# ENERGY & SUSTAINABILITY STATEMENT

71 Avenue Road

Produced by XCO2 for Private Client

May 2023

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# EXECUTIVE SUMMARY

The sustainability and energy strategy for the 71 Avenue Road development has been developed to comply with the relevant policies of the London Plan and of the London Borough of Camden's Local Plan.

The proposals incorporate a range of sustainable design and construction measures, primarily addressing the sustainable management of resources, the protection and enhancement of the environment and the effective adaptation and mitigation of the development to climate change.

This report presents the sustainability strategy and assesses the predicted energy performance and carbon dioxide emissions of the proposed development at 71 Avenue Road, located in the London Borough of Camden.

The proposed development includes the demolition of the existing residence and erection of a four storey, single family dwellinghouse (Class C3) with basement and accommodation in the roof space.

This document is divided into three parts:

1. Planning policies;
2. Proposed sustainability measures; and,
3. Energy Strategy.

The Planning Policy section provides an overview of the site and planning policies applicable to this development in accordance with the London Borough of Camden's Local Plan and supplementary guidance and the London Plan 2021.

The second section on proposed sustainability measures outlines the sustainability measures that have been adopted in the team's aim to maximise sustainability within the site.

The third section describes the predicted energy performance and carbon dioxide emissions of the proposed development at 71 Avenue Road. The development will be compared to a notional building constructed to Part L 2021 standards.

Key sustainability features of the proposals include:

- The re-use of previously developed land;
- Effective site layout in response to the neighbouring context;
- Efficient design of the proposed massing, openings and internal layouts so that habitable spaces across the site benefit from abundant daylight and sunlight levels, whilst impacts to neighbouring buildings are kept to a minimum;
- The specification of water efficient fittings to limit water consumption to less than 105 litres per person per day for domestic uses;
- The incorporation of SUDs in the form of rainwater harvesting butts, SuDS planters, and an attenuation tank;
- The protection of natural features of ecological value;
- Enhancing the biodiversity of the site through an extensive green roof, private amenity to the front and rear which incorporatesplanting throughout;
- Targeting of an Urban Greening Factor of 0.4 or less;
- Effective pollution management and control: the development is not expected to have any significant adverse effects to air, noise, land, or watercourses;
- Incorporation of electric vehicle charging points;
- Minimised overheating risk through sufficient operability of windows and low g-values;
- Highly efficient air source heat pump to provide the main heating and domestic hot water;
- Reduction of the whole life carbon of the development through;
    - Reusing materials wherever possible
    - Using local suppliers; manufacturers where feasible; and,
    - Following circular economy principles.

The energy strategy for the scheme focuses on the efficiency of the fabric and building services, so that the energy demand is reduced to the extent feasible. Energy efficiency is primarily achieved through a highly insulated building envelope (i.e. a 'fabric first approach'), a good air permeability rate and a thermal bridging y-value exceeding Part L 2021 default standards. Highly efficient lighting, space conditioning and hot water systems, as well as appropriate controls further reduce the regulated energy demand and consumption of the development. The proposals also incorporate air source heat pumps (ASHPs) as the primary heating system.

In total, the development is expected to achieve regulated $CO_2$ savings of 69.5% compared to a notional development that meets the minimum Part L 2021 Regulations standards of performance.

The proposed development therefore complies with the London Plan $CO_2$ savings target of 35% overall.

To achieve 'zero carbon' for the residential portion of the scheme, 3.98 tonnes per annum of regulated $CO_2$, equivalent to 119.4 tonnes over 30 years, should be offset offsite. This equates to an offset contribution of £11,342.

Any carbon offset contributions will be subject to viability discussions and detailed design stage calculations.

The proposals in their entirety reflect the client and design team's aspirations in delivering a high-quality, energy efficient development that underpins the sustainability of the built environment.

# INTRODUCTION

The proposed residential development is located within the London Borough of Camden. This section presents the description of the site and of the development proposal.

## SITE & PROPOSAL

The proposed development is located within the London Borough of Camden and comprises a four storey residential building which includes a basement level.

The site is located in a residential area, with the surrounding context currently comprising two to three storey residential properties. It is bounded to the northwest by Queens Grove, the northeast by Avenue Road, and the southeast and southwest by neighbouring residential properties.

The location of the development site is shown in Figure 1 below.

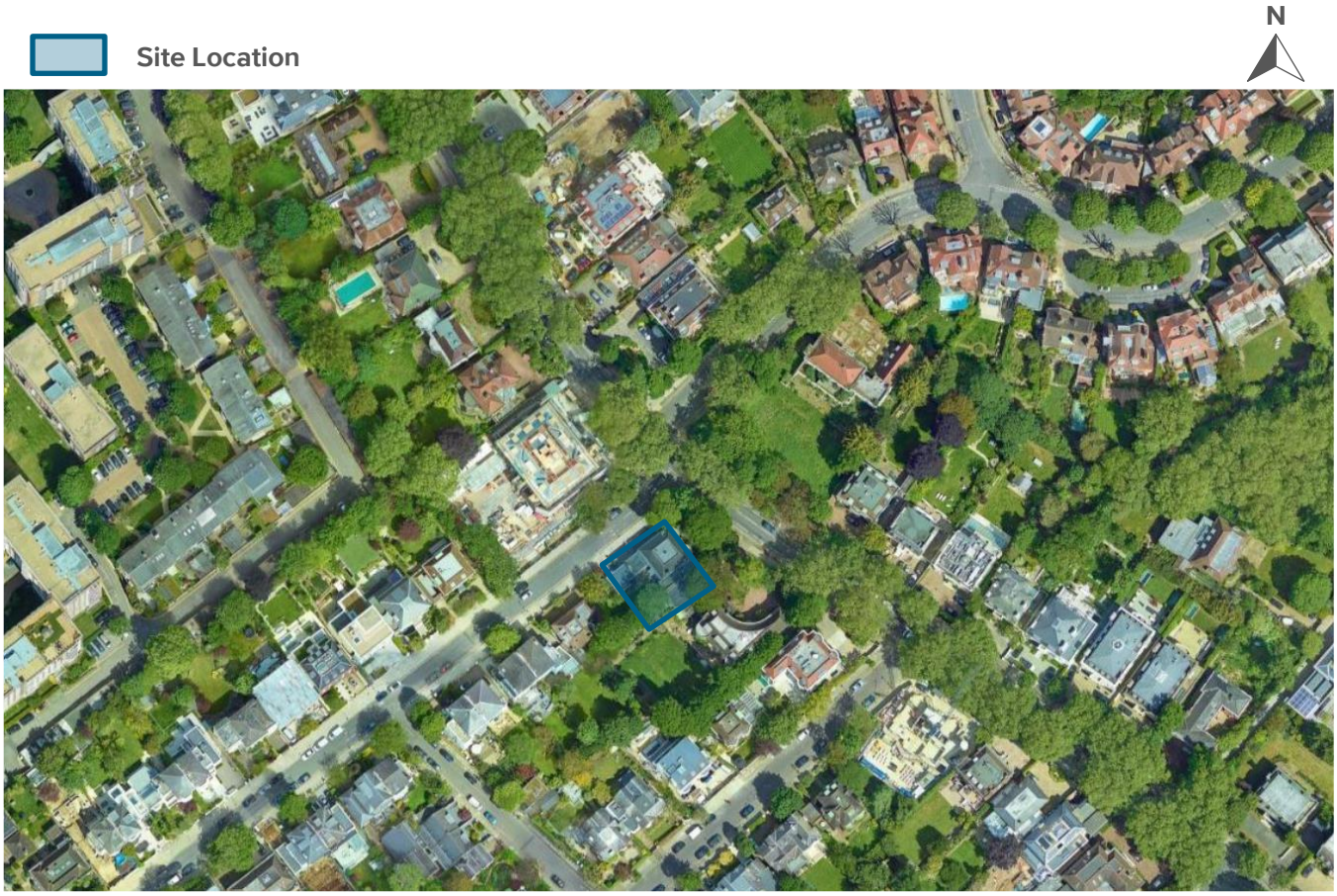



Figure 1: Location of the application site.

# PLANNING POLICIES

The proposal will seek to respond to the energy and sustainability policies of the London Plan and of the policies within the London Borough of Camden's Local Plan and supplementary guidance.

The most relevant applicable energy policies in the context of the proposed development are presented below.

## THE LONDON PLAN (2021)

The London Plan (2021) published 2nd March 2021 sets out the Mayor's overarching strategic spatial development strategy for greater London and underpins the planning framework from 2019 up to 2041. This document replaced the London Plan 2016.

The new Plan has a strong sustainability focus with many new policies addressing the concern to deliver a sustainable and zero carbon London.

**Policy GG6 Increasing Efficiency and Resilience** is an overarching policy references London's target to become zero carbon by 2050 and the need to design buildings and infrastructure for a changing climate, addressing water, flood and urban heat island.

Sustainability is a trend through the whole Plan but is particularly addressed in chapter 9 Sustainable Infrastructure. The following sections outline the key principles of sustainable design and construction to be incorporated in major proposals.

**Policy SI1 Improving air quality** requires development proposals to be at least air quality neutral and submit an Air Quality Assessment.

*"...*
*Development plans, through relevant strategic, site specific and area-based policies should seek opportunities to identify and deliver further improvements to air quality and should not reduce air quality benefits that result from the Mayor's or boroughs' activities to improve air quality.*
*..."*

Any mitigation required to meet the Air Quality Neutral target should be done on site preferably.

**Policy SI2 Minimising greenhouse gas emissions** sets the requirements for all major developments to follow the energy hierarchy and achieve net-zero-carbon for both residential and non-residential schemes (via on-site carbon reductions and offset payments) and introduces new targets at Lean stage:

*"...*
*This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:*
*1) be lean: use less energy and manage demand during operation*
*2) be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly*
*3) be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site*
*4) be seen: monitor, verify and report on energy performance.*
*..."*

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

This policy also sets the requirements to consider whole-life carbon emissions, including embodies carbon and unregulated emissions:

*"...*
*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.*

*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.*
*..."*

The policy supporting text provides additional clarifications on the requirements for major developments:

- Developments including major refurbishments should also aim to meet the net-zero carbon target.
- All developments should maximise opportunities for on-site electricity and heat production from solar technologies (photovoltaic and thermal), use innovative building materials and smart technologies.
- Recommendation to use SAP10 carbon factors as per GLA Energy Guidance.
- Recommended carbon offset price of £95 per tonne $CO_2$.
- Requirement for major developments to monitor and report operational energy performance to the GLA.

**Policy SI 3 Energy Infrastructure** requires all major developments within Heat Network Priority Areas will need to utilise a communal low-temperature heating system. Where developments are utilising CHP this policy also requires them to demonstrate that 'the emissions relating to energy generation will be equivalent or lower than those of an ultra-low NOx gas boiler'. Any combustion on site should meet the requirements of part B of Policy SI1.

**Policy SI 4 Managing heat risk** requires:

*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:*
*1) reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure*
*2) minimise internal heat generation through energy efficient design*
*3) manage the heat within the building through exposed internal thermal mass and high ceilings*
*4) provide passive ventilation*
*5) provide mechanical ventilation*
*6) provide active cooling systems.*

**Policy SI5 Water infrastructure** sets the requirements to manage water resources efficiently:

*"...*
*Development proposals should:*
*1) 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)*
*2) achieve at least the BREEAM excellent standard for the 'Wat 01' water category or equivalent (commercial development)*
*3) 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.*
*..."*

**Policy SI 7 Reducing waste and supporting the circular economy** introduces the notion of circular economy whereby materials are retained in use at their highest value for as long as possible. For referable applications a Circular Economy Statement demonstrating how developments promote circular economy and aim to be net zero-waste must be submitted.

**Policy SI12 Flood risk management** and **Policy SI 13 Sustainable drainage** sets the requirements for development proposals to ensure that flood risk is minimised, and that sustainable drainage is incorporated. This should be pursued by integrating different strategies including natural flood management. Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. For this green features should be employed, following the drainage hierarchy.

**Policy D14 Noise** requires that noise impacts are minimised and mitigated to avoid any adverse impacts on health and quality of life and to reflect the principles set in **Policy D13 Agent of Change** that "*places the responsibility for mitigating impacts from existing noise and other nuisance-generating activities or uses on the proposed new noise-sensitive development.*"

**Policy G5 Urban greening** requires major developments to contribute to greening of London assessed by an Urban Greening Factor (UGF).

Boroughs should develop their UGF but *"the Mayor recommends a target score of 0.4 for developments that are predominately residential, and a target score of 0.3 for predominately commercial development (excluding B2 and B8 uses)."*

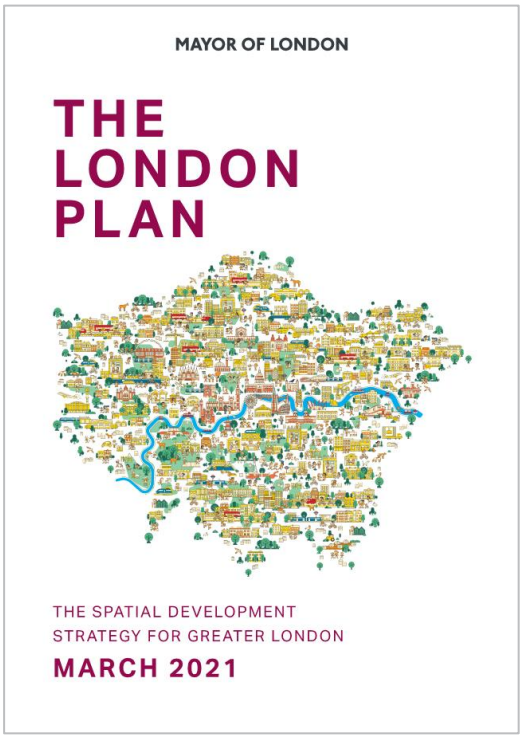
Separate guidance on UGF is under consultation in Spring/Summer 2021.

**Policy G6 Biodiversity and access to nature** states:

> *"…*
> *Development proposals should manage impacts on biodiversity and aim to secure net biodiversity gain. This should be informed by the best available ecological information and addressed from the start of the development process.*
> *…"*

It is noted that the proposed scheme does not constitute 'major' development, and therefore London Plan policies, intended for major developments, are not applicable in this case.

The London Plan's Energy Hierarchy has however been followed in developing the energy strategy for the proposals, in line with Local Plan guidance. Further details on the Energy Hierarchy can be found in the Energy Strategy Summary section of this report.

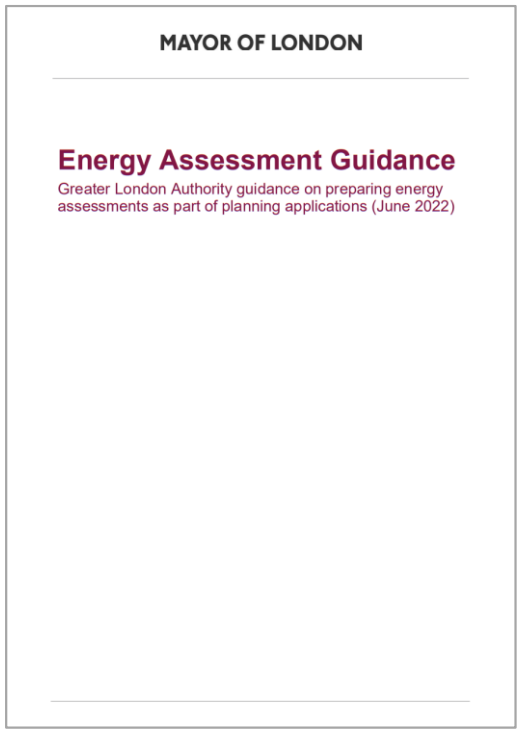


## GLA GUIDANCE ON PREPARING ENERGY ASSESSMENTS

This document (last updated in June 2022) provides guidance on preparing energy assessments to accompany strategic planning applications; it contains clarifications on Policy SI2, of the new London Plan, carbon reduction targets in the context of zero carbon policy, as well as detailed guidelines on the content of the Energy Assessments undertaken for planning.

The guidance document specifies the emission reduction targets the GLA will apply to applications as follows:

*"Major developments are required to achieve net zero-carbon by following the energy hierarchy (Policy SI 2). This means that regulated carbon emissions should be reduced so they are as close as possible to zero. Once on-site reductions have been maximised, the residual emissions should be offset via a payment into the relevant borough's carbon offset fund.*
*Major developments are required to achieve a minimum 35 per cent on-site carbon reduction over Part L 2021. ..."*
*"... If the net zero-carbon target cannot be met on site and the GLA and the relevant borough is satisfied that on-site savings have been maximised, then the annual remaining carbon emissions figure is multiplied by the assumed lifetime of the development's services (e.g. 30 years) to give the cumulative shortfall. The cumulative shortfall is multiplied by the carbon dioxide offset price to determine the required cash-in-lieu contribution. ..."*


MAYOR OF LONDON

Energy Assessment Guidance

Greater London Authority guidance on preparing energy assessments as part of planning applications (June 2022)

The new guidance also includes changes to technical requirements relating to the use of updated carbon factors, cost estimates, overheating risk analysis, the structure of the heating hierarchy and scrutiny over the performance of heat pumps. The guidance also provides information on how the new stage of the energy hierarchy 'be seen' is expected to be carried out in energy assessments, which includes calculating the unregulated carbon emissions.

The structure of this report and the presentation of the carbon emission information for the development follows the guidance in this document.

## CAMDEN LOCAL PLAN (2017)

The Camden Local Plan, adopted in 2017, sets out the following policies for energy:

***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.*

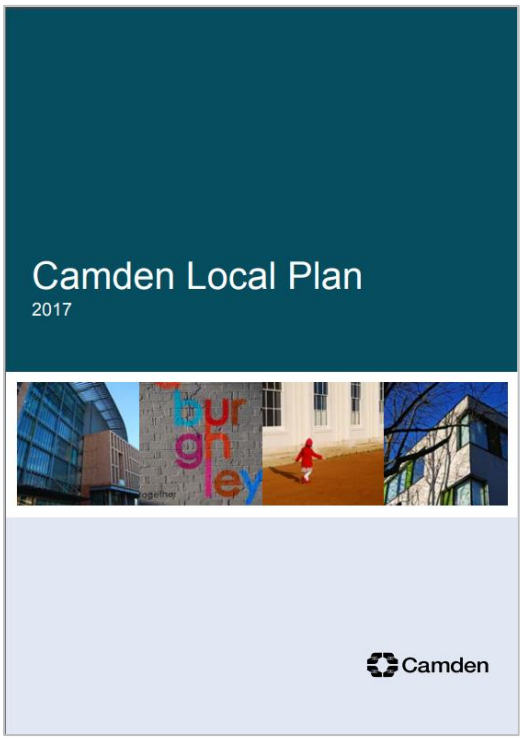
*For decentralised energy networks, we will promote decentralised energy by:*

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.*



## *CAMDEN PLANNING GUIDANCE – ENERGY EFFICIENCY AND ADAPTION*

The Camden Planning Guidance for Energy Efficiency and Adaption has been prepared to support the policies within the Camden Local Plan (2017). The guidance provides most specific information on the key energy and resource issues within the Borough. The document was adopted in January 2021 and replaces the CPG Energy Efficiency and Adaption March 2019.

The sections of the current version of the document that will be covered by the following sections of this Energy Statement are listed below :

**The energy hierarchy**

- *All developments in Camden is expected to reduce carbon dioxide emissions by following the energy hierarchy in accordance with Local Plan policy CC1.*
- *Energy strategies are to be designed following the steps set out in the energy hierarchy.*

**Making buildings more energy efficient**

- *Natural 'passive' measures should be prioritised over active measures to reduce energy.*
- *Major residential to achieve 10%, and non-residential to achieve 15% reduction (beyond part L Building regulations), in accordance with the new London Plan, through on-site energy efficiency measures (Be lean stage).*

**Decentralised energy**

- *All new major developments in Camden are expected to assess the feasibility of decentralised energy network growth.*

**Renewable energy technologies**

- *There are a variety of renewable energy technologies that can be installed to supplement a development's energy needs.*
- *Developments are to target a 20% reduction in carbon dioxide emissions from on-site renewable energy technologies.*

**Energy statements**

- *Energy statements are required for all developments involving 5 or more dwellings and/or 500sqm or more of any (gross internal) floorspace.*
- *Energy statements should demonstrate how a development has been designed following the steps in the energy hierarchy.*
- *The energy reductions should accord to those set out in the following chapter 'Energy reduction'.*

**Energy reduction**

- *All development in Camden is expected to reduce carbon dioxide emissions through the application of the energy hierarchy.*
- *All new build major development to demonstrate compliance with London Plan targets for carbon dioxide emissions.*
- *Deep refurbishments (i.e. refurbishments assessed under Building Regulations Part L1A/L2A) should also meet the London Plan carbon reduction targets for new buildings.*
- *All new build residential development (of 1 – 9 dwellings) must meet 19% carbon dioxide reduction.*
- *Developments of five or more dwellings and/or more than 500sqm of any gross internal floorspace to achieve 20% reduction in carbon dioxide emissions from on-site renewable energy generation.*

**Energy efficiency in existing buildings**

- *All developments should demonstrate how sustainable design principles have been considered and incorporated.*
- *Sensitive improvements can be made to historic buildings to reduce carbon dioxide emissions.*
- *Warm homes and buildings are key to good health and wellbeing. As a guide, at least 10% of the project cost should be spent on environmental improvements.*
- *The 20% carbon reduction target (using on-site renewable energy technologies) applies for developments of five or more dwellings and/or more than 500sqm of any gross internal floorspace.*

**Reuse and optimising resource efficiency**

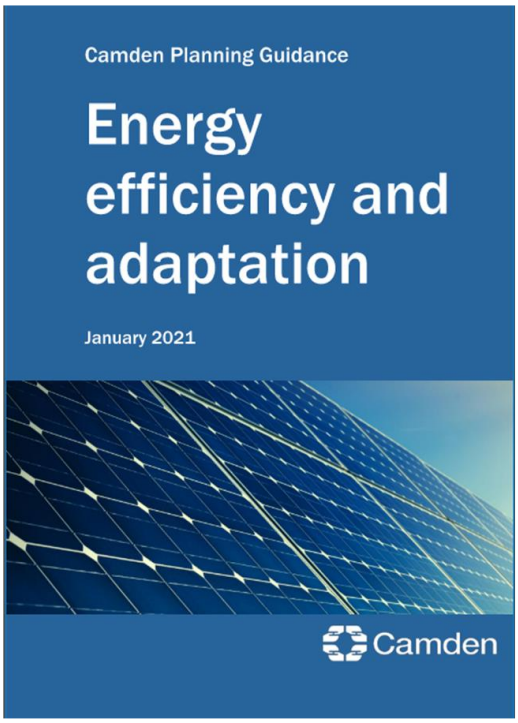
- *Creative and innovative solutions to repurposing existing buildings, and avoiding demolition where feasible will be expected.*
- *All development should seek to optimise resource efficiency and use circular economy principles.*
- *Where demolition cannot be avoided developments are expected to divert 85% of waste from landfill (see paragraph 8.17 Local Plan).*

**Sustainable design and construction principles**

- *All developments involving 500 sqm or more should address sustainable design and construction measures (proposed in design and implementation) in a Sustainability Statement (Local Plan policy CC2).*
- *Active cooling (air conditioning) will only be permitted where its need is demonstrated and the steps in the cooling hierarchy are followed (Local Plan policy CC2).*
- *Development is expected to reduce overheating risk through following the steps in the cooling hierarchy. All new development should submit a statement demonstrating how the cooling hierarchy has been followed (Local Plan policy CC2).*
- *All developments should seek opportunities to make a positive contribution to green space provision or greening.*

**Sustainable design and construction principles**

- *BREEAM Excellent is required for all non-residential development of 500sqm or more floorspace.*
- *Other assessment tools such as Home Quality Mark and Passivhaus are encouraged, they can serve to demonstrate the incorporation of sustainable design principles.*



# PROPOSED SUSTAINABILITY MEASURES

This part of the report presents the key elements of the proposal that underpin environmental sustainability, demonstrates how the development complies with sustainable development policies and incorporates guidance on sustainable design and construction.

## LAND AND SITE LAYOUT

**Land use**

The land for this proposal is efficiently used as the scheme will be constructed on previously developed land. The site currently comprises a large, detached house.

**Reuse of Existing Buildings**

A whole life cycle carbon assessment was carried out for the proposed development to assess the retain and refurbish proposal against the progressed new build proposal. This assessment concluded that when considering embodied carbon & operation energy the refurbished scheme has total carbon emissions higher than that of the new build option over a predicted 60-year lifespan. This is attributed to the lower performance of the building fabric and internal conditions from the refurbished option, compared to that possible from the demolition and erection of a new building.

The demolition waste that arises as part of this new build development will be reused within the project wherever feasible. Where this is not viable, the waste will be recycled.

**Land Form and Site Layout**

Consideration has been given to the layout and scale of the surrounding buildings. The height of the surrounding context is 2-4 storey residential buildings.

The scheme comprises a residential development that includes the construction of one, four-storey building including a basement level. Therefore, acknowledging the surrounding context within its design.

**Daylight & Sunlight Impacts**

Consideration has been given to neighbouring amenity and open spaces; due to appropriate design of the building and overall site layout these are expected to experience minimal overshadowing effects. The scheme is also expected to have no adverse effects on access to daylight and sunlight of neighbouring properties (to accurately confirm this would require a Daylight and Sunlight Assessment submitted in support of this application).

**Micro-climate**

A microclimate is the distinctive climate of a small-scale area and the variables within it, such as temperature, rainfall, wind or humidity may be subtly different to the conditions prevailing over the area as a while. The main characteristics of microclimates within London are temperatures and wind. The proposed scheme is not of a scale that could potentially have any significant impact on wind conditions around the site or any adverse effects on pedestrian and residents' comfort.

**Urban Greening**

The proposed scheme will contribute to the increase of green spaces within London by providing landscaped areas, which contribute to increase in physical activity and relaxation of the owner, improvement of local air quality, and reduction of Urban Heat Island effect.

**Impacts on Neighbours from Demolition and Construction**

Construction impacts such as dust generation and increased traffic movements will be minimised through adoption of best practice construction measures, formalised through the production of a Construction and Environmental Management Plan to be delivered by the main contractor where appropriate.

The Considerate Constructors Scheme is recommended to ensure that contractors carry out their operations in a safe and considerate manner.

**Land Contamination**

In the event of any discovery of potentially contaminated soils or materials, this discovery will be quarantined and reported to the most senior member of site staff or the designated responsible person at the site for action. The location, type and quantity will be recorded and the Local Authority, a competent and appropriate third party will be notified immediately. An approval from the Local Authority will be sought prior to implementing any proposed mitigation action.

## HEALTH AND WELLBEING

**Inclusive Design**

The development aims to prioritise the future needs of occupants by ensuring that the dwelling is designed to comply with Part M of the Building Regulations.

**Safety and Security**

The design team will follow the principles of Secured by Design to provide safe and secure spaces.

**Open Spaces/Amenity**

Private amenity spaces are provided as part of the design to allow the owner areas to gather, socialise and connect to the natural environment. This will also enhance the occupant's wellbeing as nature can significantly improve mood and happiness.

**Daylight/Sunlight**

By including good levels of glazing throughout the design the proposed development ensures that occupants enjoy satisfactory levels of visual comfort and beneficial effects from daylight exposure, whilst also reducing energy consumption by minimising the use of artificial lighting as far as feasible.

**Physical activity**

The presence of amenity providers (shops, pharmacies, public park) within walking distance to the development will encourage residents to walk rather than use personal vehicles.

## ENERGY & CARBON DIOXIDE EMISSIONS

The Energy Strategy for the development has been designed in line with the London Plan's Policy SI2 which states that every effort should be made to minimise carbon dioxide emissions in accordance with the following energy hierarchy:

- Be lean: use less energy
- Be clean: supply energy efficiently
- Be green: use renewable energy
- Be seen: monitoring

**Be Lean**

The buildings have been thoughtfully designed to reduce energy demand through an enhanced building fabric, minimising heat loss through air infiltration, reducing reliance on artificial lighting, utilising low energy lighting and ensuring adequate levels of ventilation are maintained whilst reducing heat loss through the specification of MVHR.

**Be Clean**

The application site is located in an area where district heating is not expected to be implemented in the future. ASHP are instead proposed to provide low carbon heat to the dwelling. Therefore no savings are targeted here.

**Be Green**

A range of renewable technologies were considered for generating on-site renewable energy. Air source heat pumps (ASHP) were considered a suitable technology for this development due to adequate space to house the necessary plant equipment, easy installation process, and substantial $CO_2$ savings. The incorporation of this technology into this development would contribute an additional estimated reduction of 65.4% of regulated $CO_2$ emissions over the be clean emissions.

**Be Seen**

In addition to the above design measures, the development will incorporate monitoring equipment and systems to enable occupiers to monitor and reduce their energy use.

A smart meter will be installed to monitor the heat and electricity consumption; the display board will demonstrate real-time and historical energy use data and will be installed at an accessible location within the dwelling.

## WATER

### Water Efficiency

The development at 71 Avenue Road aims to reduce water consumption to less than 105 litres per person per day, in line with the recommended target set out in the Housing SPG, through the use of water efficient fittings, and these are listed below.

Table 1: Recommended specification for sanitary fittings

| Fitting | Fitting specification |
|---|---|
| WC | 6/3 litres dual flush |
| Kitchen sink tap | 6 litres per min |
| Wash basin tap | 4 litres per min |
| Shower | 8 litres per min |
| Bath | 180 litres |
| Washing machine | 8.17 litres/kg |
| Dishwasher | 1.25 litres/place setting |

### Water Efficient Landscaping

Potable water consumption reduction from irrigation can be further maximised through a combination of water reuse and use of both native and drought resistant plant species, which will thrive with little to no irrigation and rely only on natural rainfall.

## MATERIALS AND WASTE

### Responsible Sourcing

100% of the timber used during construction will be sourced from accredited Forest Stewardship Council (FSC) or Programme for the Endorsement of forestry Certification (PEFC) source.

The main contractor will be required to prioritise products holding responsible sourcing certification (EMS/ISO14001) for the key process as per minimum, to ensure economic, social and environmentally responsible practices are implemented throughout construction products supply chain.

### Healthy Materials

To minimise potential sources of indoor air pollution, low VOC paints, finishes and other products will be prioritised as far as practically possible. Best practice design detailing and careful construction techniques will also be employed to reduce the risk of thermal bridging and condensation issues, limiting the potential for mould growth.

### Embodied Carbon

To further reduce carbon emissions over the lifecycle of the building, low embodied carbon materials will be used as far as practically possible, whilst also focusing on design practices to reduce waste production.

### Circular Economy

Circular economy is based on three key principles: design out waste, keep products and materials in use, and regenerate natural systems. These principles will be applied during the design and construction of the proposed development by following the actions noted below:

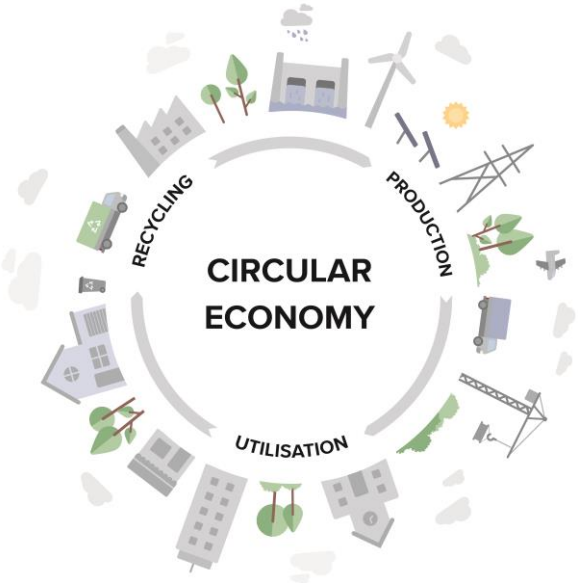
- Design out the need for building components and materials;
- Use of reclaimed materials and remanufactured components over new;
- Product selection considering its entire lifecycle, such as products which can be remanufactured or reused; products with high recycled content; products designed for disassembly; and recyclable or compostable materials.

### Construction Waste

A site waste management plan should be prepared for the development which will include a pre-demolition audit to identify any key materials suited for recovery and reuse. The SWMP will outline the methodologies for estimating waste quantities and streams generated during the demolition, excavation and construction stages of the site works, and set out recommended measures required to be adopted by the Main Contractor to minimise these as far as practically possible.

### Operational Waste

An operational waste management strategy should be produced and implemented for the proposed development. This will demonstrate how the development has taken into account sustainable methods for waste and recycling management during its operation in order to meet requirements from the London Plan and Camden policies and all applicable legal requirements.



## NATURE CONSERVATION & BIODIVERSITY

The ecology on site will be improved via the introduction of landscaped areas within the proposed private garden. The intended planting strategy for these areas is simple low-level flora, with hedge planting and small ornamental trees. Native plant species will be introduced to these areas where possible. This will help to attract invertebrates, birds and other fauna to the area.

The proposed development aims to improve the green cover of the site by introducing an extensive green roof and landscaped areas and has made provision for large private amenity space around the entire dwelling. Planting will include heat and drought resistant species, where feasible.

## CLIMATE CHANGE ADAPTATION

**Overheating**

The potential risk of overheating will be mitigated by incorporating both passive and active design measures.

The space heating and hot water to the development will be provided by individual ASHPs. All heat sources and pipe work will be sufficiently insulated to avoid excess heat loss into internal space.

Efficient lighting will be used to further minimise internal heat gains and reduce energy expenditure.

Appropriately sized windows will reduce solar heat gains. Internal blinds will be included to reduce the solar gains into occupied rooms where required. Glazing with appropriate levels of solar transmittance will be used throughout the development to reduce solar gains and reduce the risk of overheating.

During peak summer periods the thermal mass of the buildings will absorb and store excess heat. The buildings will release heat in the cooler evenings to allow for cooler internal spaces, dampening the peak diurnal weather conditions.

The dwelling has been design with mechanical ventilation as primary strategy for dissipating heat.

**Surface Water and Flooding**

Sustainable urban drainage systems (SUDS), comprising permeable paving and planting, will be incorporated on site and the buildings' fabric and structure will be designed to minimise risk of infiltration and damage via flooding where possible.

In addition, an attenuation tank which will provide attenuation of c.8.55m$^3$ will also be incorporated as part of the design.

In accordance with the London Plan, the peak surface water run-off rates will be reduced as far as feasible prior to discharge to the public sewer.

## AIR, NOISE AND LIGHT

**Air Quality**

Air pollution risks from construction and demolition activities on site will be minimal in line with the SPG 'The control of dust and emissions from construction and demolition' under the following categories:

- demolition;
- earthworks;
- construction;
- trackout; and,
- non-road mobile machinery (NRMM).

The potential impacts from dust and stationary plant emissions during the construction period and the potential impact from traffic flows on the local road network on both on-site and off-site receptors, during and after construction should be monitored. Where necessary, mitigation measures should be implemented to reduce any air quality impact.

During the operational phase of the development, combustion of fossil fuels and associated combustion emissions for heating will be completely removed through the specification of a highly efficient electricity-led servicing strategy and low carbon heating strategy in addition to improved levels of insulation and air tightness for the buildings' fabric.

**Noise**

The development will incorporate design and building fabric measures to mitigate potential noise levels from the proposed development and ensure the impact of any external sources on internal ambient noise levels are within acceptable limits.

**Light Pollution**

The lighting design of the proposed development will follow the recommendations of the Institution of Lighting Engineers' Guidance Notes for the Reduction of Obtrusive Light (2005), to minimise light pollution.

**Water Pollution**

Water pollution to surrounding watercourses will be minimised where possible. In addition, contractors will adopt best practice policies to mitigate water pollution from construction activities on site.

The development will discharge domestic sewage via a connection to the public foul sewer or combined sewer network where it is reasonable to do so.

## TRANSPORT

**Alternative means of transportation**

In order to underpin the reduction of emissions from transport, the development has been designed to encourage cycling; cycle parking will be provided to the dwelling via a secure garden shed location externally on the side of the house by the secondary entry.

**Public Transport Accessibility**

The proposed site has good transport links. The closest train station is Swiss Cottage, located approximately 0.4 miles from the site (8 minute walk). From here, the Jubilee line can be caught for transport further afield in London. Alternatively, overground trains can be caught from the South Hampstead tram station which is located approximately 0.6 miles from the site (12 minute walk).

The closest bus stops are located approximately equal distances from the site on Finchley Road, to the west of the site, and Adelaide Road, to the north of the site. From these stops a range of buses can be caught, including the 13, 31, 46, 113, 187, C11, N28, N31 and N113 services.

# ENERGY STRATEGY

This section describes the predicted energy performance and carbon dioxide emissions of the proposed 71 Avenue Road development based on the information provided by the design team.

The overall regulated $CO_2$ savings *on site* against a Part L 2021 compliant scheme are estimated at 69.5% for the site as whole.

## METHODOLOGY

The methodology used to determine $CO_2$ emissions is in accordance with the London Plan's three-step Energy Hierarchy (Policy SI 2). The development is compared to a Building Regulations Part L 2021 compliant scheme. The reductions estimated through each step are outlined below.

## BE LEAN – USE LESS ENERGY

The proposals incorporate a range of passive and active design measures that will reduce the energy demand for space conditioning, hot water, ventilation and lighting. Measures will also be put in place to reduce the risk of overheating.

### *PASSIVE DESIGN MEASURES*

#### ENHANCED U-VALUES

The heat loss of different building fabric elements is dependent upon their U-value, which is a measure of the thermal transmittance through the element. An element with low U-value provides better levels of insulation and reduced heating demand.

The proposed development will incorporate high levels of insulation and high-performance glazing beyond Part L 2021 standards and notional building specifications, in order to reduce the demand for space conditioning.

The table to the right demonstrates the improved performance of the proposed building fabric beyond the Building Regulations requirements for both domestic.

Table 2: Thermal Envelope U-values

| Domestic (U-values in W/m².K) | | | |
|---|---|---|---|
| **Element** | **Building Regulations** | **Proposed** | **Improvement** |
| External Walls | 0.26 | 0.15 | 50% |
| Swimming pool basin walls | 0.25 | 0.15 | 40% |
| Floor | 0.18 | 0.10 | 44% |
| Main Roof | 0.16 | 0.10 | 38% |
| Terraces | 0.16 | 0.10 | 38% |
| Windows | 1.60 | 1.00 | 38% |

#### AIR TIGHTNESS IMPROVEMENT

Heat loss may also occur due to air infiltration. Although this cannot be eliminated altogether, good construction detailing, and the use of best practice construction techniques can minimise the amount of air infiltration.

The proposed development will aim to improve upon the Part L 2021 minimum standards for air tightness by targeting air permeability rates of $3m^3/m^2$ at 50Pa.

### REDUCING THE NEED FOR ARTIFICIAL LIGHTING

The design of the development incorporates large areas of glazing across all building elevations, to optimise daylight in occupied spaces. Good internal daylight levels will translate to less dependency on artificial lighting and will indirectly deliver energy and carbon savings, together with pleasant, healthy spaces for occupants.

## *THERMAL BRIDGING*

Thermal bridging can cause significant heat loss within buildings, whereby junctions between insulated building fabric elements provide less thermal resistance than the surrounding envelope. While repeating thermal bridges such as timber studs, rafters and wall ties are accounted for within u-value calculations, linear thermal bridges such as floor junctions, corners, roof junctions and window reveals must be included separately within the SAP calculations.

Heat loss from linear thermal bridges is known as the Psi-value (Ψ). Psi-values can be obtained through the modelling of specific junctions based on the proposed construction details is measured in W/mK. The cumulative impact of the total heat loss expected from all the thermal bridges combined is known as the y-value. The Building Regulations Part L 2021 uses a reference y-value of 0.08 for the notional building.

The proposed development will aim to meet and exceed the Part L 2021 target of by achieving a y-value of 0.04-0.08 for the thermal envelope for each dwelling, dependent on layout and number of resultant thermal bridges, and this figure has been used within the calculations accordingly.

As the technical design of the building fabric is developed, consideration will be given to thermal bridges, and detailed modelling of the junctions will be carried out early on to ensure that these targets can be achieved.

## *ACTIVE DESIGN MEASURES*

### HIGH EFFICACY LIGHTING

The development intends to incorporate low energy lighting fittings throughout. All light fittings will be specified as low energy lighting and will primarily accommodate LEDs.

### HEAT RECOVERY VENTILATION

Mechanical ventilation heat recovery (MVHR) is proposed. The mechanical ventilation system will include heat recovery in order to achieve ventilation in the most energy-efficient way.

### HEAT GENERATION

At the Be Lean Stage of the energy hierarchy, a gas boiler with 89.5% efficiency has been assumed in the assessment to accurately reflect the estimated savings due to energy efficiency improvements only; this methodology is in line with GLA guidance. Highly efficient ASHP are proposed to be used as part of the final strategy (Be Green stage) and carbon emissions will be minimised. It is proposed that the gross efficiency of these heat pumps is at least 300%.

### CONTROLS

Advanced lighting and space conditioning controls will be incorporated, specifically:

- Heating controls in dwellings will comprise either programmer and room thermostats; and,
- Time and temperature zone controls.

### MONITORING

In addition to the above design measures, the development will incorporate monitoring equipment and systems to enable occupiers to monitor and reduce their energy use.

Smart meters will be installed to monitor the heat and electricity consumption of each dwelling; the display board will demonstrate real-time and historical energy use data and will be installed at an accessible location within the dwellings.

## *MINIMISING OVERHEATING*

The potential risk of overheating will be mitigated by incorporating passive and active design measures, in line with the London Plan Policy SI4 and the Cooling Hierarchy, as follows.

### MINIMISING INTERNAL HEAT GENERATION THROUGH ENERGY EFFICIENT DESIGN

Heat sources and pipework will be sufficiently insulated to reduce heat dissipation in occupied spaces. Efficient lighting will be used to further minimise internal heat gains and reduce energy expenditure.

### REDUCING THE AMOUNT OF HEAT ENTERING THE BUILDING IN SUMMER

The openings across the development have been appropriately designed to offer satisfactory daylight and views to occupied spaces, without disproportionately increasing solar gains and overheating risks.

### USE OF THERMAL MASS AND HIGH CEILINGS TO MANAGE THE HEAT WITHIN THE BUILDING

In summer, and during peak hours of the day a high thermal mass building envelope will absorb and store excess heat that builds up into the space maintaining a cooler indoors compared to a low thermal mass building.

The stored heat will be released back into the space during the cooler hours of the evening.

A high thermal mass envelope, when coupled with night time ventilation is therefore capable of dampening the peak internal conditions during the day that could otherwise cause thermal discomfort.

### PASSIVE VENTILATION

The development has allowed for passive ventilation as the secondary strategy for dissipating heat that builds up within the building. The passive ventilation strategy includes single-sided ventilation, cross ventilation and night purge ventilation through openable windows and doors, operated by the occupants.

### MECHANICAL VENTILATION

The primary strategy for fresh air supply will be through an MVHR system, with a by-pass 'summer mode' activated to allow for free cooling of occupied spaces through the incoming outdoor air and the dissipation of built-up heat.

The dwelling has been designed with passive ventilation as a primary strategy for dissipating heat during peak summer conditions.

### OVERHEATING RISK ASSESSMENT

A full dynamic Overheating Risk Assessment has not been undertaken for the dwelling. However, the potential risk of overheating will be mitigated by incorporating both passive and active design measures.

Efficient lighting will be used to minimise internal heat gains and reduce energy expenditure.

Appropriately sized windows will further reduce solar heat gains. Glazing with low transmittance will be used throughout the development to reduce solar gains and reduce the risk of overheating.

During peak summer periods the thermal mass of the buildings will absorb and store excess heat. The buildings will release heat in the cooler evenings to allow for cooler internal spaces, dampening the peak diurnal weather conditions.

The dwellings have allowed for passive ventilation as secondary strategy for providing fresh air and dissipating heat.

## *BE LEAN $CO_2$ EMISSIONS & SAVINGS*

By means of energy efficiency measures alone, regulated $CO_2$ emissions are estimated to reduce by 11.8%, equivalent to 9.79 tonnes per annum, across all dwellings.

Therefore, at the 'Be Lean' stage, the proposed development meets the GLA target of 10% regulated $CO_2$ emission reductions for the residential portion of the scheme.

Energy cost to the end tenant is also reduced through the implementation of energy efficiency measures that were outlined within this section.

## BE CLEAN – SUPPLY ENERGY EFFICIENTLY

The closest identified existing or proposed district heat networks are located at a distance of 1.2km and 1.8km from the site. Therefore, a connection to one of these networks is not deemed feasible for the proposed development; as a result no regulated carbon savings are targeted at this stage of the energy hierarchy.

### *ENERGY SYSTEM HIERARCHY*

The energy system for the development has been selected in accordance with the London Plan decentralised energy hierarchy. The hierarchy listed in Policy SI3 states that energy systems should consider:

- Connection to existing heating and cooling networks;
- Site wide CHP network; and,
- Communal heating and cooling.

Local heat and power sources minimise distribution losses and achieve greater efficiencies when compared to separate energy systems, thus reducing $CO_2$ emissions.

In a communal energy system, energy in the form of heat, cooling, and/or electricity is generated from a central source and distributed via a network of insulated pipes to surrounding residences.

### *CONNECTION TO AN EXISTING NETWORK*

The London Heat Map identifies existing and potential opportunities for decentralised energy projects in London. It builds on the 2005 London Community Heating Development Study.

An excerpt from the London Heat Map can be seen on the following page which shows the energy demand for different areas. Darker shades of red signify areas where energy demand is high. The map also highlights any existing and proposed district heating networks within the vicinity of the development.

A review of the map shows that the closest networks to the site are the proposed South Kilburn network and the Somers Town Heat Network. These two networks are situated approximately 1.6km west and 2.5km east of the site respectively. Therefore, a connection to either network is not deemed feasible. Please refer to Figure 2 on the following page for a snapshot of the London Heat Map.

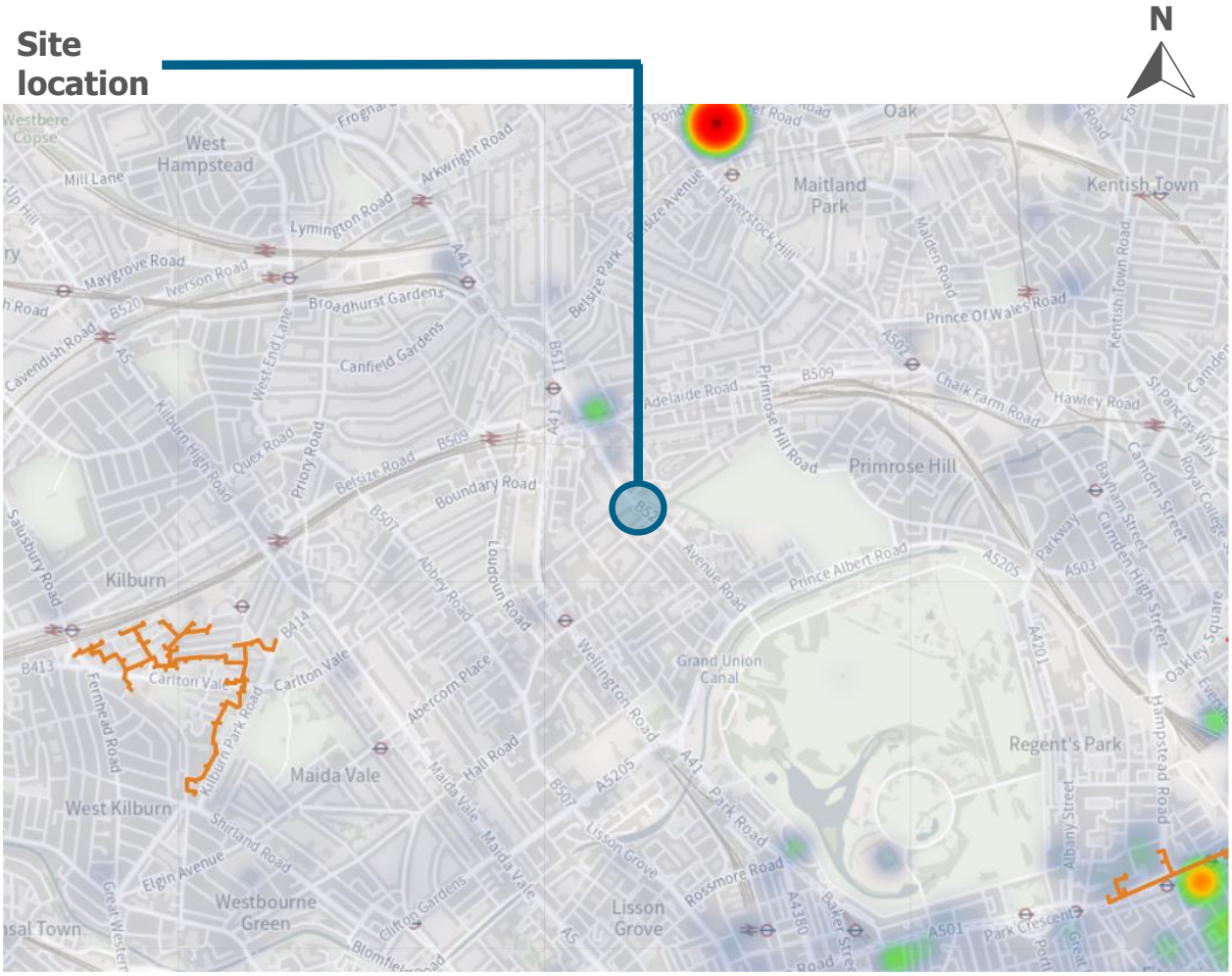



Figure 2: Excerpt from the London Heat Map. Existing district networks outlined in red, proposed networks in orange.

### *COMMUNAL HEATING AND COOLING*

A centralised system is not suitable to a development of this size, due to the development comprising only one dwelling.

### *INDIVIDUAL HEATING AND COOLING*

The proposed development comprises only one dwelling therefore an individual low carbon HVAC strategy is deemed the most suitable.

Space heating and hot water for the proposed dwelling will therefore be provided by individual ASHPs.

### *BE CLEAN $CO_2$ EMISSIONS & SAVINGS*

Given that it has not been found feasible or viable for the proposed development to incorporate the supply of low carbon heating or cooling, no carbon savings are achieved for this step of the Energy Hierarchy.

## BE GREEN – USE RENEWABLE ENERGY

The renewable technologies feasibility study carried out for the development identified air source heat pumps as suitable technologies for the development. The regulated carbon saving achieved in this step of the Energy Hierarchy is 55.9% over the site wide baseline level.

### *RENEWABLE TECHNOLOGIES FEASIBILITY STUDY*

Methods of generating on-site renewable energy (Green) were assessed, once Lean and Clean measures were taken into account.

The development of 71 Avenue Road will benefit from an energy efficient building fabric which will reduce the energy consumption of the proposed development in the first instance. A range of renewable technologies were subsequently considered including:

- Biomass;
- Ground/water source heat pumps;
- Air source heat pump;
- Wind energy;
- Photovoltaic panels, and,
- Solar thermal panels.

In determining the appropriate renewable technology for the site, the following factors were considered:

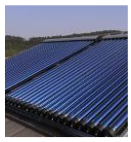
- $CO_2$ savings achieved;
- Site constraints;
- Any potential visual impacts, and,
- Compatibility with the 'Clean' stage proposals where applicable.

### *RENEWABLE ENERGY APPRAISAL SUMMARY*

The table below summarises the factors taken into account in determining the appropriate renewable technologies for this project. This includes estimated capital cost, lifetime, level of maintenance and level of impact on external appearance. The final column indicates the feasibility of the technology in relation to the site conditions (10 being the most feasible and 0 being infeasible). It is important to note that the information provided is indicative and based upon early project stage estimates.

The feasibility study demonstrates that ASHP would be the most feasible renewable technologies for the proposed Avenue Road development.

Table 3: Summary of renewable technologies feasibility study

| | | Comments | Lifetime | Maintenance | Impact on external appearance | Site feasibility |
|---|---|---|---|---|---|---|
| Biomass |  | Not adopted - burning of wood pellets releases high NOx emissions and capital cost of multiple systems to cover each dwelling would be very high. Further, there would be potential substantial traffic impacts of transporting biomass fuel to site. | 20 yrs. | High | High | 3 |
| PV |  | Not adopted - PV panels mounted on the pitched roof would alter the external appearance of the building. | 25 yrs. | Low | Med | 8 |
| Solar thermal |  | Not adopted - Solar thermal array mounted on the pitched roof would alter the external appearance of the building. Additionally, increased savings would be experienced through PV. Further, a solar thermal array would compete for the hot water demand with the proposed heat pump systems. | 25 yrs. | Low | Med | 8 |
| GSHP |  | Not adopted -the installation of ground loops requires significant space, additional time at the beginning of the construction process and very high capital costs. | 20 yrs. | Med | Low | 4 |
| ASHP |  | Adopted | 20 yrs. | Med | Med | 9 |
| Wind |  | Not adopted - Wind turbines located at the site would have a visual impact on the area, and also a significant capital cost. | 25 yrs. | Med | High | 2 |

## *DETAILED ASSESSMENT OF AIR SOURCE HEAT PUMPS*

Air source heat pumps (ASHPs) employ the same technology as ground source heat pump (GSHPs). However, instead of using heat exchangers buried in the ground, heat is extracted from the external ambient air.

The efficiency of heat pumps is very much dependent on the temperature difference between the heat source and the space required to be heated. As a result, ASHPs tend to have a lower COP than GSHPs. This is due to the varying levels of air temperature throughout the year when compared to the relatively stable ground temperature. The lower the difference between internal and external air temperature, the more efficient the system.

ASHP is considered a suitable technology for the development for the following reasons:

- It is a high efficiency system that can cater for the space heating and cooling of the most energy-intensive areas of the proposed development;
- Requires less capital cost than GSHP and other renewable technologies;
- It can be integrated with the proposed ventilation strategy; and,
- It is simple to install when compared to other renewable technologies.

The table across summarises the technical data for the proposed ASHP and estimated $CO_2$ savings from the application of this technology. In total the ASHP technology would produce regulated $CO_2$ savings of 65.4% for the development.

Table 4: Summary of technical/operational data and estimated $CO_2$ savings for ASHP

| ASHP for non-domestic spaces | | |
|---|---|---|
| COP heating | > 3.0 | |
| Carbon intensity of electricity | 0.136 | kgCO2/kWh |
| Proportion of space heating and hot water met by ASHP | 100 | % |
| Proportion of non-domestic space cooling met by ASHP | 100 | % |
| Total $CO_2$ savings | 7.53 | t/yr. |
| Regulated baseline $CO_2$ emissions | 13.04 | t/yr. |
| % Regulated $CO_2$ reduction* | 65.4 | % |
| % Total $CO_2$ reduction* | 69.5 | % |

* % reduction from site baseline


Figure 3: Outdoor unit of an ASHP

### *BE GREEN AND CUMULATIVE $CO_2$ EMISSIONS & SAVINGS*

The incorporation of air source heat pumps will reduce $CO_2$ emissions by a further 65.4% (7.53 tonnes) over the Be Clean and Be Lean stages, equating to cumulative savings of 69.5% over the site-wide baseline carbon emissions.

### *CARBON OFF-SETTING*

The proposed development complies with the London Plan $CO_2$ savings target of 35% overall.

To achieve 'zero carbon' for the residential portion of the scheme, 3.98 tonnes per annum of regulated $CO_2$, equivalent to 119.4 tonnes over 30 years, should be offset offsite. This equates to an offset contribution of £11,342.

# CONCLUSIONS

The sustainability strategy for the scheme at 71 Avenue Road has been developed in line with the relevant policies of the London Plan and of the London Borough of Camden's Local Plan and aims at the efficient management of resources, environmental protection and the effective adaptation and mitigation of the development to climate change.

The energy strategy has been developed in line with the three-step Energy Hierarchy and the cumulative $CO_2$ savings on site are estimated regulated $CO_2$ savings for the site as a whole are 69.5%.

## SUSTAINABILITY

The proposed 71 Avenue Road development will meet the targets set out by London Borough of Camden and the Greater London Authority (GLA).

Key sustainability features of the proposals include:

- Effective site layout in response to the neighbouring context;
- Efficient design of the proposed massing, openings and internal layouts so that habitable spaces across the site benefit from abundant daylight and sunlight levels, whilst impacts to neighbouring buildings are kept to a minimum;
- The specification of water efficient fittings to limit water consumption to less than 105 litres per person per day for domestic uses;
- The incorporation of SUDs in the form of rainwater harvesting butts, SuDS planters, and an attenuation tank;
- The protection of natural features of ecological value;
- Enhancing the biodiversity of the site through an extensive green roof, private amenity to the front and rear which incorporatesplanting throughout;
- Targeting of an Urban Greening Factor of 0.4 or less;
- Effective pollution management and control: the development is not expected to have any significant adverse effects to air, noise, land, or watercourses;
- Incorporation of electric vehicle charging points;
- Minimised overheating risk through sufficient operability of windows and low g-values;
- Highly efficient air source heat pump to provide the main heating and domestic hot water;
- Reduction of the whole life carbon of the development through;
    - Reusing materials wherever possible
    - Using local suppliers; manufacturers where feasible; and,
    - Following circular economy principles.

The sustainability measures incorporated reflect the client and design team's aspirations in integrating sustainability measures and demonstrates that the project is designed to exceed the planning policy sustainability requirements.

## ENERGY STRATEGY

By implementing the three step Energy Hierarchy as detailed in the previous sections, the Regulated $CO_2$ emissions for the development have been reduced against a Part L 2021 compliant scheme through on-site measures alone by:

- 69.5% (9.06 tonnes per annum) across the whole site.

The proposed development complies with the London Plan $CO_2$ savings target of 35% overall.

To achieve 'zero carbon' for the residential portion of the scheme, 3.98 tonnes per annum of regulated $CO_2$, equivalent to 119.4 tonnes over 30 years, should be

offset offsite. This equates to an offset contribution of £11,342.

The tables below summarise the implementation of the Energy Hierarchy for the proposed scheme and detail the $CO_2$ emissions and savings against the baseline scheme for each step of the hierarchy; as well as the savings achieved through carbon offset.

Overall, the proposed development has been designed to meet energy policies set out by the GLA and the London Borough of Camden, which demonstrates the client and the design team's commitment to enhancing sustainability of the scheme.

## CUMULATIVE SAVINGS ON SITE

Table 5: $CO_2$ emissions after each step of the Energy Hierarchy for the domestic part of the development.

| | Carbon dioxide emissions for domestic buildings (tonnes CO2 per annum) |
|---|---|
| | Regulated |
| Baseline | 13.04 |
| After energy demand reduction | 11.51 |
| After heat network/CHP | 11.51 |
| After renewable energy | 3.98 |

Table 6: Regulated $CO_2$ savings from each stage of the Energy Hierarchy for the domestic part of the development

| | Regulated domestic carbon dioxide savings | |
|---|---|---|
| | Tonnes $CO_2$ per annum | % over previous level of energy hierarchy |
| Savings from energy demand reduction | 1.53 | 11.80 |
| Savings from heat network | 0.00 | 0.00 |
| Savings from renewable energy | 7.53 | 65.4 |
| Cumulative on-site savings over baseline | 9.06 | 69.5 |
| Cumulative for offset payments | 119.4 tonnes CO2 cumulative shortfall over 30 years | |

# APPENDIX A – SAP RESULTS

The table below lists, the TER and DER outputs and the % $CO_2$ reduction achieved after the Be Lean, Be Clean and Be Green measures have been applied for the proposed dwelling.

| SAP Ref No. | Unit Ref. | TER ($kgCO_2/m^2/yr.$) | DER ($kgCO_2/m^2/yr.$) | % $CO_2$ reduction |
|---|---|---|---|---|
| 1 | 71 Avenue Road | 10.88 | 3.32 | 69.5 |

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