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9-10 High Street Hitchin Energy & Sustainability Statement

Document status

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Executive Summary

This Energy Assessment and Sustainability Statement has been prepared by Integration Consultancy Limited in support of the full planning application for the proposed development at 9-10 High Street, Hitchin, North Hertfordshire, which comprises 44 new build 1 and 2 bed units and a ground floor retail unit.

CARBON PERFORMANCE

Carbon modelling has been carried out for a representative sample of residential units and this development has been shown to achieve:

- 68.8% total onsite improvement in carbon dioxide (CO₂) emissions over the Target Emission Rate (TER) outlined in the national Building Regulations 2021.

The scheme uses high performance building fabric, passive low energy design and low energy building services systems such as mechanical ventilation with heat recovery (MVHR) and LED lighting.

Following a Low and Zero Carbon (LZC) Technology feasibility study it is proposed to provide:

- 16.45 kW_{peak} of solar photovoltaic (PV) modules located at roof level.
- Space heating and hot water via individual air source heat pumps which will be in part powered by the local solar PV array.

The table below shows the carbon emissions from the overall regulated and unregulated energy use.

Carbon dioxide emissions (Tonnes CO ₂ per annum)	Regulated	Unregulated
Baseline: Part L 2021 (Building Regulations) Compliance	43.8	20.3
Proposed development	13.7	20.3

Table 1: Regulated and unregulated CO₂ emissions

The carbon saving from the proposed measures is outlined below.

Regulated carbon dioxide emissions (Tonnes CO ₂ per annum)	(Tonnes CO ₂ per annum)	(%)
Savings from proposed development	30.1	68.8%

Table 2: CO₂ emissions savings

1 Introduction

Integration Consultancy Limited has been appointed to undertake an Energy and Sustainability Assessment in support of the full planning application for the proposed 9-10 High Street development in Hitchin, within the North Herts Council planning authority. The report is one of several that accompany the planning application and should be read in conjunction with these documents.

The importance of developing a robust well-considered energy and sustainability strategy cannot be overstated. This strategy sets out the roadmap for the entire project and ultimately the success of the strategy will translate into the success of the building's performance on practical completion and throughout its lifecycle.

This report demonstrates the scheme's energy performance and demonstrates, via the approved calculation methodologies, how these will be achieved through the detailed design and construction stages.

As part of this exercise, the feasibility of implementing a variety of low carbon technologies and renewable energy systems is considered based on aspects such as site location and climate, potential carbon savings, economic viability, environmental impacts and practical aspects such as integration and maintenance considerations.

1.1 THE DEVELOPMENT SITE

The site is located at 9-10 High Street Hitchin, SG5 1BH.



Figure 1: Site Location

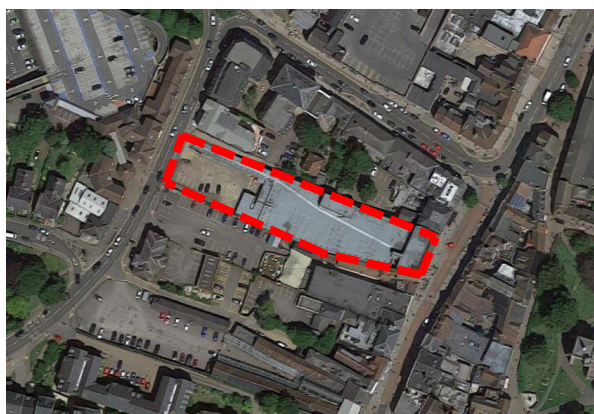


Figure 2: Aerial view of site.

1.2 PROPOSED DEVELOPMENT OVERVIEW

The proposed development includes 44 new build 1 and 2 bedroom homes, and a ground floor retail unit.



Figure 3: Proposed development ground floor plan

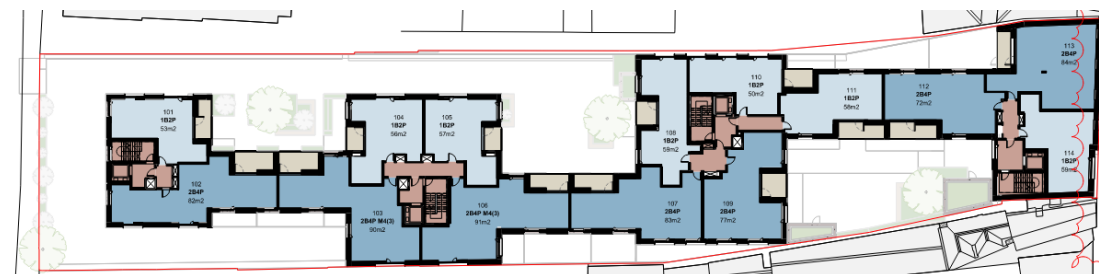


Figure 4: Proposed development first floor plan

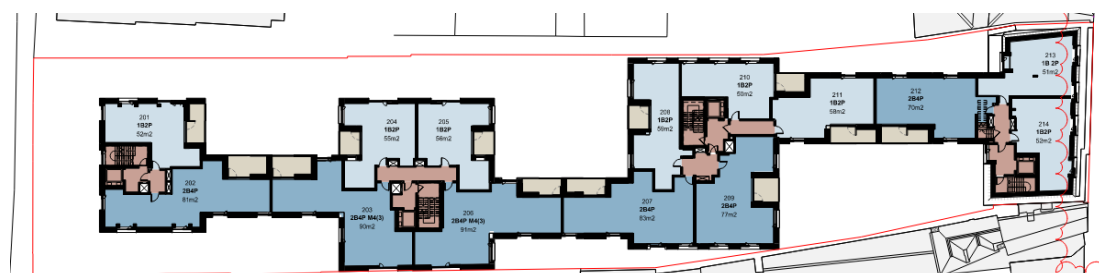


Figure 5: Proposed development second floor plan



Figure 6: Proposed development third floor plan



Figure 7: Proposed development South elevation

The proposed accommodation is summarised below.

Ref	Type	Area (m²)
Lower Ground	Retail Unit	329
Ground	Residential units	797
1st Floor	Residential units	971
2nd floor	Residential units	925
3rd floor	Residential units	348

Table 3: Accommodation Summary

2 Policy Review

2.1 NATIONAL PLANNING POLICY FRAMEWORK (NPPF – DECEMBER 2023)

2.1.1 Sustainable Development

The NPPF is very clear on the importance of sustainable development with the first line of the first main chapter stating “*The purpose of the planning system is to contribute to the achievement of sustainable development*”. Sustainable development meaning:

- a. *economic objective – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure;*
- b. *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; and by fostering well-designed, beautiful and safe places, with accessible services and open spaces that reflect current and future needs and support communities’ health, social and cultural well-being; and*
- c. *an environmental objective – to protect and enhance our natural, built and historic environment; including making effective use of land, improving biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.*

At the heart of the Framework is a presumption in favour of sustainable development.

2.1.2 Meeting the Challenge of Climate Change

Section 14 of the NPPF relates to the challenge of climate change. Paragraph 157 states:

“The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure.

The importance of renewable energy is also highlighted by paragraph 160 and 161.

2.1.3 National Carbon Targets

The UK government declared a Climate Emergency and amended the Climate Change Act in June 2019 to set a legally-binding carbon emission target for the UK of “at least 100% of 1990 levels by 2050” i.e. net zero carbon emissions¹. Around 20% of the UK’s emissions come directly from residential energy use and government has set out a consultation process leading up to the Future Homes Standard which will define how the housing sector will respond to the emergency. This will replace Building Regulations in 2025.

2.2 LOCAL POLICY

2.2.1 North Hertfordshire Local Plan (2011-2031)

Policy SP9: Design and Sustainability

The Council considers good design to be a key aspect of sustainable development. We will:

- a) *Support new development where it is well designed and located and responds positively to its local context;*
- b) *Require Strategic Masterplans to be produced for Strategic Housing Sites and other significant development. Significant development generally comprises residential development of 100 dwellings or more. Exceptionally, developments under 100 dwellings will be considered significant if there are site specific complexities and sensitivities that require a masterplan-led approach. In some circumstances a Strategic Masterplan may also be required to consider the cumulative impact of more than one site to support a co-ordinated and integrated approach to place-making and design.*
- c) *Require Strategic Masterplans and planning applications for Strategic Housing Sites and significant development to (as applicable):*

¹ Climate Change Act 2008 (c. 27) as amended by The Climate Change Act 2008 (2050 Target Amendment) Order 2019 [SI 2019 No. 1056]

- i. create buildings, spaces and streets which positively reflect and respond to the local landscape, townscape and historic character*
 - ii. create integrated, accessible and sustainable transport systems with walking, cycling and public transport designed to be the most attractive forms of transport and effectively linking into the surrounding areas;*
 - iii. provide a clear structure and hierarchy of pedestrian friendly streets and well-connected footpaths and cycleways integrate with the wider built and natural environment and communities;*
 - iv. plan for integrated and mixed-use communities with walkable locally accessible community, employment and retail facilities;*
 - v. positively integrate with adjacent rural and urban communities and positively contribute to their character and the way the area functions, including addressing cumulative, cross boundary planning and infrastructure matters;*
 - vi. create and accessible multi-functional green infrastructure network that provides:*
 - a key structuring and functional place-making feature supporting healthy lifestyles, sport, play and recreation linking into the wider Green Infrastructure Network; and*
 - a high-quality integrated network to support ecological connectivity, biodiversity net gain, climate adaptation and mitigation linking into the wider Ecological Network*
 - vii. ensure the effective use of sustainable urban drainage and sustainable water management;*
 - viii. ensure a hierarchy of linked, high quality and attractive public spaces and public realm that is safe, attractive and supports social interaction for all age groups; and*
 - ix. design to last with a clear stewardship, management and maintenance strategy*
- d) Ensure Strategic Masterplans are informed by a technical and design evidence base and include the following for Strategic Housing Sites and where applicable for other significant development:*
- i. site specific vision and place-making principles*
 - ii. Masterplan setting out the quantum, scale, type, mix and distribution of land uses, housing and community facilities;*
 - iii. Green Infrastructure Framework identifying the scale, distribution, type and design of green spaces, biodiversity net gain, strategic drainage and on and off-site linkages;*
 - iv. Movement Framework setting out the key access points, strategic highways, street hierarchy and footways and cycleways (on and off site)*
 - v. Urban Design Framework and design principles identifying how the site responds to local character and context and key structuring elements and layout principles (including heights and densities)*
 - vi. Sustainability & Energy Framework identifying site-wide and building scale opportunities for low and zero carbon*
 - vii. Illustrative Masterplan Layout*
 - viii. Infrastructure Delivery, Phasing & Management Strategy*
- e) Encourage the submission of Strategic Masterplans for the Council's consideration and agreement before the submission of a planning application. We will also confirm the scope and contents of individual Strategic Masterplans with applicants in pre-application discussions. Planning applications must be accompanied by a Strategic Masterplan. Where applications have already been submitted to the Council a Strategic Masterplan should be agreed with the Council prior to or as part of the grant of planning permission. Adherence to the Strategic Masterplan will be secured through planning conditions and/or legal agreement.*
- f) Assess proposals against detailed policy requirements set out in this Plan and have regard to the Design SPD; and*
- g) Adopt the Government's additional technical standards for the size of new homes, water efficiency and, in specified circumstances, accessibility.*

Policy SP11: Natural resources and sustainability

This Plan seeks to meet the challenges of climate change and flooding.

We will:

- a) Support proposals for renewable and low carbon energy development in appropriate locations;*
- b) Take a risk based approach to development and flood risk, directing development to areas at lowest risk in accordance with the NPPF and ensuring the provision of Sustainable Drainage Systems (SuDS) and other appropriate measures;*

c) Support the principles of the Water Environment (Water Framework Directive) Regulations 2017 and seek to protect, enhance and manage the water environment;

d) Give consideration to the potential or actual impact of land contamination and support proposals that involve the remediation of contaminated land; and

e) Work with utilities providers, East Hertfordshire District Council and relevant agencies to ensure additional wastewater treatment capacity is delivered without harm to protected European sites.

3 Design Approach - Energy

3.1 CLIMATE ANALYSIS

The UK climate is heating dominated, hence the key passive measure to be implemented are high levels of insulation and air-tightness. Temperatures in the summer can occasionally rise above comfortable levels and this will tend to intensify as a consequence of climate change and further urbanisation.

The diurnal temperature variations are high with an average daily temperature swing of 8-10°C even during peak summer. This creates potential for passive summertime cooling using night-time cooling via openable windows or mechanical ventilation.

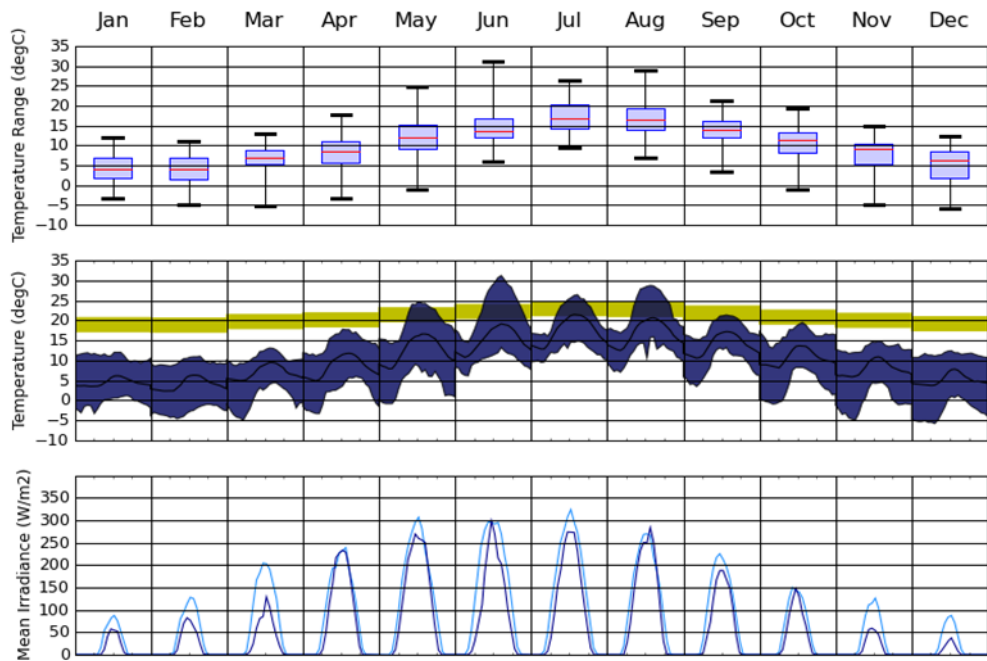


Figure 8: Average historic climate data.

3.2 BUILDING FABRIC PERFORMANCE & INSULATION

High levels of insulation are proposed as summarised later in this section. The thermal performance of all exposed elements equals or exceeds the minimum requirements for Building Regulations 2021. This will significantly reduce energy consumption and ensure optimum occupant comfort all year round by retaining heat in the winter and reducing heat gains in the summer.

This is particularly relevant for glazed surfaces that can be a cause of overheating in summer or overcooling and condensation formation in winter. High-performance glazing will also improve occupant comfort by reducing radiant temperature asymmetry which can be a comfort issue especially during the winter months.

3.3 AIR TIGHTNESS, INFILTRATION AND THERMAL BRIDGING

A low air-permeability rate has been selected as summarised later in this section. The key to achieving high levels of airtightness is the build quality of construction.

Minimising thermal bridging is an important aspect of the design. The approach to limiting thermal bridging is to use construction build ups which achieve the following psi values for the proposed development.

Reference	Thermal Bridge	Thermal Transmittance (Ψ)	
		Default	Proposed
E2	Other lintels (not including other steel lintels)	1.0	0.3
E3	Sill	0.1	0.04
E4	Jamb	0.1	0.05
E7	Intermediate floor between a dwelling	0.28	0.07
E13	Gable (insulation at rafter level)	0.25	0.08
E16	Corner (normal)	0.18	0.09
E17	Corner (inverted – internal area greater than external area)	0	0
E18	Party wall between dwellings	0.25	0.06
E24	Eaves (insulation at ceiling level – inverted)	0.15	0.15
R4	Ridge (vaulted ceiling)	0.12	0.12
R5	Ridge (inverted)	0.12	0.12
P5	Part wall (insulation at rafter level)	0.48	0.08

Table 4: Proposed thermal transmittance values for proposed thermal bridges

3.4 NATURAL VENTILATION & THERMAL MASS

Daytime natural ventilation can assist in removing excess heat during the mid-season and summer months and enables the provision of high air quality. When used in combination with thermal mass, natural ventilation will reduce high internal daily temperature fluctuations and minimise the overheating risk in the summer. Therefore, occupant comfort can be maintained with reduced reliance on mechanical cooling systems.

The overheating strategy for the development includes solar control glazing ($g=0.4$) and dual aspect design which allows for cross-flow ventilation through the main living spaces. Mechanical ventilation will increase occupant comfort by removing warm air from the apartments. The building construction includes heavyweight floor slabs which adds thermal mass to stabilise internal temperatures. Large balcony overhangs over south facing glazing limit direct solar gains during the hottest hours of the day.

3.5 SOLAR EXPOSURE & DAYLIGHT

Maximising exposure to solar energy and daylight is essential to reduce reliance on artificial lighting, reducing winter daytime heating requirements and to contribute to the general wellbeing of occupants.

The site has excellent access to solar energy and natural daylight, as there are no surrounding buildings that overshadow during the main solar hours. This makes the development roofs highly suitable for solar energy harvesting.

Fenestration on the facades maximises natural daylight to provide amenity and reduce artificial lighting energy use. Internal shading can be incorporated to minimise the risk of overheating and glare without overly compromising daylight availability.

3.6 ACTIVE BUILDING SERVICES SYSTEMS

Space heating and hot water for the residential areas will be provided via individual high-efficiency air-source heat pumps.

Energy use associated with domestic hot water (DHW) will be minimised by the use of water efficient fittings together with decreased hot water temperatures.

High-efficiency mechanical ventilation will be used with heat recovery. The system will have a summer bypass to support night-time free cooling of thermal mass.

Low-energy fixed lighting, generally comprising of high-efficiency LED fittings, will be installed throughout the development with timer, daylight dimming, and motion-sensor control as appropriate.

All building services systems will be in accordance with and exceed the efficiency requirements outlined in the Building Service Compliance Guide.

3.7 COOLING & OVERHEATING

The cooling and overheating strategies are summarised in the table below using the cooling hierarchy which has been applied to the design.

The overheating performance of the scheme has been analysed using the CIBSE TM59/52 methodology which uses dynamic thermal modelling. The scheme has been shown to surpass these standards. Please refer to the overheating report for more details.

Hierarchy Measure	Application to proposed development
1. MINIMISE INTERNAL HEAT GAINS	- Low energy LED lighting.
2. MINIMISE EXTERNAL HEAT GAINS	-High level of insulation -Low G-value windows (0.4 residential, 0.4 commercial) - Balconies to provide solar shading -Internal blinds with light coloured external facing surfaces (with relatively high reflective properties).
3 & 4 HEAT MANAGEMENT AND PASSIVE VENTILATION	- Openable window area with general high exposure to prevailing south-westerly winds - Heavyweight floor build ups to reduce temperature peaks -Night time ventilation strategy
5. MECHANICAL VENTILATION	- Mechanical Ventilation with Heat Recovery (MVHR) is specified. System will have "heat recovery by-pass" mode in order to be operable in summer night-cooling mode
6. ACTIVE COOLING Ensuring they are the lowest carbon options	-Air-source heat pumps will provide cooling in commercial areas during peak periods, if required.

Table 5: Cooling hierarchy

4 Carbon Emissions – Residential Dwellings

4.1 BASELINE

Energy demand and annual carbon emissions for residential areas are calculated using BRE accredited energy compliance SAP 10.2 software.

The amount of carbon emission reductions achieved by the proposed scheme is compared to the notional Target Emission Rate (TER) which forms the baseline comparison target. This notional building/dwelling is produced by the energy model and intends to replicate the actual building in terms of area, form, orientation and usage. The fabric parameters and system efficiencies for this notional building meets and, in some parts, exceeds the minimum requirements for compliance with Part L of the 2021 Building Regulations as summarised in the table below.

For dwellings, within Part L1 of the Building Regulations (2021), the Target Fabric Energy Efficiency (TFEE) sits alongside the TER. The TFEE is the minimum fabric energy performance requirement for a new dwelling. The Dwelling Fabric Energy Efficiency (DFEE) rate is the actual fabric energy performance of the new dwelling. The DFEE must not exceed the TFEE. It is expressed as the amount of energy demand in kWh/(m².year). The notional dwelling is not prescriptive, and specifications can be varied provided that the TFEE and TER rate is achieved or bettered. To prevent poor performance of individual elements, limiting fabric values set out in approved document Part L1 and limiting building services efficiencies set out in the Domestic Building Services Compliance Guide, have been followed.

The Notional Building baseline values, which apply to new build residential areas, are:

Building Regulations 2021

Element	U Value (W/m ² K)	G Value
External Walls	0.18	-
Floor	0.13	-
Roof	0.11	-
Windows	1.2	0.63
External opaque doors	1.0	-
External glazed doors	1.2	-
Air tightness	5.0 m ³ /m ² /h @50Pa	
Liner thermal transmittance	Standardised psi values SAP Appendix R	
Ventilation type	Natural with intermittent extract fans	
Air-conditioning	None	
Heating source	Mains Gas (89.5% SEDBUK 2009)	
Heating emitters and controls	Radiators. Time and temperature zone control. Weather compensation. Boiler interlock.	
Hot water storage	If cylinder, declared loss factor = $0.85 \cdot (0.2 + 0.051 V^{2/3})$ kWh/day where V is the volume of the cylinder in litres. Separate time control.	
Wastewater heat recovery (WWHR)	All showers connected to WWHR, including showers over baths. Instantaneous WWHR with 36% recovery efficiency utilisation of 0.98.	
Lighting	100% low energy lighting, (80lm/W)	
Photovoltaic (PV) system	For houses: kWp = 40% of ground floor area, including unheated spaces / 6.5 For flats: kWp = 40% of dwelling floor area / (6.5 · number of storeys in block) System facing south-east or south-west	

Table 6: Notional Dwelling (Building) Specification (Table 4 SAP 2021)

4.2 PROPOSED BUILDING SPECIFICATION

As part of the 'fabric first' approach, seeking to minimise energy demand, the building fabric has been specified to meet or exceed the minimum fabric parameters outlined in Part L of the Building Regulation 2013 as per table below.

Element	Proposed residential development
External walls U value	0.15 W/m ² /°C
Floor U value	0.12 W/m ² /°C
Roof U value	0.12 W/m ² /°C
Windows U value	1.0 W/m ² /°C 0.40 G-value
Insulated panels U value	0.20 W/m ² /°C
Roof light U Value	1.0 W/m ² /°C 0.40 G-value
Doors	1.0 W/m ² /°C
Air tightness	3.0 m ³ /m ² /h @50Pa
Ventilation type	MVHR Nuaire MRXBOX AB-ECO2
Heating	Air source heat pump (EcodanPUZ-WM(50))
Hot water	Air source heat pump (EcodanPUZ-WM(50))
Cooling	No active cooling is proposed
Lighting	100% low energy lighting (95 lm/W)

Table 7: Proposed residential development

4.2.1 Air Source Heat Pumps

Air source heat pumps (ASHP) extract heat energy from the air which is naturally replenished by renewable solar energy. A ASHP can create around 3kW of renewable energy for every 1kW of electrical power it consumes, which makes it one of the lowest carbon reliable heating technologies available.

High efficiency Mitsubishi EcodanPUZ-WM(50)) air source heat pumps have been selected. The Seasonal Coefficient of Performance (SCOP) for this unit is 3.24 at a 55°C supply temperature.

4.2.2 Photovoltaic (PV) panels

The image below shows the amount of roof that is available within the development and that will be used to install photovoltaic modules.

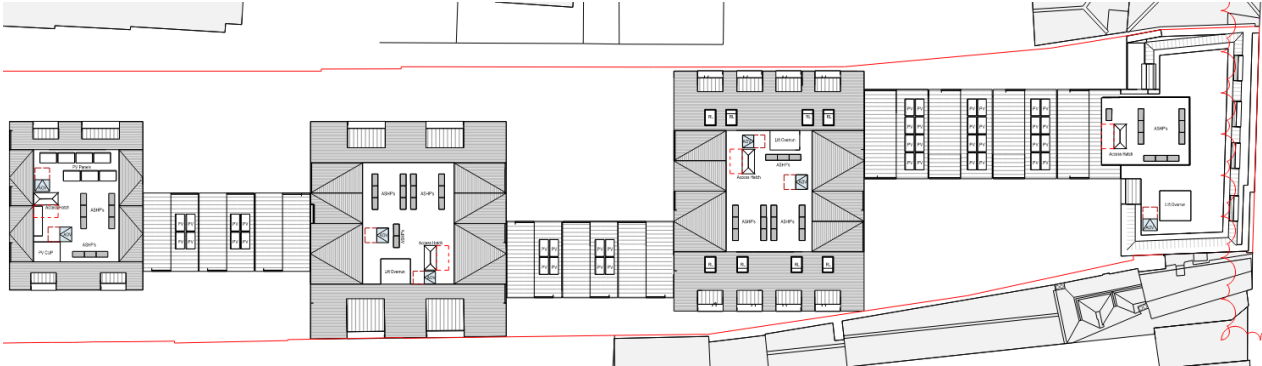


Figure 9: PV Layout

Total installed capacity of the system:	16.45(kWp)
Panel inclination:	Min 15°
Panel orientation:	East/West/South
Energy generation:	~7300 kWh/a
Carbon emission reduction:	0.95 tonnes of CO ₂ /y

4.3 CONNECTION TO THIRD PARTY HEAT NETWORKS

The BEIS: Heat Networks Planning Database has been accessed, to assess potential developments in the area which might allow connection. There are no heat networks close to the development, as such it is not proposed to use a central hot water and heating system to facilitate connection to a system in future. High efficiency individual air source heat pumps will provide heating and hot water while negating the need for central plant with high maintenance costs.

4.4 CARBON EMISSIONS SUMMARY (DWELLINGS)

The CO₂ emissions associated with regulated energy consumption, the Dwelling Emissions Rate (DER) are given below in relation to the baseline TER (Target Emission Rate).

Unit type	Area (m ²)	TER (kg.CO ₂ /m ² /yr.)	DER (kg.CO ₂ /m ² /yr.)
Unit 006	70	11.23	786.1
Unit 007	54	15.98	862.9
Unit 202	81	15.60	1263.6
Unit 210	50	15.22	761.0
Unit 212	70	15.91	1113.7
Unit 301	100	15.79	1579.0

Table 8: Regulated Emissions for dwellings

The predicted total annual CO₂ emissions of the proposed development following the introduction of energy efficiency measures, passive and active design, low carbon supply technologies and renewable energy systems are summarised below.

The table below shows the carbon emissions from the overall regulated and unregulated energy use.

Carbon dioxide emissions (Tonnes CO2 per annum)	Regulated	Unregulated
Baseline: Part L 2021 (Building Regulations) Compliance	43.8	20.3
Proposed development	13.7	20.3

Table 9: Regulated and unregulated CO₂ emissions

The carbon saving from the proposed measures is outlined below.

Regulated carbon dioxide emissions (Tonnes CO2 per annum)	(Tonnes CO ₂ per annum)	(%)
Savings from proposed development	30.1	68.8%

Table 10: CO₂ emissions savings

5 Carbon Emissions – Non - Domestic

The scheme includes a small, street fronting ground floor retail area. The retail area will be fitted out by the tenant and therefore this has not been modelled as part of this report. However, the proposed design will follow the minimum specifications as set out in the table below to ensure that the retail area performs better than Building Regulations Part L 2021.

Element	Building Regulations 2021	Proposed non-domestic development
External walls U value	0.18 W/m²K	0.16 W/m²K
Floor U value	0.15 W/m²K	0.12 W/m²/°C
Windows U value	1.4 W/m²K	1.4 W/m²K
Doors	1.9 for high use and pedestrian doors	1.9 W/m²/°C high use doors, 1.3 W/m²/°C pedestrian doors.
Air tightness	5.0 m³/m²/h @50Pa	5.0 m³/m²/h@50Pa
Lighting	95 lm/W	100 lm/W

Table 11: Notional and proposed Building Specification for non-domestic buildings

6 Summary

The predicted total annual CO₂ emissions of the proposed development following the introduction of energy efficiency measures, passive and active design, low carbon supply technologies and renewable energy systems are summarised below.

The table below shows the carbon emissions from the overall regulated and unregulated energy use.

Carbon dioxide emissions (Tonnes CO ₂ per annum)	Regulated	Unregulated
Baseline: Part L 2021 (Building Regulations) Compliance	43.8	20.3
Proposed development	13.7	20.3

Table 12: Regulated and unregulated CO₂ emissions

The carbon saving from the proposed measures is outlined below.

Regulated carbon dioxide emissions (Tonnes CO ₂ per annum)	(Tonnes CO ₂ per annum)	(%)
Savings from proposed development	30.1	68.8%

Table 13: CO₂ emissions savings

6.1 FUTURE PROOFING TO 2050 SUMMARY

The site has been future-proofed to achieve zero carbon on-site emissions by 2050 through several mechanisms. The main strategy is by avoiding fossil fuels on site and use electricity for 100% of energy requirements. This means that as the UK electricity grid continues its decarbonisation towards the 2050 goal of net zero, the scheme will be able supplied by zero carbon electricity.

6.2 COST OF ENERGY SUMMARY

The scheme aims to protect the consumer from high prices by:

- Reducing energy demands.
- Generating energy onsite via solar PV.
- Monitoring energy demand
- Creating building user guides to help occupants to reduce energy bills.
- Promoting the use of smart energy tariff such to provide cheaper electricity during non-peak times. This means energy stores can be charged at night by the heat pump when electricity costs are much lower.

Appendix A: Technology Feasibility Study Summary

The overall summary of the feasibility exercise is presented below.

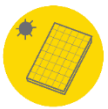
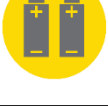
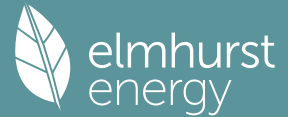
Technology	Assessment/Viability		
 Wind Power	Wind turbine installed on the roof of the development.	Due to the high cost per kW for smaller building-mounted turbines and the impacts in terms of visual, noise and shadow flicker, wind turbines are not considered a viable technology for the development.	CONCLUSION: NOT CONSIDERED FEASIBLE
 Ground Source Heat Pumps	Open or closed loop GSHP system requiring extraction of ground water and / or deep boreholes.	Ground-source heat pumps are one of the lowest carbon methods of providing reliable low-carbon heat and require low maintenance. However, they have high installation costs and there is limited space available for bore holes.	CONCLUSION: NOT CONSIDERED FEASIBLE
 Air Source Heat Pumps	Electric powered external plant serving each unit providing heating and hot water	Air-source heat pumps are one of the lowest carbon methods of providing reliable low-carbon heat. They require low maintenance. External visual or noise impacts can be suitably mitigated by an on roof acoustic enclosure.	CONCLUSION: CONSIDERED FEASIBLE
 Solar Thermal Collectors	Roof-mounted solar thermal panels providing hot water heating	Roof areas have good potential for solar thermal energy collection. However, the integration with a heat pump would result in a complex system. Therefore, solar PV is preferred over solar thermal technology.	CONCLUSION: NOT CONSIDERED FEASIBLE
 Solar Photovoltaic Panels	Roof mounted Photovoltaic panels (PV) provide electricity directly to the scheme, exporting any surplus production to the grid.	The roof has good potential for solar PV. This technology also supports air source heat pumps.	CONCLUSION: CONSIDERED FEASIBLE
 Combined Heat & Power (CHP)	Gas powered turbine generating electricity on site. Waste heat is also made available for on-site use	Carbon offsetting potential of CHP is significantly reduced now that the UK's electricity grid is much cleaner after the increase in renewable energy deployment and decrease in coal generation.	CONCLUSION: NOT CONSIDERED FEASIBLE
 Energy Storage	Energy Storage e.g. batteries	Battery scheme is not considered beneficial as there is significant daytime energy use on site.	CONCLUSION: NOT CONSIDERED FEASIBLE
 Biomass Heating	Biomass-fired community heating system.	Biomass heating is an established technology but has high maintenance requirements, fuel storage and delivery issues and is a source of increase in pollution, notably particulates (PM10), SO2 and NOX emissions.	CONCLUSION: NOT CONSIDERED FEASIBLE

Table A1: Summary of Low and Zero Carbon Study Analysis Results

Appendix C: SAP Datasheets

This appendix contains the DER TER calculation SAP datasheet.

Full SAP Calculation Printout



Property Reference	Unit 210				Issued on Date	21/05/2024
Assessment Reference	Unit 210	Prop Type Ref	Unit 210			
Property	9-10 Hitchin High Street					
SAP Rating	84 B	DER	4.74	TER	15.22	
Environmental	97 A	% DER < TER				68.86
CO ₂ Emissions (t/year)	0.21	DFEE	36.06	TFEE	36.33	
Compliance Check	See BREL	% DFEE < TFEE				0.76
% DPER < TPER	38.29	DPER	50.00	TPER	81.02	
Assessor Details	Dr. Alan Harries				Assessor ID	BC24-0001
Client						

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	50.0000 (1b)	2.5000 (2b)	125.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	125.0000 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

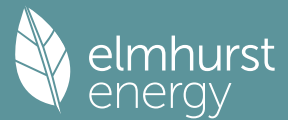
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	3.0000	(17)
Infiltration rate	0.1500	(18)
Number of sides sheltered	1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388 (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	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630 (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) =												81.0000 (23c)
Effective ac	0.2719	0.2684	0.2650	0.2476	0.2442	0.2268	0.2268	0.2233	0.2337	0.2442	0.2511	0.2580 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Window (Uw = 1.00)			14.1300	0.9615	13.5865		(27)
Entrance door			1.6600	1.0000	1.6600		(26)
Insulated Panel			7.4300	0.2000	1.4860		(26)
External Wall 1	28.8000	23.2200	5.5800	0.1500	0.8370	17.0000	94.8600 (29a)
Corridor wall	31.0000		31.0000	0.1400	4.3400	18.0000	558.0000 (29a)
Total net area of external elements Aum(A, m ²)			59.8000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	21.9095		(33)
Party Floor 1			50.0000			40.0000	2000.0000 (32d)
Party Ceiling 1			50.0000			30.0000	1500.0000 (32b)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4152.8600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							83.0572 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E7 Party floor between dwellings (in blocks of flats)				47.8000	0.0700	3.3460	

Full SAP Calculation Printout



E16 Corner (normal)						2.5000		0.0900		0.2250		
E17 Corner (inverted - internal area greater than external area)						2.5000		0.0000		0.0000		
E18 Party wall between dwellings						2.5000		0.0600		0.1500		
E25 Staggered party wall between dwellings						5.0000		0.1200		0.6000		
E2 Other lintels (including other steel lintels)						8.6200		0.3000		2.5860		
E3 Sill						5.6500		0.0400		0.2260		
E4 Jamb						35.0000		0.0500		1.7500		
E24 Eaves (insulation at ceiling level - inverted)						2.7000		0.1500		0.4050		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)											9.2880	(36)
Point Thermal bridges											0.0000	
Total fabric heat loss											(33) + (36) + (36a) =	31.1975 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	11.2161	11.0730	10.9300	10.2145	10.0714	9.3560	9.3560	9.2129	9.6422	10.0714	10.3576	10.6438 (38)
Average = Sum(39)m / 12 =	42.4137	42.2706	42.1275	41.4121	41.2690	40.5536	40.5536	40.4105	40.8397	41.2690	41.5552	41.8413 (39)
												41.3763
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.8483	0.8454	0.8425	0.8282	0.8254	0.8111	0.8111	0.8082	0.8168	0.8254	0.8311	0.8368 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31
												0.8275

4. Water heating energy requirements (kWh/year)												

Assumed occupancy												1.6901 (42)
Hot water usage for mixer showers												
	52.5569	51.7671	50.6162	48.4141	46.7890	44.9767	43.9465	45.0888	46.3409	48.2867	50.5361	52.3556 (42a)
Hot water usage for baths												
	22.7244	22.3869	21.9117	21.0354	20.3792	19.6517	19.2587	19.7306	20.2445	21.0230	21.9173	22.6476 (42b)
Hot water usage for other uses												
	31.9383	30.7769	29.6155	28.4541	27.2927	26.1314	26.1314	27.2927	28.4541	29.6155	30.7769	31.9383 (42c)
Average daily hot water use (litres/day)												98.5597 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	107.2197	104.9310	102.1434	97.9036	94.4609	90.7597	89.3366	92.1121	95.0395	98.9252	103.2304	106.9415 (44)
Energy content (annual)	169.8097	149.4203	156.9906	134.0251	127.1626	111.5996	108.0448	114.0541	117.1932	134.2406	147.0706	167.4445 (45)
Distribution loss (46)m = 0.15 x (45)m												
	25.4715	22.4130	23.5486	20.1038	19.0744	16.7399	16.2067	17.1081	17.5790	20.1361	22.0606	25.1167 (46)
Water storage loss:												
Store volume												150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.1500 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.6210 (55)
Total storage loss												
	19.2510	17.3880	19.2510	18.6300	19.2510	18.6300	19.2510	19.2510	18.6300	19.2510	18.6300	19.2510 (56)
If cylinder contains dedicated solar storage												
	19.2510	17.3880	19.2510	18.6300	19.2510	18.6300	19.2510	19.2510	18.6300	19.2510	18.6300	19.2510 (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												
	212.3231	187.8195	199.5040	175.1671	169.6760	152.7416	150.5582	156.5675	158.3352	176.7540	188.2126	209.9579 (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	212.3231	187.8195	199.5040	175.1671	169.6760	152.7416	150.5582	156.5675	158.3352	176.7540	188.2126	209.9579 (64)
12Total per year (kWh/year)												2137.6167 (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	2138 (64)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000 (64a)
Heat gains from water heating, kWh/month												
	90.4725	80.4016	86.2101	77.4770	76.2923	70.0205	69.9356	71.9337	71.8803	78.6457	81.8146	89.6860 (65)

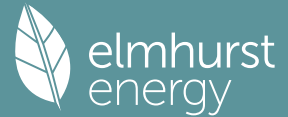
5. Internal gains (see Table 5 and 5a)												

Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	74.2626	82.2193	74.2626	76.7380	74.2626	76.7380	74.2626	74.2626	76.7380	74.2626	76.7380	74.2626 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	147.2339	148.7618	144.9117	136.7153	126.3689	116.6447	110.1484	108.6205	112.4706	120.6670	131.0134	140.7376 (68)
Pumps, fans	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505 (69)
Losses e.g. evaporation (negative values) (Table 5)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Water heating gains (Table 5)	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040 (71)
Total internal gains	121.6028	119.6452	115.8738	107.6069	102.5434	97.2507	93.9995	96.6851	99.8338	105.7066	113.6313	120.5457 (72)
	391.4508	398.9779	383.3996	369.4118	351.5264	338.9849	326.7620	327.9197	337.3940	348.9877	369.7343	383.8974 (73)

6. Solar gains												

[Jan]												
	Area											
	m2											
	Solar flux											
	Table 6a											
	W/m2											
	Specific data											
	or Table 6b											
	g											
	Specific data											
	or Table 6c											
	FF											
	Access											
	factor											
	Table 6d											
	Gains											
	W											
North	9.0000											21.2225 (74)
East	5.1300											22.3433 (76)
Solar gains	43.5659	84.2657	140.8982	215.6787	277.7781	291.3419	274.4300	225.9522	166.5777	100.1418	54.0403	36.0662 (83)
Total gains	435.0167	483.2435	524.2978	585.0905	629.3046	630.3269	601.1920	553.8719	503.9717	449.1296	423.7746	419.9637 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)	
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	27.1981	27.2902	27.3829	27.8559	27.9525	28.4457	28.4457	28.5464	28.2463	27.9525	27.7600	27.5702	
alpha	2.8132	2.8193	2.8255	2.8571	2.8635	2.8964	2.8964	2.9031	2.8831	2.8635	2.8507	2.8380	
util living area	0.8840	0.8486	0.7921	0.6809	0.5421	0.3926	0.2906	0.3261	0.5076	0.7241	0.8419	0.8917 (86)	
Living	19.6431	19.8474	20.1358	20.4933	20.7268	20.8468	20.8794	20.8737	20.7921	20.4880	20.0346	19.6195	
Non living	18.6118	18.8663	19.2226	19.6607	19.9296	20.0681	20.0982	20.0964	20.0118	19.6661	19.1129	18.5901	
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	20.3059	19.8474	20.1358	20.4933	20.7268	20.8468	20.8794	20.8737	20.7921	20.4880	20.0346	19.8126 (87)	
Th 2	20.2117	20.2141	20.2166	20.2289	20.2314	20.2437	20.2437	20.2462	20.2388	20.2314	20.2265	20.2215 (88)	
util rest of house	0.8728	0.8347	0.7734	0.6544	0.5072	0.3506	0.2426	0.2755	0.4617	0.6943	0.8253	0.8812 (89)	
MIT 2	19.5739	18.8663	19.2226	19.6607	19.9296	20.0681	20.0982	20.0964	20.0118	19.6661	19.1129	18.8841 (90)	
Living area fraction									fLA = Living area / (4) =				0.4560 (91)
MIT	19.9077	19.3137	19.6390	20.0404	20.2931	20.4232	20.4544	20.4508	20.3677	20.0409	19.5332	19.3075 (92)	
Temperature adjustment												0.0000	
adjusted MIT	19.9077	19.3137	19.6390	20.0404	20.2931	20.4232	20.4544	20.4508	20.3677	20.0409	19.5332	19.3075 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8682	0.8168	0.7583	0.6476	0.5101	0.3607	0.2561	0.2894	0.4697	0.6864	0.8086	0.8672 (94)
Useful gains	377.6718	394.6949	397.5650	378.8794	321.0075	227.3612	153.9590	160.3172	236.7185	308.2982	342.6526	364.1881 (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	661.9783	609.2760	553.5151	461.3456	354.6298	236.1502	156.3088	163.6965	255.9692	389.6170	516.6634	632.1165 (97)
Space heating kWh	211.5240	144.1985	116.0269	59.3757	25.0149	0.0000	0.0000	0.0000	0.0000	60.5012	125.2878	199.3387 (98a)
Space heating requirement - total per year (kWh/year)												941.2676
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	211.5240	144.1985	116.0269	59.3757	25.0149	0.0000	0.0000	0.0000	0.0000	60.5012	125.2878	199.3387 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												941.2676
Space heating per m2										(98c) / (4) =		18.8254 (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 %)												219.8950 (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	211.5240	144.1985	116.0269	59.3757	25.0149	0.0000	0.0000	0.0000	0.0000	60.5012	125.2878	199.3387 (98)
Space heating efficiency (main heating system 1)	219.8950	219.8950	219.8950	219.8950	219.8950	0.0000	0.0000	0.0000	0.0000	219.8950	219.8950	219.8950 (210)
Space heating fuel (main heating system)	96.1932	65.5761	52.7647	27.0018	11.3758	0.0000	0.0000	0.0000	0.0000	27.5137	56.9762	90.6518 (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	212.3231	187.8195	199.5040	175.1671	169.6760	152.7416	150.5582	156.5675	158.3352	176.7540	188.2126	209.9579 (64)
Efficiency of water heater	189.7735	189.7735	189.7735	189.7735	189.7735	189.7735	189.7735	189.7735	189.7735	189.7735	189.7735	189.7735 (216)
Fuel for water heating, kWh/month	111.8824	98.9703	105.1274	92.3032	89.4097	80.4863	79.3357	82.5023	83.4337	93.1394	99.1775	110.6360 (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	8.4188	7.6041	8.4188	8.1473	8.4188	8.1473	8.4188	8.4188	8.1473	8.4188	8.1473	8.4188 (231)
Lighting	16.0788	12.8990	11.6141	8.5090	6.5726	5.3699	5.9957	7.7935	10.1230	13.2819	15.0019	16.5257 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-4.2232	-7.3341	-13.2284	-18.2594	-22.5859	-22.0813	-21.6305	-18.7172	-14.2041	-9.4073	-5.0228	-3.4716 (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												428.0532 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												189.7735
Water heating fuel used												1126.4039 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												

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(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6500)			
mechanical ventilation fans (SFP = 0.6500)			99.1250 (230a)
Total electricity for the above, kWh/year			99.1250 (231)
Electricity for lighting (calculated in Appendix L)			129.7650 (232)
Energy saving/generation technologies (Appendices M ,N and Q)			
PV generation			-160.1659 (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			1623.1813 (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	428.0532	0.1559	66.7290 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1126.4039	0.1409	158.7182 (264)
Space and water heating			225.4472 (265)
Pumps, fans and electric keep-hot	99.1250	0.1387	13.7499 (267)
Energy for lighting	129.7650	0.1443	18.7291 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-160.1659	0.1309	-20.9619
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-20.9619 (269)
Total CO2, kg/year			236.9643 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.7400 (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	428.0532	1.5771	675.0826 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1126.4039	1.5210	1713.2868 (278)
Space and water heating			2388.3695 (279)
Pumps, fans and electric keep-hot	99.1250	1.5128	149.9563 (281)
Energy for lighting	129.7650	1.5338	199.0380 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-160.1659	1.4835	-237.6030
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-237.6030 (283)
Total Primary energy kWh/year			2499.7607 (286)
Dwelling Primary energy Rate (DPER)			50.0000 (287)

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

1. Overall dwelling characteristics

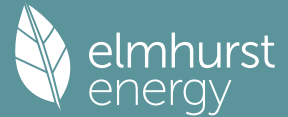
	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	50.0000 (1b)	x 2.5000 (2b)	= 125.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 125.0000 (5)

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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 20.0000 / (5) = 0.1600 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.4100 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3793 (21)

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

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Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infiltr rate	0.4835	0.4741	0.4646	0.4172	0.4077	0.3603	0.3603	0.3508	0.3793	0.4077	0.4267	0.4456 (22b)
Effective ac	0.6169	0.6124	0.6079	0.5870	0.5831	0.5649	0.5649	0.5615	0.5719	0.5831	0.5910	0.5993 (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			9.0900	1.0000	9.0900		(26)
TER Opening Type (Uw = 1.20)			3.4100	1.1450	3.9046		(27)
External Wall 1	28.8000	12.5000	16.3000	0.1800	2.9340		(29a)
Corrior wall	31.0000		31.0000	0.1800	5.5800		(29a)
Total net area of external elements Aum(A, m2)			59.8000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 21.5086		(33)

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

93.0572 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	47.8000	0.0700	3.3460
E16 Corner (normal)	2.5000	0.0900	0.2250
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	2.5000	0.0600	0.1500
E25 Staggered party wall between dwellings	5.0000	0.0600	0.3000
E2 Other lintels (including other steel lintels)	8.6200	0.0500	0.4310
E3 Sill	5.6500	0.0500	0.2825
E4 Jamb	35.0000	0.0500	1.7500
E24 Eaves (insulation at ceiling level - inverted)	2.7000	0.2400	0.6480
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			6.9075 (36)
Point Thermal bridges			0.0000 (36a) =
Total fabric heat loss			(33) + (36) + (36a) = 28.4161 (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	25.4474	25.2602	25.0766	24.2145	24.0532	23.3023	23.3023	23.1632	23.5915	24.0532	24.3795	24.7206 (38)
Heat transfer coeff	53.8635	53.6762	53.4927	52.6306	52.4692	51.7184	51.7184	51.5793	52.0076	52.4692	52.7956	53.1367 (39)
Average = Sum(39)m / 12 =												52.6298

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0773	1.0735	1.0699	1.0526	1.0494	1.0344	1.0344	1.0316	1.0402	1.0494	1.0559	1.0627 (40)
HLP (average)												1.0526
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

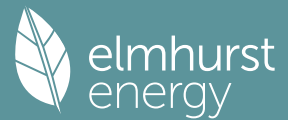
4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.6901 (42)
Hot water usage for mixer showers												
52.5569	51.7671	50.6162	48.4141	46.7890	44.9767	43.9465	45.0888	46.3409	48.2867	50.5361	52.3556 (42a)	
Hot water usage for baths												
22.7244	22.3869	21.9117	21.0354	20.3792	19.6517	19.2587	19.7306	20.2445	21.0230	21.9173	22.6476 (42b)	
Hot water usage for other uses												
31.9383	30.7769	29.6155	28.4541	27.2927	26.1314	26.1314	27.2927	28.4541	29.6155	30.7769	31.9383 (42c)	
Average daily hot water use (litres/day)												98.5597 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												
107.2197	104.9310	102.1434	97.9036	94.4609	90.7597	89.3366	92.1121	95.0395	98.9252	103.2304	106.9415 (44)	
Energy content (annual)	169.8097	149.4203	156.9906	134.0251	127.1626	111.5996	108.0448	114.0541	117.1932	134.2406	147.0706	167.4445 (45)
Distribution loss (46)m = 0.15 x (45)m												
25.4715	22.4130	23.5486	20.1038	19.0744	16.7399	16.2067	17.1081	17.5790	20.1361	22.0606	25.1167 (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 (59)	
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)	
Total heat required for water heating calculated for each month												
216.4047	191.5060	203.5855	179.1170	173.7575	156.6915	154.6398	160.6490	162.2850	180.8355	192.1624	214.0394 (62)	
WWHRS	-24.0268	-21.2495	-22.2513	-18.4249	-17.1714	-14.6937	-13.7730	-14.6462	-15.2026	-17.9222	-20.3037	-23.5819 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)	
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)	
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)	
Output from w/h												
192.3778	170.2565	181.3342	160.6920	156.5861	141.9978	140.8668	146.0028	147.0824	162.9133	171.8587	190.4575 (64)	
12Total per year (kWh/year)												Total per year (kWh/year) = Sum(64)m = 1962.4258 (64)
Electric shower(s)												1962 (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												
93.7377	83.3508	89.4753	80.6368	79.5575	73.1803	73.2008	75.1989	75.0402	81.9109	84.9744	92.9512 (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	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	92.2020	102.0808	92.2020	95.2754	92.2020	95.2754	92.2020	92.2020	95.2754	92.2020	95.2754	92.2020 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	147.2339	148.7618	144.9117	136.7153	126.3689	116.6447	110.1484	108.6205	112.4706	120.6670	131.0134	140.7376 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505 (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)

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Losses e.g. evaporation (negative values) (Table 5)	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040 (71)
Water heating gains (Table 5)	125.9915	124.0340	120.2625	111.9956	106.9321	101.6394	98.3882	101.0738	104.2225	110.0953	118.0201	124.9344 (72)
Total internal gains	416.7790	426.2281	408.7277	395.3379	376.8546	361.9110	349.0901	350.2479	360.3201	374.3159	395.6604	409.2256 (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
North						2.1700	10.6334	0.6300	0.7000	0.7700		7.0519 (74)
East						1.2400	19.6403	0.6300	0.7000	0.7700		7.4429 (76)
Solar gains	14.4947	28.0363	46.8778	71.7534	92.4076	96.9171	91.2924	75.1694	55.4204	33.3184	17.9798	11.9994 (83)
Total gains	431.2737	454.2644	455.6055	467.0913	469.2622	458.8282	440.3825	425.4172	415.7404	407.6343	413.6402	421.2250 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil, m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	23.9951	24.0788	24.1615	24.5572	24.6327	24.9904	24.9904	25.0577	24.8514	24.6327	24.4805	24.3233
alpha	2.5997	2.6053	2.6108	2.6371	2.6422	2.6660	2.6660	2.6705	2.6568	2.6422	2.6320	2.6216
util living area	0.9171	0.9015	0.8795	0.8259	0.7395	0.6008	0.4696	0.4990	0.6712	0.8211	0.8898	0.9211 (86)
MIT	18.7970	19.0098	19.3565	19.8925	20.3774	20.7543	20.9078	20.8888	20.6462	20.0682	19.3882	18.7818 (87)
Th 2	20.0194	20.0225	20.0255	20.0397	20.0424	20.0548	20.0548	20.0571	20.0500	20.0424	20.0370	20.0314 (88)
util rest of house	0.9068	0.8893	0.8636	0.8015	0.6997	0.5370	0.3831	0.4138	0.6128	0.7919	0.8743	0.9113 (89)
MIT 2	17.4639	17.7323	18.1692	18.8402	19.4226	19.8512	19.9981	19.9852	19.7390	19.0639	18.2201	17.4521 (90)
Living area fraction									fLA = Living area / (4) =			0.4560 (91)
MIT	18.0718	18.3148	18.7106	19.3200	19.8580	20.2630	20.4129	20.3973	20.1527	19.5219	18.7527	18.0585 (92)
Temperature adjustment												0.0000
adjusted MIT	18.0718	18.3148	18.7106	19.3200	19.8580	20.2630	20.4129	20.3973	20.1527	19.5219	18.7527	18.0585 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.8809	0.8628	0.8377	0.7804	0.6913	0.5519	0.4171	0.4458	0.6196	0.7735	0.8491	0.8860 (94)
Useful gains	379.8994	391.9206	381.6580	364.5152	324.4088	253.2259	183.7009	189.6638	257.6023	315.3164	351.2020	373.1878 (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	741.7980	720.0573	653.1794	548.4119	428.0429	292.8819	197.1970	206.1757	314.7870	468.1233	615.2121	736.3942 (97)
Space heating kWh	269.2526	220.5079	202.0119	132.4056	77.1038	0.0000	0.0000	0.0000	0.0000	113.6883	190.0873	270.2256 (98a)
Space heating requirement - total per year (kWh/year)												1475.2830
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	269.2526	220.5079	202.0119	132.4056	77.1038	0.0000	0.0000	0.0000	0.0000	113.6883	190.0873	270.2256 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1475.2830
Space heating per m2										(98c) / (4) =		29.5057 (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	269.2526	220.5079	202.0119	132.4056	77.1038	0.0000	0.0000	0.0000	0.0000	113.6883	190.0873	270.2256 (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)	291.7146	238.9035	218.8645	143.4514	83.5360	0.0000	0.0000	0.0000	0.0000	123.1726	205.9451	292.7688 (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	192.3778	170.2565	181.3342	160.6920	156.5861	141.9978	140.8668	146.0028	147.0824	162.9133	171.8587	190.4575 (64)
Efficiency of water heater (217)m	84.8137	84.6408	84.3025	83.6290	82.5608	79.8000	79.8000	79.8000	79.8000	83.2687	84.2864	79.8000 (216)
Fuel for water heating, kWh/month	226.8239	201.1517	215.0994	192.1488	189.6615	177.9421	176.5248	182.9609	184.3137	195.6476	203.8985	224.4797 (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	19.1578	15.3691	13.8381	10.1384	7.8312	6.3982	7.1439	9.2859	12.0615	15.8253	17.8746	19.6902 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-17.2725	-25.2668	-37.6658	-43.9793	-48.8576	-46.1581	-45.6450	-42.4240	-36.9179	-29.6763	-19.3312	-14.8318 (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)

Full SAP Calculation Printout



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	-7.1308	-15.2506	-30.7740	-46.8878	-62.6314	-63.1308	-62.3365	-52.4390	-38.0252	-21.9683	-9.5748	-5.6162	(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												1598.3565	(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												2370.6525	(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)												154.6141	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-823.7918	(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												3385.8314	(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	1598.3565	0.2100	335.6549	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2370.6525	0.2100	497.8370	(264)
Space and water heating			833.4919	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	154.6141	0.1443	22.3156	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-408.0264	0.1338	-54.5928	
PV Unit electricity exported	-415.7654	0.1255	-52.1766	
Total			-106.7694	(269)
Total CO2, kg/year			760.9673	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			15.2200	(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	1598.3565	1.1300	1806.1428	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2370.6525	1.1300	2678.8374	(278)
Space and water heating			4484.9802	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	154.6141	1.5338	237.1523	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-408.0264	1.4944	-609.7740	
PV Unit electricity exported	-415.7654	0.4606	-191.5165	
Total			-801.2905	(283)
Total Primary energy kWh/year			4050.9427	(286)
Target Primary Energy Rate (TPER)			81.0200	(287)