Integration

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10 Lyndhurst Road
Energy & Sustainability Statement

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—	23.01.2024	Issue	Ronan McDaid	Alan Harries

Contents

Executive Summary

This Energy Assessment and Sustainability Statement has been prepared by Integration Consultancy Limited in support of the full planning application for the proposed 10 Lyndhurst Road new build development in Camden Council, London which comprises a 3-bedroom house with a garden studio.

The local planning authority is the Camden Council.

The London Plan has a zero-carbon target with a minimum onsite contribution of 35% below Part L for a major scheme. As a minor scheme this does not apply, and must instead comply with the local policy target of 19% below Part L. In relation to these targets, this development has been shown to have:

– 67.1% total onsite improvement in carbon dioxide (CO2) emissions over the Target Emission Rate (TER) outlined in the national Building Regulations Part L 2021, compared to the target of 19%

The proposed design achieves this via the following strategies:

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

Following a Low and Zero Carbon (LZC) Technology feasibility study it is proposed to provide space heating and hot water via air source heat pumps.

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

Carbon dioxide emissions (Tonnes CO_2 per annum)	**Regulated**	**Unregulated**
Baseline: Part L 2021 (Building Regulations) Compliance	8.4	3.1
After “Be Lean” (energy demand reduction)	7.9	3.1
After “Be Clean” (heat network / CHP)	7.9	3.1
After “Be Green” (renewable energy)	2.8	3.1

Table 1: Summary of new build carbon emissions

This performance can be expressed as savings between each stage in the energy hierarchy.

Regulated carbon dioxide savings	**(Tonnes CO_2 per annum)**	**(%)**
Savings from “Be Lean” (energy demand reduction)	0.5	5.8
Savings from "Be Clean" (heat network / CHP)	0.0	0.0%
Savings from "Be Green" (renewable energy)	5.2	61.3%
Total cumulative on-site savings	5.7	67.1%

Table 2: Regulated CO2 emissions savings for the whole development

In addition to the low energy performance set out above, the scheme benefits from several sustainability aspects. These include the use of water saving devices to achieve 105 litre per person per day in residential areas. Health and wellbeing is supported by aspects such as high levels of fresh air provided by mechanical ventilation with heat recovery. In terms of sustainable travel, the development is an 11 minute walk from Hampstead and Belsize Park stations.

1 Introduction

Integration Consultancy Limited has been appointed to undertake an Energy and Sustainability Assessment in support of the full planning application for the proposed 10 Lyndhurst Road development within the Camden Council planning authority. The report is one of several that accompany the planning application and should be read in conjunction with these documents.

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

Underpinning the energy strategy is the 'Be Lean', 'Be Clean', and 'Be Green' design framework which has been adopted by the London Plan.

- 'Be Lean' (energy demand minimisation through 'passive' and 'active' design measures)
- 'Be Clean' (efficient energy supply)
- 'Be Green' (renewable energy generation)

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

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

1.1 THE DEVELOPMENT SITE

The site is located at 10 Lyndhurst Road, NW3 5PX.

Figure 1: Site Location

Figure 2: Aerial view of site.

1.2 PROPOSED DEVELOPMENT OVERVIEW

The proposed development comprises a 3 story 3-bedroom property, with a single-story garden studio.

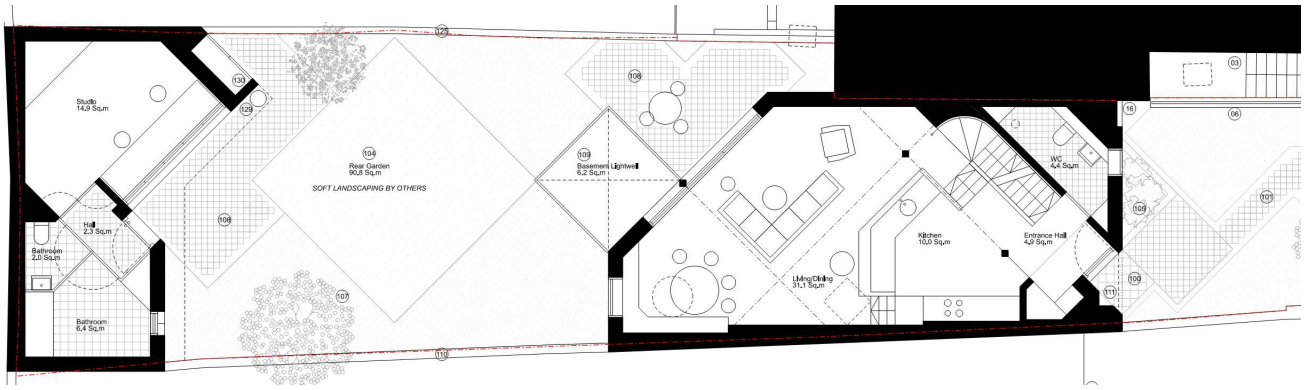

Figure 3: Proposed development scheme site in plan

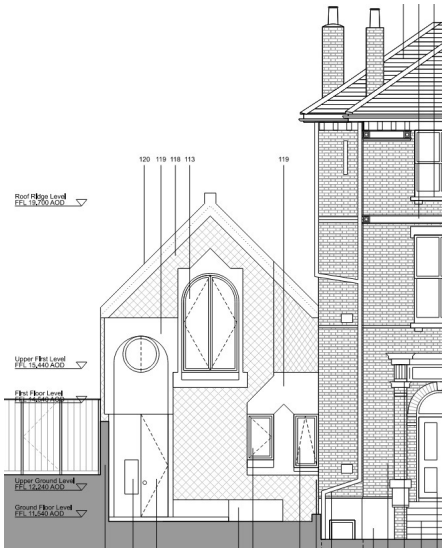

Figure 4: Proposed development scheme elevation

The proposed accommodation is summarised below.

Ref	Type	Area (m²)
Basement	Residential	62
Ground	Residential	96
1st Floor	Residential	49

Table 3: Accommodation Summary

1.3 ENERGY AND SUSTAINABILITY ASPIRATIONS

The scheme has adopted energy and sustainability targets in line with the national and local policy as detailed in section 2. These include:

Low Water Use: The development aims to meet the London Plan target of achieving at least 105l/p/day

Zero Fossil Fuels on site: In order to achieve zero carbon on-site by 2050 the scheme aims not to use any fossil fuels on site.

2 Policy Review

2.1 NATIONAL PLANNING POLICY FRAMEWORK (NPPF – SEPTEMBER 2023)

Sustainable Development

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

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

b. *a social objective – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering well-designed, beautiful and safe places, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and*

c. *an environmental objective – to protect and enhance our natural, built and historic environment; including making effective use of land, improving biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.*

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

Meeting the Challenge of Climate Change

Section 14 of the NPPF relates to the challenge of climate change. Paragraph 152 states:

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

The importance of renewable energy is also highlighted by paragraph 155 and 156.

National Carbon Targets

The UK government declared a Climate Emergency and amended the Climate Change Act in June 2019 to set a legally-binding carbon emission target for the UK of "at least 100% of 1990 levels by 2050" i.e. net zero carbon emissions[1]. Around 20% of the UK's emissions come directly from residential energy use and government has set out a consultation process leading up to the Future Homes Standard which will define how the housing sector will respond to the emergency. This will replace Building Regulations in 2025.

2.2 LONDON PLAN 2021

Regional policy in London is controlled by The Greater London Authority and is set out in The London Plan adopted on 2nd March 2021 which provides policy and guidance in the London context. One of the key overarching goals for London is to become a zero-carbon city by 2030.

The plan states that all 'major' developments (greater than 1,000m^2 or 10 units or more) must achieve net zero carbon (100% below Part L) with a minimum on site contribution of 35% below Part L. The remaining regulated carbon dioxide emissions to 100% can be off-set using a cash-in-lieu contribution to the local borough, to secure carbon dioxide savings elsewhere.

Chapter 9 (Sustainable Infrastructure) of the London Plan sets out a range of policies in relation to sustainability, including air quality improvement, reducing greenhouse gas emissions, managing infrastructures, minimising waste and protecting waterways. Some of the key aspects to note are summarised below:

- Zero carbon residential and commercial. 100% below part L for 'major' development (>1000m^2 or 10 units +) with minimum onsite contribution of 35% below Part L.
- Energy efficiency ('Be lean') of residential areas to achieve 10% below Part L and commercial to achieve 15% below Part L

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

- Overheating studies TM59 (residential and TM52 (commercial) compulsory for 'major' schemes
- Carbon tax increased to £95/tCO2 (from £60tCO2)
- Energy cost considerations.
- Future strategy. Details of how the scheme will achieve zero-carbon on-site emissions onsite by 2050.
- Demand-Side Response proposals for carbon reduction via demand side response.
- Communal low-temperature heating. 'Major' schemes within Heat Network Priority Areas should have low temperature central systems.
- Lifecycle Carbon Assessment. LCA required for "referable" schemes (150 residential units or more / over 30 metres tall)

The details of the main London Plan policy requirement are given below:

POLICY SI 2 – MINIMISING GREENHOUSE GAS EMISSIONS

a. Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

- *Be lean: use less energy and manage demand during operation*
- *Be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly*
- *Be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site*
- *Be seen: monitor, verify and report on energy performance.*

b. Mayor development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.

c. A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:

- *through a cash in lieu contribution to the borough's carbon offset fund, or*
- *off-site provided that an alternative proposal is identified and delivery is certain.*

d. Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.

e. Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.

f. Development proposals referable to the Mayor should calculate whole lifecycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.

Other key policies within the London Plan applicable to the proposed development and addressed in this report are:

POLICY SI 4 – MANAGING HEAT RISK

a. Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.

b. Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:

c. Reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure

d. Minimise internal heat generation through energy efficient design

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

f. Provide passive ventilation

g. Provide mechanical ventilation

h. Provide active cooling systems.

The Chartered Institution of Building Services Engineers (CIBSE) has produced guidance on assessing and mitigating overheating risk in new developments, which can also be applied to refurbishment projects. TM 59 should be used for domestic

developments and TM 52 should be used for non-domestic developments. In addition, TM 49 guidance and datasets should also be used to ensure that all new development is designed for the climate it will experience over its design life.

POLICY SI 5 – WATER INFRASTRUCTURE

a. *In order to minimise the use of mains water, water supplies and resources should be protected and conserved in a sustainable manner.*

b. Development Plans should promote improvements to water supply infrastructure to contribute to security of supply. This should be done in a timely, efficient and sustainable manner taking energy consumption into account.

c. Development proposals should:

- *through the use of Planning Conditions minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving mains water consumption of 105 litres or less per head per day (excluding allowance of up to five litres for external water consumption)*
- *achieve at least the BREEAM excellent standard for the 'Wat 01' water category 160 or equivalent (commercial development)*
- *incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise future-proofing.*

2.3 THE LONDON BOROUGH OF CAMDEN

Applicable local borough policy for the proposed development comes from the Camden Local Plan 2017 supported by the Energy efficiency and adaptation CPG 2021.

Policy CC1 Climate change mitigation

The Council will require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

We will: a. promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;

b. require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;

c. ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;

d. support and encourage sensitive energy efficiency improvements to existing buildings;

e. require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building;

f. expect all developments to optimise resource efficiency.

For decentralised energy networks, we will promote decentralised energy by:

g. working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;

h. protecting existing decentralised energy networks (e.g. at Gower Street, Bloomsbury, King's Cross, Gospel Oak and Somers Town) and safeguarding potential network routes; and

i. requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.

To ensure that the Council can monitor the effectiveness of renewable and low carbon technologies, major developments will be required to install appropriate monitoring equipment

Policy CC2 Adapting to climate change

The Council will require development to be resilient to climate change.

All development should adopt appropriate climate change adaptation measures such as:

a. the protection of existing green spaces and promoting new appropriate green infrastructure;

b. not increasing, and wherever possible reducing, surface water run-off through increasing permeable surfaces and use of Sustainable Drainage Systems;

c. incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and

d. measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.

Sustainable design and construction measures The Council will promote and measure sustainable design and construction by:

e. ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;

f. encourage new build residential development to use the Home Quality Mark and Passivhaus design standards;

g. encouraging conversions and extensions of 500 sqm of residential floorspace or above or five or more dwellings to achieve "excellent" in BREEAM domestic refurbishment;

and h. expecting non-domestic developments of 500 sqm of floorspace or above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019.

2.4 CAMDEN PLANNING GUIDE

ENERGY EFFICIENCY AND ADAPTION – ENERGY REDUCTION

a. *All development in Camden is expected to reduce carbon dioxide emissions through the application of the energy hierarchy.*

b. *All new build residential development (of 1 – 9 dwellings) must meet 19% carbon dioxide reduction*

3 Design Approach - Sustainability

3.1 WATER USE

For accommodation areas the development adopts equipment specification in line with the higher water use standard of 105 l/person/day.

Fitting	Water Consumption
WC	4 / 2.6 litres dual flush
Shower	8 litres / minute
Washbasin	5 litres / minute
Kitchen sink	6 litres / minute
Dishwasher	1.25 litres/place setting
Washing machine	8.17 litres/kg

Table 4: Minimum water fitting standards for units.

3.2 AIR QUALITY

Air quality is a priority for London and Policy SI 1 "Improving Air" states that developments proposals must be at least Air Quality Neutral.

The scheme supports air quality by:

- The use of air-source heat pumps and direct electric for all space heating and hot water use which means no fossil fuel combustion on site.
- Mechanical ventilation with heat recovery (MVHR) offers a means for occupants to filter fresh air.
- Construction environmental management plan (CEMP) to incorporate best practice for air quality and dust control.

3.3 NOISE

Quality of life is improved by reducing the number of people adversely affected by noise and promoting more quiet and tranquil spaces. The scheme supports low noise impacts:

- High air tightness and MVHR reduces external noise ingress for occupants.
- Ensuring noise emissions from air source heat pump system are mitigated by a means of a suitably designed acoustic enclosure

3.4 SUSTAINABLE MATERIALS & MINIMISING WASTE

New materials will be sustainably procured and using local supplies where feasible, following the BRE Green Guide to Specification[2]. The construction build-up for each element can be rated from A+ to E where A+ is least likely to affect the environment and E is the likely to have the most impact.

The materials for the new extension will aim to achieve a rating between A to C.

All timber used during the site preparation and construction will be Forest Stewardship Council (FSC) certified or Programme for the Endorsement of Forestry Certification (PEFC) and all nontimber materials to be sourced from organisations with an environmental management system such as ISO 14001 or BES 6001. This standard enables construction product manufacturers to ensure and then prove that their products have been made with constituent materials that have been responsibly sourced. The standard describes a framework for the organisational governance, supply chain management and environmental and social aspects that must be addressed in order to ensure the responsible sourcing of construction products.

A construction waste recycling requirement will be included in the contractor specification to ensure a construction waste management plan is in place. This will include ways to design out waste, reduce amounts of packaging and to participate in packaging take back schemes as well as ensuring that all waste is sent to private local dedicated construction waste plants with high landfill diversion rates.

The scheme has dedicated waste storage and segregation area.

3.5 SUSTAINABLE TRANSPORT

The site has links to low energy public transportation e.g. 11 minute walk to Hampstead and Belsize Park stations, providing connection to London Overground and London Underground services. The site is near to a number of bus stops, the closest is located on Rosslyn Hill approximately 300m east, offering services on Routes 1, 268, C11 and N5.

2 https://www.bregroup.com/greenguide/podpage.jsp?id=2126

4 Design Approach - Energy

4.1 CLIMATE ANALYSIS

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

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

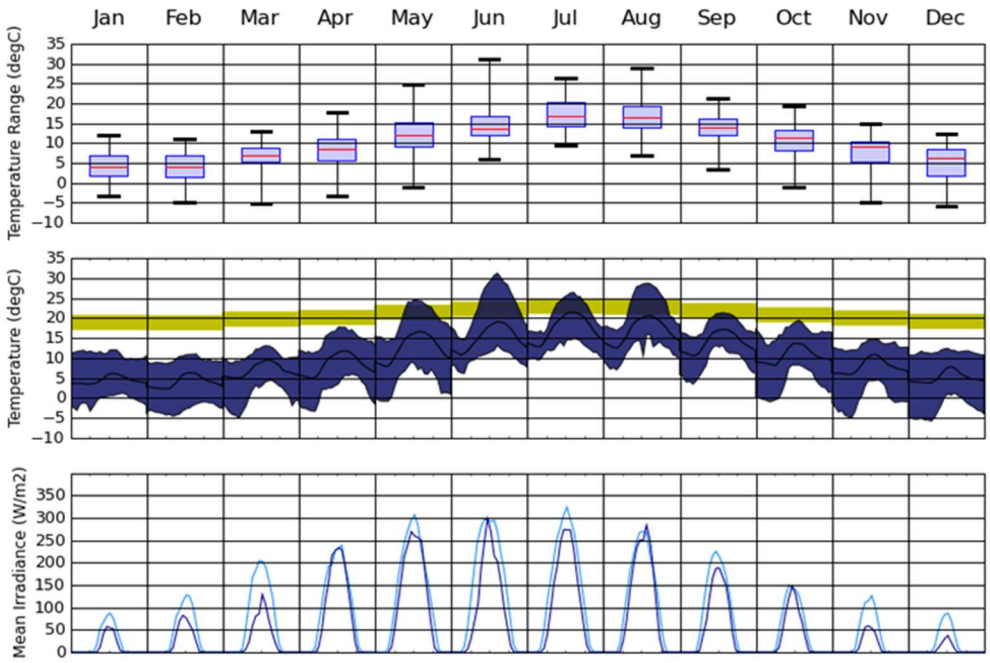

Figure 5: Average historic climate data for London

4.2 BUILDING FABRIC PERFORMANCE & INSULATION

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

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

4.3 AIR TIGHTNESS, INFILTRATION AND THERMAL BRIDGING

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

Minimising thermal bridging is an important aspect of the design, see table below for proposed Psi values.

Thermal Bridge	Thermal Transmittance (Ψ)
E2 Lintels	0.3
E3 Sill	0.04
E4 Jamb	0.05
E5 Ground floor	0.16
E22 Basement	0.22
E13 Gable	0.04
E15 Flat roof with parapet	0.3
E16 Corner	0.09
E17 Corner (inverted)	-0.09
E18 Party wall between dwellings	0.06
P1 Party wall – ground floor	0.12
P2 Party wall – intermediate floor within a dwelling	0
P4 Party wall - roof	0.20
R1 Head of roof window	0.08
R2 Sill of roof window	0.06
R3 Jamb of roof window	0.08
R4 Ridge	0.08
R5 Ridge (inverted)	0.04

Table 5: Proposed Psi Values

4.4 NATURAL VENTILATION & THERMAL MASS

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

The summer ventilation strategy includes large openable areas for windows/doors to allow for good natural ventilation. Secure openable windows allow for night ventilation to pre-cool thermal mass.

4.5 SOLAR EXPOSURE & DAYLIGHT

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

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

4.6 ACTIVE BUILDING SERVICES SYSTEMS

Space heating and hot water will be provided via a central high-efficiency air-source heat pump system in conjunction with underfloor heating.

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

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

Low-energy fixed lighting, generally comprising of high-efficiency LED fittings, will be installed throughout the property.

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

5 Carbon Emissions

5.1 BASELINE

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

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

For dwellings, within Part L1 of the Building Regulations (2021), the Target Fabric Energy Efficiency (TFEE) sits alongside the TER. The TFEE is the minimum fabric energy performance requirement for a new dwelling. The Dwelling Fabric Energy Efficiency (DFEE) rate is the actual fabric energy performance of the new dwelling. The DFEE must not exceed the TFEE. It is expressed as the amount of energy demand in kWh/(m^2.year). The notional dwelling is not prescriptive, and specifications can be varied provided that the TFEE and TER rate is achieved or bettered. To prevent poor performance of individual elements, limiting fabric values set out in approved document Part L1 and limiting building services efficiencies set out in the Domestic Building Services Compliance Guide, have been followed.

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

Building Regulations 2021

Element	U Value (W/m2K)	G Value
External Walls	0.18	-
Floor	0.13	-
Roof	0.11	-
Windows	1.2	0.63 (0.4)
External opaque doors	1.0	-
External glazed doors	1.2	-
Air tightness	5.0 $m^3/m^2/h$ @50Pa	
Liner thermal transmittance	Standardised psi values SAP Appendix R	
Ventilation type	Natural with intermittent extract fans	
Air-conditioning	None	
Heating source	Mains Gas (89.5% SEDBUK 2009)	
Heating emitters and controls	Radiators. Time and temperature zone control. Weather compensation. Boiler interlock.	
Hot water storage	If cylinder, declared loss factor = 0.85 ´ (0.2 + 0.051 V2/3) kWh/day where V is the volume of the cylinder in litres. Separate time control.	
Wastewater heat recovery (WWHR)	All showers connected to WWHR, including showers over baths. Instantaneous WWHR with 36% recovery efficiency utilisation of 0.98.	
Lighting	100% low energy lighting, (80lm/W)	
Photovoltaic (PV) system	For houses: kWp = 40% of ground floor area, including unheated spaces / 6.5 For flats: kWp = 40% of dwelling floor area / (6.5 ´ number of storeys in block) System facing south-east or south-west	

Table 6: Notional Dwelling (Building) Specification (Table 4 SAP 10.2)

5.2 "BE LEAN" EMISSIONS

As part of the approach seeking to minimise energy demand, the building fabric has been specified to meet or exceed the minimum fabric parameters outlined in Part L of the Building Regulation 2021 as per table below.

Element	Proposed residential development
External walls U value	0.12 W/m²/°C
Floor U value	0.12 W/m²/°C
Roof U value	0.11 W/m²/°C
Windows U value	1 W/m²/°C 0.5 G-value
Roof light U Value	1 W//m2/°C
Doors	1 W/m²/°C 0.5 G-value
Air tightness	3 m³/m²/h @50Pa
Ventilation type	MVHR
Heating	Central gas-fired boiler (Note: "Be Green" uses an ASHP)
Hot water	Central gas-fired boiler (Note: "Be Green" uses an ASHP)
Lighting	100% low energy lighting

Table 7: Proposed residential development and baseline comparison "Notional" building – Be Lean

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

Area (m^2)	TER ($kg.CO_2/m^2/yr.$)	DER ($kg.CO_2/m^2/yr.$)
208	10.15	9.56

Table 8: Be Lean regulated emissions for dwellings

5.3 "BE CLEAN" EMISSIONS

Combined heat and power (CHP) and connection to district heat networks are not suitable at this point, due to the size of the scheme.

5.4 "BE GREEN" EMISSIONS

Air Source Heat Pumps

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

Heat pumps are most efficient when used in conjunction with low temperature heat delivery systems such as underfloor heating. As such the proposed heat pump will work well with the proposed underfloor heating system.

High efficiency Daikin EDLA08EV3 air source heat pumps have been selected. The Seasonal Coefficient of Performance (SCOP) for this unit is 3.32 at a 45°C supply temperature.

Residential Carbon Emissions

The CO_2 emissions associated with regulated energy consumption are given below.

Area (m^2)	TER ($kg.CO_2/m^2/yr.$)	DER ($kg.CO_2/m^2/yr.$)
208	10.15	3.34

Table 9: Carbon Emissions for property

6 Summary

6.1 SUSTAINABILITY SUMMARY

In addition to the low energy performance set out above, the scheme benefits from several sustainability aspects. These include the use of water saving devices to achieve 105 litre per person per day. Health and wellbeing is supported by aspects such as high levels of fresh air provided by mechanical ventilation with heat recovery.

6.2 CARBON EMISSIONS SUMMARY

The predicted total annual CO_2 emissions of the proposed development following the introduction of energy efficiency measures, passive and active design (Be Lean), low carbon supply technologies (Be Clean) and renewable energy systems (Be Green) are summarised below. The table below shows the total regulated and unregulated use.

Carbon dioxide emissions (Tonnes CO_2 per annum)	**Regulated**	**Unregulated**
Baseline: Part L 2021 (Building Regulations) Compliance	8.4	3.1
After "Be Lean" (energy demand reduction)	7.9	3.1
After "Be Clean" (heat network / CHP)	7.9	3.1
After "Be Green" (renewable energy)	2.8	3.1

Table 10: Summary of carbon emissions for development

This performance can be expressed as savings between each stage in the energy hierarchy.

Regulated carbon dioxide savings	**(Tonnes CO_2 per annum)**	**(%)**
Savings from "Be Lean" (energy demand reduction)	0.5	5.8
Savings from "Be Clean" (heat network / CHP)	0.0	0.0%
Savings from "Be Green" (renewable energy)	5.2	61.3%
Total cumulative on-site savings	5.7	67.1%

Table 91: Regulated CO2 emissions savings for the whole development

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

Appendix A: Technology Feasibility Study Summary

The overall summary of the feasibility exercise is presented below.

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

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

Appendix B: SAP Datasheets

This appendix contains the SAP datasheets.