29a)
Total net area of external elements Aum(A, m2)			182.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.4218			(33)
Party Ceiling			72.8000			30.0000	2184.0000	(32b)
Internal Walls			127.4000			9.0000	1146.6000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17056.6000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	234.2940 (35)
List of Thermal Bridges	

K1 Element	Length	Psi-value	Total	
E5 Ground floor (normal)	35.8400	0.0610	2.1862	
E7 Party floor between dwellings (in blocks of flats)	35.8400	0.0370	1.3261	
E16 Corner (normal)	15.2500	0.0420	0.6405	
E1 Steel lintel with perforated steel base plate	7.9700	0.3610	2.8772	
E3 Sill	6.9600	0.0190	0.1322	
E4 Jamb	21.0800	0.0220	0.4638	
E17 Corner (inverted – internal area greater than external area)	3.0500	-0.0850	-0.2592	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			7.3667	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	47.7886	(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	18.8724	18.6389	18.4053	17.2375	17.0040	15.8362	15.8362	15.6026	16.3033	17.0040	17.4711	17.9382	(38)
Heat transfer coeff	66.6610	66.4275	66.1939	65.0261	64.7925	63.6248	63.6248	63.3912	64.0919	64.7925	65.2597	65.7268	(39)
Average = Sum(39)m / 12 =												64.9677	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9157	0.9125	0.9093	0.8932	0.8900	0.8740	0.8740	0.8708	0.8804	0.8900	0.8964	0.9028	(40)
HLP (average)												0.8924	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy											2.3121	(42)
Hot water usage for mixer showers	70.8600	69.7951	68.2433	65.2743	63.0833	60.6399	59.2510	60.7910	62.4791	65.1026	68.1354	70.5885 (42a)
Hot water usage for baths	27.2095	26.8054	26.2364	25.1871	24.4015	23.5303	23.0597	23.6248	24.2401	25.1723	26.2431	27.1175 (42b)
Hot water usage for other uses	38.3086	36.9156	35.5225	34.1295	32.7364	31.3434	31.3434	32.7364	34.1295	35.5225	36.9156	38.3086 (42c)
Average daily hot water use (litres/day)												125.3840 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	136.3781	133.5161	130.0022	124.5910	120.2212	115.5136	113.6542	117.1523	120.8487	125.7974	131.2941	136.0146	(44)
Energy conte	215.9896	190.1251	199.8086	170.5588	161.8409	142.0374	137.4549	145.0590	149.0186	170.7059	187.0525	212.9660	(45)
Energy content (annual)										Total = Sum(45)m =		2082.6172	
Distribution loss (46)m = 0.15 x (45)m	32.3984	28.5188	29.9713	25.5838	24.2761	21.3056	20.6182	21.7589	22.3528	25.6059	28.0579	31.9449	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6100	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8694	(55)
Total storage loss	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	(56)
If cylinder contains dedicated solar storage	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	(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	266.2034	235.4795	250.0224	219.1528	212.0547	190.6314	187.6687	195.2728	197.6126	220.9197	235.6465	263.1798	(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	266.2034	235.4795	250.0224	219.1528	212.0547	190.6314	187.6687	195.2728	197.6126	220.9197	235.6465	263.1798	(64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2673.8442	(64)
Electric shower(s)												2674	(64)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month	111.9876	99.5001	106.6074	95.5860	93.9831	86.1026	85.8748	88.4032	88.4239	96.9308	101.0702	110.9822	(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	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	106.7833	118.2244	106.7833	110.3428	106.7833	110.3428	106.7833	106.7833	110.3428	106.7833	110.3428	106.7833	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	203.7419	205.8561	200.5284	189.1863	174.8689	161.4126	152.4230	150.3088	155.6365	166.9786	181.2960	194.7523	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	(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)	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	(71)
Water heating gains (Table 5)	150.5209	148.0657	143.2895	132.7583	126.3214	119.5870	115.4231	118.8214	122.8109	130.2833	140.3752	149.1697	(72)
Total internal gains	518.7282	529.8282	508.2833	489.9695	465.6557	449.0245	432.3115	433.5957	446.4723	461.7273	489.6961	508.3874	(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	
South	4.6400	46.7521	0.4200	0.7000	0.7700	44.1977	(78)
South	3.2200	46.7521	0.4200	0.7000	0.7700	30.6717	(78)
West	3.2200	19.6403	0.4200	0.7000	0.7700	12.8850	(80)
West	0.8100	19.6403	0.0000	0.7000	0.7700	0.0000	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	87.7543	147.8224	197.7022	237.0710	258.1503	252.9837	245.2802	230.0914	211.4390	162.1623	104.8117	75.2900	(83)

Total gains	606.4825	677.6507	705.9855	727.0405	723.8061	702.0082	677.5917	663.6870	657.9113	623.8896	594.5078	583.6773	(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	71.0752	71.3251	71.5768	72.8622	73.1248	74.4670	74.4670	74.7414	73.9243	73.1248	72.6014	72.0855	
alpha	5.7383	5.7550	5.7718	5.8575	5.8750	5.9645	5.9645	5.9828	5.9283	5.8750	5.8401	5.8057	
util living area													
	0.9858	0.9722	0.9487	0.8857	0.7662	0.5704	0.4119	0.4376	0.6498	0.8853	0.9691	0.9882	(86)
MIT	20.1639	20.3334	20.5288	20.7671	20.9218	20.9889	20.9986	20.9980	20.9760	20.8019	20.4609	20.1422	(87)
Th 2	20.1542	20.1569	20.1596	20.1733	20.1760	20.1897	20.1897	20.1924	20.1842	20.1760	20.1705	20.1651	(88)
util rest of house													
	0.9820	0.9650	0.9353	0.8577	0.7162	0.5022	0.3367	0.3617	0.5815	0.8522	0.9598	0.9850	(89)
MIT 2	19.1939	19.4080	19.6514	19.9443	20.1116	20.1832	20.1892	20.1917	20.1688	19.9902	19.5804	19.1749	(90)
Living area fraction										fLA = Living area / (4) =		0.3522	(91)
MIT	19.5355	19.7339	19.9604	20.2341	20.3969	20.4670	20.4743	20.4757	20.4531	20.2761	19.8906	19.5156	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5355	19.7339	19.9604	20.2341	20.3969	20.4670	20.4743	20.4757	20.4531	20.2761	19.8906	19.5156	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9784	0.9607	0.9317	0.8599	0.7303	0.5259	0.3632	0.3884	0.6047	0.8566	0.9560	0.9818	(94)
Useful gains	593.3984	650.9876	657.7563	625.2018	528.5816	369.1948	246.1227	257.8035	397.8187	534.4358	568.3638	573.0568	(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													
	1015.6163	985.3780	890.9965	737.0123	563.4963	373.2859	246.4998	258.3624	407.1817	626.9373	834.7072	1006.6447	(97)
Space heating kWh													
	314.1301	224.7104	173.5307	80.5035	25.9766	0.0000	0.0000	0.0000	0.0000	68.8211	191.7673	322.5894	(98a)
Space heating requirement - total per year (kWh/year)												1402.0290	
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													
	314.1301	224.7104	173.5307	80.5035	25.9766	0.0000	0.0000	0.0000	0.0000	68.8211	191.7673	322.5894	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1402.0290	
Space heating per m2											(98c) / (4) =	19.2586	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												100.0000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	314.1301	224.7104	173.5307	80.5035	25.9766	0.0000	0.0000	0.0000	0.0000	68.8211	191.7673	322.5894	(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)													
	314.1301	224.7104	173.5307	80.5035	25.9766	0.0000	0.0000	0.0000	0.0000	68.8211	191.7673	322.5894	(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													
	266.2034	235.4795	250.0224	219.1528	212.0547	190.6314	187.6687	195.2728	197.6126	220.9197	235.6465	263.1798	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	156.5902	138.5174	147.0720	128.9134	124.7380	112.1361	110.3933	114.8664	116.2427	129.9528	138.6156	154.8117	(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	27.3783	24.7288	27.3783	26.4952	27.3783	26.4952	27.3783	27.3783	26.4952	27.3783	26.4952	27.3783	(231)
Lighting	22.1971	17.8073	16.0335	11.7469	9.0736	7.4132	8.2773	10.7591	13.9750	18.3359	20.7104	22.8140	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												1402.0290	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												170.0000	
Water heating fuel used												1572.8496	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.1900)													
mechanical ventilation fans (SFP = 1.1900)												322.3577	(230a)
Total electricity for the above, kWh/year												322.3577	(231)

Electricity for lighting (calculated in Appendix L)	179.1434 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	0.0000 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-734.6500 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	2741.7297 (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	1402.0290	0.1566	219.5466 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1572.8496	0.1409	221.6845 (264)
Space and water heating			441.2311 (265)
Pumps, fans and electric keep-hot	322.3577	0.1387	44.7150 (267)
Energy for lighting	179.1434	0.1443	25.8559 (268)
Appendix Q item 'aroSTOR domestic hot water heat pump' - energy saved	-734.6500	0.1360	-99.9124 (270)
Appendix Q item 'aroSTOR domestic hot water heat pump' - energy used	0.0000	0.0000	0.0000 (271)
Total CO2, kg/year			411.8896 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			5.6600 (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	1402.0290	1.5797	2214.8075 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1572.8496	1.5212	2392.5621 (278)
Space and water heating			4607.3696 (279)
Pumps, fans and electric keep-hot	322.3577	1.5128	487.6627 (281)
Energy for lighting	179.1434	1.5338	274.7761 (282)
Appendix Q item 'aroSTOR domestic hot water heat pump' - energy saved	-734.6500	1.5010	-1102.7096 (284)
Appendix Q item 'aroSTOR domestic hot water heat pump' - energy used	0.0000	0.0000	0.0000 (285)
Total Primary energy kWh/year			4267.0988 (286)
Dwelling Primary energy Rate (DPER)			58.6100 (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	72.8000	(1b)	x 3.0500	(2b) =	222.0400	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		222.0400	(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) =	0.1351 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3851 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3273 (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	0.4174	0.4092	0.4010	0.3601	0.3519	0.3110	0.3110	0.3028	0.3273	0.3519	0.3683	0.3846	(22b)
Effective ac	0.5871	0.5837	0.5804	0.5648	0.5619	0.5484	0.5484	0.5458	0.5536	0.5619	0.5678	0.5740	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.20)			11.8900	1.1450	13.6145			(27)
Ground Floor			72.8000	0.1300	9.4640			(28a)
External Wall	54.6600	11.8900	42.7700	0.1800	7.6986			(29a)
Sheltered	54.6600	2.1300	52.5300	0.1800	9.4554			(29a)
Total net area of external elements Aum(A, m2)			182.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		42.3625			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 244.2940 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E5 Ground floor (normal)	35.8400	0.1600	5.7344
E7 Party floor between dwellings (in blocks of flats)	35.8400	0.0700	2.5088
E16 Corner (normal)	15.2500	0.0900	1.3725
E1 Steel lintel with perforated steel base plate	7.9700	0.0500	0.3985
E3 Sill	6.9600	0.0500	0.3480
E4 Jamb	21.0800	0.0500	1.0540
E17 Corner (inverted – internal area greater than external area)	3.0500	-0.0900	-0.2745

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 11.1417 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 53.5042 (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	43.0184	42.7706	42.5277	41.3868	41.1733	40.1796	40.1796	39.9956	40.5624	41.1733	41.6051	42.0566	(38)
Heat transfer coeff	96.5226	96.2748	96.0319	94.8910	94.6775	93.6838	93.6838	93.4998	94.0666	94.6775	95.1094	95.5608	(39)

Average = Sum(39)m / 12 = 94.8900

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3259	1.3225	1.3191	1.3034	1.3005	1.2869	1.2869	1.2843	1.2921	1.3005	1.3064	1.3126	(40)
HLP (average)												1.3034	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.3121 (42)

Hot water usage for mixer showers

62.9866	62.0401	60.6607	58.0216	56.0740	53.9021	52.6676	54.0365	55.5370	57.8690	60.5648	62.7453	(42a)

Hot water usage for baths

27.2095	26.8054	26.2364	25.1871	24.4015	23.5303	23.0597	23.6248	24.2401	25.1723	26.2431	27.1175	(42b)

Hot water usage for other uses

38.3086	36.9156	35.5225	34.1295	32.7364	31.3434	31.3434	32.7364	34.1295	35.5225	36.9156	38.3086	(42c)

Average daily hot water use (litres/day) 118.1251 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	128.5048	125.7611	122.4196	117.3383	113.2120	108.7758	107.0707	110.3977	113.9066	118.5638	123.7235	128.1715	(44)
Energy conte	203.5201	179.0821	188.1544	160.6302	152.4051	133.7526	129.4928	136.6954	140.4582	160.8900	176.2668	200.6855	(45)
Energy content (annual)										Total = Sum(45)m =		1962.0332	
Distribution loss (46)m = 0.15 x (45)m	30.5280	26.8623	28.2232	24.0945	22.8608	20.0629	19.4239	20.5043	21.0687	24.1335	26.4400	30.1028	(46)

Water storage loss:

Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6525	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8924	(55)
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(56)
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	254.4462	225.0798	239.0805	209.9135	203.3311	183.0358	180.4188	187.6215	189.7415	211.8161	225.5501	251.6116	(62)
WWHRS	-28.7949	-25.4664	-26.6670	-22.0813	-20.5790	-17.6096	-16.5062	-17.5527	-18.2195	-21.4788	-24.3329	-28.2616	(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	225.6514	199.6134	212.4135	187.8322	182.7522	165.4263	163.9127	170.0689	171.5220	190.3372	201.2172	223.3500	(64)
									Total per year (kWh/year) = Sum(64)m =			2294.0969	(64)
12Total per year (kWh/year)												2294	(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	108.4113	96.3430	103.3022	92.8362	91.4155	83.8994	83.7972	86.1921	86.1290	94.2368	98.0354	107.4688	(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	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	106.7833	118.2244	106.7833	110.3428	106.7833	110.3428	106.7833	106.7833	110.3428	106.7833	110.3428	106.7833	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	203.7419	205.8561	200.5284	189.1863	174.8689	161.4126	152.4230	150.3088	155.6365	166.9786	181.2960	194.7523	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	(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)	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	(71)
Water heating gains (Table 5)	145.7141	143.3675	138.8470	128.9391	122.8703	116.5269	112.6306	115.8496	119.6236	126.6623	136.1602	144.4473	(72)
Total internal gains	516.9214	528.1301	506.8408	489.1503	465.2047	445.9644	429.5191	430.6238	443.2850	461.1064	488.4810	506.6650	(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	
South	7.8600	46.7521	0.6300	0.7000	0.7700	112.3040	(78)
West	4.0300	19.6403	0.6300	0.7000	0.7700	24.1893	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	136.4933	231.2445	312.2163	378.4501	415.2212	408.1342	395.2044	368.5738	335.3753	254.5289	163.2798	116.9331	(83)
Total gains	653.4148	759.3746	819.0571	867.6004	880.4259	854.0985	824.7235	799.1976	778.6603	715.6353	651.7608	623.5981	(84)

7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	51.1814	51.3132	51.4430	52.0615	52.1789	52.7323	52.7323	52.8361	52.5178	52.1789	51.9420	51.6966	
alpha	4.4121	4.4209	4.4295	4.4708	4.4786	4.5155	4.5155	4.5224	4.5012	4.4786	4.4628	4.4464	
util living area	0.9888	0.9778	0.9584	0.9110	0.8175	0.6527	0.4887	0.5226	0.7369	0.9208	0.9779	0.9908	(86)
MIT	19.5975	19.8266	20.1168	20.4783	20.7655	20.9384	20.9865	20.9818	20.8901	20.5249	20.0023	19.5625	(87)
Th 2	19.8206	19.8233	19.8259	19.8381	19.8404	19.8511	19.8511	19.8531	19.8470	19.8404	19.8358	19.8309	(88)
util rest of house	0.9853	0.9710	0.9453	0.8822	0.7593	0.5547	0.3667	0.4000	0.6468	0.8891	0.9699	0.9879	(89)
MIT 2	18.2288	18.5192	18.8828	19.3282	19.6491	19.8171	19.8471	19.8471	19.7777	19.3938	18.7528	18.1916	(90)
Living area fraction										fLA = Living area / (4) =		0.3522	(91)
MIT	18.7109	18.9797	19.3174	19.7332	20.0423	20.2120	20.2484	20.2467	20.1695	19.7921	19.1929	18.6745	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7109	18.9797	19.3174	19.7332	20.0423	20.2120	20.2484	20.2467	20.1695	19.7921	19.1929	18.6745	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9808	0.9645	0.9382	0.8791	0.7705	0.5872	0.4099	0.4433	0.6741	0.8875	0.9640	0.9839	(94)
Useful gains	640.8468	732.4352	768.4056	762.7297	678.3758	501.4853	338.0184	354.2551	524.9029	635.1269	628.3160	613.5533	(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	1390.9732	1355.5161	1230.8829	1027.9771	789.8263	525.7539	341.7974	359.6675	570.9371	870.2896	1150.1480	1383.1904	(97)
Space heating kWh	558.0940	418.7103	344.0831	190.9782	82.9192	0.0000	0.0000	0.0000	0.0000	174.9611	375.7190	572.6100	(98a)
Space heating requirement - total per year (kWh/year)												2718.0749	
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	558.0940	418.7103	344.0831	190.9782	82.9192	0.0000	0.0000	0.0000	0.0000	174.9611	375.7190	572.6100	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2718.0749	
Space heating per m2											(98c) / (4) =	37.3362	(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	558.0940	418.7103	344.0831	190.9782	82.9192	0.0000	0.0000	0.0000	0.0000	174.9611	375.7190	572.6100	(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)	604.6522	453.6407	372.7877	206.9102	89.8366	0.0000	0.0000	0.0000	0.0000	189.5570	407.0628	620.3792	(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	225.6514	199.6134	212.4135	187.8322	182.7522	165.4263	163.9127	170.0689	171.5220	190.3372	201.2172	223.3500	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.0072	85.6804	85.1351	84.0971	82.4068	79.8000	79.8000	79.8000	79.8000	83.8713	85.4393	86.0759	(217)
Fuel for water heating, kWh/month	262.3633	232.9743	249.5019	223.3517	221.7684	207.3011	205.4043	213.1189	214.9398	226.9395	235.5090	259.4801	(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	22.1875	17.7996	16.0266	11.7418	9.0697	7.4100	8.2737	10.7544	13.9689	18.3280	20.7014	22.8041	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-24.7303	-35.9698	-53.3227	-61.8951	-68.4224	-64.4779	-63.6923	-59.3049	-51.8371	-42.0010	-27.5798	-21.2540	(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	-10.8009	-23.0236	-46.3257	-70.4075	-93.9057	-94.6467	-93.5287	-78.8156	-57.2800	-33.1935	-14.5072	-8.5183	(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	2944.8265 (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	2752.6524 (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)	179.0656 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-1199.4408 (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	4763.1038 (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	2944.8265	0.2100	618.4136	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2752.6524	0.2100	578.0570	(264)
Space and water heating			1196.4706	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	179.0656	0.1443	25.8447	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-574.4872	0.1339	-76.9419	
PV Unit electricity exported	-624.9536	0.1256	-78.4630	
Total			-155.4049	(269)
Total CO2, kg/year			1078.8396	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.8200	(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	2944.8265	1.1300	3327.6540	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2752.6524	1.1300	3110.4973	(278)
Space and water heating			6438.1512	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	179.0656	1.5338	274.6568	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-574.4872	1.4950	-858.8301	
PV Unit electricity exported	-624.9536	0.4608	-288.0031	
Total			-1146.8332	(283)
Total Primary energy kWh/year			5696.0756	(286)
Target Primary Energy Rate (TPER)			78.2400	(287)

Full SAP Calculation Printout

Property Reference	Parnall Road Plot 06	**Issued on Date**	06/03/2024
Assessment Reference	00001	**Prop Type Ref**	Parnall Road Plot 06
Property	Plot 06, Parnall Road, Harlow, CM18 7PP		

SAP Rating	79 C	**DER**	5.66	**TER**	14.82
Environmental	96 A	**% DER < TER**			61.81
CO Emissions (t/year)	0.37	**DFEE**	42.67	**TFEE**	44.80
Compliance Check	See BREL	**% DFEE < TFEE**			4.74
% DPER < TPER	25.08	**DPER**	58.61	**TPER**	78.24

Assessor Details	Mr. Robert Stubbings	**Assessor ID**	Y779-0001
Client			

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

---

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	72.8000 (1b)	x	3.0500 (2b)	=	222.0400	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.8000					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	222.0400	(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) =	0.1351 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.2851 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2423 (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	0.3090	0.3029	0.2969	0.2666	0.2605	0.2302	0.2302	0.2242	0.2423	0.2605	0.2726	0.2848	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.5477	0.5459	0.5441	0.5355	0.5339	0.5265	0.5265	0.5251	0.5294	0.5339	0.5372	0.5405	(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	
Solid Doors			2.1300	1.0000	2.1300			(26)
Fully Glazed Doors (Uw = 1.20)			4.6400	1.1450	5.3130			(27)
Windows (Uw = 1.20)			6.4400	1.1450	7.3740			(27)
Spandrel Panels (Uw = 0.30)			0.8100	0.2964	0.2401			(27)
Ground Floor			72.8000	0.1200	8.7360	110.0000	8008.0000	(28a)
External Wall	54.6600	11.8900	42.7700	0.1800	7.6986	60.0000	2566.2000	(29a)
Sheltered	54.6600	2.1300	52.5300	0.1700	8.9301	60.0000	3151.8000	(29a)
Total net area of external elements Aum(A, m2)			182.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.4218			(33)
Party Ceiling			72.8000			40.0000	2912.0000	(32b)
Internal Walls			127.4000			9.0000	1146.6000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17784.6000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		244.2940 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E5 Ground floor (normal)	35.8400	0.0610	2.1862
E7 Party floor between dwellings (in blocks of flats)	35.8400	0.0370	1.3261

E16 Corner (normal)	15.2500	0.0420	0.6405	
E1 Steel lintel with perforated steel base plate	7.9700	0.3610	2.8772	
E3 Sill	6.9600	0.0190	0.1322	
E4 Jamb	21.0800	0.0220	0.4638	
E17 Corner (inverted – internal area greater than external area)	3.0500	-0.0850	-0.2592	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.3667 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 47.7886 (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	40.1344	39.9986	39.8655	39.2401	39.1232	38.5785	38.5785	38.4776	38.7883	39.1232	39.3598	39.6073	(38)
Heat transfer coeff	87.9230	87.7872	87.6541	87.0287	86.9117	86.3671	86.3671	86.2662	86.5769	86.9117	87.1484	87.3959	(39)
Average = Sum(39)m / 12 =												87.0282	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2077	1.2059	1.2040	1.1954	1.1938	1.1864	1.1864	1.1850	1.1892	1.1938	1.1971	1.2005	(40)
HLP (average)												1.1954	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.3121 (42)

Hot water usage for mixer showers

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

27.2095	26.8054	26.2364	25.1871	24.4015	23.5303	23.0597	23.6248	24.2401	25.1723	26.2431	27.1175	(42b)

Hot water usage for other uses

38.3086	36.9156	35.5225	34.1295	32.7364	31.3434	31.3434	32.7364	34.1295	35.5225	36.9156	38.3086	(42c)

Average daily hot water use (litres/day) 60.0535 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	65.5181	63.7210	61.7589	59.3166	57.1379	54.8737	54.4032	56.3613	58.3696	60.6948	63.1587	65.4262	(44)
Energy conte	103.7647	90.7379	94.9211	81.2015	76.9186	67.4736	65.7959	69.7870	71.9755	82.3623	89.9811	102.4416	(45)
Energy content (annual)										Total = Sum(45)m =		997.3609	
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	88.2000	77.1272	80.6830	69.0213	65.3808	57.3526	55.9265	59.3190	61.1792	70.0079	76.4840	87.0753	(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													
	88.2000	77.1272	80.6830	69.0213	65.3808	57.3526	55.9265	59.3190	61.1792	70.0079	76.4840	87.0753	(64)
										Total per year (kWh/year) = Sum(64)m =		847.7568	(64)
12Total per year (kWh/year)												848	(64)
Electric shower(s)													
	50.4418	44.9441	49.0772	46.8338	47.7126	45.5132	47.0303	47.7126	46.8338	49.0772	48.1543	50.4418	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 573.7724 (64a)													
Heat gains from water heating, kWh/month													
	34.6605	30.5178	32.4400	28.9638	28.2734	25.7164	25.7392	26.7579	27.0032	29.7713	31.1596	34.3793	(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	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	106.7833	118.2244	106.7833	110.3428	106.7833	110.3428	106.7833	106.7833	110.3428	106.7833	110.3428	106.7833	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	203.7419	205.8561	200.5284	189.1863	174.8689	161.4126	152.4230	150.3088	155.6365	166.9786	181.2960	194.7523	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	(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)	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	(71)
Water heating gains (Table 5)	46.5866	45.4134	43.6022	40.2274	38.0018	35.7173	34.5957	35.9649	37.5045	40.0152	43.2772	46.2087	(72)
Total internal gains	414.7939	427.1760	408.5960	397.4386	377.3362	365.1548	351.4841	350.7391	361.1659	371.4592	392.5980	405.4264	(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	
South	4.6400	46.7521	0.4200	0.7000	0.7700	44.1977	(78)
South	3.2200	46.7521	0.4200	0.7000	0.7700	30.6717	(78)
West	3.2200	19.6403	0.4200	0.7000	0.7700	12.8850	(80)
West	0.8100	19.6403	0.0000	0.7000	0.7700	0.0000	(80)

Solar gains	87.7543	147.8224	197.7022	237.0710	258.1503	252.9837	245.2802	230.0914	211.4390	162.1623	104.8117	75.2900	(83)
Total gains	502.5482	574.9984	606.2982	634.5096	635.4865	618.1385	596.7643	580.8305	572.6049	533.6215	497.4098	480.7164	(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	56.1874	56.2743	56.3598	56.7648	56.8412	57.1996	57.1996	57.2665	57.0610	56.8412	56.6868	56.5263	
alpha	4.7458	4.7516	4.7573	4.7843	4.7894	4.8133	4.8133	4.8178	4.8041	4.7894	4.7791	4.7684	
util living area	0.9959	0.9917	0.9843	0.9628	0.9101	0.7787	0.6084	0.6444	0.8448	0.9655	0.9916	0.9967	(86)
MIT	19.5641	19.7486	19.9991	20.3425	20.6580	20.8936	20.9747	20.9665	20.8308	20.4219	19.9324	19.5305	(87)
Th 2	19.9138	19.9153	19.9168	19.9236	19.9249	19.9309	19.9309	19.9320	19.9286	19.9249	19.9223	19.9196	(88)
util rest of house	0.9946	0.9890	0.9788	0.9484	0.8721	0.6887	0.4745	0.5132	0.7716	0.9493	0.9883	0.9956	(89)
MIT 2	18.6186	18.8029	19.0518	19.3919	19.6860	19.8792	19.9242	19.9222	19.8351	19.4730	18.9920	18.5897	(90)
Living area fraction										fLA = Living area / (4) =		0.3522	(91)
MIT	18.9516	19.1360	19.3854	19.7267	20.0283	20.2365	20.2942	20.2900	20.1858	19.8072	19.3232	18.9210	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9516	19.1360	19.3854	19.7267	20.0283	20.2365	20.2942	20.2900	20.1858	19.8072	19.3232	18.9210	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9930	0.9863	0.9753	0.9452	0.8764	0.7169	0.5221	0.5596	0.7916	0.9471	0.9858	0.9943	(94)
Useful gains	499.0145	567.1463	591.3237	599.7253	556.9309	443.1568	311.5709	325.0603	453.2511	505.3861	490.3589	477.9526	(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	1288.2145	1249.7385	1129.4612	942.2356	723.8299	486.8065	319.0579	335.5724	526.8885	800.2113	1065.2316	1286.5577	(97)
Space heating kWh	587.1648	458.7020	400.3743	246.6074	124.1729	0.0000	0.0000	0.0000	0.0000	219.3499	413.9084	601.6022	(98a)
Space heating requirement - total per year (kWh/year)												3051.8819	
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	587.1648	458.7020	400.3743	246.6074	124.1729	0.0000	0.0000	0.0000	0.0000	219.3499	413.9084	601.6022	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3051.8819	
Space heating per m2											(98c) / (4) =	41.9215	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	811.8506	639.1164	655.6233	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7468	0.8388	0.8178	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	606.2962	536.0786	536.1942	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	679.0978	656.3071	639.7947	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	52.4171	89.4500	77.0788	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	13.1043	22.3625	19.2697	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												54.7365	(107)
Energy for space heating												41.9215	(99)
Energy for space cooling												0.7519	(108)
Total												42.6733	(109)
Fabric Energy Efficiency (DFEE)												42.7	(109)

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

---

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	72.8000 (1b)	x	3.0500 (2b)	=	222.0400	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		222.0400	(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) =	0.1351	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	

Measured/design AP50												5.0000	(17)
Infiltration rate												0.3851	(18)
Number of sides sheltered												2	(19)
Shelter factor								(20) = 1 - [0.075 x (19)] =				0.8500	(20)
Infiltration rate adjusted to include shelter factor								(21) = (18) x (20) =				0.3273	(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	0.4174	0.4092	0.4010	0.3601	0.3519	0.3110	0.3110	0.3028	0.3273	0.3519	0.3683	0.3846	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.5871	0.5837	0.5804	0.5648	0.5619	0.5484	0.5484	0.5458	0.5536	0.5619	0.5678	0.5740	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.20)			11.8900	1.1450	13.6145			(27)
Ground Floor			72.8000	0.1300	9.4640			(28a)
External Wall	54.6600	11.8900	42.7700	0.1800	7.6986			(29a)
Sheltered	54.6600	2.1300	52.5300	0.1800	9.4554			(29a)
Total net area of external elements Aum(A, m2)			182.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.3625			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K			244.2940 (35)
List of Thermal Bridges			
K1 Element	Length	Psi-value	Total
E5 Ground floor (normal)	35.8400	0.1600	5.7344
E7 Party floor between dwellings (in blocks of flats)	35.8400	0.0700	2.5088
E16 Corner (normal)	15.2500	0.0900	1.3725
E1 Steel lintel with perforated steel base plate	7.9700	0.0500	0.3985
E3 Sill	6.9600	0.0500	0.3480
E4 Jamb	21.0800	0.0500	1.0540
E17 Corner (inverted – internal area greater than external area)	3.0500	-0.0900	-0.2745
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			11.1417 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss		(33) + (36) + (36a) =	53.5042 (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	43.0184	42.7706	42.5277	41.3868	41.1733	40.1796	40.1796	39.9956	40.5624	41.1733	41.6051	42.0566	(38)
Heat transfer coeff	96.5226	96.2748	96.0319	94.8910	94.6775	93.6838	93.6838	93.4998	94.0666	94.6775	95.1094	95.5608	(39)
Average = Sum(39)m / 12 =												94.8900	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3259	1.3225	1.3191	1.3034	1.3005	1.2869	1.2869	1.2843	1.2921	1.3005	1.3064	1.3126	(40)
HLP (average)												1.3034	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.3121	(42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	27.2095	26.8054	26.2364	25.1871	24.4015	23.5303	23.0597	23.6248	24.2401	25.1723	26.2431	27.1175	(42b)
Hot water usage for other uses	38.3086	36.9156	35.5225	34.1295	32.7364	31.3434	31.3434	32.7364	34.1295	35.5225	36.9156	38.3086	(42c)
Average daily hot water use (litres/day)												60.0535	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	65.5181	63.7210	61.7589	59.3166	57.1379	54.8737	54.4032	56.3613	58.3696	60.6948	63.1587	65.4262	(44)
Energy conte	103.7647	90.7379	94.9211	81.2015	76.9186	67.4736	65.7959	69.7870	71.9755	82.3623	89.9811	102.4416	(45)
Energy content (annual)										Total = Sum(45)m =		997.3609	
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	88.2000	77.1272	80.6830	69.0213	65.3808	57.3526	55.9265	59.3190	61.1792	70.0079	76.4840	87.0753	(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	88.2000	77.1272	80.6830	69.0213	65.3808	57.3526	55.9265	59.3190	61.1792	70.0079	76.4840	87.0753	(64)
										Total per year (kWh/year) = Sum(64)m =		847.7568	(64)
12Total per year (kWh/year)												848	(64)
Electric shower(s)	50.4418	44.9441	49.0772	46.8338	47.7126	45.5132	47.0303	47.7126	46.8338	49.0772	48.1543	50.4418	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		573.7724	(64a)
Heat gains from water heating, kWh/month	34.6605	30.5178	32.4400	28.9638	28.2734	25.7164	25.7392	26.7579	27.0032	29.7713	31.1596	34.3793	(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	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	(66)

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

	106.7833	118.2244	106.7833	110.3428	106.7833	110.3428	106.7833	106.7833	110.3428	106.7833	110.3428	106.7833 (67)

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

	203.7419	205.8561	200.5284	189.1863	174.8689	161.4126	152.4230	150.3088	155.6365	166.9786	181.2960	194.7523 (68)

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

	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607 (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)

	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855 (71)

Water heating gains (Table 5)

	46.5866	45.4134	43.6022	40.2274	38.0018	35.7173	34.5957	35.9649	37.5045	40.0152	43.2772	46.2087 (72)

Total internal gains

	414.7939	427.1760	408.5960	397.4386	377.3362	365.1548	351.4841	350.7391	361.1659	371.4592	392.5980	405.4264 (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
South	7.8600	46.7521	0.6300	0.7000	0.7700	112.3040 (78)
West	4.0300	19.6403	0.6300	0.7000	0.7700	24.1893 (80)

Solar gains	136.4933	231.2445	312.2163	378.4501	415.2212	408.1342	395.2044	368.5738	335.3753	254.5289	163.2798	116.9331 (83)
Total gains	551.2873	658.4205	720.8123	775.8887	792.5573	773.2889	746.6885	719.3129	696.5412	625.9881	555.8778	522.3595 (84)

7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	51.1814	51.3132	51.4430	52.0615	52.1789	52.7323	52.7323	52.8361	52.5178	52.1789	51.9420	51.6966	
alpha	4.4121	4.4209	4.4295	4.4708	4.4786	4.5155	4.5155	4.5224	4.5012	4.4786	4.4628	4.4464	
util living area													
	0.9942	0.9868	0.9731	0.9363	0.8577	0.7022	0.5345	0.5730	0.7882	0.9477	0.9878	0.9954	(86)
MIT	19.4551	19.6918	19.9953	20.3851	20.7072	20.9172	20.9808	20.9737	20.8538	20.4290	19.8736	19.4200	(87)
Th 2	19.8206	19.8233	19.8259	19.8381	19.8404	19.8511	19.8511	19.8531	19.8470	19.8404	19.8358	19.8309	(88)
util rest of house													
	0.9923	0.9825	0.9641	0.9137	0.8059	0.6034	0.4037	0.4422	0.7023	0.9244	0.9830	0.9939	(89)
MIT 2	18.4395	18.6756	18.9756	19.3584	19.6478	19.8141	19.8465	19.8461	19.7719	19.4083	18.8669	18.4124	(90)
Living area fraction										fLA = Living area / (4) =		0.3522	(91)
MIT	18.7972	19.0335	19.3348	19.7200	20.0209	20.2026	20.2460	20.2432	20.1529	19.7678	19.2215	18.7673	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7972	19.0335	19.3348	19.7200	20.0209	20.2026	20.2460	20.2432	20.1529	19.7678	19.2215	18.7673	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9900	0.9787	0.9592	0.9109	0.8150	0.6358	0.4501	0.4885	0.7276	0.9226	0.9797	0.9920	(94)
Useful gains	545.7686	644.4215	691.4137	706.7800	645.9381	491.6463	336.0755	351.3760	506.7718	577.5239	544.5667	518.1621	(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													
	1399.3098	1360.7037	1232.5456	1026.7231	787.8056	524.8757	341.5716	359.3425	569.3786	867.9862	1152.8664	1392.0584	(97)
Space heating kWh													
	635.0347	481.3416	402.6021	230.3590	105.5494	0.0000	0.0000	0.0000	0.0000	216.1040	437.9758	650.1788	(98a)
Space heating requirement - total per year (kWh/year)												3159.1454	
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													
	635.0347	481.3416	402.6021	230.3590	105.5494	0.0000	0.0000	0.0000	0.0000	216.1040	437.9758	650.1788	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3159.1454	
Space heating per m2											(98c) / (4) =	43.3949	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	880.6278	693.2602	710.5984	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8091	0.8845	0.8646	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	712.4925	613.1818	614.3578	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	860.4424	831.5432	801.6572	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	106.5239	162.4609	139.3508	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	26.6310	40.6152	34.8377	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												102.0839	(107)
Energy for space heating												43.3949	(99)
Energy for space cooling												1.4023	(108)
Total												44.7971	(109)
Fabric Energy Efficiency (TFEE)												44.8	(109)

Full SAP Calculation Printout

Property Reference	Parnall Road Plot 06	**Issued on Date**	06/03/2024
Assessment Reference	00001	**Prop Type Ref**	Parnall Road Plot 06
Property	Plot 06, Parnall Road, Harlow, CM18 7PP		

SAP Rating	79 C	**DER**	5.66	**TER**	14.82
Environmental	96 A	**% DER < TER**			61.81
CO Emissions (t/year)	0.37	**DFEE**	42.67	**TFEE**	44.80
Compliance Check	See BREL	**% DFEE < TFEE**			4.74
% DPER < TPER	25.08	**DPER**	58.61	**TPER**	78.24

Assessor Details	Mr. Robert Stubbings	**Assessor ID**	Y779-0001
Client			

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

---

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	72.8000 (1b)	x	3.0500 (2b)	=	222.0400	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.8000					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	222.0400	(5)

---

2. Ventilation rate

---

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	0 * 10 =	0.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275 (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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)
Effective ac	0.2576	0.2544	0.2512	0.2352	0.2321	0.2161	0.2161	0.2129	0.2225	0.2321	0.2384	0.2448	(25)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	81.0000 (23c)

---

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	
Solid Doors			2.1300	1.0000	2.1300			(26)
Fully Glazed Doors (Uw = 1.20)			4.6400	1.1450	5.3130			(27)
Windows (Uw = 1.20)			6.4400	1.1450	7.3740			(27)
Spandrel Panels (Uw = 0.30)			0.8100	0.2964	0.2401			(27)
Ground Floor			72.8000	0.1200	8.7360	110.0000	8008.0000	(28a)
External Wall	54.6600	11.8900	42.7700	0.1800	7.6986	60.0000	2566.2000	(29a)
Sheltered	54.6600	2.1300	52.5300	0.1700	8.9301	60.0000	3151.8000	(29a)
Total net area of external elements Aum(A, m2)			182.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.4218			(33)
Party Ceiling			72.8000			30.0000	2184.0000	(32b)
Internal Walls			127.4000			9.0000	1146.6000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17056.6000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	234.2940 (35)
List of Thermal Bridges	

K1 Element	Length	Psi-value	Total	
E5 Ground floor (normal)	35.8400	0.0610	2.1862	
E7 Party floor between dwellings (in blocks of flats)	35.8400	0.0370	1.3261	
E16 Corner (normal)	15.2500	0.0420	0.6405	
E1 Steel lintel with perforated steel base plate	7.9700	0.3610	2.8772	
E3 Sill	6.9600	0.0190	0.1322	
E4 Jamb	21.0800	0.0220	0.4638	
E17 Corner (inverted – internal area greater than external area)	3.0500	-0.0850	-0.2592	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			7.3667	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	47.7886	(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	18.8724	18.6389	18.4053	17.2375	17.0040	15.8362	15.8362	15.6026	16.3033	17.0040	17.4711	17.9382	(38)
Heat transfer coeff	66.6610	66.4275	66.1939	65.0261	64.7925	63.6248	63.6248	63.3912	64.0919	64.7925	65.2597	65.7268	(39)
Average = Sum(39)m / 12 =												64.9677	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9157	0.9125	0.9093	0.8932	0.8900	0.8740	0.8740	0.8708	0.8804	0.8900	0.8964	0.9028	(40)
HLP (average)												0.8924	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy											2.3121	(42)
Hot water usage for mixer showers	70.8600	69.7951	68.2433	65.2743	63.0833	60.6399	59.2510	60.7910	62.4791	65.1026	68.1354	70.5885 (42a)
Hot water usage for baths	27.2095	26.8054	26.2364	25.1871	24.4015	23.5303	23.0597	23.6248	24.2401	25.1723	26.2431	27.1175 (42b)
Hot water usage for other uses	38.3086	36.9156	35.5225	34.1295	32.7364	31.3434	31.3434	32.7364	34.1295	35.5225	36.9156	38.3086 (42c)
Average daily hot water use (litres/day)												125.3840 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	136.3781	133.5161	130.0022	124.5910	120.2212	115.5136	113.6542	117.1523	120.8487	125.7974	131.2941	136.0146	(44)
Energy conte	215.9896	190.1251	199.8086	170.5588	161.8409	142.0374	137.4549	145.0590	149.0186	170.7059	187.0525	212.9660	(45)
Energy content (annual)										Total = Sum(45)m =		2082.6172	
Distribution loss (46)m = 0.15 x (45)m	32.3984	28.5188	29.9713	25.5838	24.2761	21.3056	20.6182	21.7589	22.3528	25.6059	28.0579	31.9449	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6100	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8694	(55)
Total storage loss	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	(56)
If cylinder contains dedicated solar storage	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	(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	266.2034	235.4795	250.0224	219.1528	212.0547	190.6314	187.6687	195.2728	197.6126	220.9197	235.6465	263.1798	(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	266.2034	235.4795	250.0224	219.1528	212.0547	190.6314	187.6687	195.2728	197.6126	220.9197	235.6465	263.1798	(64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2673.8442	(64)
Electric shower(s)												2674	(64)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month	111.9876	99.5001	106.6074	95.5860	93.9831	86.1026	85.8748	88.4032	88.4239	96.9308	101.0702	110.9822	(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	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	106.7833	118.2244	106.7833	110.3428	106.7833	110.3428	106.7833	106.7833	110.3428	106.7833	110.3428	106.7833	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	203.7419	205.8561	200.5284	189.1863	174.8689	161.4126	152.4230	150.3088	155.6365	166.9786	181.2960	194.7523	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	(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)	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	(71)
Water heating gains (Table 5)	150.5209	148.0657	143.2895	132.7583	126.3214	119.5870	115.4231	118.8214	122.8109	130.2833	140.3752	149.1697	(72)
Total internal gains	518.7282	529.8282	508.2833	489.9695	465.6557	449.0245	432.3115	433.5957	446.4723	461.7273	489.6961	508.3874	(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	
South	4.6400	46.7521	0.4200	0.7000	0.7700	44.1977	(78)
South	3.2200	46.7521	0.4200	0.7000	0.7700	30.6717	(78)
West	3.2200	19.6403	0.4200	0.7000	0.7700	12.8850	(80)
West	0.8100	19.6403	0.0000	0.7000	0.7700	0.0000	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	87.7543	147.8224	197.7022	237.0710	258.1503	252.9837	245.2802	230.0914	211.4390	162.1623	104.8117	75.2900	(83)

Total gains	606.4825	677.6507	705.9855	727.0405	723.8061	702.0082	677.5917	663.6870	657.9113	623.8896	594.5078	583.6773	(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	71.0752	71.3251	71.5768	72.8622	73.1248	74.4670	74.4670	74.7414	73.9243	73.1248	72.6014	72.0855	
alpha	5.7383	5.7550	5.7718	5.8575	5.8750	5.9645	5.9645	5.9828	5.9283	5.8750	5.8401	5.8057	
util living area													
	0.9858	0.9722	0.9487	0.8857	0.7662	0.5704	0.4119	0.4376	0.6498	0.8853	0.9691	0.9882	(86)
MIT	20.1639	20.3334	20.5288	20.7671	20.9218	20.9889	20.9986	20.9980	20.9760	20.8019	20.4609	20.1422	(87)
Th 2	20.1542	20.1569	20.1596	20.1733	20.1760	20.1897	20.1897	20.1924	20.1842	20.1760	20.1705	20.1651	(88)
util rest of house													
	0.9820	0.9650	0.9353	0.8577	0.7162	0.5022	0.3367	0.3617	0.5815	0.8522	0.9598	0.9850	(89)
MIT 2	19.1939	19.4080	19.6514	19.9443	20.1116	20.1832	20.1892	20.1917	20.1688	19.9902	19.5804	19.1749	(90)
Living area fraction										fLA = Living area / (4) =		0.3522	(91)
MIT	19.5355	19.7339	19.9604	20.2341	20.3969	20.4670	20.4743	20.4757	20.4531	20.2761	19.8906	19.5156	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5355	19.7339	19.9604	20.2341	20.3969	20.4670	20.4743	20.4757	20.4531	20.2761	19.8906	19.5156	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9784	0.9607	0.9317	0.8599	0.7303	0.5259	0.3632	0.3884	0.6047	0.8566	0.9560	0.9818	(94)
Useful gains	593.3984	650.9876	657.7563	625.2018	528.5816	369.1948	246.1227	257.8035	397.8187	534.4358	568.3638	573.0568	(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													
	1015.6163	985.3780	890.9965	737.0123	563.4963	373.2859	246.4998	258.3624	407.1817	626.9373	834.7072	1006.6447	(97)
Space heating kWh													
	314.1301	224.7104	173.5307	80.5035	25.9766	0.0000	0.0000	0.0000	0.0000	68.8211	191.7673	322.5894	(98a)
Space heating requirement - total per year (kWh/year)												1402.0290	
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													
	314.1301	224.7104	173.5307	80.5035	25.9766	0.0000	0.0000	0.0000	0.0000	68.8211	191.7673	322.5894	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1402.0290	
Space heating per m2											(98c) / (4) =	19.2586	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												100.0000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	314.1301	224.7104	173.5307	80.5035	25.9766	0.0000	0.0000	0.0000	0.0000	68.8211	191.7673	322.5894	(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)													
	314.1301	224.7104	173.5307	80.5035	25.9766	0.0000	0.0000	0.0000	0.0000	68.8211	191.7673	322.5894	(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													
	266.2034	235.4795	250.0224	219.1528	212.0547	190.6314	187.6687	195.2728	197.6126	220.9197	235.6465	263.1798	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	156.5902	138.5174	147.0720	128.9134	124.7380	112.1361	110.3933	114.8664	116.2427	129.9528	138.6156	154.8117	(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	27.3783	24.7288	27.3783	26.4952	27.3783	26.4952	27.3783	27.3783	26.4952	27.3783	26.4952	27.3783	(231)
Lighting	22.1971	17.8073	16.0335	11.7469	9.0736	7.4132	8.2773	10.7591	13.9750	18.3359	20.7104	22.8140	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												1402.0290	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												170.0000	
Water heating fuel used												1572.8496	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.1900)													
mechanical ventilation fans (SFP = 1.1900)												322.3577	(230a)
Total electricity for the above, kWh/year												322.3577	(231)

Electricity for lighting (calculated in Appendix L)	179.1434 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	0.0000 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-734.6500 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	2741.7297 (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	1402.0290	0.1566	219.5466 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1572.8496	0.1409	221.6845 (264)
Space and water heating			441.2311 (265)
Pumps, fans and electric keep-hot	322.3577	0.1387	44.7150 (267)
Energy for lighting	179.1434	0.1443	25.8559 (268)
Appendix Q item 'aroSTOR domestic hot water heat pump' - energy saved	-734.6500	0.1360	-99.9124 (270)
Appendix Q item 'aroSTOR domestic hot water heat pump' - energy used	0.0000	0.0000	0.0000 (271)
Total CO2, kg/year			411.8896 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			5.6600 (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	1402.0290	1.5797	2214.8075 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1572.8496	1.5212	2392.5621 (278)
Space and water heating			4607.3696 (279)
Pumps, fans and electric keep-hot	322.3577	1.5128	487.6627 (281)
Energy for lighting	179.1434	1.5338	274.7761 (282)
Appendix Q item 'aroSTOR domestic hot water heat pump' - energy saved	-734.6500	1.5010	-1102.7096 (284)
Appendix Q item 'aroSTOR domestic hot water heat pump' - energy used	0.0000	0.0000	0.0000 (285)
Total Primary energy kWh/year			4267.0988 (286)
Dwelling Primary energy Rate (DPER)			58.6100 (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	72.8000	(1b)	x 3.0500	(2b) =	222.0400	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		222.0400	(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) =	0.1351 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3851 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3273 (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	0.4174	0.4092	0.4010	0.3601	0.3519	0.3110	0.3110	0.3028	0.3273	0.3519	0.3683	0.3846	(22b)
Effective ac	0.5871	0.5837	0.5804	0.5648	0.5619	0.5484	0.5484	0.5458	0.5536	0.5619	0.5678	0.5740	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.20)			11.8900	1.1450	13.6145			(27)
Ground Floor			72.8000	0.1300	9.4640			(28a)
External Wall	54.6600	11.8900	42.7700	0.1800	7.6986			(29a)
Sheltered	54.6600	2.1300	52.5300	0.1800	9.4554			(29a)
Total net area of external elements Aum(A, m2)			182.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		42.3625			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 244.2940 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E5 Ground floor (normal)	35.8400	0.1600	5.7344
E7 Party floor between dwellings (in blocks of flats)	35.8400	0.0700	2.5088
E16 Corner (normal)	15.2500	0.0900	1.3725
E1 Steel lintel with perforated steel base plate	7.9700	0.0500	0.3985
E3 Sill	6.9600	0.0500	0.3480
E4 Jamb	21.0800	0.0500	1.0540
E17 Corner (inverted – internal area greater than external area)	3.0500	-0.0900	-0.2745

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 11.1417 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 53.5042 (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	43.0184	42.7706	42.5277	41.3868	41.1733	40.1796	40.1796	39.9956	40.5624	41.1733	41.6051	42.0566	(38)
Heat transfer coeff	96.5226	96.2748	96.0319	94.8910	94.6775	93.6838	93.6838	93.4998	94.0666	94.6775	95.1094	95.5608	(39)

Average = Sum(39)m / 12 = 94.8900

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3259	1.3225	1.3191	1.3034	1.3005	1.2869	1.2869	1.2843	1.2921	1.3005	1.3064	1.3126	(40)
HLP (average)												1.3034	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.3121 (42)

Hot water usage for mixer showers

62.9866	62.0401	60.6607	58.0216	56.0740	53.9021	52.6676	54.0365	55.5370	57.8690	60.5648	62.7453	(42a)

Hot water usage for baths

27.2095	26.8054	26.2364	25.1871	24.4015	23.5303	23.0597	23.6248	24.2401	25.1723	26.2431	27.1175	(42b)

Hot water usage for other uses

38.3086	36.9156	35.5225	34.1295	32.7364	31.3434	31.3434	32.7364	34.1295	35.5225	36.9156	38.3086	(42c)

Average daily hot water use (litres/day) 118.1251 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	128.5048	125.7611	122.4196	117.3383	113.2120	108.7758	107.0707	110.3977	113.9066	118.5638	123.7235	128.1715	(44)
Energy conte	203.5201	179.0821	188.1544	160.6302	152.4051	133.7526	129.4928	136.6954	140.4582	160.8900	176.2668	200.6855	(45)
Energy content (annual)										Total = Sum(45)m =		1962.0332	
Distribution loss (46)m = 0.15 x (45)m	30.5280	26.8623	28.2232	24.0945	22.8608	20.0629	19.4239	20.5043	21.0687	24.1335	26.4400	30.1028	(46)

Water storage loss:

Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6525	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8924	(55)
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(56)
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	254.4462	225.0798	239.0805	209.9135	203.3311	183.0358	180.4188	187.6215	189.7415	211.8161	225.5501	251.6116	(62)
WWHRS	-28.7949	-25.4664	-26.6670	-22.0813	-20.5790	-17.6096	-16.5062	-17.5527	-18.2195	-21.4788	-24.3329	-28.2616	(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	225.6514	199.6134	212.4135	187.8322	182.7522	165.4263	163.9127	170.0689	171.5220	190.3372	201.2172	223.3500	(64)
									Total per year (kWh/year) = Sum(64)m =			2294.0969	(64)
12Total per year (kWh/year)												2294	(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	108.4113	96.3430	103.3022	92.8362	91.4155	83.8994	83.7972	86.1921	86.1290	94.2368	98.0354	107.4688	(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	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	115.6069	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	106.7833	118.2244	106.7833	110.3428	106.7833	110.3428	106.7833	106.7833	110.3428	106.7833	110.3428	106.7833	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	203.7419	205.8561	200.5284	189.1863	174.8689	161.4126	152.4230	150.3088	155.6365	166.9786	181.2960	194.7523	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	34.5607	(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)	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	-92.4855	(71)
Water heating gains (Table 5)	145.7141	143.3675	138.8470	128.9391	122.8703	116.5269	112.6306	115.8496	119.6236	126.6623	136.1602	144.4473	(72)
Total internal gains	516.9214	528.1301	506.8408	489.1503	465.2047	445.9644	429.5191	430.6238	443.2850	461.1064	488.4810	506.6650	(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	
South	7.8600	46.7521	0.6300	0.7000	0.7700	112.3040	(78)
West	4.0300	19.6403	0.6300	0.7000	0.7700	24.1893	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	136.4933	231.2445	312.2163	378.4501	415.2212	408.1342	395.2044	368.5738	335.3753	254.5289	163.2798	116.9331	(83)
Total gains	653.4148	759.3746	819.0571	867.6004	880.4259	854.0985	824.7235	799.1976	778.6603	715.6353	651.7608	623.5981	(84)

7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	51.1814	51.3132	51.4430	52.0615	52.1789	52.7323	52.7323	52.8361	52.5178	52.1789	51.9420	51.6966	
alpha	4.4121	4.4209	4.4295	4.4708	4.4786	4.5155	4.5155	4.5224	4.5012	4.4786	4.4628	4.4464	
util living area	0.9888	0.9778	0.9584	0.9110	0.8175	0.6527	0.4887	0.5226	0.7369	0.9208	0.9779	0.9908	(86)
MIT	19.5975	19.8266	20.1168	20.4783	20.7655	20.9384	20.9865	20.9818	20.8901	20.5249	20.0023	19.5625	(87)
Th 2	19.8206	19.8233	19.8259	19.8381	19.8404	19.8511	19.8511	19.8531	19.8470	19.8404	19.8358	19.8309	(88)
util rest of house	0.9853	0.9710	0.9453	0.8822	0.7593	0.5547	0.3667	0.4000	0.6468	0.8891	0.9699	0.9879	(89)
MIT 2	18.2288	18.5192	18.8828	19.3282	19.6491	19.8171	19.8471	19.8471	19.7777	19.3938	18.7528	18.1916	(90)
Living area fraction										fLA = Living area / (4) =		0.3522	(91)
MIT	18.7109	18.9797	19.3174	19.7332	20.0423	20.2120	20.2484	20.2467	20.1695	19.7921	19.1929	18.6745	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7109	18.9797	19.3174	19.7332	20.0423	20.2120	20.2484	20.2467	20.1695	19.7921	19.1929	18.6745	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9808	0.9645	0.9382	0.8791	0.7705	0.5872	0.4099	0.4433	0.6741	0.8875	0.9640	0.9839	(94)
Useful gains	640.8468	732.4352	768.4056	762.7297	678.3758	501.4853	338.0184	354.2551	524.9029	635.1269	628.3160	613.5533	(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	1390.9732	1355.5161	1230.8829	1027.9771	789.8263	525.7539	341.7974	359.6675	570.9371	870.2896	1150.1480	1383.1904	(97)
Space heating kWh	558.0940	418.7103	344.0831	190.9782	82.9192	0.0000	0.0000	0.0000	0.0000	174.9611	375.7190	572.6100	(98a)
Space heating requirement - total per year (kWh/year)												2718.0749	
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	558.0940	418.7103	344.0831	190.9782	82.9192	0.0000	0.0000	0.0000	0.0000	174.9611	375.7190	572.6100	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2718.0749	
Space heating per m2											(98c) / (4) =	37.3362	(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	558.0940	418.7103	344.0831	190.9782	82.9192	0.0000	0.0000	0.0000	0.0000	174.9611	375.7190	572.6100	(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)	604.6522	453.6407	372.7877	206.9102	89.8366	0.0000	0.0000	0.0000	0.0000	189.5570	407.0628	620.3792	(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	225.6514	199.6134	212.4135	187.8322	182.7522	165.4263	163.9127	170.0689	171.5220	190.3372	201.2172	223.3500	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.0072	85.6804	85.1351	84.0971	82.4068	79.8000	79.8000	79.8000	79.8000	83.8713	85.4393	86.0759	(217)
Fuel for water heating, kWh/month	262.3633	232.9743	249.5019	223.3517	221.7684	207.3011	205.4043	213.1189	214.9398	226.9395	235.5090	259.4801	(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	22.1875	17.7996	16.0266	11.7418	9.0697	7.4100	8.2737	10.7544	13.9689	18.3280	20.7014	22.8041	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-24.7303	-35.9698	-53.3227	-61.8951	-68.4224	-64.4779	-63.6923	-59.3049	-51.8371	-42.0010	-27.5798	-21.2540	(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	-10.8009	-23.0236	-46.3257	-70.4075	-93.9057	-94.6467	-93.5287	-78.8156	-57.2800	-33.1935	-14.5072	-8.5183	(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	2944.8265 (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	2752.6524 (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)	179.0656 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-1199.4408 (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	4763.1038 (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	2944.8265	0.2100	618.4136	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2752.6524	0.2100	578.0570	(264)
Space and water heating			1196.4706	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	179.0656	0.1443	25.8447	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-574.4872	0.1339	-76.9419	
PV Unit electricity exported	-624.9536	0.1256	-78.4630	
Total			-155.4049	(269)
Total CO2, kg/year			1078.8396	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.8200	(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	2944.8265	1.1300	3327.6540	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2752.6524	1.1300	3110.4973	(278)
Space and water heating			6438.1512	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	179.0656	1.5338	274.6568	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-574.4872	1.4950	-858.8301	
PV Unit electricity exported	-624.9536	0.4608	-288.0031	
Total			-1146.8332	(283)
Total Primary energy kWh/year			5696.0756	(286)
Target Primary Energy Rate (TPER)			78.2400	(287)

QODA

Bristol | Cambridge | London | Norwich | Oxfordshire | Peterborough

www.qodaconsulting.com
enquiries@qodaconsulting.com