

**Energy and Sustainability
Statement
July 2025**

EAS

**Land Adjacent to 524
Northumberland Avenue
RG2 8NY**

Opal Group Ltd

Document History

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The content of this report is based on information available as of July 2025, the validity of the statements made may therefore vary over time as planning guidance / policies and the evidence base change.

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1 Introduction

- 1.1 EAS has been commissioned to provide an Energy and Sustainability Report to inform a full planning application at Land adjacent to 524 Northumberland Avenue, Reading, RG2 8NY.
- 1.2 The proposed planning application entails the development of 1x retail unit at the ground floor (GIA 51 sqm), and 1x residential apartment (GIA 63.4 sqm) on the first floor.
- 1.3 The site is situated within the jurisdiction of Reading Borough Council. This Statement details how the proposed scheme adheres to regional and local policy requirements in relation to Energy and Sustainability.
- 1.4 This energy statement has aligned with the planning policy requirements outlined in the Reading Borough Local Plan (2019) and the Sustainable Design and Construction SPD (2019). The proposed scheme complies with all policies pertinent to Energy and Sustainability set by the Local Authority.
- 1.5 In summary, the site achieves a site wide **CO2 reduction of 54% beyond Part L (2021)**, through implementing the energy hierarchy; Be Lean, Be Clean, Be Green.
- 1.6 Table 1.1 below denotes the operational regulated carbon savings that are achieved at each stage of the hierarchy based on the proposed energy strategy detailed within this report.

Savings from each stage of Hierarchy	Regulated site-wide carbon dioxide savings		
	Total regulated emissions (tCO2/ year)	CO2 savings (tCO2 / year)	Percentage savings (%)
Baseline Emissions (Part L 2021 Notional Specification)	1.1	-	-
Be Lean	1.0	0.1	7%
Be Clean	1.0	0.0	0%
Be Green	0.5	0.5	47%
Total on-site savings	-	0.6	54%

Table 1.1: Summary of the potential operational regulated CO2 emissions.

- 1.7 This document includes the following sections:

Section 2 – describes relevant local, regional and national planning policy;
 Section 3 – details the methodology for assessing the scheme's operational carbon emissions;
 Section 4 – denotes the 'Be Lean' measures included at the scheme;
 Section 5 – assesses feasibility of potential 'Be Clean' measures;
 Section 6 – denotes the 'Be Green' measures included at the scheme;
 Section 7 – summarises the total regulated operational carbon emission achieved;
 Section 8 – reviews additional sustainability measures of the development and site; and
 Section 9 – concludes the report.

2 Policy Context

Introduction

- 2.1 The National Planning Policy Framework (NPPF) (December 2024) establishes the Government's planning policies for England and denotes how these are expected to be applied. It provides a clear framework for which local authorities can use to develop their own distinctive local and neighbourhood plans. At the heart of the NPPF is a presumption in favour of sustainable development, which should be a core principle of plan making and decision taking. The core elements of the NPPF relating to sustainability focused decisions are listed below:

"Plans and decisions should apply a presumption in favour of sustainable development. For plan-making this means that:

- a. *All plans should promote a sustainable pattern of development that seeks to: meet the development needs of their area; align growth and infrastructure; improve the environment; mitigate climate change (including by making effective use of land in urban areas) and adapt to its effects.*
- b. *Strategic policies should, as a minimum, provide for objectively assessed needs for housing and other uses, as well as any needs that cannot be met within neighbouring areas, unless:*
 - i. *The application of policies in this Framework that protect areas or assets of particular importance provides a strong reason for restricting the overall scale, type or distribution of development in the plan area; or*
 - ii. *Any adverse impacts of doing so would significantly and demonstrably outweigh the benefits, when assessed against the policies in this Framework taken as a whole. For decision-taking this means:*
- c. *Approving development proposals that accord with an up-to-date development plan without delay; or*
- d. *Where there are no relevant development plan policies, or the policies which are most important for determining the application are out-of-date, granting permission unless:*
 - i. *The application of policies in this Framework that protect areas or assets of particular importance provides a clear reason for refusing the development proposed; or*
 - ii. *any adverse impacts of doing so would significantly and demonstrably outweigh the benefits, when assessed against the policies in this Framework taken as a whole."*

- 2.2 The NPPF also acknowledges that 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. To this extent, the policies relevant to procuring a low carbon future include:

“New development should be planned for in ways that:

- a. Avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and*
- b. Can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government’s policy for national technical standards.*

To help increase the use and supply of renewable and low carbon energy and heat, plans should:

- c. provide a positive strategy for energy from these sources, that maximises the potential for suitable development, and their future re-powering and life extension, while ensuring that adverse impacts are addressed appropriately (including cumulative landscape and visual impacts);*
- d. consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and*
- e. identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for collocating potential heat customers and suppliers.”*

Reading Borough Local Plan (2019)

- 2.3 The Reading Borough Local Plan was adopted on the 4th November 2019. The document sets out planning policies for development in Reading up to 2036 and is the main consideration in deciding planning applications.
- 2.4 The vision that underpins the local plan envisages a place where low carbon living is the norm,. And the built environment, technology and innovation have combined to create a smart and dynamic sustainable city.
- 2.5 To promote sustainable development, there are several policies contained within the Local Plan that establish the requirements and expectations of new development in the Borough. Policies deemed relevant to this application and Energy and Sustainability Statement include:
 - **Policy H5 Standards for New Housing:** Requires new build housing to be built in accordance with the higher water efficiency standards of 110 litres per person per day, and for all minor development to achieve a minimum of a 19% improvement in the dwelling emission rate over the target emission rate (as defined in the 2013 Building Regulations – superseded by Part L (2021).

- **Policy CC1 Presumption in Favour of Sustainable Development:** Sets out how a positive approach to considering development proposals will be taken in favour of sustainable development, in line with the NPPF.
- **Policy CC2 Sustainable Design and Construction:** States the requirements for certification schemes for new minor and major development to adhere to, and for non-residential development to incorporate water conservation measures, with both residential and non-residential including greywater and/or rainwater harvesting where systems are energy and cost effective.
- **Policy CC3 Adaptation to Climate Change:** Requires new development to demonstrate how they have been designed to incorporate measures to adapt to climate change, incorporating optimised orientation, natural ventilation, climate resilience through solar shade, thermal mass, minimise surface water runoff and use trees and planting where appropriate to provide shading,
- **Policy CC4: Decentralised Energy:** Although not applicable to this development as a minor application, Policy CC4 encourages new development to evaluate feasibility of connecting to district heating networks.

2.6 Additional policies contained in this section of the Local Plan cover Flood Risk, Biodiversity, Open Space and Green Corridors.

2.7 The proposed scheme has considered the policies listed above and incorporated sustainable measures into its design. Compliance with these policies is outlined in the body of this report.

Sustainable Design and Construction SPD (2019)

- 2.8 The Sustainable Design and Construction SPD sets out the Borough's commitment to producing sustainable buildings and interprets policies contained in the Local Plan covering topics such as climate change, energy efficiency and renewable energy.
- 2.9 The SPD explains how development should utilise the energy hierarchy, and then offset residual emissions at £60/tonne CO₂ over 30 years; £1,800 per tonne of residual carbon.
- 2.10 It also sets out the expectations of Energy Statements, and, therefore, has been used to inform this report.

3 Methodology

Energy Strategy & Hierarchy

- 3.1 The approach to the energy strategy for the proposed development has been to ensure that a robust and future-proofed building fabric and services strategy is implemented.
- 3.2 To maximise the sustainability credentials of the development and associated carbon reduction, the proposed scheme has adopted the energy hierarchy, comprised of:
- **Be Lean** – use less energy; achieved through implementation of a well-insulated building envelope and passive design measures.
 - **Be Clean** – supply energy efficiently; connecting to existing or future District Heating Networks
 - **Be Green** – use renewable technology, achieved through the implementation of green measures, such as Air Source Heat Pumps and Solar Photovoltaic Panels.



Figure 3.1: Summary of the Energy Hierarchy.

Energy Modelling

- 3.3 The latest version of SAP software (SAP 10.2) has been used to model the residential portion proposed scheme and accordingly, SAP 10.2 carbon factors have also been used in line with Part L (2021) Building Regulations. SBEM software has been used to model the commercial elements on the ground floor. For this report, renewable technology includes the provision of low carbon technologies, such as Air Source Heat Pumps.
- 3.4 All residential and commercial units have been modelled to calculate the proposed energy demand consumption and operational regulated CO2 emissions at each stage of the energy hierarchy using the latest drawing set received from Studio Mac Architects on the 8th July 2025.
- 3.5 For the purposes of the residential 'Be Lean' energy modelling, space heating and domestic hot water is provided by gas boilers with a default efficiency of 89.5%, to standardise a target for comparison of energy efficiency. The 'Be Green' stage of the energy modelling then utilises an energy strategy comprised of Air Source Heat Pumps (ASHPs) and Solar Photovoltaic Panels (PV), which is the proposed energy strategy for this scheme.

- 3.6 All carbon reductions and SAP calculations are in reference to the latest Part L (2021) Building Regulation standard.

Decarbonisation of the Grid and Future Homes and Building Standard

- 3.7 The UK has seen substantial progress in decarbonising the grid. As a result, and considering proposed future scenarios indicating additional decarbonisation, the scheme will opt for an all-electric energy strategy to ensure that the energy it uses, comes from the lowest-carbon sources. Governmental guidance provided via adopted and proposed Part L Building Regulation standards supports this approach and encourages new dwellings and buildings to capitalise on the opportunity to remove fossil-fuel combustion on-site, and transition to an electric alternative.
- 3.8 These governmental changes are most recently demonstrated in the draft Future Home Standard (FHS) and Future Building Standard (FBS), which is proposed to replace Part L (2021) in the foreseeable future. The Future-Standard focuses on delivering improve energy and carbon performance of new domestic and non-domestic buildings. The new standard will introduce a ban on gas-boilers and focus on reducing energy demand. The idea behind this is to ensure that new buildings use as little energy as possible through their design coupled with an electric energy strategy. This will render new developments 'net-zero' ready; as the grid continues to decarbonise, to a point where all electricity is provided by renewables, these new homes built to the FHS and FBS will, by default, become 'net-zero. The proposed energy strategy takes this into account and will provide a policy-proofed scheme in alignment with the proposed FHS and FBS requirements. It is also pertinent to note, that both FHS and FBS requirements are still not adopted, and therefore may be subject to change.

4 Energy: Be Lean

Building Fabric, Passive & Active Design Measures

- 4.1 Be Lean refers to the passive design and utilisation of energy efficient solutions to minimise energy demand on-site. It is generally a more cost-effective means to achieve carbon savings than low carbon or renewable technologies. These measures can be included through passive design (architecture), and active measures (energy saving equipment). By adopting the Be Lean principles, and using a combination of active and passive measures, the subsequent stages of the energy hierarchy will also benefit; energy demand is minimised and therefore any low/ zero carbon technologies can operate with reduced loads and higher efficiencies, meeting a greater need of the dwelling's energy consumption.
- 4.2 This energy strategy aims to reduce energy demand by optimising the envelopes and services contained within the dwellings.
- 4.3 To provide thermally comfortable, energy efficient dwellings and commercial space, with the highest possible dwelling fabric energy efficiency rating (DFEE), the proposed design will include building envelope U-values that represent a significant improvement in comparison to the Part L (2021) backstop values. The following envelope performance characteristics and passive design measures should be included, as detailed in Table 1 below. This fabric will support in maximising energy efficiency, reducing space heating demand whilst also providing sufficient thermal mass to aid passive cooling. The high-performance envelope will minimise heat loss in colder periods and prevent excess solar gain in warmer periods, providing optimal thermal comfort for residents and occupants.

Parameter	Residential Input	Commercial Input	Unit
Floor U-Value	N/A (Party Floor)	0.12	W/m2K
Roof U-Value	0.11	N/A	W/m2K
External Walls U-Value	0.16	0.16	W/m2K
Glazing U-Value	1.2 (High Performance Double Glazing)	1.4 (High Performance Double Glazing)	W/m2K
Glazing G-Value	0.76 (Default)	0.76 (Default)	-
Frame Factor	0.8 (Default)	0.8 (Default)	-
Thermal Mass Parameter	250 (Default)	250 (Default)	kJ/m2K
Thermal Bridge Y-Value	<0.1 (Default)	<0.1 (Default)	w/mK
Ventilation Method	Natural Ventilation	Natural Ventilation	-
Air Permeability	3	5	@50Pa (m3/(h.m2))
Lighting	110	110	Lumens/watt
Other Measures	Wastewater Heat Recovery System (~60% efficiency)	N/A	Recoup Pipe

Table 4.1: Building fabric parameters included in the proposed scheme's energy model.

4.4 As a summary, the proposed Be Lean Measures include:

- Well-insulated building fabric with low air permeability, exceeding Part L (2021), FBS and FHS back-stop values
- High performance double glazing, with low g-value and good daylight transmittance
- Accredited Construction Details (ACDs) as a minimum for non-repeating thermal bridges
- 100% low energy lighting with PIR sensors to common and external parts
- A low air permeability has been targeted to minimise heat loss.
- An orientation that suits sunlight and daylight access.
- High efficiency LED lighting throughout, with a minimum efficacy of 110 lumens per Watt.
- Wastewater Heat Recovery System to the residential apartment.

4.5 A fabric first approach will be taken to reduce the energy demand and CO2 emissions from the proposed development. An overriding objective for the façade design of each dwelling will be to achieve the optimal balance between providing natural daylighting benefits to reduce lighting demand, the provision of passive solar heating to limit space heating demand, whilst limiting summertime solar gains through low solar-transmittance windows and external shade to reduce overheating risks. Additional measures to mitigate the impacts of increasing temperatures as a result of climate change are detailed in the sustainability section of this report. This approach results in a 7% CO2 reduction at the Be Lean stage of the Energy Hierarchy beyond Part L 2021.

5 Energy: Be Clean

District Heat Networks and Combined Heat & Power (CHP)

- 5.1 The Be Clean stage of the energy hierarchy refers to measures that serve to reduce the overall emissions of the development using either District Heating Networks or Combined Heat and Power engines. These measures should be implemented where feasible once the energy demand has been minimised through appropriate Be Lean measures. This stage of the hierarchy is achieved through exploiting local energy resources in proximity to the site boundary, such as secondary heat.

Area Wide Energy Networks: Existing and Planned

- 5.2 The first stage in assessing feasibility of the Be Clean stage is to evaluate localised opportunities for connecting to District Heating Networks (DHN) that are either already existing or planned within the vicinity of the proposed development.
- 5.3 An investigation has been carried out to determine the presence of any area wide district heating networks in the area or if any are planned in the future. This investigation has been conducted utilising the Department for Energy Security and Net Zero's (DESNZ) [Heat Network Planning Database](#).
- 5.4 The investigation concluded that there are no District Heat Networks, either in situ or proposed, in vicinity of the site. As a minor development of a highly energy efficient building, it is not envisioned that the on-site space heating and hot water demand would be sufficiently large enough to warrant any form of on-site communal systems. Therefore, there are no carbon savings at this stage of the energy hierarchy.
- 5.5 The investigation has determined that no carbon reductions are feasible at the Be Clean stage of the Energy Hierarchy.

6 Energy: Be Green

Renewable and Low Carbon Technologies Appraisal

- 6.1 Once all Be Lean and Be Clean measures have been incorporated into the design, the scheme should then look to reduce the overall emissions of the development through the inclusion of renewable and low carbon technologies such as Air Source Heat Pumps or Solar Photovoltaic Panels (PV).
- 6.2 The following renewable and low carbon technologies were reviewed for their compatibility with the proposed scheme and discussed with the design team:
- **Solar Photovoltaic Panels (PV):** PV panels generate electricity on site through exposure to solar radiation.
 - **Solar Thermal Panels:** Solar Thermal panels capture long-wave radiation and use it to heat fluid contained in vacuum sealed circuits.
 - **Biomass Heating:** Biomass relies on the combustion of organic material such as woodchips to provide space heating and domestic hot water.
 - **Air Source Ground Heat Pumps (ASHPs):** ASHPs work by capturing energy from the ambient outdoor air and use it to evaporate and compress refrigerant. This compression generates heat. ASHPs can be used for both space heating and/or domestic hot water supply.
 - **Ground Source Heat Pumps (GSHPs):** GSHPs capture heat from the earth or sub-terrain aquifers and use this heat to evaporate and compress refrigerant; generating heat.

Site Constraints Review

- 6.3 A review of the potential technologies listed above illustrated that Air Source Heat Pumps were the best low carbon and renewable technologies suited to the proposed scheme.
- 6.4 The use of **Air Source Heat Pumps** will supply space heating and domestic water at high efficiencies. This will facilitate the electrification of the site, enabling the development to benefit from the on-going decarbonisation of the UK's Grid.
- 6.5 Solar Photovoltaic Panels are also deemed suitable to the west portion area of the proposed roof space, and will be allocated to the retail unit.
- 6.6 Biomass was ruled out as a Be Green measure, owing to its requirements for large storage areas for fuel and equally as a result of the potential impact on local air quality; the combustion process can emit oxides of nitrogen as well as particulate matter.
- 6.7 Ground Source Heat Pumps were assessed for their feasibility at the site, however due to complications with both their requirement for borehole or sinkhole arrangements, and subsequent potential for further environmental complications, they were ruled out.

Energy Strategy: Residential - Air Source Heat Pumps (ASHPs)

- 6.8 The scheme will look to utilise an individual Air Source Heat Pump (ASHP) solution to provide 100% of space heating and domestic hot water demand (DHW) to each of the proposed dwellings.
- 6.9 Heat Pumps work by extracting energy from the ambient air temperature outside, and using it to evaporate and compress refrigerant, which in turn, generates hot water. They capture the energy from ambient air via an external condenser unit (Figure 3), which connects to an internal heat pump unit. It is currently proposed that the condensers will be discreetly situated at the scheme, away from any local sensitive noise receptors. The image below demonstrates indicative dimensions of the external condensers. Specifications will be mapped out at the detailed design stage and procured based on their efficiencies and noise levels.

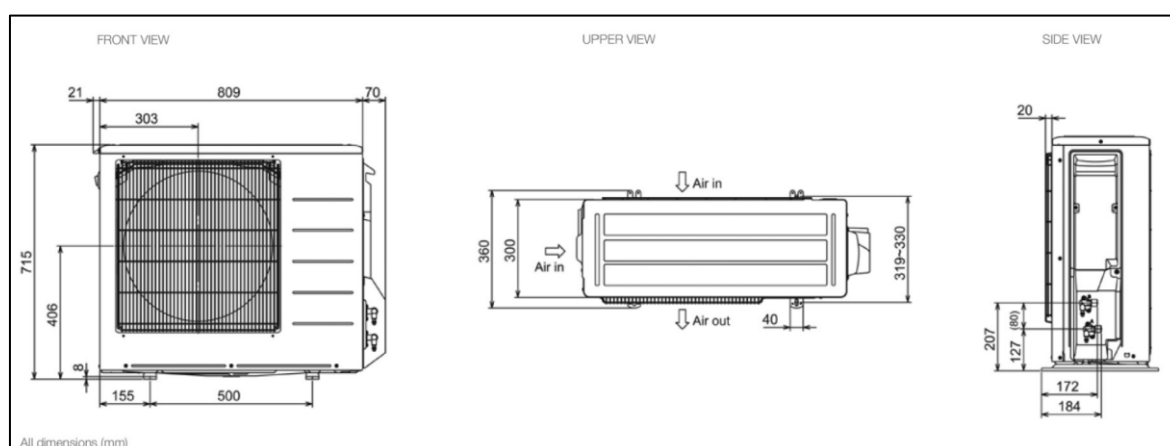


Figure 6.1: Indicative dimensions of an external condenser.

- 6.10 The water generated by the Heat Pump systems will be stored in a well-insulated hot water cylinder. The space will be heated using a wet-underfloor heating system to maximise efficiency.
- 6.11 The Heat Pump will seek to comply with the minimum performance standards as set out in the Enhanced Capital Allowances (ECA) criteria and the Microgeneration Certification Scheme (MCS) for Heat Pump Certification.
- 6.12 The inputs included for the 'Be Green' energy model, relating to the space heating and domestic hot water inputs are detailed below. For the purposes of this application, default efficiencies for the ASHP system have been used as extracted from the Standard Assessment Procedure. In practice, units often have significantly higher efficiencies (SCOP) than the default values subject to specification.
- 6.13 The use of Air Source Heat Pumps facilitates the notional all-electric energy strategy, enabling the proposed development to capitalise on the benefits of the continued decarbonisation of the UK electricity grid.
- 6.14 It is proposed that the systems will use a low Global Warming Potential (GWP) refrigerant, such as R32 and be equipped with leakage detection systems, to minimise potential risk of leakages and harm to the environment.

Residential Space Heating and DHW Strategy	Type	Details
Space Heating System	ASHP	170% (SAP default efficiency) (MCS)
Heating Emitters	Underfloor Heating	-
Domestic Hot Water	Same as space heating	170% (SAP default efficiency) (MCS)
DHW Storage	Cylinder	~170 litres, 1 kWh loss per day

Table 6.1: Summary of Space Heating and Domestic Hot Water Strategy at the Be Green Stage

Energy Strategy: Commercial – Air Source Heat Pumps (ASHPs)

- 6.15 The commercial portion of the development will also use Air Source Heat Pumps to provide space heating as well as cooling, however this will be via a dry system (contrary to wet-system proposed for residential).
- 6.16 Of the technologies reviewed, this solution was deemed most suitable owing to its adaptability to future tenant requirements and high efficiencies. It is important to provide an energy strategy that can be adapted by future tenants to avoid embodied carbon emissions that would otherwise be emitted if occupants were to be required to amend HVAC arrangements at the on-set of their tenancy. The condensers will be situated away from any noise sensitive receptors.
- 6.17 The commercial spaces will be heated using either wall-mounted fan coil units (FCUs) or ceiling-hung cassette units to maximise efficiency. Further details, including specification of systems, will be mapped out at the detailed design stage. The Heat Pumps will seek to comply with the minimum performance standards as set out in the Enhanced Capital Allowances (ECA) criteria and the Microgeneration Certification Scheme (MCS) for Heat Pump Certification, where sizing permits.
- 6.18 Hot water will be provided by electric point of use heaters. This enables electrification of the scheme, whilst providing hot water at 100% efficiencies, in a quantum suited to commercial application.
- 6.19 Details of the proposed commercial energy strategy are set out in table 6.2 below.

Residential Space Heating and DHW Strategy	Type	Details
Space Heating and Cooling System	ASHP (Split System)	SCOP: 4.0 SEER: 6.5
Heating Emitters		Fan Coil Unit / Cassette
Hot Water	Point of Use	100% Efficiency Direct Electric

Table 6.2: Summary of Commercial Space Heating and Hot Water Strategy at the Be Green Stage

Energy Strategy: Commercial – Solar Photovoltaic Panels

- 6.20 The proposed scheme intends to maximise its carbon reduction and reduce its environmental impact as much as possible. Therefore, given the southern orientation of a portion of the roof, solar PV will be included at the site. This will enable future tenants to utilise the energy themselves, reducing the primary energy demand from the grid.
- 6.21 The scheme has space for approximately 3 PV panels, indicated in the figure below, achieving a total estimated annual carbon saving of approximately 0.15 tonne CO₂e. Additional PV panels were ruled out as the roof orientations are not suitable.

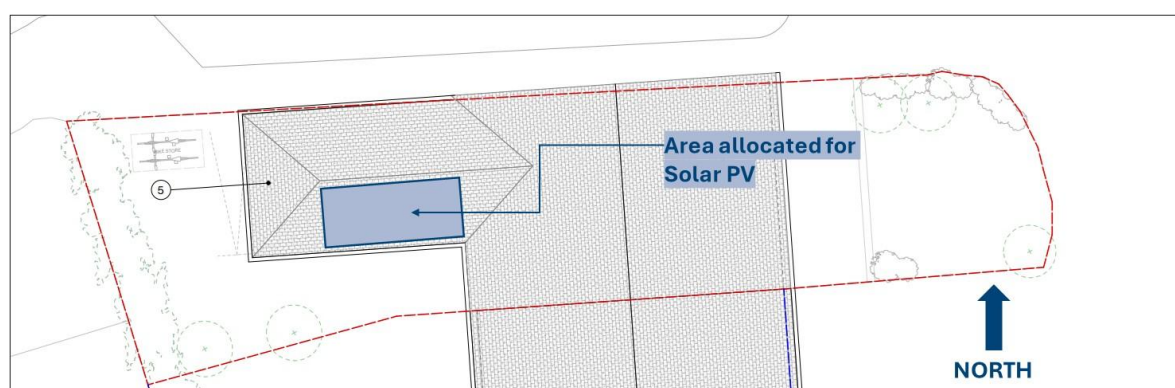


Figure 6.: Proposed area allocated for Solar PV Panels.

Solar PV Detail	Quantum	Unit
Approx PV array size	7	M2
Length of individual panel	1.6	M
Width of individual panel	1.1	M
Total panel size	1.76	m2
Assumed panel power	450	Watts/panel
Inclination of panel	30	Degrees
Assumed number of panels	3	#
PV Peak power	1.35	kWp
Total CO₂ savings (p/a)	0.15	tCO₂

Table 6.3: Details of proposed Solar PV array.

7 Carbon Reduction Summary

Regulated Carbon Reduction

- 7.1 The proposed energy strategy follows the energy hierarchy; firstly, adopting fabric first measures comprising a well-insulated building envelope as well as various passive and active design measures. The site then maximises its carbon reduction at the Be Green Stage by opting for Air Source Heat Pumps and Solar Photovoltaic Panels, capitalising on the decarbonisation efforts of the grid through electrification.
- 7.2 Based on this energy strategy being implemented, the has achieves an overall **on-site regulated CO2 reduction of 54%**, exceeding local policy requirements.
- 7.3 The tables below summarise the carbon reductions achieved at each stage of the energy hierarchy.

Savings from each stage of Hierarchy	Regulated site-wide carbon dioxide savings		
	Total regulated emissions (tCO2/ year)	CO2 savings (tCO2 / year)	Percentage savings (%)
Baseline Emissions (Part L 2021 Notional Specification)	1.1	-	-
Be Lean	1.0	0.1	7%
Be Clean	1.0	0.0	0%
Be Green	0.5	0.5	47%
Total on-site savings	-	0.6	54%

Table 7.1: Regulated site-wide CO2 reductions achieved.

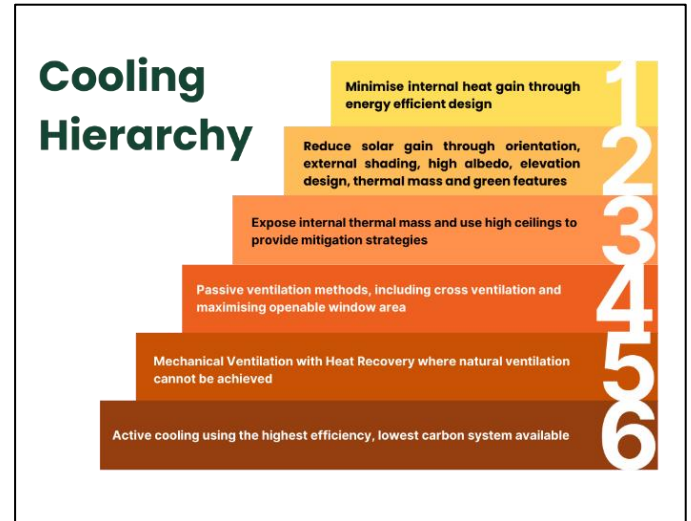
8 Other Sustainability Measures

Introduction

- 8.1 This section of the report details the measures included in the proposed development to meet both local and national standards for sustainable design and construction. The approach spans multiple focus areas, including resource efficiency, environmental protection, and occupant health, ensuring the development is climate-resilient and environmentally responsible.
- 8.2 In summary, the site would benefit from a sustainable design strategy, energy efficiency buildings, water conservation equipment, flood risk management, waste reduction in construction and operation, and biodiversity improvements. The cooling hierarchy has been considered to address overheating, emphasising passive cooling strategies to maintain indoor comfort while limiting reliance on mechanical systems. Placing an early emphasis on overheating design principles will ensure that future overheating risk is minimised, and that the dwellings are thermally comfortable year-round.
- 8.3 It is envisaged that, through the combination of the proposed low-carbon energy strategy, and the sustainability measures detailed in this report, BREEAM Very Good certification could be achieved for both the residential and commercial elements. However, it is proposed that as a minor development of around 100sqm, the principles of BREEAM are integrated in the scheme, and the money that would be spent on achieving certification, is instead allocated to improved building fabric, equipment and sustainability measures.
- 8.4 The development will also incorporate sustainable transport features, including pedestrian and cycling infrastructure and links to public transport, aiming to reduce dependence on private vehicles and support carbon reduction and air quality goals.
- 8.5 Further considerations in this section include strategies for health and wellbeing to enhance air quality and thermal comfort, pollution management, and responsible land use with ecological enhancements.

Overheating and the Cooling Hierarchy

- 8.6 With rising summer temperatures, the risk of overheating in buildings is increasing, potentially impacting occupant comfort and health. The proposed dwellings will seek to comply with Building Regulations Part O, which addresses overheating in residential settings. Passive solar design measures and adherence to the cooling hierarchy will be incorporated into the building design, as illustrated in the figure to the right, to minimise overheating risk. By applying the cooling hierarchy, the development prioritises passive cooling techniques, enabling buildings to manage indoor temperatures effectively, adapt to future climate conditions, and mitigate the impact of higher temperatures.



Passive Overheating Measures

- 8.7 Passive overheating measures are essential to maintain comfortable indoor temperatures as external temperatures rise, reducing reliance on energy-intensive mechanical ventilation and/or cooling. The following passive strategies will be incorporated within the designs, supporting the scheme in limiting solar gain, reducing energy consumption, and supporting occupant wellbeing.
- Minimising internal heat through fully insulated pipework.
 - Reducing heat entering using ~200mm window reveals.
 - Openable windows with large free area to maximise passive ventilation to habitable spaces.
 - Careful design of internal spaces to facilitate natural and cross-ventilation as much as possible at the scheme through dual-aspect design.
 - Active cooling has been avoided to the residential unit, due to the increased energy consumption associated with its use.
 - Active cooling requirements to the commercial units have been minimised by maximising passive measures at the proposed site. The layout facilitates natural and cross-ventilation throughout useable spaces, ensuring a comfortable environment with minimal dependence on the cooling function of the split system.
- 8.8 It is envisioned that through the combination of the above measures, and by adopting principles included within Part O (2021) Building Regulations, the overheating risk of the scheme is reduced.

Sustainable Construction Management

- 8.9 To ensure that construction activities are managed responsibly and have minimal impact on the environment and neighbouring properties, the contractor will be selected based on their commitment to the principles of the Considerate Constructors Scheme. This includes a proactive approach to minimising noise, dust, and disruption, as well as prioritising environmental practices on-site. Principal contractors and subcontractors will be encouraged to monitor energy and water consumption closely to support conservation efforts and minimise resource use. In line with sustainable sourcing policies, all timber will be verified as legally harvested and FSC-certified.
- 8.10 To guarantee that building services and the energy strategy are implemented to a high standard, the scheme will aim for MCS certification for any low carbon or renewable measures included.
- 8.11 Upon completion, a building user guide will be provided to occupants to familiarise them with building systems and to promote efficient use of the space. This guide will address practical questions on system operation and maintenance, supporting sustainable building use and maximising energy efficiency throughout the building's lifecycle.

Health and Wellbeing

- 8.12 The development is designed to promote a healthy and safe environment, both internally and externally, enhancing occupant comfort and wellbeing. All habitable spaces will be designed to meet daylight standards as recommended by the Building Research Establishment's *Site Layout Planning for Daylight and Sunlight – A Guide to Good Practice* (2022), ensuring that interiors receive ample natural light, which contributes to occupant wellbeing. Building materials will be specified to enhance thermal efficiency, reducing heating demand, and to improve sound insulation, minimising noise from external sources and between dwellings.
- 8.13 Ventilation strategies will be optimised to ensure a constant supply of fresh air across all units. Passive ventilation methods are integrated to support natural airflow, reducing dependency on mechanical systems and promoting a healthy indoor atmosphere. Cross-ventilation will be maximised according to best practice standards, enhancing airflow throughout the units and reducing the risk of overheating during warmer months. These design measures will support a comfortable and healthy living environment by optimising thermal comfort, air quality, and noise control.

Energy

- 8.14 The proposed scheme demonstrates a carbon reduction that demonstrates a regulated CO₂ reduction of 0.6 tonnes beyond Building Regulations Part L (2021) requirements.
- 8.15 To further support with energy conservation, the units will benefit from the ability to display energy consumption data and record energy use, which will enable residents to monitor their unregulated energy use.
- 8.16 Where white goods are provided to the units, the scheme will procure A-rated energy efficient appliances where feasible. This will reduce both energy consumption and carbon emissions from appliance use within the units.

- 8.17 All external lighting will use energy efficient bulbs and operate on either a timer or passive infrared (PIR) sensor to minimise use when the spaces are not in use and reduce disturbance to local wildlife.

Transport

- 8.18 To encourage public transport use, occupants will be provided with details of the site's local public transport connections.
- 8.19 To encourage cycling and reduce reliance on short vehicle trips, secure on-site bike storage facilities will be provided for residents of the apartments and users of the commercial spaces provided.
- 8.20 To reduce trips by private vehicles, the development will be car-free. This will encourage residents to utilise nearby public transport nodes and active travel.

Water

- 8.21 The scheme will aim to reduce potable water consumption and alleviate pressure on local water resources. In alignment with local policies, the development will target a consumption rate of 110 litres per person per day, as stipulated by Building Regulations Part G. This will be achieved through high-efficiency sanitary fixtures and water-saving fittings across all units, including low-flow taps and dual-flush toilets, which significantly reduce water demand.
- 8.22 External water use will also be addressed, with space provided for water butts at the site. Rainwater harvesting will allow residents to reduce dependency on mains water for irrigation, supporting sustainable gardening practices.
- 8.23 Additionally, all units will be metered to enable residents to monitor their usage and water efficiency.

Materials and Embodied Carbon

- 8.24 Materials with a low environmental impact and low embodied carbon footprint will be prioritised, with a focus on those that are recycled, sustainably sourced, and procured locally to reduce transportation emissions. Where possible, materials will achieve a rating of A+ to D in the BRE Green Guide, ensuring compliance with best practices for sustainable construction.
- 8.25 In line with circular economy principles, waste from the demolition of existing structures and excavation on-site will be assessed for potential reuse within the new development, reducing the need for new resources and minimising waste.

Waste

- 8.26 A construction site waste management plan will also be implemented, setting targets for waste and establishing procedures for managing hazardous materials.
- 8.27 To support municipal waste reduction, dedicated on-site recycling facilities will be provided for residents. The commercial and residential unit will have access to clearly designated recycling containers, encouraging occupants to separate and recycle waste effectively.

Pollution

- 8.28 To control emissions and minimise pollution, the development will implement several targeted strategies. No combustion boilers will be installed on-site, which will prevent direct emissions of carbon dioxide and nitrogen oxides (NOx), supporting improved air quality.
- 8.29 External lighting will be designed to minimise light spill and glare, operating on timers or sensors where feasible to prevent unnecessary nighttime illumination. These measures are intended to limit both air and light pollution, maintaining environmental quality and reducing potential impacts on surrounding areas and residents.

Land Use and Ecology

- 8.30 To promote an improvement in ecological value, the site will look to protect existing ecological features during the construction stage and will also benefit from new planting of shrubs and other native species to the communal green spaces.
- 8.31 The development will also provide a quantifiable biodiversity net gain in accordance with National Requirements. .

Sustainability Summary

- 8.32 The measures identified and detailed in this section for the proposed development demonstrate a holistic approach that aligns with Reading's Local Plan. The scheme will integrate energy efficiency, water conservation, and sustainable transport features to achieve low operational carbon emissions, in line with local policy requirements. Passive and active design measures reduce the development's energy demand, and all installed appliances and systems are selected for minimal environmental impact and high efficiency.
- 8.33 Biodiversity will be improved through a commitment to measurable net gains, including prioritising native planting and establishing ecological corridors, providing both functional and recreational benefits for residents.
- 8.34 Resource efficiency will be addressed by selecting materials with low embodied carbon and integrating waste minimisation practices, including on-site recycling facilities and provisions for responsibly managing construction waste. Pollution control measures include the elimination of combustion-based heating to reduce NOx and CO₂ emissions and carefully designed external lighting to limit light spill and protect local amenity. These strategies collectively support the development's alignment with Reading's sustainability objectives and will provide a scheme with long-term environmental resilience and good occupant wellbeing.

9 Conclusion

- 9.1 This Energy and Sustainability Statement reports how the proposed development at Land adjacent to 524 Northumberland Avenue, Reading, RG2 8NY, has responded to local policy requirements regarding sustainability, energy and climate change.
- 9.2 This assessment has been prepared to support the detailed application for the development of commercial premises at the ground floor and a residential apartment on the first.
- 9.3 The proposed energy strategy complies with all relevant local policies relevant to Energy and Sustainability contained in the local development framework.
- 9.4 The scheme will benefit from significant passive design and energy efficiency improvements, including an improved building fabric, beyond requirements of Part L (2021). The energy strategy is comprised of an Air Source Heat Pump solution providing space heating and domestic hot water coupled with Solar Photovoltaic Panels to maximise on-site CO2 reduction.
- 9.5 The energy strategy follows the energy hierarchy; Be Lean, Be Clean, Be Green to maximise the carbon reduction. The proposed energy strategy is set out in this report and demonstrates that the scheme has the potential to achieve an on-site CO2 reduction of 54% beyond Building Regulations Part L (2021).
- 9.6 The scheme has incorporated the core principles of sustainability in its design and will continue to integrate the sustainability requirements set out in local policy throughout the next stages of the development.

Appendices

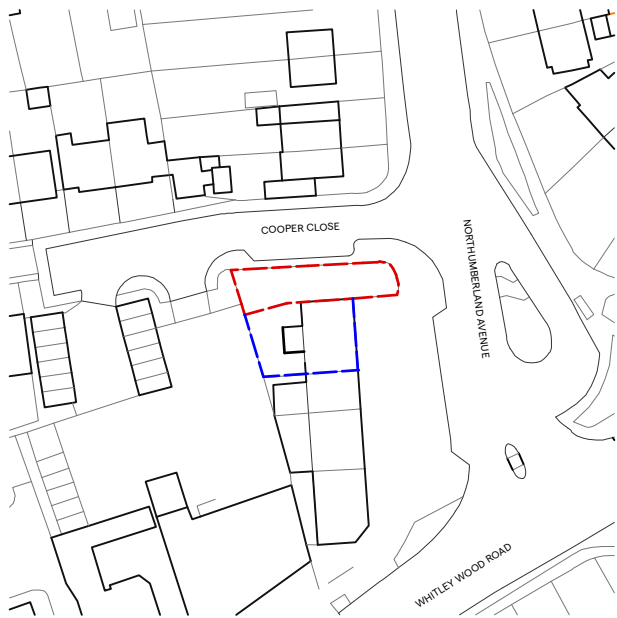
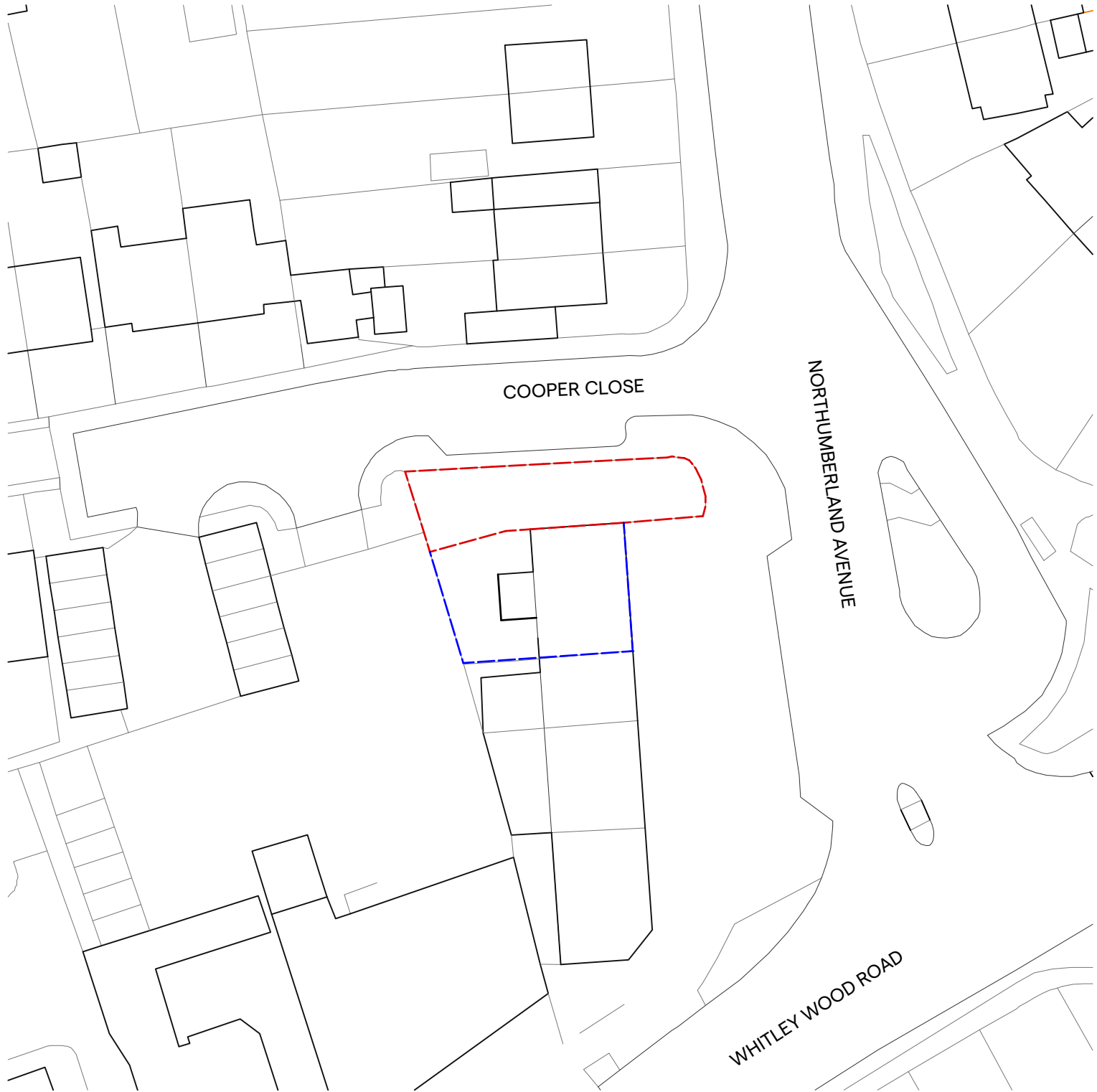
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Appendix: A - Location Plan

LEGEND

SITE BOUNDARY

OWNED PROPERTY



1:1250

**EXISTING -
BLOCK PLAN**

**MA
C.**

Hamberlins Cottages, Northchurch
Berkhamsted HP4 3TB
Matthews Architectural Consulting

07947800228
shaun@
studiomac.uk

DRAWING NO.
913-00-010-A
STATUS
PLANNING

SCALE
1:500
PROJECT NO.
913

DATE
04/07/2025
CLIENT
Opal Group

DRAWN
SM
APPROVED
SM

Existing - Location Plan
Land Adjacent to 524 Northumberland Avenue

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Do not scale this drawing.
All indicated dimensions to be checked and verified on site by the contractor before commencement of any fabrication drawings or works on site whatsoever.
Report any discrepancies to the Architect immediately.
Drawings to be read in conjunction with relevant Consultant's drawings and specification.
Red line boundary shown is indicative, to be confirmed by legal drawing and or party wall surveyor



1:500

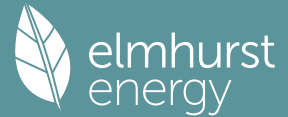
A

04/07/2025

Change to road name Cooper Close

Appendix: B – SAP Worksheets

Full SAP Calculation Printout



Property Reference	Flat 1_Lean				Issued on Date	25/07/2025
Assessment Reference	00001	Prop Type Ref				
Property	Flat 1 , 524 Northumberland Avenue					
SAP Rating	85 B	DER	14.99	TER	13.06	
Environmental	89 B	% DER < TER				-14.78
CO ₂ Emissions (t/year)	0.84	DFEE	39.34	TFEE	39.22	
Compliance Check	See BREL	% DFEE < TFEE				-0.31
% DPER < TPER	-21.45	DPER	83.09	TPER	68.41	
Assessor Details	Mr. Oliver Eggenton				Assessor ID	AQ01-0001
Client						

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling			
Ground floor	63.4000 (1b)	2.7000 (2b)	171.1800 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	63.4000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	171.1800 (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	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) = 0.1168 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.2668 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2668 (21)

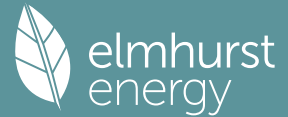
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infiltr rate	0.3402	0.3335	0.3269	0.2935	0.2868	0.2535	0.2535	0.2468	0.2668	0.2868	0.3002	0.3135 (22b)
Effective ac	0.5579	0.5556	0.5534	0.5431	0.5411	0.5321	0.5321	0.5305	0.5356	0.5411	0.5451	0.5492 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Window			17.0000	1.1450	19.4656		(27)
Door			2.1500	1.0000	2.1500		(26)
External Wall 1	83.7000	19.1500	64.5500	0.1600	10.3280		(29a)
External Roof 1	63.4000		63.4000	0.1000	6.3400		(30)
Total net area of external elements Aum(A, m ²)			147.1000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.2836		(33)
Main dwelling							
Party Floor 1			63.4000				(32d)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)							7.3550 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	45.6386 (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	31.5139	31.3870	31.2626	30.6781	30.5687	30.0597	30.0597	29.9654	30.2558	30.5687	30.7900	31.0212 (38)
	77.1526	77.0256	76.9012	76.3167	76.2074	75.6983	75.6983	75.6041	75.8944	76.2074	76.4286	76.6599 (39)
Average = Sum(39)m / 12 =												76.3162

Full SAP Calculation Printout



HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2169	1.2149	1.2130	1.2037	1.2020	1.1940	1.1940	1.1925	1.1971	1.2020	1.2055	1.2091 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	1.2037
												31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.0760 (42)
Hot water usage for mixer showers												
71.9190	70.8180	69.1953	66.6990	64.4625	61.3335	58.8587	61.7519	63.2070	66.3061	69.5336	71.8542 (42a)	
Hot water usage for baths												
24.9380	24.5615	24.0260	23.2239	22.5012	21.5061	20.7513	21.6744	22.1588	23.1447	24.1697	24.9182 (42b)	
Hot water usage for other uses												
35.8898	34.5848	33.2797	31.9746	30.6695	29.3644	29.3644	30.6695	31.9746	33.2797	34.5848	35.8898 (42c)	
Average daily hot water use (litres/day)												122.0543 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	132.7468	129.9642	126.5009	121.8976	117.6331	112.2041	108.9744	114.0958	117.3404	122.7305	128.2881	132.6622 (44)
Energy content (annual)	195.4263	171.9690	180.7672	159.2287	151.5822	129.7603	120.4199	134.2928	136.1090	158.1507	173.3856	194.8242 (45)
Distribution loss (46)m = 0.15 x (45)m										Total = Sum(45)m =		1905.9158
29.3139	25.7953	27.1151	23.8843	22.7373	19.4640	18.0630	20.1439	20.4164	23.7226	26.0078	29.2236 (46)	
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.5400 (55)
Total storage loss												
16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (56)	
If cylinder contains dedicated solar storage												
16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (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 (61)	
Total heat required for water heating calculated for each month												
235.4287	208.1002	220.7696	197.9407	191.5846	168.4723	160.4223	174.2952	174.8210	198.1531	212.0976	234.8266 (62)	
WWHRS	-56.2754	-49.7222	-52.0038	-44.8170	-41.8717	-34.4177	-30.0765	-34.9673	-35.6350	-43.0693	-49.0029	-56.0399 (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												
179.1533	158.3779	168.7658	153.1237	149.7129	134.0546	130.3458	139.3279	139.1861	155.0838	163.0947	178.7867 (64)	
12Total per year (kWh/year)												1849.0131 (64)
Electric shower(s)												1849 (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												
96.9812	86.0846	92.1070	83.9131	82.4030	74.1149	72.0415	76.6543	76.2259	84.5870	88.6203	96.7810 (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	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	91.5122	101.3171	91.5122	94.5626	91.5122	94.5626	91.5122	91.5122	94.5626	91.5122	94.5626	91.5122 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	181.4332	183.3159	178.5716	168.4714	155.7217	143.7388	135.7335	133.8508	138.5951	148.6953	161.4450	173.4279 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798 (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)	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382 (71)
Water heating gains (Table 5)	130.3510	128.1021	123.7998	116.5460	110.7567	102.9373	96.8300	103.0299	105.8692	113.6922	123.0838	130.0819 (72)
Total internal gains	460.4358	469.8745	451.0229	436.7193	415.1299	395.3781	378.2150	382.5322	393.1663	411.0391	436.2307	452.1614 (73)

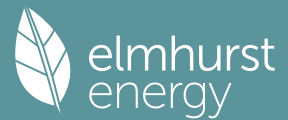
6. Solar gains

[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					7.0000	10.6334	0.7600	0.7000	0.7700		27.4419 (74)	
East					6.0000	19.6403	0.7600	0.7000	0.7700		43.4454 (76)	
West					4.0000	19.6403	0.7600	0.7000	0.7700		28.9636 (80)	
Solar gains	99.8509	194.0902	322.3862	483.3535	609.7669	633.2390	599.0685	501.9461	378.4491	230.5029	124.1386	82.4225 (83)
Total gains	560.2867	663.9647	773.4091	920.0728	1024.8969	1028.6170	977.2835	884.4783	771.6154	641.5420	560.3693	534.5839 (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	57.0658	57.1599	57.2524	57.6909	57.7736	58.1621	58.1621	58.2347	58.0119	57.7736	57.6064	57.4326
alpha	4.8044	4.8107	4.8168	4.8461	4.8516	4.8775	4.8775	4.8823	4.8675	4.8516	4.8404	4.8288
util living area												
	0.9896	0.9764	0.9403	0.8305	0.6512	0.4646	0.3396	0.3907	0.6418	0.9037	0.9781	0.9916 (86)
MIT	19.7739	20.0110	20.3517	20.7332	20.9308	20.9889	20.9981	20.9963	20.9523	20.6436	20.1392	19.7324 (87)
Th 2	19.9065	19.9081	19.9097	19.9170	19.9184	19.9248	19.9248	19.9260	19.9223	19.9184	19.9156	19.9127 (88)
util rest of house												
	0.9863	0.9692	0.9230	0.7896	0.5880	0.3894	0.2573	0.3008	0.5558	0.8683	0.9702	0.9889 (89)

Full SAP Calculation Printout



MIT 2	18.5101	18.8092	19.2289	19.6714	19.8676	19.9193	19.9243	19.9249	19.8943	19.5894	18.9795	18.4619 (90)
Living area fraction									FLA = Living area / (4) =			0.3155 (91)
MIT	18.9087	19.1883	19.5831	20.0063	20.2030	20.2567	20.2630	20.2628	20.2281	19.9220	19.3453	18.8627 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.7587	19.0383	19.4331	19.8563	20.0530	20.1067	20.1130	20.1128	20.0781	19.7720	19.1953	18.7127 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9815	0.9617	0.9138	0.7870	0.5962	0.4023	0.2718	0.3166	0.5689	0.8626	0.9631	0.9847	(94)
Useful gains	549.8968	638.5542	706.7680	724.1307	611.0622	413.8094	265.5904	279.9991	438.9537	553.3929	539.6938	526.4053	(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	1115.5294	1089.0129	994.5725	836.1517	636.5585	416.8515	265.9293	280.7062	453.7040	698.9715	924.4302	1112.5402	(97)
Space heating kWh	420.8307	302.7083	214.1265	80.6551	18.9692	0.0000	0.0000	0.0000	0.0000	108.3104	277.0102	436.0843	(98a)
Space heating requirement - total per year (kWh/year)												1858.6948	
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	420.8307	302.7083	214.1265	80.6551	18.9692	0.0000	0.0000	0.0000	0.0000	108.3104	277.0102	436.0843	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1858.6948	
Space heating per m2										(98c) / (4) =		29.3170	(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 %)													84.5000 (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	420.8307	302.7083	214.1265	80.6551	18.9692	0.0000	0.0000	0.0000	0.0000	108.3104	277.0102	436.0843	(98)
Space heating efficiency (main heating system 1)	84.5000	84.5000	84.5000	84.5000	84.5000	0.0000	0.0000	0.0000	0.0000	84.5000	84.5000	84.5000	(210)
Space heating fuel (main heating system)	498.0245	358.2347	253.4042	95.4498	22.4488	0.0000	0.0000	0.0000	0.0000	128.1780	327.8227	516.0761	(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	179.1533	158.3779	168.7658	153.1237	149.7129	134.0546	130.3458	139.3279	139.1861	155.0838	163.0947	178.7867	(64)
Efficiency of water heater	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	(216)
Fuel for water heating, kWh/month	212.0158	187.4295	199.7228	181.2115	177.1750	158.6445	154.2554	164.8851	164.7172	183.5311	193.0114	211.5819	(219)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	3.4822	3.1452	3.4822	3.3699	3.4822	3.3699	3.4822	3.4822	3.3699	3.4822	3.3699	3.4822	(231)
Lighting	19.9864	16.0339	14.4367	10.5770	8.1699	6.6749	7.4529	9.6876	12.5832	16.5098	18.6478	20.5419	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1													2199.6388 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													89.5000
Water heating fuel used													2188.1811 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans:													
central heating pump													41.0000 (230c)
Total electricity for the above, kWh/year													41.0000 (231)
Electricity for lighting (calculated in Appendix L)													161.3020 (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													4590.1219 (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	2199.6388	0.2100	461.9241	(261)

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Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2188.1811	0.2100	459.5180 (264)
Space and water heating			921.4422 (265)
Pumps, fans and electric keep-hot	41.0000	0.1387	5.6872 (267)
Energy for lighting	161.3020	0.1443	23.2809 (268)
Total CO2, kg/year			950.4103 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			14.9900 (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	2199.6388	1.1300	2485.5918 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2188.1811	1.1300	2472.6447 (278)
Space and water heating			4958.2365 (279)
Pumps, fans and electric keep-hot	41.0000	1.5128	62.0248 (281)
Energy for lighting	161.3020	1.5338	247.4104 (282)
Total Primary energy kWh/year			5267.6717 (286)
Dwelling Primary energy Rate (DPER)			83.0900 (287)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling	63.4000 (1b)	2.7000 (2b)	171.1800 (1b) - (3b)
Ground floor			
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	63.4000		171.1800 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 171.1800 (5)

2. Ventilation rate

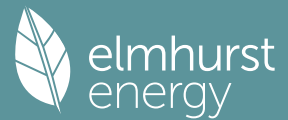
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	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) = 0.1168 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3668 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3668 (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	0.4677	0.4585	0.4494	0.4035	0.3943	0.3485	0.3485	0.3393	0.3668	0.3943	0.4127	0.4310 (22b)
Effective ac	0.6094	0.6051	0.6010	0.5814	0.5778	0.5607	0.5607	0.5576	0.5673	0.5778	0.5852	0.5929 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
Main dwelling												
TER Opaque door			2.1500	1.0000	2.1500		(26)					
TER Opening Type			13.6900	1.1450	15.6756		(27)					
External Wall 1	83.7000	15.8400	67.8600	0.1800	12.2148		(29a)					
External Roof 1	63.4000		63.4000	0.1100	6.9740		(30)					
Total net area of external elements Aum(A, m2)			147.1000				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.0144		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
List of Thermal Bridges												
K1 Element				Length	Psi-value	Total						
E7 Party floor between dwellings (in blocks of flats)				31.0000	0.0700	2.1700						
E16 Corner (normal)				5.4000	0.0900	0.4860						
E18 Party wall between dwellings				5.4000	0.0600	0.3240						
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							2.9800 (36)					
Point Thermal bridges						(36a) =	0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	39.9944 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 34.4235	Feb 34.1835	Mar 33.9484	Apr 32.8437	May 32.6371	Jun 31.6750	Jul 31.6750	Aug 31.4968	Sep 32.0456	Oct 32.6371	Nov 33.0552	Dec 33.4923 (38)

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Heat transfer coeff	74.4178	74.1779	73.9427	72.8381	72.6314	71.6693	71.6693	71.4912	72.0399	72.6314	73.0495	73.4866 (39)
Average = Sum(39)m / 12 =												72.8371
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1738	1.1700	1.1663	1.1489	1.1456	1.1304	1.1304	1.1276	1.1363	1.1456	1.1522	1.1591 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.0760 (42)
Hot water usage for mixer showers												
59.0265	58.1395	56.8469	54.3737	52.5485	50.5132	49.3562	50.6391	52.0453	54.2307	56.7570	58.8004 (42a)	
Hot water usage for baths												
25.5066	25.1278	24.5943	23.6107	22.8743	22.0576	21.6165	22.1462	22.7230	23.5968	24.6006	25.4203 (42b)	
Hot water usage for other uses												
35.8898	34.5848	33.2797	31.9746	30.6695	29.3644	29.3644	30.6695	31.9746	33.2797	34.5848	35.8898 (42c)	
Average daily hot water use (litres/day)												110.6962 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	120.4229	117.8520	114.7209	109.9590	106.0923	101.9352	100.3372	103.4548	106.7428	111.1072	115.9424	120.1106 (44)
Energy conte	190.7205	167.8197	176.3217	150.5284	142.8206	125.3412	121.3491	128.0986	131.6246	150.7714	165.1812	188.0641 (45)
Energy content (annual)										Total = Sum(45)m =		1838.6411
Distribution loss (46)m = 0.15 x (45)m												
28.6081	25.1729	26.4483	22.5793	21.4231	18.8012	18.2024	19.2148	19.7437	22.6157	24.7772	28.2096 (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	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	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												
241.6466	213.8174	227.2477	199.8117	193.7467	174.6245	172.2752	179.0247	180.9079	201.6974	214.4645	238.9902 (62)	
WWHRS	-26.9845	-23.8653	-24.9903	-20.6930	-19.2851	-16.5024	-15.4684	-16.4491	-17.0740	-20.1284	-22.8030	-26.4848 (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	214.6621	189.9521	202.2574	179.1187	174.4616	158.1221	156.8068	162.5756	163.8339	181.5690	191.6614	212.5054 (64)
12Total per year (kWh/year)												2187.5261 (64)
Electric shower(s)												2188 (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	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												
104.1554	92.5982	99.3678	89.4773	88.2287	81.1026	81.0894	83.3337	83.1918	90.8723	94.3494	103.2722 (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
103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
91.6120	101.4276	91.6120	94.6658	91.6120	94.6658	91.6120	91.6120	91.6120	94.6658	91.6120	94.6658	91.6120 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
181.4332	183.3159	178.5716	168.4714	155.7217	143.7388	135.7335	133.8508	138.5951	148.6953	161.4450	173.4279 (68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798 (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)												
-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382 (71)
Water heating gains (Table 5)												
139.9938	137.7950	133.5589	124.2741	118.5870	112.6425	108.9912	112.0076	115.5442	122.1402	131.0408	138.8067 (72)	
Total internal gains												
470.1784	479.6779	460.8818	444.5505	423.0600	405.1864	390.4760	391.6097	402.9444	419.5869	444.2909	460.9859 (73)	

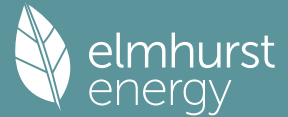
6. Solar gains

[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					5.6400	10.6334	0.6300	0.7000	0.7700	18.3283 (74)		
East					4.8300	19.6403	0.6300	0.7000	0.7700	28.9912 (76)		
West					3.2200	19.6403	0.6300	0.7000	0.7700	19.3275 (80)		
Solar gains	66.6470	129.5479	215.1819	322.6278	407.0132	422.6842	399.8741	335.0405	252.6035	153.8521	82.8581	55.0143 (83)
Total gains	536.8254	609.2258	676.0637	767.1783	830.0733	827.8706	790.3501	726.6502	655.5480	573.4391	527.1490	516.0003 (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	
59.1629	59.3543	59.5431	60.4461	60.6181	61.4318	61.4318	61.5849	61.1158	60.6181	60.2711	59.9126	
4.9442	4.9570	4.9695	5.0297	5.0412	5.0955	5.0955	5.1057	5.0744	5.0412	5.0181	4.9942	
util living area												
0.9910	0.9823	0.9601	0.8863	0.7384	0.5415	0.3968	0.4482	0.7030	0.9259	0.9817	0.9925 (86)	
MIT												
19.8034	19.9962	20.2868	20.6594	20.8942	20.9824	20.9970	20.9946	20.9385	20.6203	20.1585	19.7805 (87)	

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Th 2	19.9410	19.9441	19.9471	19.9611	19.9638	19.9761	19.9761	19.9783	19.9713	19.9638	19.9584	19.9529 (88)
util rest of house	0.9881	0.9768	0.9477	0.8539	0.6776	0.4603	0.3056	0.3509	0.6186	0.8968	0.9751	0.9901 (89)
MIT 2	18.5725	18.8181	19.1822	19.6343	19.8818	19.9669	19.9752	19.9766	19.9333	19.6037	19.0361	18.5520 (90)
Living area fraction									fLA = Living area / (4) =			0.3155 (91)
MIT	18.9608	19.1897	19.5306	19.9577	20.2012	20.2872	20.2975	20.2977	20.2504	19.9244	19.3901	18.9396 (92)
Temperature adjustment												0.0000
adjusted MIT	18.9608	19.1897	19.5306	19.9577	20.2012	20.2872	20.2975	20.2977	20.2504	19.9244	19.3901	18.9396 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9845	0.9716	0.9417	0.8538	0.6924	0.4855	0.3344	0.3817	0.6428	0.8955	0.9703	0.9869	(94)
Useful gains	528.5211	591.9472	636.6318	654.9882	574.7194	401.9292	264.3257	277.3624	421.3953	513.5147	511.4699	509.2635	(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	1091.0231	1059.9827	963.5194	805.4207	617.4534	407.5994	264.9991	278.6536	443.0770	677.2428	897.7895	1083.1615	(97)
Space heating kWh	418.5015	314.5199	243.2044	108.3114	31.7941	0.0000	0.0000	0.0000	0.0000	121.8136	278.1501	426.9801	(98a)
Space heating requirement - total per year (kWh/year)												1943.2752	
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	418.5015	314.5199	243.2044	108.3114	31.7941	0.0000	0.0000	0.0000	0.0000	121.8136	278.1501	426.9801	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1943.2752	
Space heating per m2											(98c) / (4) =	30.6510	(99)

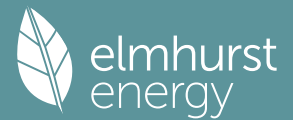
9a. Energy requirements - Individual heating systems, including micro-CHP

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	418.5015	314.5199	243.2044	108.3114	31.7941	0.0000	0.0000	0.0000	0.0000	121.8136	278.1501	426.9801	(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)	453.4144	340.7583	263.4934	117.3471	34.4465	0.0000	0.0000	0.0000	0.0000	131.9758	301.3544	462.6003	(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	214.6621	189.9521	202.2574	179.1187	174.4616	158.1221	156.8068	162.5756	163.8339	181.5690	191.6614	212.5054	(64)
Efficiency of water heater	85.5296	85.1826	84.4743	82.9687	81.0665	79.8000	79.8000	79.8000	79.8000	83.1852	84.8940	85.5922	(216)
Fuel for water heating, kWh/month	250.9798	222.9941	239.4307	215.8870	215.2079	198.1480	196.4997	203.7289	205.3056	218.2709	225.7655	248.2767	(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	19.0352	15.2707	13.7496	10.0735	7.7811	6.3572	7.0982	9.2265	11.9843	15.7240	17.7602	19.5642	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	-29.9088	-42.2984	-61.0061	-68.8576	-74.5047	-69.6648	-68.8260	-64.8569	-57.8793	-48.5040	-32.9363	-25.8442	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)	-16.5062	-34.7657	-69.1665	-103.9718	-137.5475	-138.2026	-136.5547	-115.5725	-84.6624	-49.7241	-22.0428	-13.0478	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												2105.3902	(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												2640.4948	(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)												153.6248	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1566.8519	(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												3418.6578	(238)

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

Energy	Emission factor	Emissions
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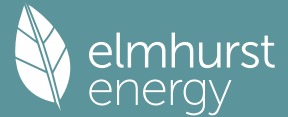


	kWh/year	kg CO2/kWh	kg CO2/year
Space heating - main system 1	2105.3902	0.2100	442.1319 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2640.4948	0.2100	554.5039 (264)
Space and water heating			996.6359 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	153.6248	0.1443	22.1728 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-645.0872	0.1345	-86.7653
PV Unit electricity exported	-921.7647	0.1259	-116.0274
Total			-202.7927 (269)
Total CO2, kg/year			827.9452 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.0600 (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	2105.3902	1.1300	2379.0910 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2640.4948	1.1300	2983.7591 (278)
Space and water heating			5362.8501 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	153.6248	1.5338	235.6348 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-645.0872	1.4971	-965.7540
PV Unit electricity exported	-921.7647	0.4620	-425.8997
Total			-1391.6537 (283)
Total Primary energy kWh/year			4336.9319 (286)
Target Primary Energy Rate (TPER)			68.4100 (287)

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Property Reference	Flat 1_Green				Issued on Date	25/07/2025	
Assessment Reference	00001			Prop Type Ref			
Property	Flat 1 , 524 Northumberland Avenue						
SAP Rating	83 B	DER	4.65	TER	13.06		
Environmental	96 A	% DER < TER				64.40	
CO ₂ Emissions (t/year)	0.27	DFEE	39.34	TFEE	39.22		
Compliance Check	See BREL	% DFEE < TFEE				-0.31	
% DPER < TPER	28.74	DPER	48.75	TPER	68.41		
Assessor Details	Mr. Oliver Eggenton				Assessor ID	AQ01-0001	
Client							

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling			
Ground floor	63.4000 (1b)	2.7000 (2b)	171.1800 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	63.4000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	171.1800 (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	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) = 0.1168 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.2668 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2668 (21)

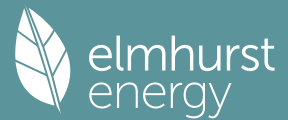
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infiltr rate	0.3402	0.3335	0.3269	0.2935	0.2868	0.2535	0.2535	0.2468	0.2668	0.2868	0.3002	0.3135 (22b)
Effective ac	0.5579	0.5556	0.5534	0.5431	0.5411	0.5321	0.5321	0.5305	0.5356	0.5411	0.5451	0.5492 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Window			17.0000	1.1450	19.4656		(27)
Door			2.1500	1.0000	2.1500		(26)
External Wall 1	83.7000	19.1500	64.5500	0.1600	10.3280		(29a)
External Roof 1	63.4000		63.4000	0.1000	6.3400		(30)
Total net area of external elements Aum(A, m ²)			147.1000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.2836		(33)
Main dwelling							
Party Floor 1			63.4000				(32d)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)							7.3550 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	45.6386 (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	31.5139	31.3870	31.2626	30.6781	30.5687	30.0597	30.0597	29.9654	30.2558	30.5687	30.7900	31.0212 (38)
	77.1526	77.0256	76.9012	76.3167	76.2074	75.6983	75.6983	75.6041	75.8944	76.2074	76.4286	76.6599 (39)
Average = Sum(39)m / 12 =												76.3162

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HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2169	1.2149	1.2130	1.2037	1.2020	1.1940	1.1940	1.1925	1.1971	1.2020	1.2055	1.2091 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	1.2037
												31

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.0760 (42)
Hot water usage for mixer showers	71.9190	70.8180	69.1953	66.6990	64.4625	61.3335	58.8587	61.7519	63.2070	66.3061	69.5336	71.8542 (42a)	
Hot water usage for baths	24.9380	24.5615	24.0260	23.2239	22.5012	21.5061	20.7513	21.6744	22.1588	23.1447	24.1697	24.9182 (42b)	
Hot water usage for other uses	35.8898	34.5848	33.2797	31.9746	30.6695	29.3644	29.3644	30.6695	31.9746	33.2797	34.5848	35.8898 (42c)	
Average daily hot water use (litres/day)												122.0543 (43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	132.7468	129.9642	126.5009	121.8976	117.6331	112.2041	108.9744	114.0958	117.3404	122.7305	128.2881	132.6622 (44)	
Energy conte	195.4263	171.9690	180.7672	159.2287	151.5822	129.7603	120.4199	134.2928	136.1090	158.1507	173.3856	194.8242 (45)	
Energy content (annual)										Total = Sum(45)m =		1905.9158	
Distribution loss (46)m = 0.15 x (45)m	29.3139	25.7953	27.1151	23.8843	22.7373	19.4640	18.0630	20.1439	20.4164	23.7226	26.0078	29.2236 (46)	
Water storage loss:													
Store volume												200.0000 (47)	
a) If manufacturer declared loss factor is known (kWh/day):												1.0000 (48)	
Temperature factor from Table 2b												0.5400 (49)	
Enter (49) or (54) in (55)												0.5400 (55)	
Total storage loss	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (56)	
If cylinder contains dedicated solar storage	16.7400	15.1200	16.7400	16.2000	16.7400	16.2000	16.7400	16.7400	16.2000	16.7400	16.2000	16.7400 (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	235.4287	208.1002	220.7696	197.9407	191.5846	168.4723	160.4223	174.2952	174.8210	198.1531	212.0976	234.8266 (62)	
WWHRS	-56.2754	-49.7222	-52.0038	-44.8170	-41.8717	-34.4177	-30.0765	-34.9673	-35.6350	-43.0693	-49.0029	-56.0399 (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	179.1533	158.3779	168.7658	153.1237	149.7129	134.0546	130.3458	139.3279	139.1861	155.0838	163.0947	178.7867 (64)	
								Total per year (kWh/year) = Sum(64)m =				1849.0131 (64)	
								1849				(64)	
12Total per year (kWh/year)													
Electric shower(s)													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)	
								Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =				0.0000 (64a)	
Heat gains from water heating, kWh/month	96.9812	86.0846	92.1070	83.9131	82.4030	74.1149	72.0415	76.6543	76.2259	84.5870	88.6203	96.7810 (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	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	91.5122	101.3171	91.5122	94.5626	91.5122	94.5626	91.5122	91.5122	94.5626	91.5122	94.5626	91.5122 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	181.4332	183.3159	178.5716	168.4714	155.7217	143.7388	135.7335	133.8508	138.5951	148.6953	161.4450	173.4279 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798 (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)												
	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382 (71)
Water heating gains (Table 5)												
	130.3510	128.1021	123.7998	116.5460	110.7567	102.9373	96.8300	103.0299	105.8692	113.6922	123.0838	130.0819 (72)
Total internal gains												
	460.4358	469.8745	451.0229	436.7193	415.1299	395.3781	378.2150	382.5322	393.1663	411.0391	436.2307	452.1614 (73)

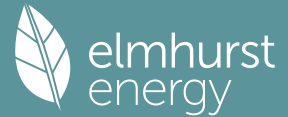
6. Solar gains

[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			7.0000	10.6334	0.7600	0.7000	0.7700				27.4419 (74)	
East			6.0000	19.6403	0.7600	0.7000	0.7700				43.4454 (76)	
West			4.0000	19.6403	0.7600	0.7000	0.7700				28.9636 (80)	
Solar gains	99.8509	194.0902	322.3862	483.3535	609.7669	633.2390	599.0685	501.9461	378.4491	230.5029	124.1386	82.4225 (83)
Total gains	560.2867	663.9647	773.4091	920.0728	1024.8969	1028.6170	977.2835	884.4783	771.6154	641.5420	560.3693	534.5839 (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	57.0658	57.1599	57.2524	57.6909	57.7736	58.1621	58.1621	58.2347	58.0119	57.7736	57.6064	57.4326
alpha	4.8044	4.8107	4.8168	4.8461	4.8516	4.8775	4.8775	4.8823	4.8675	4.8516	4.8404	4.8288
util living area												
	0.9896	0.9764	0.9403	0.8305	0.6512	0.4646	0.3396	0.3907	0.6418	0.9037	0.9781	0.9916 (86)
MIT	20.0160	20.1939	20.4495	20.7360	20.8843	20.9282	20.9351	20.9338	20.9006	20.6689	20.2904	19.9851 (87)
Th 2	19.9065	19.9081	19.9097	19.9170	19.9184	19.9248	19.9248	19.9260	19.9223	19.9184	19.9156	19.9127 (88)
util rest of house												
	0.9863	0.9692	0.9230	0.7896	0.5880	0.3894	0.2573	0.3008	0.5558	0.8683	0.9702	0.9889 (89)

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MIT 2	18.7765	19.0013	19.3166	19.6508	19.7984	19.8392	19.8429	19.8438	19.8197	19.5898	19.1315	18.7423 (90)
Living area fraction									FLA = Living area / (4) =			0.3155 (91)
MIT	19.1675	19.3775	19.6740	19.9931	20.1409	20.1828	20.1875	20.1876	20.1607	19.9302	19.4971	19.1344 (92)
Temperature adjustment												0.0000
adjusted MIT	19.1675	19.3775	19.6740	19.9931	20.1409	20.1828	20.1875	20.1876	20.1607	19.9302	19.4971	19.1344 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9834	0.9649	0.9186	0.7927	0.6015	0.4077	0.2775	0.3229	0.5757	0.8688	0.9663	0.9864	(94)
Useful gains	550.9731	640.6429	710.4677	729.3528	616.5107	419.3382	271.1848	285.5715	444.2400	557.3501	541.4747	527.2917	(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	1147.0651	1115.1418	1013.0970	846.5918	643.2617	422.6059	271.5651	286.3591	459.9731	711.0285	947.4902	1144.8681	(97)
Space heating kWh	443.4924	318.8632	225.1562	84.4121	19.9028	0.0000	0.0000	0.0000	0.0000	114.3367	292.3312	459.4769	(98a)
Space heating requirement - total per year (kWh/year)												1957.9715	
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	443.4924	318.8632	225.1562	84.4121	19.9028	0.0000	0.0000	0.0000	0.0000	114.3367	292.3312	459.4769	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1957.9715	
Space heating per m2											(98c) / (4) =	30.8828	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													249.9000 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	443.4924	318.8632	225.1562	84.4121	19.9028	0.0000	0.0000	0.0000	0.0000	114.3367	292.3312	459.4769	(98)
Space heating efficiency (main heating system 1)	249.9000	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000	(210)
Space heating fuel (main heating system)	177.4680	127.5963	90.0985	33.7784	7.9643	0.0000	0.0000	0.0000	0.0000	45.7530	116.9793	183.8643	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	179.1533	158.3779	168.7658	153.1237	149.7129	134.0546	130.3458	139.3279	139.1861	155.0838	163.0947	178.7867	(64)
Efficiency of water heater	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(216)
Fuel for water heating, kWh/month	102.3149	90.4500	96.3825	87.4493	85.5014	76.5589	74.4408	79.5705	79.4895	88.5687	93.1437	102.1055	(217)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(219)
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	19.9864	16.0339	14.4367	10.5770	8.1699	6.6749	7.4529	9.6876	12.5832	16.5098	18.6478	20.5419	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1													783.5020 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													175.1000
Water heating fuel used													1055.9755 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year													0.0000 (231)
Electricity for lighting (calculated in Appendix L)													161.3020 (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													2000.7795 (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	783.5020	0.1568	122.8655 (261)	
Total CO2 associated with community systems			0.0000 (373)	

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Water heating (other fuel)	1055.9755	0.1406	148.5001 (264)
Space and water heating			271.3656 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	161.3020	0.1443	23.2809 (268)
Total CO ₂ , kg/year			294.6465 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.6500 (273)

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

	Energy kWh/year	Primary energy factor kg CO ₂ /kWh	Primary energy kWh/year
Space heating - main system 1	783.5020	1.5805	1238.3474 (275)
Total CO ₂ associated with community systems			0.0000 (473)
Water heating (other fuel)	1055.9755	1.5200	1605.0595 (278)
Space and water heating			2843.4069 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	161.3020	1.5338	247.4104 (282)
Total Primary energy kWh/year			3090.8173 (286)
Dwelling Primary energy Rate (DPER)			48.7500 (287)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling	63.4000 (1b)	x 2.7000 (2b)	= 171.1800 (1b) - (3b)
Ground floor			(4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	63.4000		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 171.1800 (5)
Dwelling volume			

2. Ventilation rate

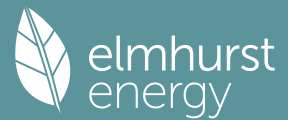
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	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) =	Air changes per hour 20.0000 / (5) = 0.1168 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3668 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3668 (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	0.4677	0.4585	0.4494	0.4035	0.3943	0.3485	0.3485	0.3393	0.3668	0.3943	0.4127	0.4310 (22b)
Effective ac	0.6094	0.6051	0.6010	0.5814	0.5778	0.5607	0.5607	0.5576	0.5673	0.5778	0.5852	0.5929 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
Main dwelling												
TER Opaque door			2.1500	1.0000	2.1500		(26)					
TER Opening Type			13.6900	1.1450	15.6756		(27)					
External Wall 1	83.7000	15.8400	67.8600	0.1800	12.2148		(29a)					
External Roof 1	63.4000		63.4000	0.1100	6.9740		(30)					
Total net area of external elements Aum(A, m2)			147.1000				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.0144		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
List of Thermal Bridges												
K1 Element				Length	Psi-value	Total						
E7 Party floor between dwellings (in blocks of flats)				31.0000	0.0700	2.1700						
E16 Corner (normal)				5.4000	0.0900	0.4860						
E18 Party wall between dwellings				5.4000	0.0600	0.3240						
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							2.9800 (36)					
Point Thermal bridges						(36a) =	0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	39.9944 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	34.4235	34.1835	33.9484	32.8437	32.6371	31.6750	31.6750	31.4968	32.0456	32.6371	33.0552	33.4923 (38)
Heat transfer coeff												

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Average = Sum(39)m / 12 =	74.4178	74.1779	73.9427	72.8381	72.6314	71.6693	71.6693	71.4912	72.0399	72.6314	73.0495	73.4866 (39)
												72.8371
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1738	1.1700	1.1663	1.1489	1.1456	1.1304	1.1304	1.1276	1.1363	1.1456	1.1522	1.1591 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	1.1489
												31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.0760 (42)
Hot water usage for mixer showers												
59.0265	58.1395	56.8469	54.3737	52.5485	50.5132	49.3562	50.6391	52.0453	54.2307	56.7570	58.8004 (42a)	
Hot water usage for baths												
25.5066	25.1278	24.5943	23.6107	22.8743	22.0576	21.6165	22.1462	22.7230	23.5968	24.6006	25.4203 (42b)	
Hot water usage for other uses												
35.8898	34.5848	33.2797	31.9746	30.6695	29.3644	29.3644	30.6695	31.9746	33.2797	34.5848	35.8898 (42c)	
Average daily hot water use (litres/day)												110.6962 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												
120.4229	117.8520	114.7209	109.9590	106.0923	101.9352	100.3372	103.4548	106.7428	111.1072	115.9424	120.1106 (44)	
Energy content	190.7205	167.8197	176.3217	150.5284	142.8206	125.3412	121.3491	128.0986	131.6246	150.7714	165.1812	188.0641 (45)
Energy content (annual)										Total = Sum(45)m =		1838.6411
Distribution loss (46)m = 0.15 x (45)m												
28.6081	25.1729	26.4483	22.5793	21.4231	18.8012	18.2024	19.2148	19.7437	22.6157	24.7772	28.2096 (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	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	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												
241.6466	213.8174	227.2477	199.8117	193.7467	174.6245	172.2752	179.0247	180.9079	201.6974	214.4645	238.9902 (62)	
WWHRS	-26.9845	-23.8653	-24.9903	-20.6930	-19.2851	-16.5024	-15.4684	-16.4491	-17.0740	-20.1284	-22.8030	-26.4848 (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												
214.6621	189.9521	202.2574	179.1187	174.4616	158.1221	156.8068	162.5756	163.8339	181.5690	191.6614	212.5054 (64)	
									Total per year (kWh/year) = Sum(64)m =			2187.5261 (64)
												2188 (64)
12Total per year (kWh/year)												
Electric shower(s)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
												0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												
Heat gains from water heating, kWh/month												
104.1554	92.5982	99.3678	89.4773	88.2287	81.1026	81.0894	83.3337	83.1918	90.8723	94.3494	103.2722 (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	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977	103.7977 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	91.6120	101.4276	91.6120	94.6658	91.6120	94.6658	91.6120	91.6120	94.6658	91.6120	94.6658	91.6120 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	181.4332	183.3159	178.5716	168.4714	155.7217	143.7388	135.7335	133.8508	138.5951	148.6953	161.4450	173.4279 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798	33.3798 (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)												
	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382	-83.0382 (71)
Water heating gains (Table 5)												
	139.9938	137.7950	133.5589	124.2741	118.5870	112.6425	108.9912	112.0076	115.5442	122.1402	131.0408	138.8067 (72)
Total internal gains												
	470.1784	479.6779	460.8818	444.5505	423.0600	405.1864	390.4760	391.6097	402.9444	419.5869	444.2909	460.9859 (73)

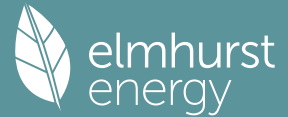
6. Solar gains

[Jan]												
			Area	Solar flux	g	FF		Access				Gains
			m2	Table 6a	Specific data	Specific data		factor				W
				W/m2	or Table 6b	or Table 6c		Table 6d				
North			5.6400	10.6334	0.6300	0.7000		0.7700				18.3283 (74)
East			4.8300	19.6403	0.6300	0.7000		0.7700				28.9912 (76)
West			3.2200	19.6403	0.6300	0.7000		0.7700				19.3275 (80)
Solar gains	66.6470	129.5479	215.1819	322.6278	407.0132	422.6842	399.8741	335.0405	252.6035	153.8521	82.8581	55.0143 (83)
Total gains	536.8254	609.2258	676.0637	767.1783	830.0733	827.8706	790.3501	726.6502	655.5480	573.4391	527.1490	516.0003 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	59.1629	59.3543	59.5431	60.4461	60.6181	61.4318	61.4318	61.5849	61.1158	60.6181	60.2711	59.9126
alpha	4.9442	4.9570	4.9695	5.0297	5.0412	5.0955	5.0955	5.1057	5.0744	5.0412	5.0181	4.9942
util living area												
	0.9910	0.9823	0.9601	0.8863	0.7384	0.5415	0.3968	0.4482	0.7030	0.9259	0.9817	0.9925 (86)
MIT	19.8034	19.9962	20.2868	20.6594	20.8942	20.9824	20.9970	20.9946	20.9385	20.6203	20.1585	19.7805 (87)
Th 2	19.9410	19.9441	19.9471	19.9611	19.9638	19.9761	19.9761	19.9783	19.9713	19.9638	19.9584	19.9529 (88)

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util rest of house												
MIT 2	0.9881	0.9768	0.9477	0.8539	0.6776	0.4603	0.3056	0.3509	0.6186	0.8968	0.9751	0.9901 (89)
Living area fraction	18.5725	18.8181	19.1822	19.6343	19.8818	19.9669	19.9752	19.9766	19.9333	19.6037	19.0361	18.5520 (90)
MIT	18.9608	19.1897	19.5306	19.9577	20.2012	20.2872	20.2975	20.2977	20.2504	19.9244	19.3901	18.9396 (92)
Temperature adjustment												0.0000
adjusted MIT	18.9608	19.1897	19.5306	19.9577	20.2012	20.2872	20.2975	20.2977	20.2504	19.9244	19.3901	18.9396 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9845	0.9716	0.9417	0.8538	0.6924	0.4855	0.3344	0.3817	0.6428	0.8955	0.9703	0.9869	(94)
Useful gains	528.5211	591.9472	636.6318	654.9882	574.7194	401.9292	264.3257	277.3624	421.3953	513.5147	511.4699	509.2635	(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	1091.0231	1059.9827	963.5194	805.4207	617.4534	407.5994	264.9991	278.6536	443.0770	677.2428	897.7895	1083.1615	(97)
Space heating kWh	418.5015	314.5199	243.2044	108.3114	31.7941	0.0000	0.0000	0.0000	0.0000	121.8136	278.1501	426.9801	(98a)
Space heating requirement - total per year (kWh/year)												1943.2752	
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	418.5015	314.5199	243.2044	108.3114	31.7941	0.0000	0.0000	0.0000	0.0000	121.8136	278.1501	426.9801	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1943.2752	
Space heating per m2										(98c) / (4) =		30.6510	(99)

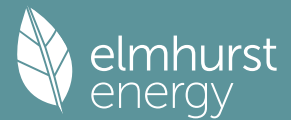
9a. Energy requirements - Individual heating systems, including micro-CHP

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)
Space heating requirement	418.5015	314.5199	243.2044	108.3114	31.7941	0.0000	0.0000	0.0000	0.0000	121.8136	278.1501	426.9801	(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)	453.4144	340.7583	263.4934	117.3471	34.4465	0.0000	0.0000	0.0000	0.0000	131.9758	301.3544	462.6003	(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	214.6621	189.9521	202.2574	179.1187	174.4616	158.1221	156.8068	162.5756	163.8339	181.5690	191.6614	212.5054	(64)
Efficiency of water heater	85.5296	85.1826	84.4743	82.9687	81.0665	79.8000	79.8000	79.8000	79.8000	83.1852	84.8940	79.8000	(216)
Fuel for water heating, kWh/month	250.9798	222.9941	239.4307	215.8870	215.2079	198.1480	196.4997	203.7289	205.3056	218.2709	225.7655	248.2767	(219)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	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	19.0352	15.2707	13.7496	10.0735	7.7811	6.3572	7.0982	9.2265	11.9843	15.7240	17.7602	19.5642	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	-29.9088	-42.2984	-61.0061	-68.8576	-74.5047	-69.6648	-68.8260	-64.8569	-57.8793	-48.5040	-32.9363	-25.8442	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)	-16.5062	-34.7657	-69.1665	-103.9718	-137.5475	-138.2026	-136.5547	-115.5725	-84.6624	-49.7241	-22.0428	-13.0478	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												2105.3902	(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												2640.4948	(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)												153.6248	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1566.8519	(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												3418.6578	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
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Full SAP Calculation Printout



Space heating - main system 1	2105.3902	0.2100	442.1319 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2640.4948	0.2100	554.5039 (264)
Space and water heating			996.6359 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	153.6248	0.1443	22.1728 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-645.0872	0.1345	-86.7653
PV Unit electricity exported	-921.7647	0.1259	-116.0274
Total			-202.7927 (269)
Total CO2, kg/year			827.9452 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.0600 (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	2105.3902	1.1300	2379.0910 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2640.4948	1.1300	2983.7591 (278)
Space and water heating			5362.8501 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	153.6248	1.5338	235.6348 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-645.0872	1.4971	-965.7540
PV Unit electricity exported	-921.7647	0.4620	-425.8997
Total			-1391.6537 (283)
Total Primary energy kWh/year			4336.9319 (286)
Target Primary Energy Rate (TPER)			68.4100 (287)

Appendix: C – BRUKL Worksheet

Project name

Building 1

As designed

Date: Mon Jul 14 21:53:37 2025

Administrative information

Building Details

Address: Land adjacent to 524 Northumberland Avenue,

Certifier details

Name: Daniel Montlake

Telephone number:

Address: , ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v6.1.e.2

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v7.3.1

BRUKL compliance module version: v6.1.e.1

Foundation area [m²]: 25.52The CO₂ emission and primary energy rates of the building must not exceed the targets

Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	5.05
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	3.85
Target primary energy rate (TPER), kWh _{PE} /m ² annum	54.01
Building primary energy rate (BPER), kWh _{PE} /m ² annum	41.43
Do the building's emission and primary energy rates exceed the targets?	BER ≤ TER BPER ≤ TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	U _{a-Limit}	U _{a-Calc}	U _{i-Calc}	First surface with maximum value
Walls*	0.26	0.16	0.16	Block 1 - store_W_6
Floors	0.18	0.12	0.12	Block 1 - store_S_3
Pitched roofs	0.16	-	-	No heat loss pitched roofs
Flat roofs	0.18	-	-	No heat loss flat roofs
Windows** and roof windows	1.6	1.4	1.4	Block 1 - retail_G_6
Rooflights***	2.2	-	-	No external rooflights
Personnel doors^	1.6	1.4	1.4	Block 1 - retail_D_8
Vehicle access & similar large doors	1.3	-	-	No external vehicle access doors
High usage entrance doors	3	-	-	No external high usage entrance doors

U_{a-Limit} = Limiting area-weighted average U-values [W/(m²K)]U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

** Display windows and similar glazing are excluded from the U-value check.

*** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m²K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
m ³ /(h.m ²) at 50 Pa	8	5

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- AC

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	6.5	-	-	-
Standard value	2.5*	5	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

1- Ins

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	1	N/A

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

"LENI calculation for lighting energy provided in a separate submission."

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Block 1 - store	N/A	N/A
Block 1 - retail	YES (+85.2%)	NO
Block 1 - circ	N/A	N/A
Block 1 - wc	N/A	N/A

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m ²]	51	51
External area [m ²]	135.9	135.9
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	5	3
Average conductance [W/K]	46.86	52.67
Average U-value [W/m ² K]	0.34	0.39
Alpha value* [%]	13.05	23.81

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
100	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger Terminals
	Others: Emergency Services
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	8.17	14.64
Cooling	17.46	6.61
Auxiliary	0	0
Lighting	21.21	13.73
Hot water	1.27	1.27
Equipment*	17.41	17.41
TOTAL **	48.11	36.24

* Energy used by equipment does not count towards the total for consumption or calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	20.99	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>20.99</i>	<i>0</i>

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	399.66	243.77
Primary energy [kWh _{PE} /m ²]	41.43	54.01
Total emissions [kg/m ²]	3.85	5.05

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity									
Actual	109.6	290.1	8.2	17.5	0	3.73	4.62	4	6.5
Notional	139.1	104.7	14.6	6.6	0	2.64	4.4	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type