Integration

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Kilburn High Road
Energy & Sustainability Statement

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Document status

Project no	**Project**	**Client**	**In conjunction with:**
759	238-240 Kilburn High Road, London NW6 2BS	AHK Estates Ltd 77 Baker Street, London W1U 6RF	Osel architecture Ltd, G.04 The Record Hall , 16-16A Baldwin's Gardens , London EC1N 7RJ

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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 part new-build, part refurbishment development at 238-240 Kilburn High Road in Camden, London which includes 9 residential units and 77 m^2 of Class E commercial Class E on the ground floor.

CARBON PERFORMANCE

For minor schemes (less than 1000m^2) Camden Planning Authority has a minimum overall onsite contribution requirement of 19% below Part L with a 20% reduction in carbon dioxide emissions from on-site renewable energy generation.

In relation to these targets, this development has been shown to have:

- 54 % total onsite improvement in carbon dioxide (CO_2) emissions over the Target Emission Rate (TER) outlined in the national Building Regulations 2021 - compared to the target of 19%.
- 47 % total onsite renewable energy contribution in carbon dioxide (CO_2) emissions over the 'as designed' Be Lean carbon emissions - compared to the target of 20%.

All areas, including refurbished areas, are evaluated here under SAP 10.2 as refurbished areas are combined with new build areas.

The proposed design achieves this via the following strategies:

High-Efficiency Building (Be Lean)

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

Local Renewable Energy (Be Green)

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

- 19.4 kWpeak of solar photovoltaic (PV) modules located at roof level.
- 100% space heating and hot water via individual air source heat pumps for units 1, 2, 4, and 6.

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

Carbon dioxide emissions (Tonnes CO2 per annum)	Regulated	Unregulated
Baseline: Part L 2021 (Building Regulations) Compliance	8.8	4.5
After "Be Lean" (energy demand reduction)	7.7	4.5
After "Be Clean" (heat network / CHP)	7.7	4.5
After "Be Green" (renewable energy)	4.1	4.5

Table 1: Regulated and unregulated CO_2 emissions after each stage of the energy hierarchy

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

Regulated carbon dioxide emissions (Tonnes CO2 per annum)	**(Tonnes CO_2 per annum)**	**(%)**
Savings from "Be Lean" (energy demand reduction)	1.1	13%
Savings from "Be Clean" (heat network / CHP)	0.0	0%
Savings from "Be Green" (renewable energy)	3.6	41%
Total cumulative on-site savings	4.8	54%

Table 2: CO_2 emissions savings after each stage of the energy hierarchy

SUSTAINABILITY PERFORMANCE

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 scheme has covered bicycle storage and is a 5 minutes' walk to Brondesbury station. The scheme also benefits from a 19.4 kWp solar PV array on a biosolar roof which will help to reduce cost of energy for occupants and increase biodiversity.

A residents' guide will be created to help residents reduce energy, water and waste, avoid overheating and keep air quality high as well as other aspects such as taking advantage of local transport facilities.

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 development at 238-240 Kilburn High Road. 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 No. 238-240 Kilburn High Road, NW6 2BS.

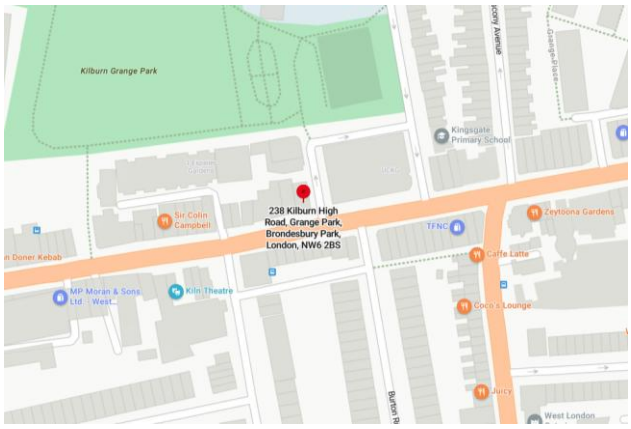

Figure 1: Site Location

Figure 2: Aerial view of site

1.2 PROPOSED DEVELOPMENT OVERVIEW

The scheme will redevelop the site at 238 Kilburn High Road and reconfigure part of 240 Kilburn High Road with an aim to convert and upgrade two existing studios and one 1 Bed unit at 240 Kilburn High Rd into 2Bed family sized units with private amenity space; provide a class E unit at ground floor level and 5 new residential dwellings above 238 Kilburn High Rd.

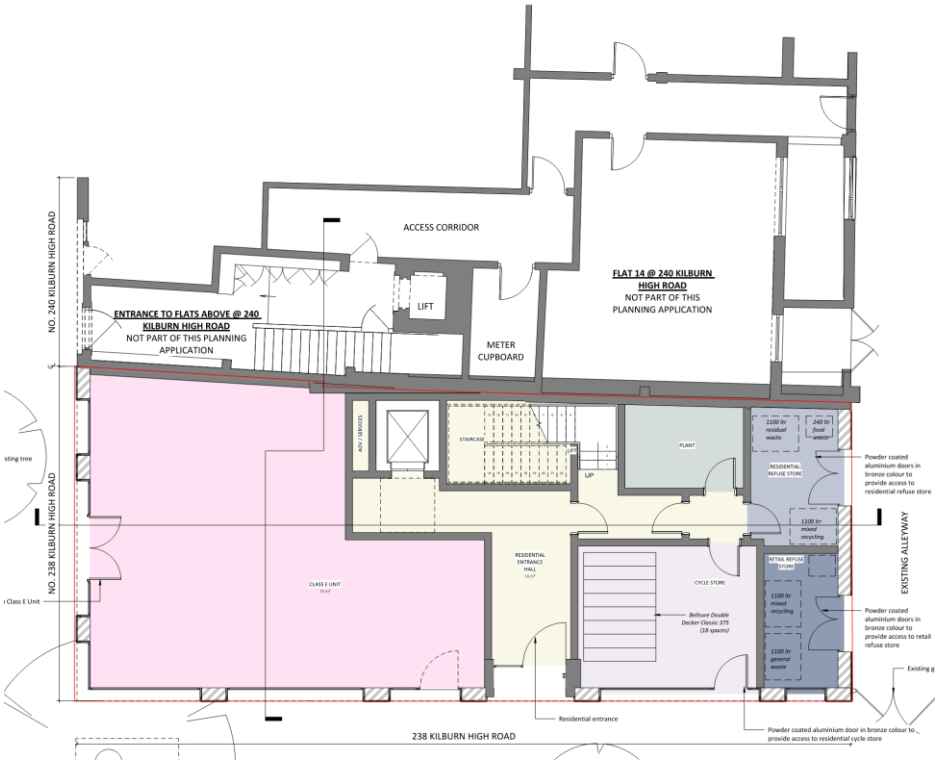

Figure 3: Proposed development scheme (ground floor plan)

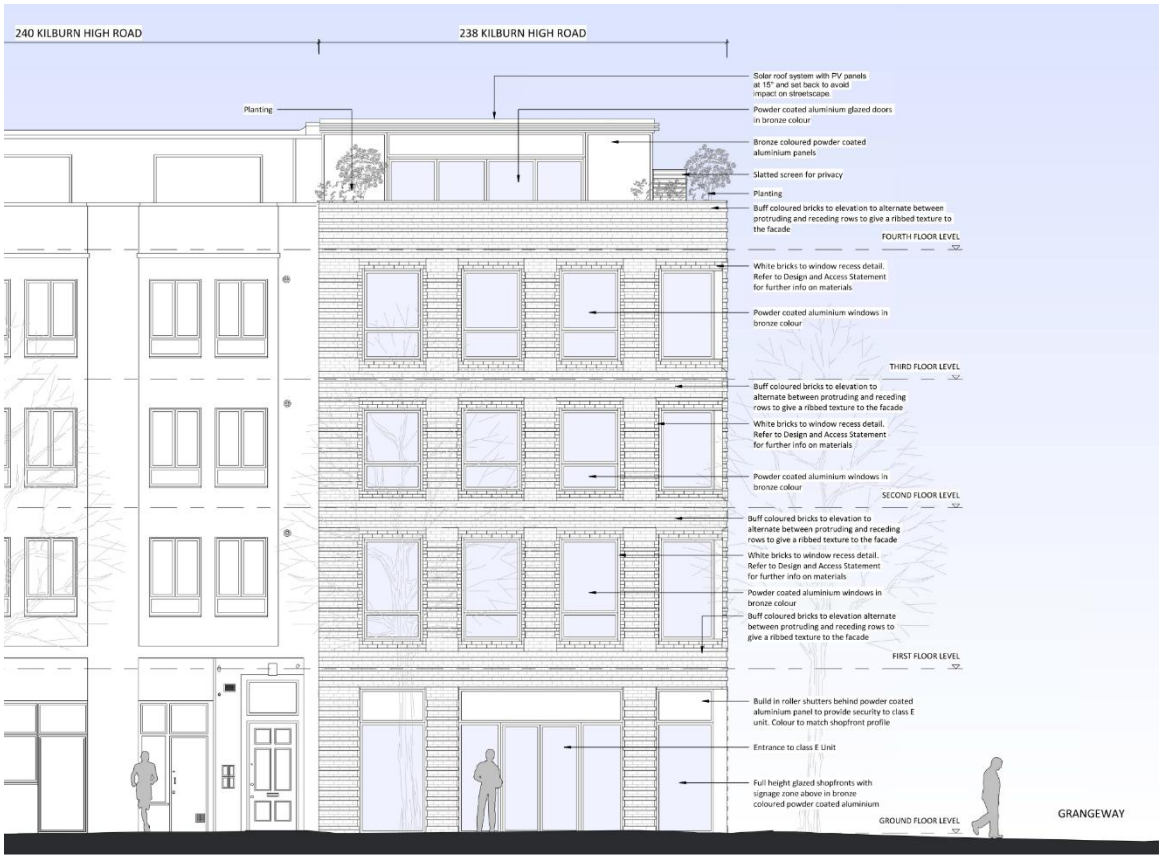

Figure 4: Proposed development scheme (south west elevation)

The proposed accommodation is summarised below.

Ref	Type	Area (m²)
Ground	Commercial unit (Class E) and bike store / bins	157
1st Floor	Residential units	132
2nd floor	Residential units	171
3rd floor	Residential units	171
4th floor	Residential units	193

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 CO_2 emissions: Achieve a minimum on-site contribution of 19% below Part L, with a 20% contribution from renewable technologies.

Low Water Use: The development aims to meeting the London Plan target of achieving 105l/p/d.

Sustainable Transport: Promoting public transport and cycle use.

2 Policy Review

2.1 NATIONAL PLANNING POLICY FRAMEWORK (NPPF – DECEMBER 2024)

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:*

b. an 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;

c. 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

d. 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 161 states:

"The planning system should support the transition to net zero by 2050 and take full account of all climate impacts including overheating, water scarcity, storm and flood risks 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."

2.1.1 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.

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

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

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. *Major 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 CAMDEN LOCAL POLICY

Policy CC1 - Climate change mitigation

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; and f. expect all developments to optimise resource efficiency.

8.6 The Council's Sustainability Plan 'Green Action for Change' commits the Council to seek low and where possible zero carbon buildings

8.11 The Council will expect developments of five or more dwellings and/or more than 500 sqm of any gross internal floorspace to achieve a 20% reduction in carbon dioxide emissions from on-site renewable energy generation (which can include sources of site related decentralised renewable energy), unless it can be demonstrated that such provision is not feasible. This is in line with stage three of the energy hierarchy 'Be green'. The 20% reduction should be calculated from the regulated CO2 emissions of the development after all proposed energy efficiency measures and any CO2 reduction from non-renewable decentralised energy (e.g. CHP) have been incorporated

8.28 Monitoring. The installation of monitoring equipment in all major developments will provide important information showing actual energy performance and will aid the Council's and developers' understanding of the effectiveness of measures implemented in the borough. Such data would also inform the Council as to whether policy requirements are being met. Monitoring shall include any renewable or low carbon technology that contributes to meeting London Plan Policy 5.2.

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 runoff 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.

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.

8.37 Sustainable drainage and biodiversity. To support a sustainable approach to drainage, all development should install green roofs, permeable landscaping, green walls and combination green and blue roofs, where appropriate. Further information on these systems can be found in our supplementary planning document Camden Planning Guidance on sustainability

8.41 Cooling. All new developments will be expected to submit a statement demonstrating how the London Plan's 'cooling hierarchy' has informed the building design. Any development that is likely to be at risk of overheating (for example due to large expanses of south or south west facing glazing) will be required to complete dynamic thermal modelling to demonstrate that any risk of overheating has been mitigated.

8.42 Active cooling (air conditioning) will only be permitted where dynamic thermal modelling demonstrates there is a clear need for it after all of the preferred measures are incorporated in line with the cooling hierarchy.

8.50 The Home Quality Mark, launched 2015, is one way of demonstrating the standard of a new residential dwelling, which includes measures for low CO2, sustainable materials, good air quality and natural daylight. The Council will strongly encourage schemes to use the Home Quality Mark. The use of Passivhaus standard is also encouraged in demonstrating energy efficient design. Further details on energy efficient design and principles and Passivhaus are set out in our supplementary planning document Camden Planning Guidance on sustainability.

Local Plan Policy CC1 requires all major developments to assess the feasibility of connecting to an existing decentralised energy network.

Policy CC3 - Water and flooding

We will require development to:

a. incorporate water efficiency measures;

b. avoid harm to the water environment and improve water quality;

c. consider the impact of development in areas at risk of flooding (including drainage);

d. incorporate flood resilient measures in areas prone to flooding;

e. utilise Sustainable Drainage Systems (SuDS) in line with the drainage hierarchy to achieve a greenfield run-off rate where feasible; and

f. not locate vulnerable development in flood-prone areas.

8.55. Residential developments will be expected to meet the requirement of 110 litres per person per day (including 5 litres for external water use).

Policy CC4 Air quality

The Council will ensure that the impact of development on air quality is mitigated and ensure that exposure to poor air quality is reduced in the borough

8.83 A development can affect air quality in three significant ways:

• emissions from construction and demolition;

• emissions from the combustion of fuel for energy within the building; and

• emissions from transport to and from the building.

Policy CC5 Waste

We will:

a. aim to reduce the amount of waste produced in the borough and increase recycling and the reuse of materials to meet the London Plan targets of 50% of household waste recycled/composted by 2020 and aspiring to achieve 60% by 2031;

b. deal with North London's waste by working with our partner boroughs in North London to produce a Waste Plan, which will ensure that sufficient land is allocated to manage the amount of waste apportioned to the area in the London Plan;

c. safeguard Camden's existing waste site at Regis Road unless a suitable compensatory waste site is provided that replaces the maximum throughput achievable at the existing site; and

d. make sure that developments include facilities for the storage and collection of waste and recycling.

8.98 Waste Management Plan. To ensure an integrated approach to waste management and the highest possible reuse and recycling rates, the Council will encourage the submission of a site waste management plan prior to construction. For further details please refer to our supplementary planning document Camden Planning Guidance on sustainability

2.3.1 SUMMARY OF KEY POLICY

1. Low Carbon Emissions. For minor schemes, Camden require a 19% improvement in regulated CO2 emissions over the Target Emission Rate (TER) outlined in the national Building Regulations 2021 for residential areas.

2. Renewable Energy. Minor development proposals should incorporate renewable energy technology. A 20% contribution to the annual energy demand of the entire scheme should be targeted where feasible.

3. Low Water Use. Residential development should be designed so that mains water consumption would meet a target of 105 litres or less per head per day, excluding an allowance of 5 litres or less per head per day for external water use.

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/p.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.

The development will meet the London Plan target of achieving at least the BREEAM excellent standard for the 'Wat 01' water category for commercial areas.

3.2 WATER MANAGEMENT

In addition to the water efficiency measures outlined above the proposal has considered the risk of flooding. The maps below show the risk of flooding to Kilburn High Road is high however, the water depth would be below 300mm.

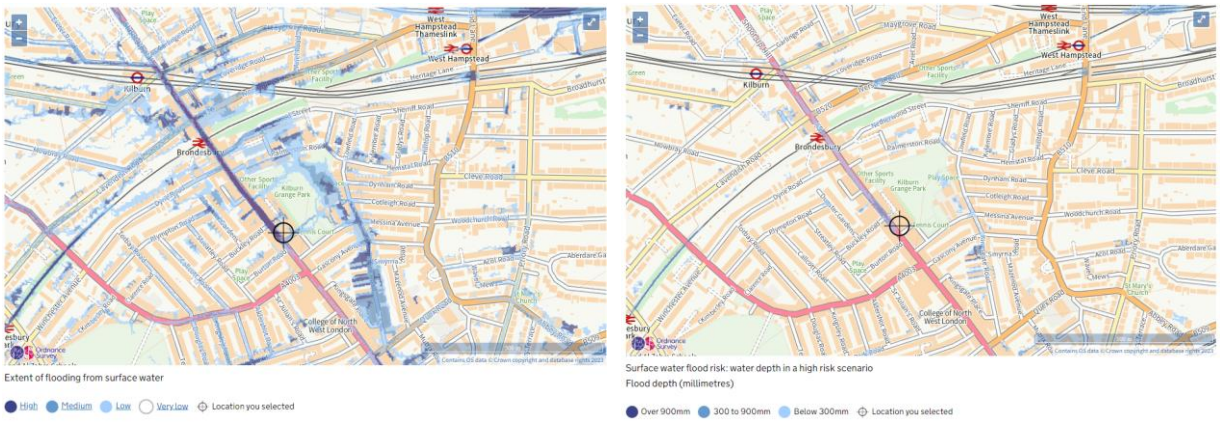

Figure 5: Flood risk map

To help mitigate this the proposal does not seek to increase hard surfacing on site and will provide extra greening. The addition of the proposed green roofs and planting will retain rainwater in the substrate and plants. This water will then be used by the vegetation or evaporate back into the atmosphere. Over the course of a calendar year, an extensive green roof with 20-40mm of substrate and sedum vegetation can retain around 40% of the rainfall.

3.3 AIR QUALITY

The scheme supports air quality by:

- The use of air-source heat pumps for space heating and hot water use for selected apartments.
- Mechanical ventilation with heat recovery (MVHR) offers a means for occupants to filter fresh air.
- The green roof provides extra vegetation which may assist in filtering out gaseous pollutants and dust particles.
- Construction environmental management plan (CEMP) to incorporate best practice for air quality and dust control.

3.4 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.

3.5 GREENING, BIODIVERSITY AND CLIMATE RESILIENCE

The development does not involve the loss of any ecological feature or habitat and proposes to improve urban greening. A green roof is proposed on both the new flat roof on the top floor and the small north facing flat roof on the fourth floor. The green roof comprises of mature sedum species pre-grown on an integrated blanket with 20mm of extensive substrate and is suitable for direct use over waterproofing. The terraces on the fourth floor will also benefit from flower-rich perennial planting as shown in the image below.

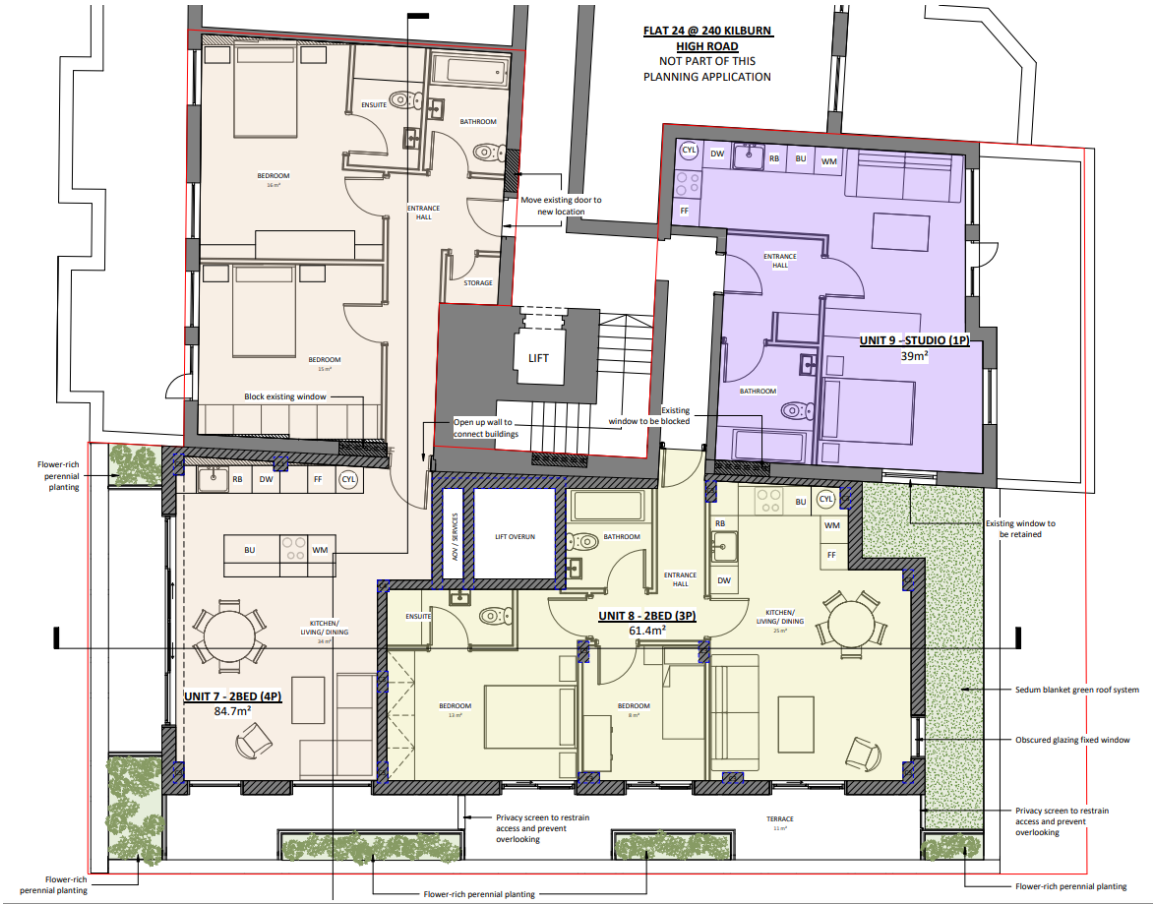

Figure 6: Proposed planting

3.6 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 where feasible.

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.

3.7 SUSTAINABLE TRANSPORT

The site achieves a very high PTAL rating (6a - see image below) which analyses proximity to frequent public transport services. Links to low energy public transportation include a 5 minute walk to Brondesbury Station, 10 minute walk to Kilburn high road station and 7 minute walk to Kilburn underground station providing connection to London Overground and London Underground services. The site is near to a number of bus stops, the closest is located on Kilburn High Road approximately 160 yards, offering services on Routes 16, 32, 189, 316, 632 and N32. The scheme also provides full covered, secure cycle storage facilities.

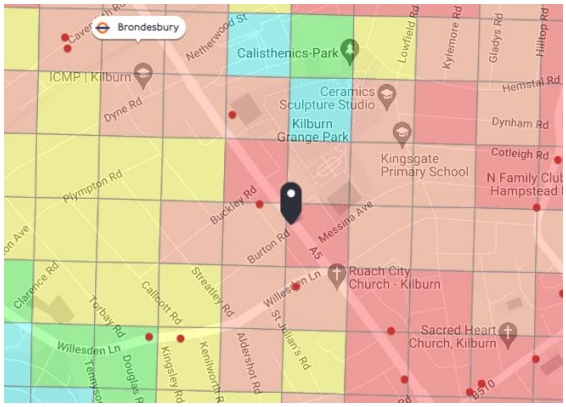

Figure 7: Transport for London PTAL rating (6a)

3.8 DEMAND SIDE RESPONSE

Demand-side response / flexibility initiatives are encouraged by the London Plan. Demand side flexibility refers to the ability of a system to reduce or increase energy consumption for a period of time in response to an external driver (e.g. energy price or carbon signal change, grid availability).

Smart buildings have been identified and acknowledged as key enablers of future energy systems for which there will be a larger share of renewables, distributed power and heat generation, and demand-side flexibility to match demand to supply and make best use of existing network connection and local generation capacity.

The scheme facilitates the use of Demand Side Response and reduces peak energy demand by:

- The use of electrical equipment such as heat pumps which can be turned up/down.
- The installation of smart meters.
- The use of on-site generation, solar PV.

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

4 Design Approach - Energy

4.1 THE ENERGY HIERARCHY

The energy hierarchy, as referred to in the London Plan and illustrated below, sets out a four-stage approach to strategic decision-making for the reduction of energy and associated greenhouse gas emissions. The evaluation of the scheme's carbon emissions, as presented in the subsequent sections, follows this structure.

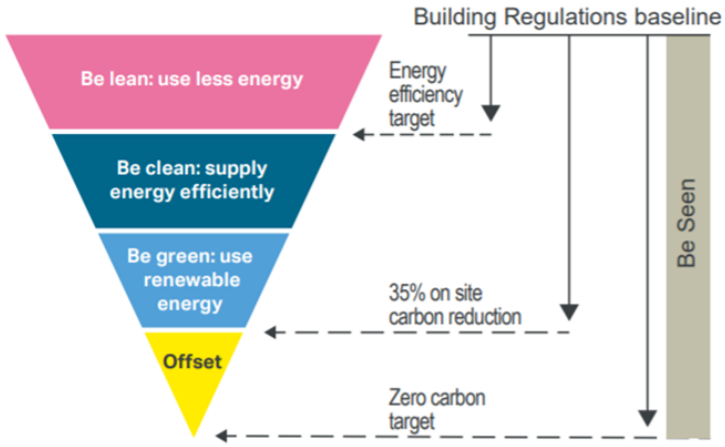

Figure 8: Energy Hierarchy Methodology

BE LEAN - Minimise Energy Demand
Passive design such as optimising form, orientation and site layout, natural ventilation with thermal mass, daylight and solar shading as well as active design measures such as LED lighting and efficient mechanical ventilation with heat recovery.

BE CLEAN - Deliver Energy Efficiently
Efficient energy provision for space heating and cooling infrastructure e.g. high efficiency cooling plant, combined heat and power (CHP) or, if available, connection to a district heating/cooling network.

BE GREEN - Use Renewable Energy
Energy supply derived from local renewable resources including solar irradiation, wind energy, hydropower and local heat sources such as geothermal energy. Provision of non-local options can also be considered.

BE SEEN – Control Energy
Monitor, verify and report on energy performance.

4.2 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.

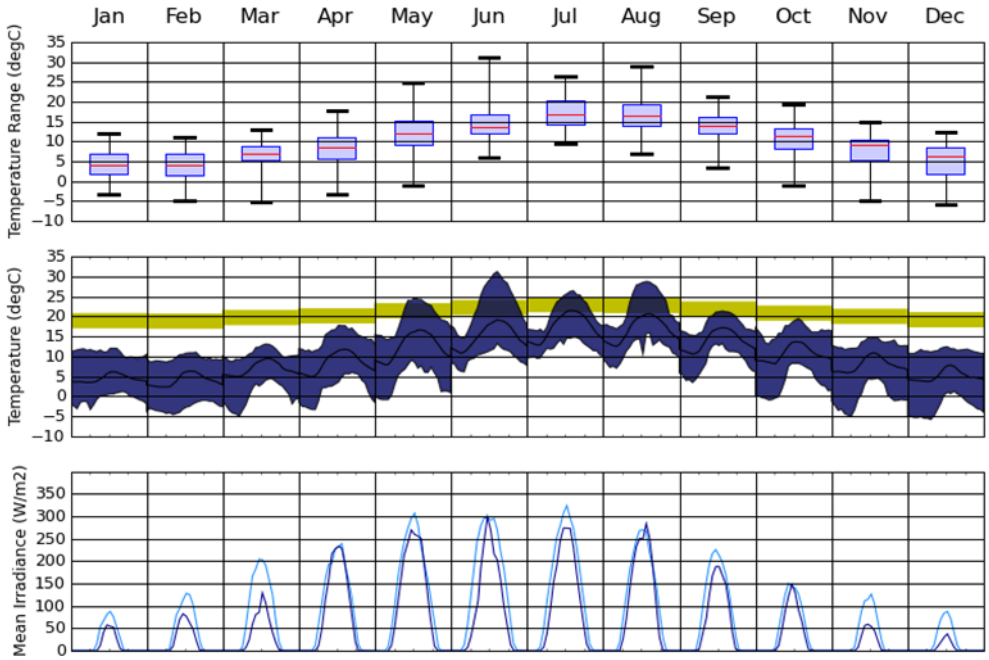

Figure 9: Average historic climate data for London

4.3 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.

4.4 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. The approach to limiting thermal bridging is to implement Accredited Details or similar for new build areas.

4.5 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 scheme takes advantage of the prevailing south-westerly wind through the south facing frontage. The summer ventilation strategy includes large openable areas for windows/doors to allow for good natural ventilation and horizontal external shading from recessed balconies. The scheme also benefits from heavyweight constructions, which will be pre-cooled at night to lower the risk of overheating during the day.

4.6 SOLAR EXPOSURE & DAYLIGHT

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

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

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

4.7 ACTIVE BUILDING SERVICES SYSTEMS

Space heating and hot water will be provided via a mix of individual high-efficiency gas boilers and air-source heat pump systems in residential units, and a VRF system for the commercial space.

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

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.

Demand led control system will be implemented in commercial areas to control fan use based on CO_2 levels. This ensures that fresh air levels will be high (i.e. CO_2 below 1000ppm) and energy requirements will be reduced to the absolute minimum.

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

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

4.8 COOLING & OVERHEATING

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

Hierarchy Measure	Application to proposed development
1. MINIMISE INTERNAL HEAT GAINS	- Low energy LED lighting.
2. MINIMISE EXTERNAL HEAT GAINS	-High level of insulation -Low G-value windows (0.40 new residential, 0.5 existing residential, 0.4 commercial) - Balconies to provide solar shading -Internal blinds with light coloured external facing surfaces (with relatively high reflective properties) in commercial areas.
3 & 4 HEAT MANAGEMENT AND PASSIVE VENTILATION	-High openable window area with general high exposure to prevailing south-westerly winds -Night time ventilation strategy
5. MECHANICAL VENTILATION	- Mechanical Ventilation with Heat Recovery (MVHR) is specified. System will have "heat recovery by-pass" mode in order to be operable in summer night-cooling mode
6. ACTIVE COOLING Ensuring they are the lowest carbon options	-Fan coils will provide cooling in commercial areas during peak periods. Local solar PV will in part power the units during these periods.

Table 5: Cooling hierarchy

5 Carbon Emissions – Residential Dwellings

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 new build 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 2021)

5.2 "BE LEAN EMISSIONS"

As part of the "Be Lean" 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.

Important note:

The scheme contains a mixture of new-build units and part new-build / part refurbished units. It should be noted that **all areas, including refurbished areas are evaluated here under SAP 10.2**. Although the refurbished area will have upgraded glazing, the insulation and thermal bridging for these areas will be well below the Part L notional building standard. This will mean that the overall Be Lean score will be lower than that of a pure new build development. As some units are part new build and part refurbished, separate modelling of new build and refurbished areas cannot be carried out.

Element	Proposed residential development
External walls U value	0.15 W/m²/°C 0.3 W/m²/°C for existing elements
Floor U value	0.13 W/m²/°C
Party floor U-value	0.25 W/m²/°C
Roof U value	0.13W/m²/°C 0.18 W/m²/°C for existing elements
Windows U value	0.8 W/m²/°C with 0.4 G-value (new build glazing) 1.4 W/m²/°C with 0.5 G-value (existing glazing)
Roof light U Value	NA
Doors	1.4 W/m²/°C glazed doors, 1.0 W/m²/°C solid doors
Air tightness	3 m³/m²/h @50Pa
Ventilation type	Mechanical Ventilation with Heat Recovery Nuaire MRXBOXAB-Eco 2
Heating	Unit 3, 5, 7,8 & 9- Boiler Worcester Greenstar 4000 Unit 1, 2, 4, & 6- ASHP Mitsubishi Electric Ecodan PUZ-WM60VAA
Hot water	Unit 3, 5, 7,8 & 9- Boiler Worcester Greenstar 4000 Unit 1, 2, 4, & 6- ASHP Mitsubishi Electric Ecodan PUZ-WM60VAA
Cooling	None
Lighting	100% low energy lighting

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

5.3 "BE LEAN" TOTAL CARBON EMISSIONS

The "Be Lean" CO_2 emissions associated with regulated energy consumption, the Dwelling Emissions Rate (DER) are given below in relation to the baseline TER (Target Emission Rate).

Unit type	Area (m^2)	TER ($kg.CO_2/m^2/yr.$)	DER ($kg.CO_2/m^2/yr.$)
Unit 1	53.08	16.01	13.87
Unit 2	51.22	21.17	18.62
Unit 3	90.68	10.83	10.78
Unit 4	51.64	15.91	13.57
Unit 5	90.68	11.41	11.22
Unit 6	51.64	16.66	14.22
Unit 7	87.30	12.32	12.73
Unit 8	61.60	14.75	13.59
Unit 9	39.03	19.25	24.08

Table 8: Be Lean regulated Emissions for dwellings

5.4 "BE CLEAN" EMISSIONS

5.4.1 Connection to Third Party Heat Networks

Heat networks are encouraged by the London Plan and the Mayor has identified Heat Network Priority Areas as shown in the map below. The London Heat Map tool[3] shows that the site is within the heat network priority area and that it is over 2.5km from the nearest potential heat network area. Therefore, currently a connection to third party heat networks is not considered viable for this development.

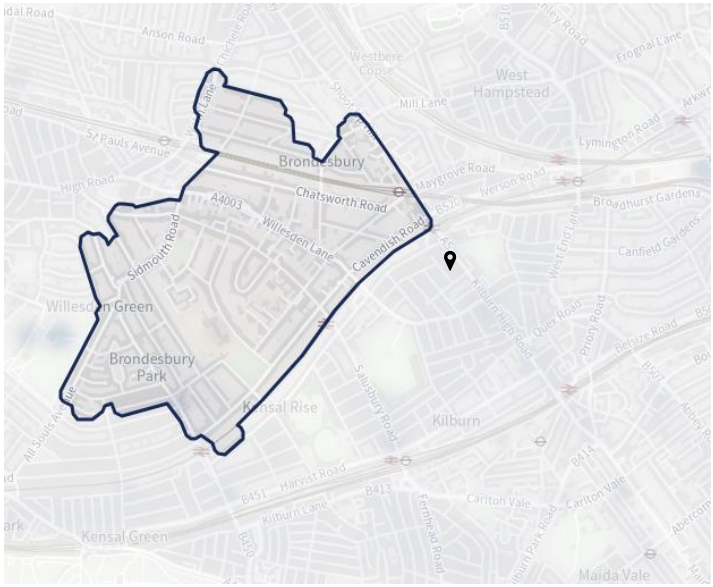

Figure 10: London Heat Map tool showing the heat network priority areas in relation to the proposed scheme

[3] https://www.london.gov.uk/what-we-do/environment/energy/london-heat-map/view-london-heat-map

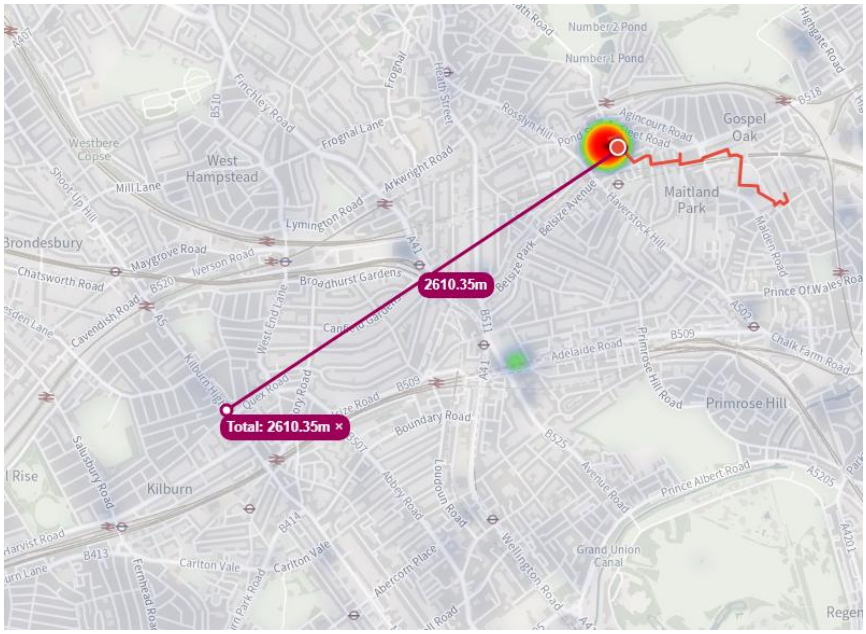

Figure 11: London Heat Map tool showing live networks (red), proposed heat networks (purple) and potential heat supply sites (orange)

5.4.2 CHP Combined Heat and Power

The London Plan limits the role of CHP to low-emission CHP and only in instances where it can support the delivery of an area-wide heat network at large, strategic sites, according to the Energy Assessment Guidance Greater London Authority guidance on preparing energy assessments as part of planning applications (April 2020). Therefore, CHP has not been adopted.

5.5 "BE GREEN" EMISSIONS

A renewable energy feasibility exercise has been carried out in order to determine the most viable option(s) for the development (see Appendix A). The viable technology options, air source heat pumps and solar PV, are presented below.

5.5.1 Air Source Heat Pumps

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

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 Mitsubishi Ecodan air source heat pumps have been selected for units 1,2,4 and 6. The Seasonal Coefficient of Performance (SCOP) for this unit is 3.11 at a 55°C supply temperature.

5.5.2 Photovoltaic (PV) panels

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

Total installed capacity of the system:	19.4 (kWp)
Panel inclination:	min 15°
Panel orientation:	South-east
Total energy generation:	15721 kWh/a
Total carbon emission reduction:	2.14 tonnes of CO_2/y
PV allocated to residential areas:	16.6 (kWp)
Energy generation (residential):	13709 kWh/a

Carbon emission reduction (residential): 1.86 tonnes of CO_2/y

Local shading is considered to be very low.

The performance and output of the renewable energy systems will be monitored.

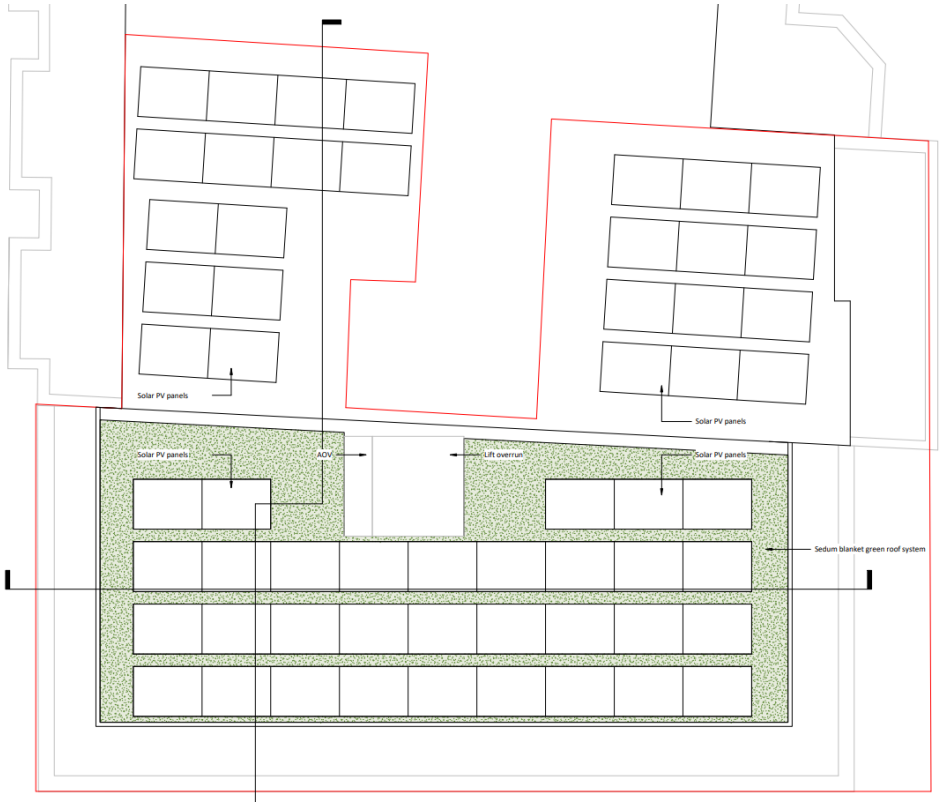

Figure 12: Solar PV layout

5.5.3 "Be Green" Total Carbon Emissions

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

Unit type	Area (m^2)	TER (kg.CO_2/m^2/yr.)	DER (kg.CO_2/m^2/yr.)
Unit 1	53.08	16.01	1.61
Unit 2	51.22	21.17	2.64
Unit 3	90.68	10.83	9.21
Unit 4	51.64	15.91	1.36
Unit 5	90.68	11.41	9.66
Unit 6	51.64	16.66	1.52
Unit 7	87.30	12.32	10.7
Unit 8	61.60	14.75	10.72
Unit 9	39.03	19.25	19.55

Table 9: Be Green Carbon Emissions for new build area

5.6 CARBON EMISSIONS SUMMARY (DWELLINGS)

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 in the format recommended by the GLA.

The table below shows the regulated and unregulated energy use.

Carbon dioxide emissions (Tonnes CO_2 per annum)	**Regulated**	**Unregulated**
Baseline: Part L 2021 (Building Regulations) Compliance	8.4	4.0
After "Be Lean" (energy demand reduction)	7.3	4.0
After "Be Clean" (heat network / CHP)	7.3	4.0
After "Be Green" (renewable energy)	3.9	4.0

Table 10: Summary of new build carbon emissions for new build dwelling areas

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)	1.1	13%
Savings from "Be Clean" (heat network / CHP)	0.0	0%
Savings from "Be Green" (renewable energy)	3.4	40%
Total cumulative on-site savings	4.5	54%

Table 11: Residential regulated CO_2 emissions savings after each stage of the Energy Hierarchy

As stated previously, all areas, including refurbished areas are evaluated here under SAP 10.2. As some units are part new build and part refurbished, separate modelling of new build and refurbished areas cannot be carried out. Although the refurbished area will have upgraded glazing, the insulation and thermal bridging for these areas will be well below the Part L notional building standard. This will mean that the overall Be Lean score is lower than that of a 100% new build development.

6 Carbon Emissions – Non - Domestic

6.1 BASELINE

Energy demand and annual carbon emissions are calculated using BRE accredited energy compliance software SBEM for the non-domestic areas.

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 Building Regulations as summarised in the table below.

The Notional Building baseline values, which apply to new build non-domestic areas, are:

Element	Building Regulations L2 2021
External walls U value	0.18 W/m^{2}K
Floor U value	0.13 W/m^{2}K
Roof U value	NA
Windows U value	1.6 W/m^{2}K
Air tightness	5.0 m^3/m^2/h @50Pa
Ventilation type	No heat recovery
Heating (SSEEF)	ASHP: heating 264%
Cooling (SSEER)	Cooling 2.7
Lighting	95 lm/W

Table 12: Notional Building Specification for Non Domestic (Part L2 2021)

6.2 "BE LEAN" EMISSIONS

As part of the "Be Lean" 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 non-domestic development
Roof U-value	NA
Windows U-value	1.2 (0.40 G-value)
External walls U-value	0.15 W/m²/°C
Ground floor U-value	0.13 W/m²/°C
Party ceiling U-value	0.18 W/m²/°C
Air Permeability	3.0 m³/m²/h@50Pa
Primary space heating	VRF system (SCOP 4.63, SSEEF 3.88)
Controls	Time/temperature control.
Hot water	Instantaneous electric 100% efficient
Ventilation	MVHR heat recovery efficiency 80%, SFP 1.3 W/l/s.
Cooling	VRF (SEER 6.6, SSEER 5.03)
Lighting	100 lm/W
Lighting control	Daylight control

Table 13: Proposed non-domestic development (Be Lean)

6.2.1 "Be Lean" Total Carbon Emissions

The Be Lean CO_2 emissions associated with regulated energy consumption (Building Emissions Rate - BER) are given below in relation to the baseline TER (Target Emission Rate).

Area (m²)	TER (kg.CO_2/m²/yr.)	BER (kg.CO_2/m²/yr.)
76.6	5.74	5.69

Table 14: Be Lean non-domestic regulated emissions

6.3 "BE CLEAN" EMISSIONS

Please refer to the Be Clean commentary given for the residential carbon assessment.

6.4 "BE GREEN" EMISSIONS

The commercial areas will have VRF heating and cooling systems with hot water supplied by an instantaneous electric boiler.

The commercial building has a 2.72kWp PV installation, which will work in part to power the VRF system. A breakdown of the PV installed can be seen below, please refer to figure 13 in section 5.5.2.

Total installed capacity of the system:	19.4 (kWp)
Panel inclination:	min 15°
Panel orientation:	South
Total energy generation:	15721 kWh/a
Total carbon emission reduction:	2.14 tonnes of CO_2/y
PV allocated to commercial areas:	2.72 (kWp)
Energy generation (commercial):	2012 kWh/a
Carbon emission reduction (commercial):	0.27 tonnes of CO_2/y

Local shading is considered to be very low.

The performance and output of the renewable energy systems will be monitored.

6.4.1 "Be Green" Total Carbon Emissions

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

Area (m^2)	TER ($kg.CO_2/m^2/yr.$)	BER ($kg.CO_2/m^2/yr.$)
77.6	5.74	2.14

Table 15: Be Green non-domestic carbon emissions

6.5 CARBON EMISSIONS SUMMARY (NON-DOMESTIC)

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 in the format recommended by the GLA.

The table below shows the regulated and unregulated energy use.

Carbon dioxide emissions (Tonnes CO2 per annum)	Regulated	Unregulated
Baseline: Part L 2021 (Building Regulations) Compliance	0.4	0.5
After "Be Lean" (energy demand reduction)	0.4	0.5
After "Be Clean" (heat network / CHP)	0.4	0.5
After "Be Green" (renewable energy)	0.2	0.5

Table 16: Summary of non-domestic carbon emissions for commercial areas

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)	0.0	1%
Savings from "Be Clean" (heat network / CHP)	0.0	0%
Savings from "Be Green" (renewable energy)	0.3	62%
Total cumulative on-site savings	0.3	63%

Table 17: Regulated CO_2 emissions of savings after each stage of the Energy Hierarchy for commercial areas

7 Summary

7.1 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 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 scheme has covered bicycle storage and is a 5 minutes' walk to Brondesbury station. The scheme also benefits from a 19.4 kWp solar PV array on a biosolar roof which will help to reduce cost of energy for occupants and increase biodiversity.

7.2 WHOLE DEVELOPMENT 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 in the format recommended by the GLA.

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

Carbon dioxide emissions (Tonnes CO2 per annum)

	Regulated	Unregulated
Baseline: Part L 2021 (Building Regulations) Compliance	8.8	4.5
After "Be Lean" (energy demand reduction)	7.7	4.5
After "Be Clean" (heat network / CHP)	7.7	4.5
After "Be Green" (renewable energy)	4.1	4.5

Table 18: Summary of carbon emissions for the whole development

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

Regulated carbon dioxide emissions (Tonnes CO2 per annum)

	(Tonnes CO_2 per annum)	(%)
Savings from "Be Lean" (energy demand reduction)	1.1	13%
Savings from "Be Clean" (heat network / CHP)	0.0	0%
Savings from "Be Green" (renewable energy)	3.6	41%
Total cumulative on-site savings	4.8	54%

Table 19: Regulated CO_2 emissions savings for the whole development after each stage of the Energy Hierarchy.

7.3 RENEWABLE ENERGY CONTRIBUTION

The as designed carbon emissions are 7.7 tonnes CO_2 per year compared to 3.6 tonnes CO_2 per year are saved via Be Green / renewables. As per the Camden council renewable energy calculation process, the renewable energy contribution is 47**%**

7.4 COST OF ENERGY SUMMARY

The scheme aims to protect the consumer from high prices by: reducing energy demands; generating energy onsite via solar PV and creating building user guides to help occupants to reduce energy bills and promote the use of smart energy tariff such to provide cheaper electricity during non-peak times.

Appendix A: Technology Feasibility Study Summary

The overall summary of the feasibility exercise is presented below.

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

See appendix folder which contains the Be Lean and Be Green SBEM BRUKL documents for the commercial area together with Be Lean / Be Green SAP datasheets.