Highgate Studios
London Borough of Camden
Planning Energy Statement

Client	Kentish Town UK Office Propco Limited

Date	25 April 2023
File Ref	P.019009 - Highgate Studios - Energy Statement_R004 (WIP)
Revision	R004
Classification	☒ Public | ☐ Internal | ☐ Restricted | ☐ Confidential

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Revision

REVISION	REVISION DETAILS / ISSUE TYPE	PAGE NOS	DOCUMENT PREPARED BY			DOCUMENT CHECKED BY		
			NAME	SIGNATURE	DATE	NAME	SIGNATURE	DATE
R001	First Issue	All	CDG		08/02/2023	OH		08/02/2023
R002	Refurbished Units added	All	CDG		31/03/2023	OH		31/03/2023
R003	Site Description Updated	All	CDG		24/04/2023	OH		24/04/2023
R004	Updated to Architectural Comments	All	CDG		25/04/2023	OH		25/04/2023

This document and its contents are confidential and have been prepared and are intended solely for **Kentish Town UK Office Propco Limited's** information and use in relation to the **Highgate Studios**, **in London.**

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Executive Summary

RED Engineering design has been commissioned to advise on compliance of the designed scheme with the current planning policies as stipulated by the **Camden Local Plan (2017)** and **The London Plan (2021)** policies.

The proposed site is located in Kentish Town, in the London Borough of Camden. The proposed development includes the demolition of existing buildings and structures at Plot A and Plot F and erection of a 7-storey building at Plot A and 4-storey building at Plot F; part demolition of the basement at Plot G in connection with erection of a new building at Plot F and part demolition of the basement at Plot D in connection with the extension to Plot E; erection of extensions at Plot B, E and J on the existing buildings; roof extension of Plot I; external refurbishment of the existing buildings at Plot C and D; demolition of existing security structure and replacement with a new entrance pavilion, with cycle parking, hard and soft landscaping and associated works and plant; to provide Class E (g) use plus a range of other supporting and ancillary uses.

The planning policies as presented by the Greater London Authority require the energy statement to include a calculation of baseline energy demand and CO_2 emissions after the application of energy efficiency measures, decentralised Low/Zero Carbon generation and renewable energy sources.

In accordance with the GLA document **Energy Assessment Guidance (June 2022),** the calculations within this report are based upon the latest Part L 2021 carbon emissions factors, as stated within tables 29, 30 & 31 of the **NCM Modelling Guide 2021 Edition**, and tables created using the latest (at the time of writing) GLA spreadsheet, ***Part_L_2021_gla_carbon_emission_reporting_spreadsheet_v2.0_0***.

The energy assessment addresses requirements in Policies SI 2 to SI 4 inclusive; recognises the integrated nature of London Plan policies; and takes account of relevant design, spatial, air quality, transport and climate change adaptation policies in the Plan. The assessment also considers the GLA guidance (June 2022) for calculating regulated CO_2 emissions. The process is summarised in the energy hierarchy below.

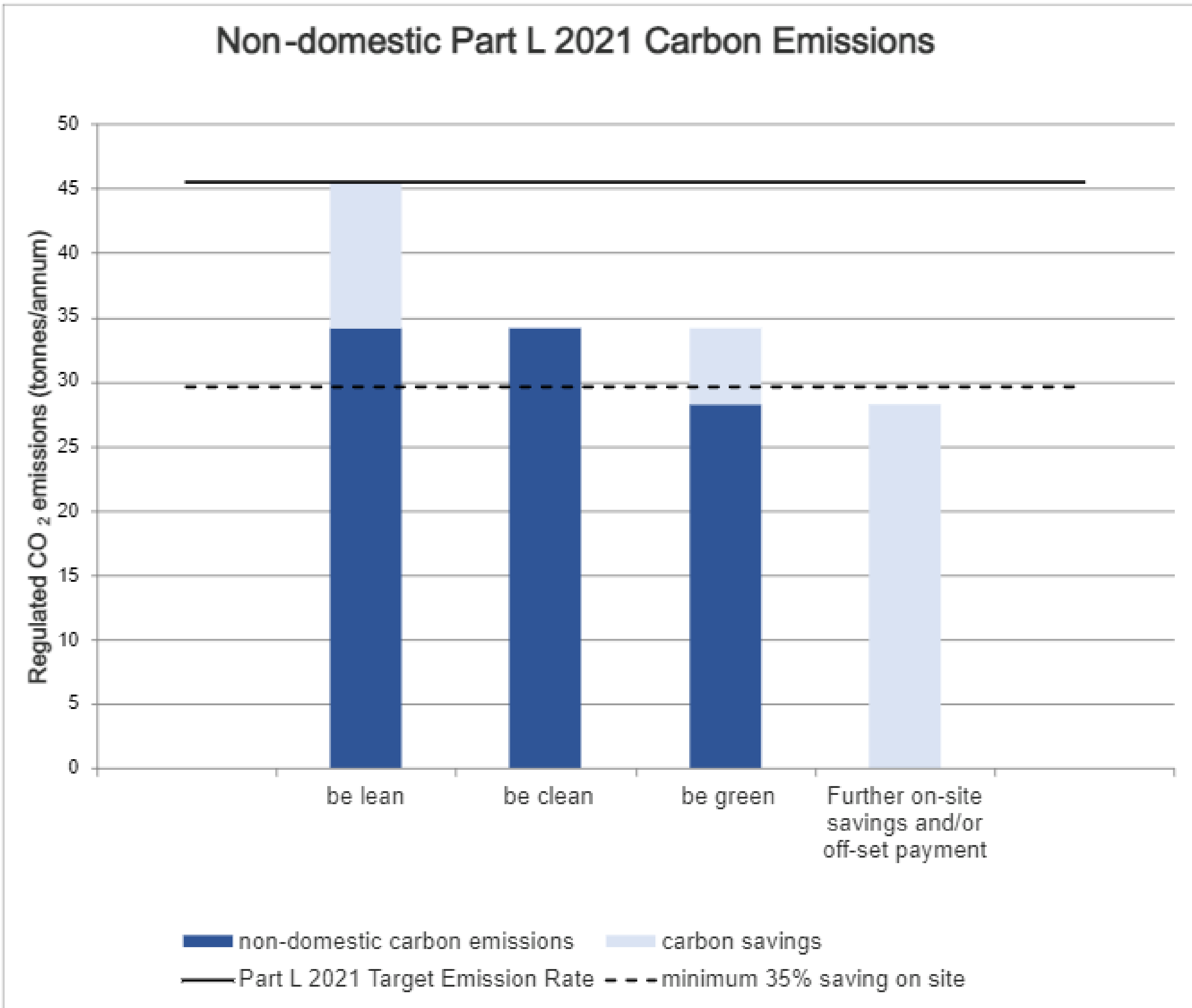


Figure 1 - Energy Hierarchy (New Builds and Extensions)

Lean CO_2 emissions reductions are achieved by the energy efficient design of the new buildings and new extensions to existing buildings, and by implementing passive and active energy saving measures. The key energy efficiency measures incorporated within the design are as follows:

- New building fabric with very high levels of insulation
- High levels of air tightness
- Optimised glazed areas
- External shading
- Solar control glazing to minimise cooling loads
- Air Source heat Pump (ASHP) [1] for space heating with no gas on site
- Mechanical ventilation with heat recovery
- High Efficacy LED Luminaires
- Lighting control including presence detection and daylight linked dimming
- 100% electric DHW

[1] Unlike previous versions of the London plan, the Lean variant now includes an ASHP with default efficiencies if this is part of the design.

Clean CO_2 emissions reductions are not achievable due to the absence of any existing or future district heating networks in the vicinity of the site and CHP not being feasible for the proposed development. As such, the Clean building CO_2 emissions are equal to those for the Lean building.

Green CO_2 emissions reductions are achieved by the introduction of Hybrid VRF Air Source heat pumps (ASHP) for space heating, and the 250 m^2 photovoltaic solar panels installed across Plots B, E, and J. The carbon reduction results for the site are shown in **Table 1 and 2** below, which demonstrate that the proposed office extensions improve upon the recommended emissions reduction of 35%, the remainder of the target reduction of 100% compared to the Baseline building is achieved through a carbon offset payment.

New Builds and Extensions	CARBON DIOXIDE EMISSIONS (TONNES CO_2 PER ANNUM)	
	REGULATED	UNREGULATED
Baseline: Part L 2021 of the Building Regulations Compliant Development	45.5	77.95
After Energy Demand Reduction (Be Lean)	34.2	77.95
After Heat Network Connection/CHP (Be Clean)	34.2	77.95
After Renewable energy (Be Green)	28.2	77.95

Table 1 - Carbon Dioxide Emissions after each stage of the energy hierarchy for new and extended non-domestic buildings.

New Builds and Extensions	REGULATED CARBON DIOXIDE SAVINGS	
	TONNES CO_2 PER ANNUM	%
Be Lean: Savings from energy demand reduction	11.3	25%
Be Clean: Savings from heat network / CHP	0.0	0%
Be Green: Saving from renewable energy	6.0	13%
Total Cumulative Savings	17.3	38%
Annual savings from off-set payment	28.2	-
	TONNES CO_2 PER ANNUM	
Cumulative savings for off-set payment	846	-
Cash-in-lieu contribution (£)	80,382	-

Table 2 - Regulated Carbon Dioxide Emissions savings after each stage of the energy hierarchy for new and extended non-domestic buildings.

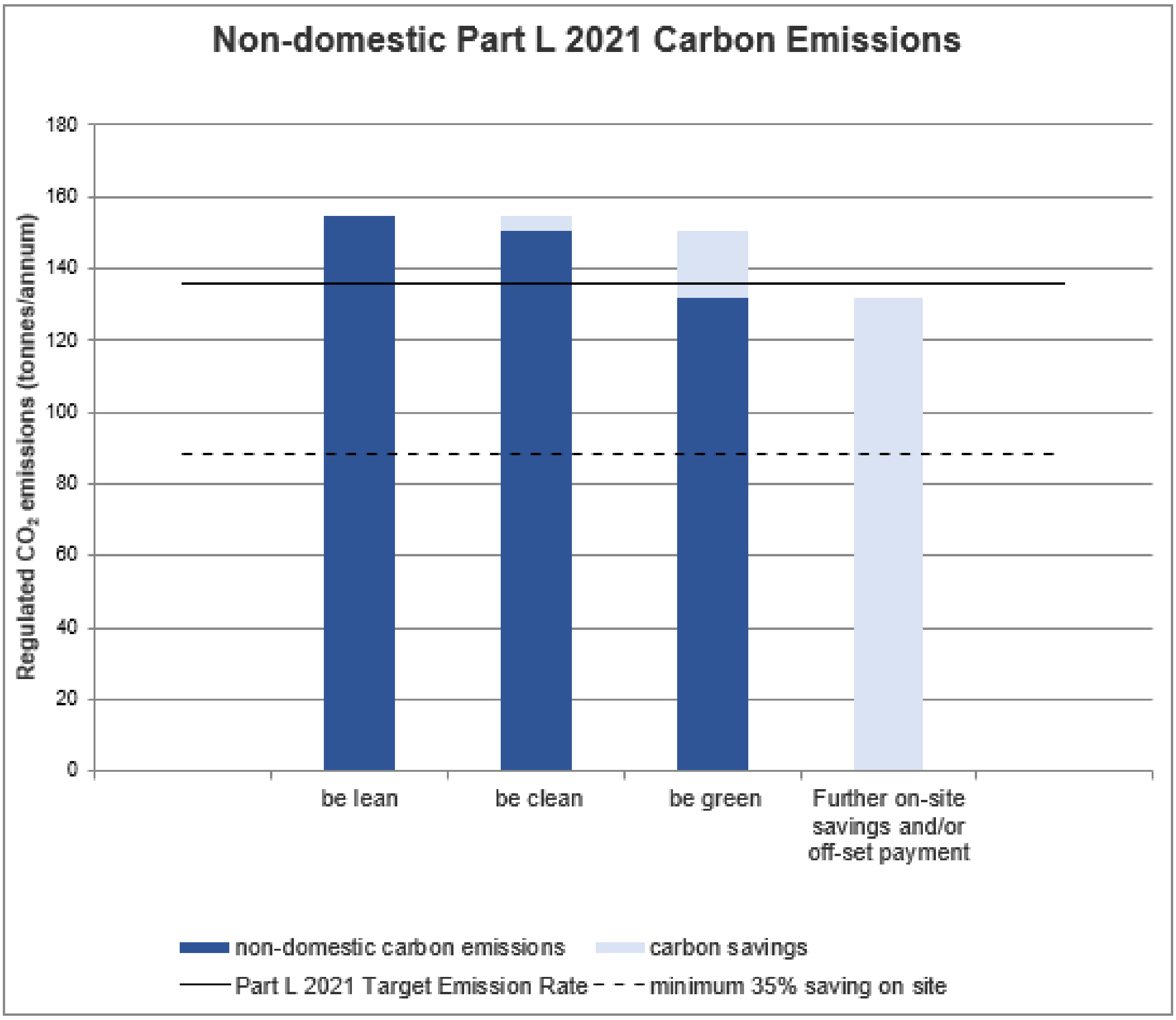


Figure 2 - Energy Hierarchy (Refurbished Buildings)

The following tables relate to the **refurbished buildings only** and demonstrate the energy efficiency of the refurbished building in accordance with the GLA requirements, it should be noted that the **carbon reduction targets are not mandatory for refurbished buildings** and no carbon offset payment is payable in relation to the buildings' refurbished parts.

Lean CO_2 emissions' reductions are achieved by the energy efficient design of the building and by implementing passive and active energy saving measures where feasible. The key energy efficiency measures incorporated within the design are as follows:

- Glazing thermal performance upgrades (U-value of 1.4 $W/m^2.K$)
- Air Source heat Pump (ASHP) [2] for space heating with no gas on site
- Mechanical ventilation with heat recovery
- High Efficacy LED Luminaires
- Lighting control including presence detection and daylight linked dimming
- 100% electric DHW

Clean CO_2 emissions reductions are not achievable due to the absence of District Heating networks and CHP not being feasible for the proposed development. As such, the Clean building CO_2 emissions are equal to those for the Lean building.

Green CO_2 emissions reductions are achieved by the introduction of Air Source Heat Pumps (ASHP) for heating throughout the development. The carbon reduction results for the site are shown in the **Table 3 and 4** below, which demonstrate that **the proposed refurbishment achieves carbon savings better than the baseline but falls short of the target 35%** due to limitations of the building fabric.

Refurbished Buildings	CARBON DIOXIDE EMISSIONS (TONNES CO_2 PER ANNUM)	
	REGULATED	UNREGULATED
Baseline: Part L 2021 of the Building Regulations Compliant Development	139.8	434.32
After Energy Demand Reduction (Be Lean)	162.6	434.32
After Heat Network Connection/CHP (Be Clean)	162.6	434.32
After Renewable energy (Be Green)	138.3	434.32

Table 3 - Carbon Dioxide Emissions after each stage of the energy hierarchy for the refurbished non-domestic buildings.

[2] Unlike previous versions of the London plan, the Lean variant now includes an ASHP with default efficiencies if this is part of the design.

Refurbished Buildings	REGULATED CARBON DIOXIDE SAVINGS	
	TONNES CO_2 PER ANNUM	%
Be Lean: Savings from energy demand reduction	-22.8	-16%
Be Clean: Savings from heat network / CHP	0.0	0%
Be Green: Saving from renewable energy	24.3	17%
Total Cumulative Savings	1.5	1%
Annual savings from off-set payment	138.3	-
	TONNES CO_2 PER ANNUM	
Cumulative savings for offset payment	N/A	-
Cash-in-lieu contribution	N/A	-

Table 4 - Regulated Carbon Dioxide Emissions savings after each stage of the energy hierarchy for the refurbished non-domestic buildings.

CONTENTS

1.0 Introduction

This report sets out the approach to energy efficiency at a national level as well as how energy efficient design measures will be integrated into the new buildings and extensions to the existing buildings that houses offices, restaurants, and cafes located at Highgate Studios in Kentish Town.

The London Borough of Camden is committed to achieving sustainable development. It sets demanding standards and targets so that all development contributes to improvements to job opportunities, reduction in CO_2 emissions, protection of other natural resources, stronger communities, protection of our environment, historic places and buildings, better homes and much more.

1.1 Summary of Energy Statement Requirements

The objective of this report is to define and outline how to incorporate low energy and renewable energy systems into the project at an early stage so that advice can be given early on the implications of compliance with Part L of the Building Regulations and the implications in relation to relevant planning policies.

In this document, the principles for developing an energy strategy are presented, where the main objective of the energy strategy is to reduce the CO_2 emissions from the proposed development.

The development of the energy strategy is based on the following principles:

- Reduce demand
- Meet end-use demand efficiently
- Supply from low/zero carbon technologies
- Enable effective energy management

1.2 Structure of Report

The structure is in accordance with the GLA Guidance on preparing energy assessments. This report comprises a number of sections that together provide a full description of the evaluation criteria, input data, assumptions and modelling methodology used in order to provide recommendations for the project to reduce energy consumption and associated CO_2 emissions.

This comprises:

2.0	Site Context
3.0	Policy Review
4.0	Description of Calculation Methodology and Simulation Software
5.0	‘Lean’ Building
6.0	Cooling & Overheating
7.0	‘Clean’ Building decentralised energy
8.0	‘Green’ building Review of LZC technologies
9.0	‘Green’ building energy & CO_2
10.0	Conclusion

2.0 Site Context

The **proposed site** is located in **The London Borough of Camden.**

As shown in **Figure 3**, it is located on the western side of Highgate Road, bounded by Sanderson Close to the north, the Murphy’s Yard site to the west and Carker’s Lane to the south. The Site falls within the Kentish Town Industrial Area and varies between 4-5 storeys in height, comprising a self- contained café and flexible uses as either office, nursery or retail.

Figure 3 - Aerial View of the Site location

3.0 Policy Review

This section reviews the planning policies, energy and sustainability targets that are relevant to this development.

3.1 National Planning Policy Framework (July 2021)

Planning law requires that applications for planning permission be determined in accordance with the development plan, unless material considerations indicate otherwise. The National Planning Policy Framework must be taken into account in preparing the development plan; and is a material consideration in planning decisions. Planning policies and decisions must also reflect relevant international obligations and statutory requirements.

Achieving sustainable development means that the planning system has three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways (so that opportunities can be taken to secure net gains across each of the different objectives):

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

These objectives should be delivered through the preparation and implementation of plans and the application of the policies in this Framework; they are not criteria against which every decision can or should be judged. Planning policies and decisions should play an active role in guiding development towards sustainable solutions, but in doing so should take local circumstances into account, to reflect the character, needs and opportunities of each area.

Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure.

New development should be planned for in ways that:

- avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and

- can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

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

- provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);
- consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and
- identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co- locating potential heat customers and suppliers.

Local planning authorities should support community-led initiatives for renewable and low carbon energy, including developments outside areas identified in local plans or other strategic policies that are being taken forward through neighbourhood planning.

In determining planning applications, local planning authorities should expect new development to:

- comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and
- take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

When determining planning applications for renewable and low carbon development, local planning authorities should:

a. not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and

- approve the application if its impacts are (or can be made) acceptable. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas.

3.2 The London Plan (March 2021)

3.2.1 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 % beyond Building Regulations is required for major development. Residential development should achieve 10 %, and non-residential development should achieve 15% 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.

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.

The Mayor is committed to London becoming a zero-carbon city. This will require reduction of all greenhouse gases, of which carbon dioxide is the most prominent. London's homes and workplaces are responsible for producing approximately 78% of its greenhouse gas emissions. If London is to achieve its objective of becoming a zero-carbon city by 2050, new development needs to meet the requirements of this policy. Development involving major refurbishment should also aim to meet this policy.

The energy hierarchy should inform the design, construction and operation of new buildings. The priority is to minimise energy demand, and then address how energy will be supplied and renewable technologies incorporated. An important aspect of managing demand will be to reduce peak energy loadings.

Boroughs should ensure that all developments maximise opportunities for on-site electricity and heat production from solar technologies (photovoltaic and thermal) and use innovative building materials and smart technologies. This approach will reduce carbon emissions, reduce energy costs to occupants, improve London's energy resilience and support the growth of green jobs.

A zero-carbon target for major residential developments has been in place for London since October 2016 and applies to major non-residential developments on final publication of this Plan.

To meet the zero-carbon target, an on-site reduction of at least 35% beyond the baseline of Part L of the current Building Regulations is required. The minimum improvement over the Target Emission Rate (TER) will increase over a period of time in order to achieve the zero-carbon London ambition and reflect the costs of more efficient construction methods. This will be reflected in future updates to the London Plan.

The Mayor recognises that Building Regulations use outdated carbon emission factors and that this will continue to cause uncertainty until they are updated by Government. Interim guidance has been published in the Mayor's Energy Planning Guidance on the use of appropriate emissions factors. This guidance will be updated again once Building Regulations are updated to help provide certainty to developers on how these policies are implemented.

Developments are expected to achieve carbon reductions beyond Part L from energy efficiency measures alone to reduce energy demand as far as possible. Residential development should achieve 10% and non-residential development should achieve 15% over Part L. Achieving energy credits as part of a Building

Research Establishment Environmental Assessment Method (BREEAM) rating can help demonstrate that energy efficiency targets have been met. Boroughs are encouraged to include BREEAM targets in their Local Plans where appropriate.

The price for offsetting carbon is regularly reviewed. Changes to the GLA's suggested carbon offset price will be updated in future guidance. New development is expected to get as close as possible to zero-carbon onsite, rather than relying on offset fund payments to make up any shortfall in emissions. However, offset funds have the potential to unlock carbon savings from the existing building stock through energy efficiency programmes and by installing renewable technologies – typically more expensive to deliver in London due to the building age, type and tenure.

The Mayor provides support to boroughs by advising those which are at the early stages of setting up their carbon offsetting funds, and by setting out guidance on how to select projects. To ensure that offset funds are used effectively to reduce carbon whilst encouraging a holistic approach to retrofitting, Mayoral programmes offer additional support.

The move towards zero-carbon development requires comprehensive monitoring of energy demand and carbon emissions to ensure that planning commitments are being delivered. Major developments are required to monitor and report on energy performance, such as by displaying a Display Energy Certificate (DEC), and reporting to the Mayor for at least five years via an online portal to enable the GLA to identify good practice and report on the operational performance of new development in London.

Operational carbon emissions will make up a declining proportion of a development's whole life-cycle carbon emissions as operational carbon targets become more stringent. To fully capture a development's carbon impact, a whole life-cycle approach is needed to capture its unregulated emissions (i.e. those associated with cooking and small appliances), its embodied emissions

The Mayor may publish further planning guidance on sustainable design and construction and will continue to regularly update the guidance on preparing energy strategies for major development. Boroughs are encouraged to request energy strategies for other development proposals where appropriate. As a minimum, energy strategies should contain the following information:

a. a calculation of the energy demand and carbon emissions covered by Building Regulations and, separately, the energy demand and carbon emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations (i.e. the unregulated emissions), at each stage of the energy hierarchy
b. proposals to reduce carbon emissions beyond Building Regulations through the energy efficient design of the site, buildings and services, whether it is categorised as a new build, a major refurbishment or a consequential improvement
c. proposals to further reduce carbon emissions through the use of zero or low-emission decentralised energy where feasible, prioritising connection to district heating and cooling networks and utilising local secondary heat sources. (Development in Heat Network Priority Areas should follow the heating hierarchy in Policy SI 3 Energy infrastructure)
d. proposals to further reduce carbon emissions by maximising opportunities to produce and use renewable energy on-site, utilising storage technologies where appropriate
e. proposals to address air quality risks (see Policy SI 1 Improving air quality). Where an air quality assessment has been undertaken, this could be referenced instead
f. the results of dynamic overheating modelling which should be undertaken in line with relevant Chartered Institution of Building Services Engineers (CIBSE) guidance, along with any mitigating actions (see Policy SI 4 Managing heat risk)
g. proposals for demand-side response, specifically through installation of smart meters, minimising peak energy demand and promoting short-term energy storage, as well as consideration of smart grids and local micro grids where feasible
h. a plan for monitoring and annual reporting of energy demand and carbon emissions post-construction for at least five years

i. proposals explaining how the site has been future-proofed to achieve zero-carbon on-site emissions by 2050
j. confirmation of offsetting arrangements, if required
k. a whole life-cycle carbon emissions assessment, and actions to reduce lifecycle carbon emissions (for development proposals referable to the Mayor)
l. analysis of the expected cost to occupants associated with the proposed energy strategy
m. proposals that connect to or create new heat networks should include details of the design and specification criteria and standards for their systems as set out in Policy SI 3 Energy infrastructure.

3.2.2 Policy SI 3 Energy infrastructure

A Boroughs and developers should engage at an early stage with relevant energy companies and bodies to establish the future energy and infrastructure requirements arising from large-scale development proposals such as Opportunity Areas, Town Centres, other growth areas or clusters of significant new development.

B Energy masterplans should be developed for large-scale development locations (such as those outlined in Part A and other opportunities) which establish the most effective energy supply options. Energy masterplans should identify:

1) major heat loads (including anchor heat loads, with particular reference to sites such as universities, hospitals and social housing)
2) heat loads from existing buildings that can be connected to future phases of a heat network
3) major heat supply plant including opportunities to utilise heat from energy from waste plants
4) secondary heat sources, including both environmental and waste heat
5) opportunities for low and ambient temperature heat networks
6) possible land for energy centres and/or energy storage
7) possible heating and cooling network routes
8) opportunities for futureproofing utility infrastructure networks to minimise the impact from road works
9) infrastructure and land requirements for electricity and gas supplies
10) implementation options for delivering feasible projects, considering issues of procurement, funding and risk, and the role of the public sector
11) opportunities to maximise renewable electricity generation and incorporate demand-side response measures.

C Development Plans should:

1) identify the need for, and suitable sites for, any necessary energy infrastructure requirements including energy centres, energy storage and upgrades to existing infrastructure
2) identify existing heating and cooling networks, identify proposed locations for future heating and cooling networks and identify opportunities for expanding and inter-connecting existing networks as well as establishing new networks.

D Major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system:

1) the heat source for the communal heating system should be selected in accordance with the following heating hierarchy:
   a) connect to local existing or planned heat networks
   b) use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)
   c) use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development’s electricity demand and provide demand response to the local electricity network)
   d) use ultra-low NOx gas boilers

2) CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements in Part B of Policy SI 1 Improving air quality
3) where a heat network is planned but not yet in existence the development should be designed to allow for the cost-effective connection at a later date.

E Heat networks should achieve good practice design and specification standards for primary, secondary and tertiary systems comparable to those set out in the CIBSE/ADE Code of Practice CP1 or equivalent.

The Mayor will work with boroughs, energy companies and major developers to promote the timely and effective development of London's energy system (energy production, distribution, storage, supply and consumption).

London is part of a national energy system and currently sources approximately 95 per cent of its energy from outside the GLA boundary. Meeting the Mayor's zero-carbon target by 2050 requires changes to the way we use and supply energy so that power and heat for our buildings and transport is generated from local clean, low-carbon and renewable sources. London will need to shift from its reliance on using natural gas as its main energy source to a more diverse range of low and zero-carbon sources, including renewable energy and secondary heat sources. Decentralised energy and local secondary heat sources will become an increasingly important element of London's energy supply and will help London become more self-sufficient and resilient in relation to its energy needs.

Many of London's existing heat networks have grown around combined heat and power (CHP) systems. However, the carbon savings from gas engine CHP are now declining as a result of national grid electricity decarbonising, and there is increasing evidence of adverse air quality impacts. Heat networks are still considered to be an effective and low-carbon means of supplying heat in London, and offer opportunities to transition to zero-carbon heat sources faster than individual building approaches. Where there remains a strategic case for low-emission CHP systems to support area-wide heat networks, these will continue to be considered on a case-by-case basis. Existing networks will need to establish decarbonisation plans. These should include the identification of low- and zero-carbon heat sources that may be utilised in the future, in order to be zero-carbon by 2050. The Mayor will consider how boroughs and network operators can be supported to achieve this.

Developments should connect to existing heat networks wherever feasible. New and existing networks should incorporate good practice design and specification standards comparable to those set out in the CIBSE/ADE Code of Practice CP1 for the UK or equivalent. They should also register with the Heat Trust or an equivalent scheme. This will support the development of good quality networks whilst helping network operators prepare for regulation and ensuring that customers are offered a reliable, cost-competitive service. Stimulating the delivery of new district heating infrastructure enables the opportunities that district heating can provide for London's energy system to be maximised. The Mayor has identified Heat Network Priority Areas, which can be found on the London Heat Map website. These identify where in London the heat density is sufficient for heat networks to provide a competitive solution for supplying heat to buildings and consumers. Data relating to new and expanded networks will be regularly captured and made publicly available. Major development proposals outside Heat Network Priority Areas should select a low-carbon heating system that is appropriate to the heat demand of the development, provides a solution for managing peak demand, as with heat networks, and avoids high energy bills for occupants.

Where developments are proposed within Heat Network Priority Areas but are beyond existing heat networks, the heating system should be designed to facilitate cost-effective future connection. This may include, for example, allocating space in plant rooms for heat exchangers and thermal stores, safeguarding suitable routes for pipework from the site boundary and making provision for connections to the future network at the site boundary. The Mayor is taking a more direct role in the delivery of district-level heat networks so that more new and existing communally-heated developments will be able to connect into them, and has developed a comprehensive decentralised energy support package. Further details are available in the London Environment Strategy.

The Mayor also supports the development of low-temperature networks for both new and existing systems as this allows cost-effective use of low-grade waste heat. It is expected that network supply temperatures will drop from the traditional 90°C-95°C to 70°C and less depending on system design and the temperature of available heat sources. Further guidance on designing and operating heat networks will be set out in the updated London Heat Network Manual.

Low-emission CHP in this policy refers to those technologies which inherently emit very low levels of NOx. It is not expected that gas engine CHP will fit this category with the technology that is currently available. Further details on circumstances in which it will be appropriate to use low-emission CHP and what additional emissions monitoring will be required will be provided in further guidance. This guidance will be regularly updated to ensure that it reflects changes in technology.

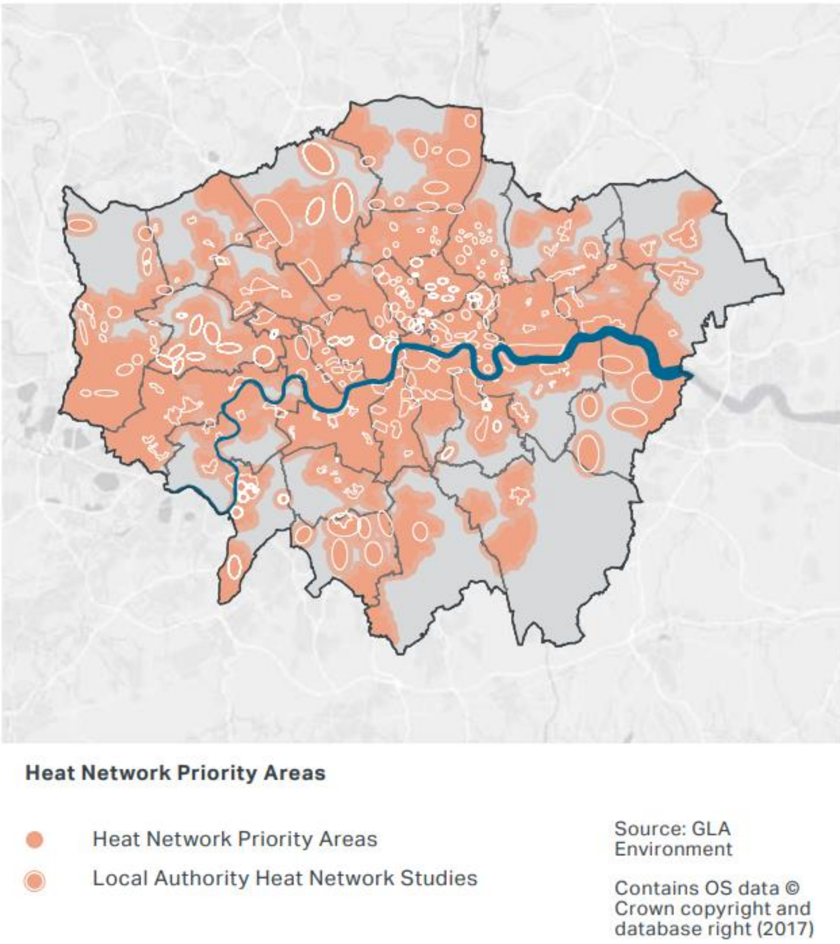


Figure 4 - GLA heat network priority areas

Increasing the amount of renewable and secondary energy is supported and development proposals should identify opportunities to maximise both secondary heat sources and renewable energy production on-site. This includes the use of solar photovoltaics, heat pumps and solar thermal, both on buildings and at a larger scale on appropriate sites. There is also potential for wind and hydropower-based renewable energy in some locations within London. Innovative low- and zero-carbon technologies will also be supported.

Electricity is essential for the functioning of any modern city. Demand is expected to rise in London in response to a growing population and economy, the increased take up of electric vehicles, and the switch to electric heating systems (such as through heat pumps). It is of concern that the electricity network and substations are at or near to capacity in a number of areas, especially in central London. The Mayor will work with the electricity and heat industry, boroughs and developers to ensure that appropriate infrastructure is in place and integrated within a wider smart energy system designed to meet London's needs.

Demand for natural gas in London has been decreasing over the last few years, with a 25 per cent reduction since 2000. This trend is expected to continue due to improved efficiency and a move away from individual gas boilers. Alongside the continuing programme of replacing old metal gas mains (predominantly with plastic piping), local infrastructure improvements may be required to supply energy centres, associated with heat networks, that will support growth in Opportunity Areas and there may also be a requirement for the provision of new pressure reduction stations. These requirements should be identified in energy masterplans.

Cadent Gas and SGN operate London's gas distribution network. Both companies are implementing significant gasholder de-commissioning programmes, replacing them with smaller gas pressure reduction stations. The Mayor will work with key stakeholders including the Health and Safety Executive to achieve the release of the resulting brownfield sites for redevelopment including energy infrastructure where appropriate.

Land will be required for energy supply infrastructure including energy centres. These centres can capture and store energy as well as generate it. The ability to efficiently store energy as well as to generate it can reduce overall energy consumption, reduce peak demand and integrate greater levels of renewable energy into the energy system.

3.2.3 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:

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

Climate change means London is already experiencing higher than historic average temperatures and more severe hot weather events. This, combined with a growing population, urbanisation and the urban heat island effect, means that London must manage heat risk in new developments, using the cooling hierarchy set out above. Whilst the cooling hierarchy applies to major developments, the principles can also be applied to minor development.

In managing heat risk, new developments in London face two challenges – the need to ensure London does not overheat (the urban heat island effect) and the need to ensure that individual buildings do not overheat. The urban heat island effect is caused by the extensive built-up area absorbing and retaining heat during the day and night leading to parts of London being several degrees warmer than the surrounding area. This can become problematic on the hottest days of the year as daytime temperatures can reach well over 30°C and not drop below 18°C at night. These circumstances can lead many people to feel too hot or not be able to sleep, but for those with certain health conditions, and 'at risk' groups such as some young or elderly Londoners, the effects can be serious and worsen health conditions. Green infrastructure can provide some mitigation of this effect by shading roof surfaces and through evapotranspiration. Development proposals should incorporate green infrastructure in line with Policy G1 Green infrastructure and Policy G5 Urban greening.

Many aspects of building design can lead to increases in overheating risk, including high proportions of glazing and an increase in the air tightness of buildings. Single-aspect dwellings are more difficult to ventilate naturally and are more likely to overheat, and should normally be avoided in line with Policy D6 Housing quality and standards. There are a number of low-energy measures that can mitigate overheating risk. These include solar shading, building orientation and solar-controlled glazing. Occupant behaviour will also have an impact on overheating risk. The Mayor's London Environment Strategy sets out further detail on actions being taken to address this.

Passive ventilation should be prioritised, taking into account external noise and air quality in determining the most appropriate solution. The increased use of air conditioning systems is not desirable as these have significant energy requirements and, under conventional operation, expel hot air, thereby adding to the urban heat island effect. If active cooling systems, such as air conditioning systems, are unavoidable, these should be designed to reuse the waste heat they produce. Future district heating networks are expected to be supplied with heat from waste heat sources such as building 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. Further information will be provided in guidance on how these documents and datasets should be used.

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

3.3.1 Purpose of Energy Statements - Introduction

The Mayor of London has declared a climate emergency and has set an ambition for London to be net zero-carbon. This means all new buildings must be net zero carbon. The Mayor's London Plan sets the targets and policies required to achieve this. It includes:

- a net zero-carbon target for all major developments, which has applied to major residential developments since 2016. This guidance document explains how to achieve this.
- a requirement for all major development to 'be seen' i.e. to monitor and report its energy performance post-construction to ensure that the actual carbon performance of the development is aligned with the Mayor's net zero carbon target. A separate guidance document1 explains how to meet this requirement.
- a requirement for all referable planning applications to calculate and reduce whole life-cycle carbon emissions to fully capture a development's carbon impact. A separate guidance document explains this requirement further.

The guidance document explains how to prepare an energy assessment to accompany strategic planning applications referred to the Mayor[3] as set out in London Plan Policy SI 2. It is for anyone involved in, or with an interest in developing energy assessments including developers, energy consultants and local government officials. Although primarily aimed at strategic planning applications, London boroughs are encouraged to apply the same structure for energy assessments related to non-referable applications and adapt it for relevant scales of development.

The purpose of an energy assessment is to demonstrate that the proposed climate change mitigation measures comply with London Plan energy policies, including the energy hierarchy. It also ensures energy remains an integral part of the development's design and evolution.

In line with the London Plan, major developments are expected to be net zero-carbon by incorporating a series of measures outlined in the following energy hierarchy:

- be lean: use less energy and manage demand during operation through fabric and servicing improvements and the incorporation of flexibility measures
- be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly by connecting to district heating networks
- 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 through the Mayor's post construction monitoring platform

The energy assessment must fully comply with Policies SI 2 to SI 4 inclusive of the London Plan and, recognising the integrated nature of London Plan policies, take account of relevant design, spatial, air quality, transport and climate change adaptation policies in the Plan.

The energy assessment must clearly outline the applicant's commitments in terms of CO_2 savings and measures proposed to reduce energy demand. It is also important to consider and mitigate any potential air quality impacts arising as a result of the technologies proposed. Part 2 of this document provides guidance on details required within an energy assessment.

[3] An application is referable to the Mayor if it meets the criteria set out in the Mayor of London Order (2008), which include development of 150 residential units or more, development over 30 metres in height (outside the City of London) or development on Green Belt or Metropolitan Open Land.

Each application is considered on its merits, taking into account the individual characteristics of the development. For all strategic planning applications case specific energy comments for each development are provided at Stage 1 and 2 of the GLA planning process by GLA energy officers to ensure applications comply with London Plan policy. However, for the avoidance of doubt, energy assessments must:

- be submitted at the planning application stage, not submitted post planning in response to a condition
- report estimated site-wide regulated CO2 emissions and reductions (broken down for the domestic and non-domestic elements of the development), expressed in tonnes per annum, after each stage of the energy hierarchy
- demonstrate how the net zero carbon target4 for major domestic and nondomestic development will be met, with at least a 35% on-site reduction beyond Part L 2013 and proposals for making up the shortfall to achieve net zero carbon, where required
- commit to reducing regulated CO2 emissions by 10 percent below those of a development compliant with Part L 2013 of the Building Regulations through energy efficiency measures alone, and by 15% for non-residential applications
- include information demonstrating that the risk of overheating has been mitigated through the incorporation of passive design measures
- demonstrate that connection to existing or planned district heating networks has been prioritised and provide correspondence to support this
- commit to a communal heat network to allow connection to existing or planned district heating networks identified in the area
- minimise the number of energy centres and provide a single point of connection to the District Heating Network (DHN)
- investigate suitable low carbon and/or renewable heating plant for installation within the energy centre if connection can’t be made to an area wide network
- investigate and commit to maximising the installation of renewable technologies (including the potential for storage) on site
- include information on how the building’s actual energy performance will be monitored post-construction and report the energy and carbon performance on the GLA’s online platform
- align with related documents and assessments that are submitted as part of the planning application, e.g., Whole Life-Cycle Carbon Assessments, Air Quality Assessments, Sustainability Statements

3.4 London Borough of Camden Local Plan (2017)

3.4.1 Policy CC1 Climate change mitigation

The policy states the following:

"*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; and
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) 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."

3.5 Energy Statement Approach

The energy statement presented within this report is based on the following principles of the 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.

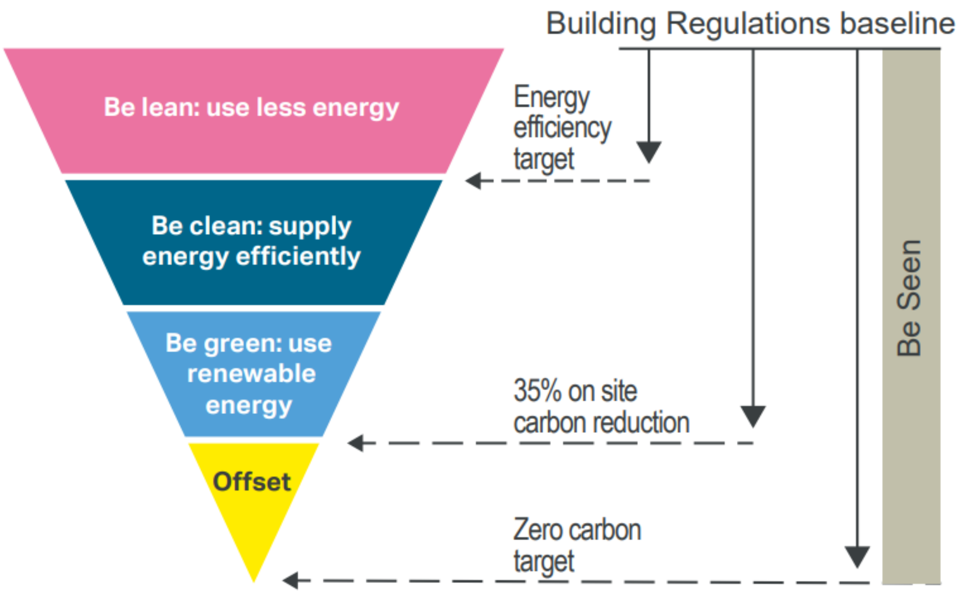


Figure 5 - Energy Hierarchy

4.0 Description of Calculation Methodology and Simulation Software Used

In this section of the report, the calculation methodology for the development alongside the energy consumption and CO_2 emissions for the baseline building will be presented.

4.1 Dynamic Simulation Modelling (DSM)

4.1.1 Description of Process

Dynamic Simulation Modelling (DSM), as used for Part L Building regulations compliance, has been conducted using the IES Virtual Environment (IES-VE) software package.

The Virtual Environment (VE) 2022 software package has been used for this project, as it allows a single model to be used for all the required analysis related to the building performance regarding passive and active strategies, energy efficient mechanical and electrical systems, and LZC technologies.

IES-VE is dynamic simulation modelling (DSM) software assists architects and engineers in developing a sustainable building design by offering quantitative feedback as a response to different design options/input.

The software allows the user to create a “virtual environment” where building mass, form, climate, natural resource availability, occupancy, materials, and services are taken into consideration in order to analyse different energy saving strategies.

The CO_2 emission factors used in the calculations are as per Part L 2021 2nd tier document, **NCM Modelling Guide 2021 Edition**.

4.1.2 Estimation of Annual Building Energy Profiles: VE-Compliance

It should be noted, both the initial and final calculations contained within this report are bespoke for this particular development using inputs and simulation models based on the latest architectural drawings and concept MEP services design.

Mechanical and Electrical services designs have been completed using the Dynamic Simulation Modelling (DSM) software described above. The thermal calculation and simulation engine Apache within IES was used in order to evaluate the energy consumption and carbon dioxide emissions of the development as the DSM software takes into account all energy efficient and passive design technologies, we intend to incorporate with some of which are not possible to model using SAP or SBEM.

National Calculation Methodology (NCM) profiles have been assigned to different rooms based on their activity as per Part L2A methodology.

4.1.3 External Weather Conditions

CIBSE London TRY (Test Reference Year) weather file has been used in the modelling calculations, the dry bulb temperatures throughout the year are shown in the graph below.

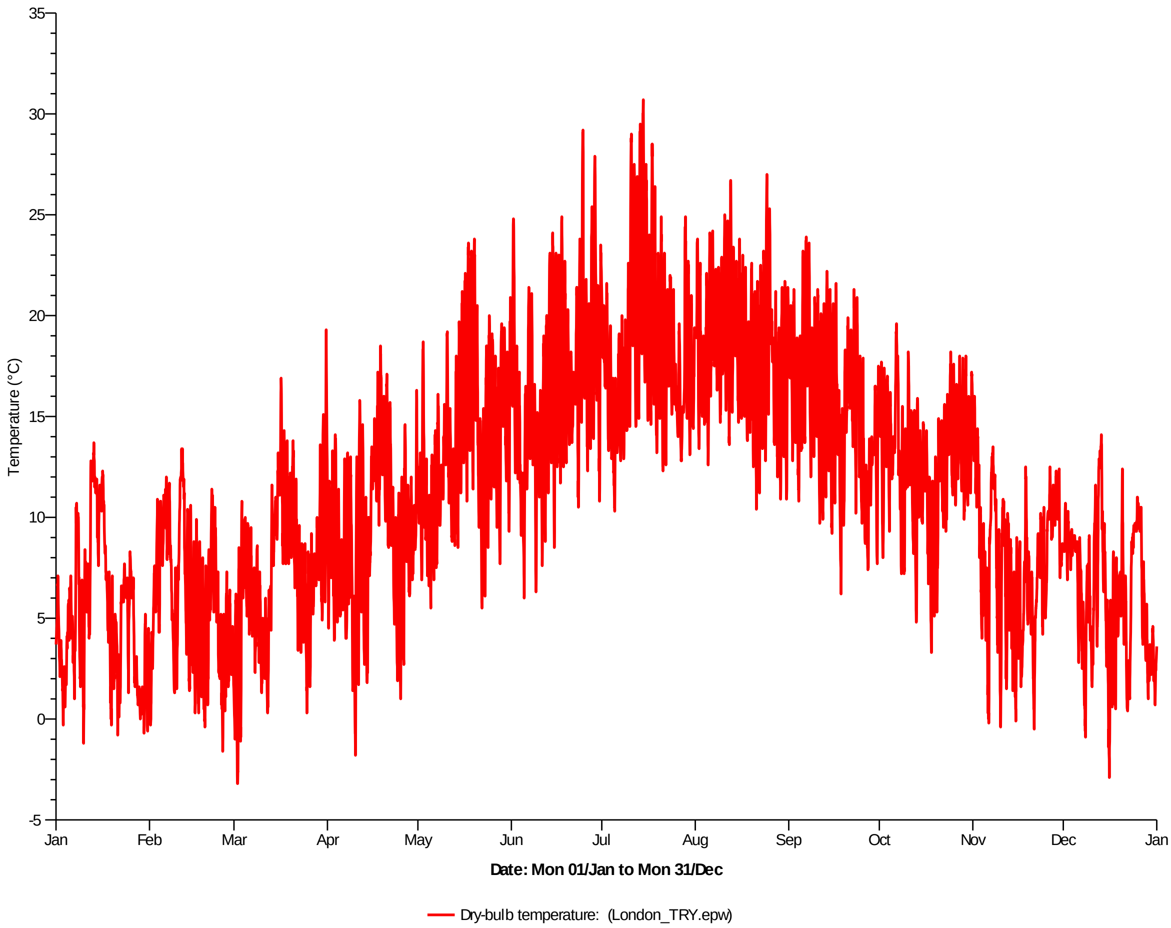


Figure 6 - Annual dry bulb temperature distribution for London

4.2 Building Model Isometric Views

The presented model below captures the building geometry, constructions, usage, climate and equipment through the Integrated Data Model (IDM) within IES-VE. The following isometric views show the proposed extensions based on the drawings provided by **Piercy and Co.**

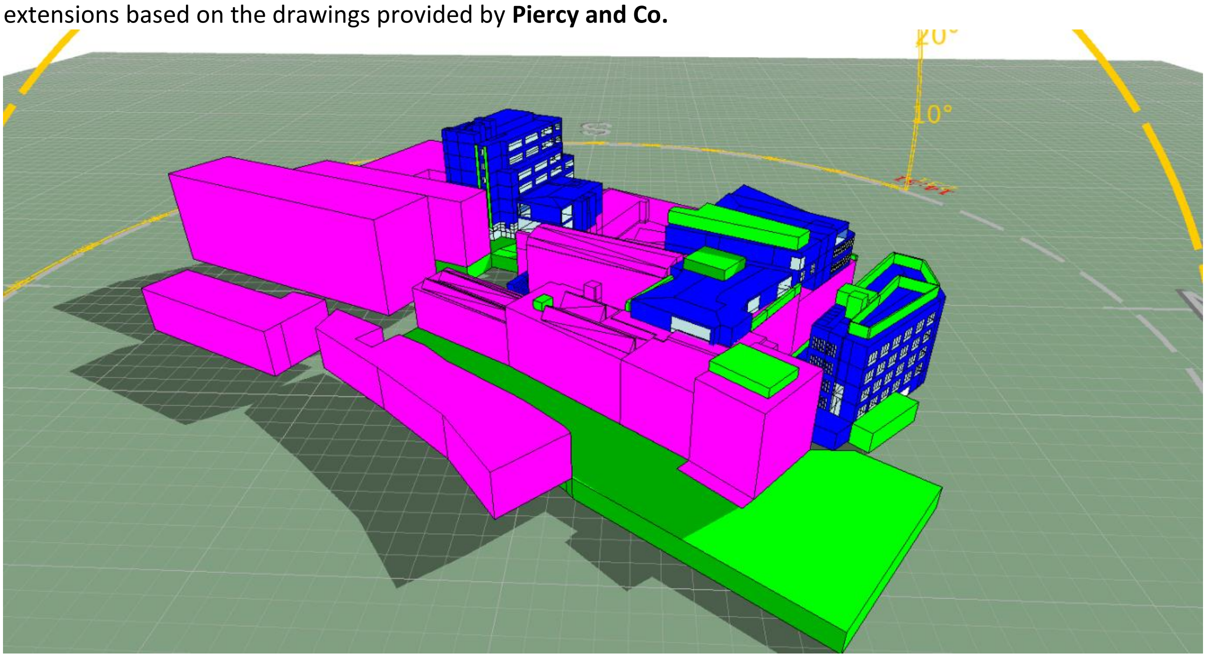


Figure 7 - North Orientation

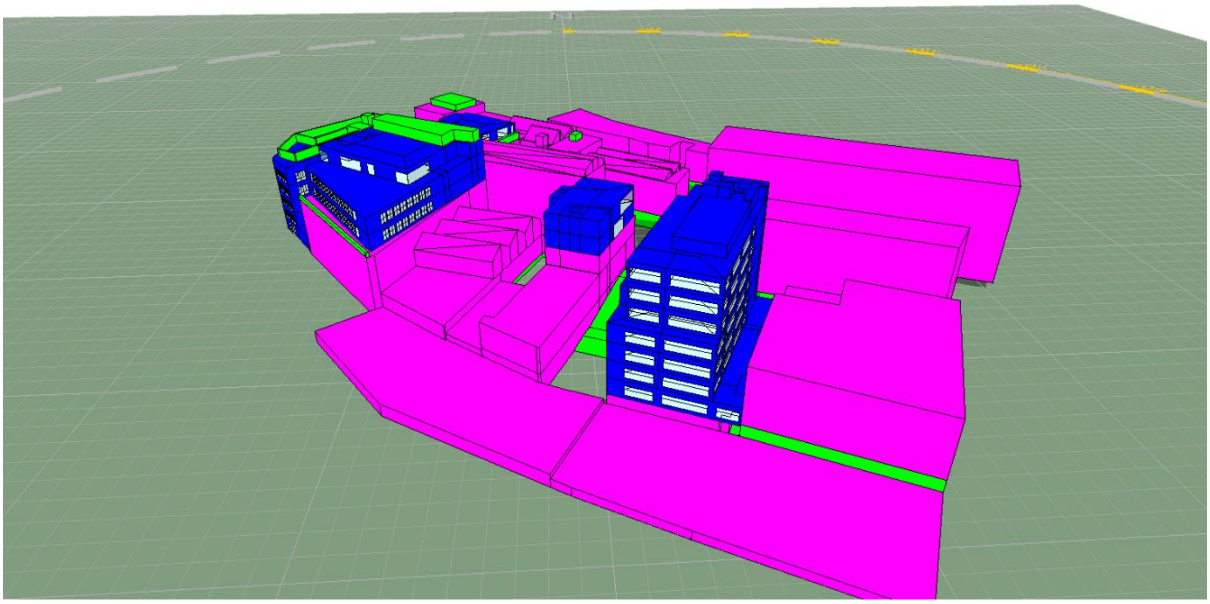


Figure 8 - South Orientation

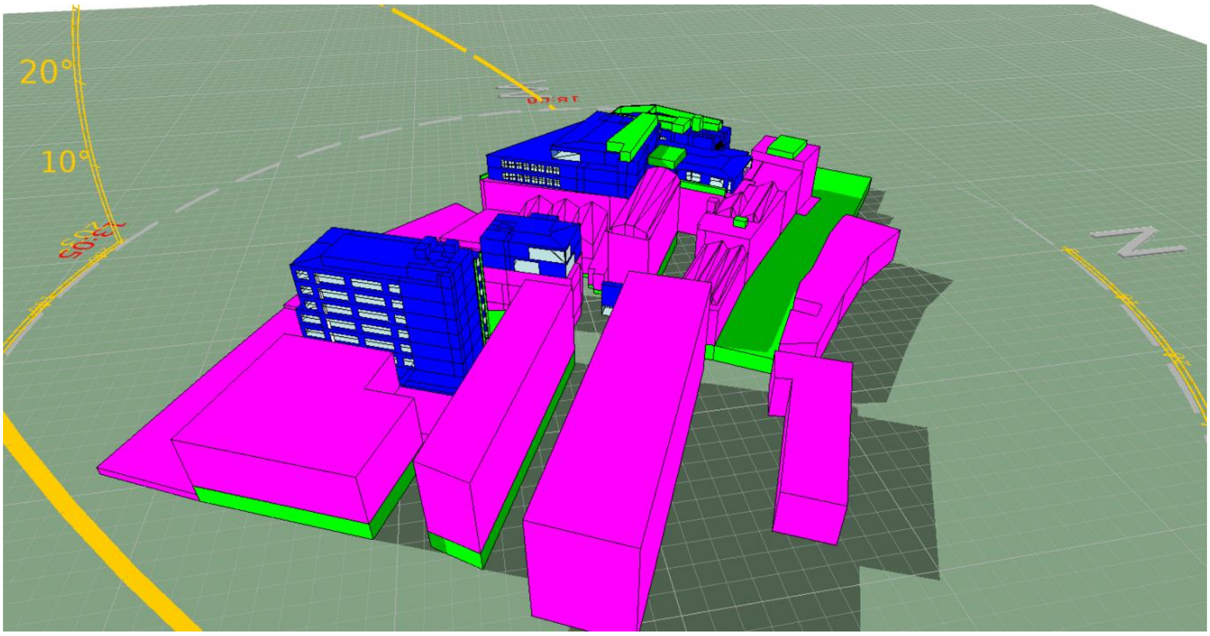


Figure 9 - East Orientation

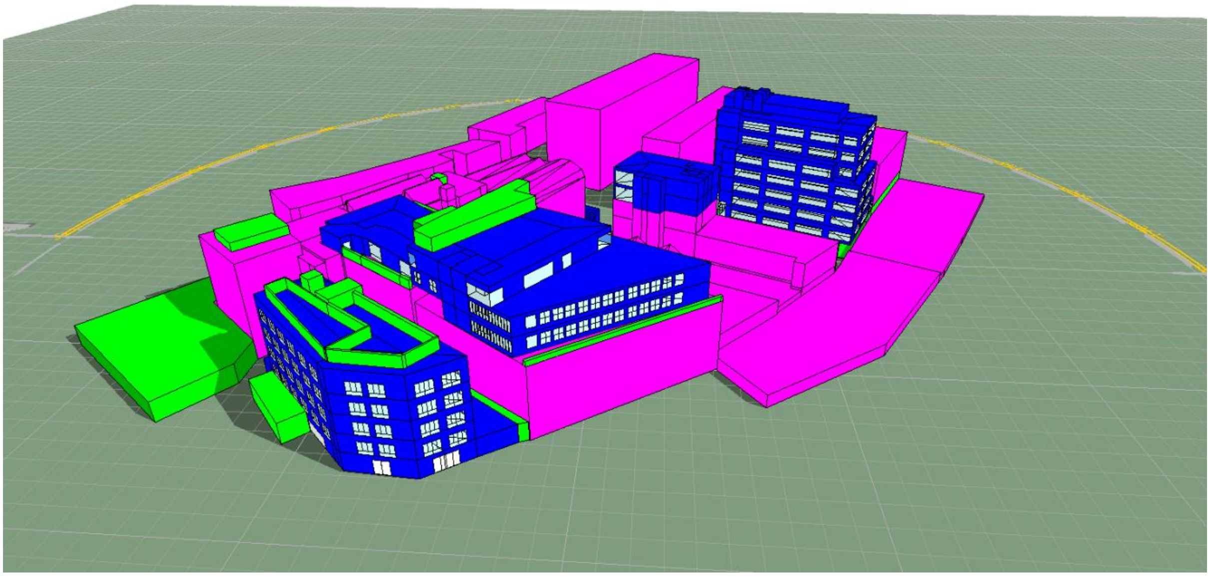


Figure 10 - West Orientation

5.0 Demand reduction (Be Lean)

This section of the report describes the demand reduction measures, which have been considered and will be included in the design for the 'Lean' case building model. Measures include both architectural and building fabric elements (passive design) and energy efficient services (active design).

5.1 Description of Passive Energy Features.

5.1.1 Site Orientation and Site Location

The proposed development comprises of new buildings and extensions to existing Plots. As such the site is highly constrained and the building orientation and locations are relatively fixed.

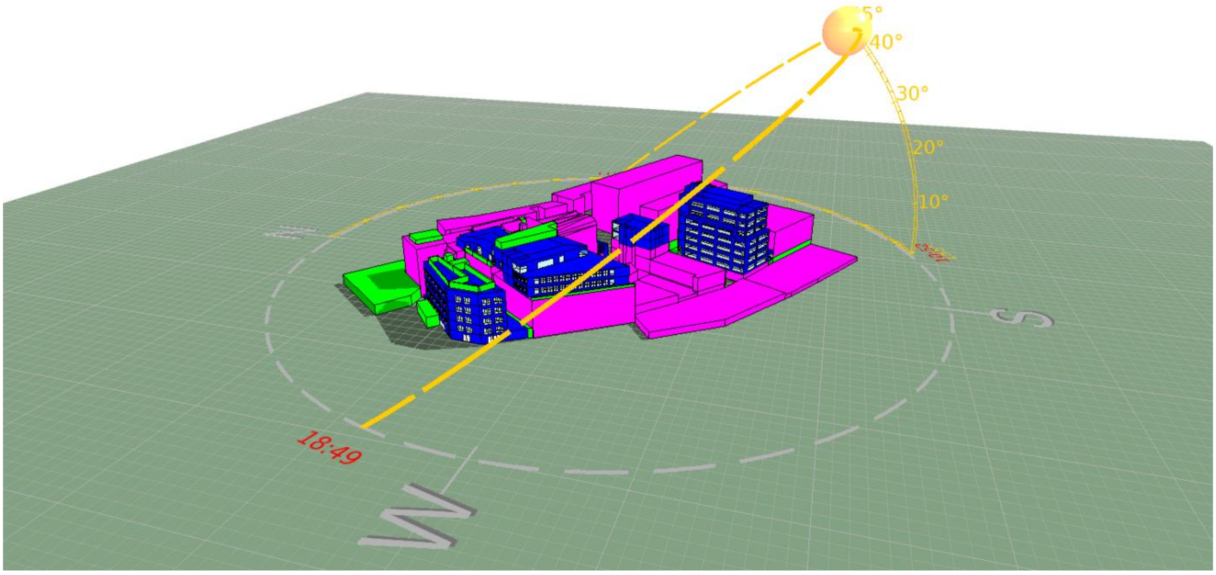


Figure 11 - Solar Path Diagram

5.1.2 Building Form / Glazing Percentage

The building form for the new buildings and extensions to existing plots provides a low building envelope area to volume ratio which makes it thermally efficient. The average glazing percentage for the new buildings and extensions to existing plots (glazed area / façade area) is approximately 26.5**%,** with glazed areas optimised to provide high levels of daylighting to the occupied office areas.

5.1.3 U-values and Thermal Mass.

The U-values for the new buildings and extension to existing plots' elements provide a 15% improvement upon the NCM Modelling Guide 2021 notional values to prevent excessive heat transfer through the building thermal envelope. These figures are shown further in this report.

5.1.4 Glazing Performance

The thermal performance of the new glazing is 15% better than the NCM Modelling Guide 2021 value.

5.1.5 Natural Ventilation

Due to the site location in an AQMA and the nature of the offices, occupied areas will be mechanically ventilated to allow intake of fresh air from as high as possible which can then be filtered prior to supply to the building. The mechanical ventilation system also allows heat recovery to be employed.

5.2 Description of Active Energy Features

This section of the report describes the active energy reduction features which have been considered and will be included in the design for lean building model:

5.2.1 Energy Efficient Lighting

High efficacy LED luminaires will be employed throughout the new buildings and extensions to existing plots.

5.2.2 Lighting Controls

Lighting throughout the new buildings and extensions to existing plots will benefit from automated controls including occupancy detection and daylight linked dimming.

5.2.3 Use of low energy fans

Low energy fans will be used with specific fan powers as good as or better than the limiting efficiencies defined in the Non-domestic Building Services Compliance Guide (2013). Duct sizing and routes will be designed to minimise pressure drops.

5.2.4 Mechanical ventilation with heat recovery

The centralised ventilation system will incorporate heat recovery to extract heat from stale vitiated air prior to discharging it to atmosphere.

5.2.5 Variable Speed Drives

Variable speed drives will be used to ensure new fans and pumps operate no faster than required, thereby reducing energy consumption.

5.2.6 Effective Building Energy Management System

A full building management system will be incorporated to ensure plant is controlled and operated efficiently.

5.3 Definition of Parameters used for the 'Baseline' Building Model

This section of the report provides reference values for the parameters used in the 'Baseline' building models, for the new buildings and extension to existing plots, in order to establish the energy consumption and CO_2 emissions of the development upon which further energy reduction measures will be applied as per the outlined energy hierarchy in the London Plan.

Construction parameters used as inputs to the energy model simulations have been based on Part L 2021 of the Building Regulations.

5.3.1 Building Fabric Thermal Performance

The 'baseline' building fabric for the new buildings and extension to existing plots is that of the Part L 2021 notional building.

EXPOSED ELEMENT	BASELINE U-VALUE (W/m²K)
External Wall	0.18
Floor	0.15
Roof	0.15
Glazing	1.4
Personnel Door	1.9

Table 5 – 'Baseline' models' Elements' U-Values

GLAZING ELEMENT	BASELINE BUILDING G-VALUE
Windows	0.28

Table 6 – 'Baseline' models' Glazing Elements G-Values

5.3.2 Air Permeability

AIR PERMEABILITY	BASELINE BUILDING
$m^3/(h.m^2)$ at 50 Pa	3

Table 7 – 'Baseline' models' Air Permeability

5.3.3 Lighting

The 'baseline' lighting for the new buildings and extension to existing plots is based upon a luminaire efficacy of 95 lumens per circuit watt.

5.3.4 HVAC systems

The primary HVAC system is a VRF system. Fresh air is supplied to occupied areas by a central air handling unit with heat recovery.

The Table below presents efficiencies of the HVAC systems used for the 'Baseline' thermal model for the new buildings and extension to existing plots.

HVAC SYSTEM	EFFICIENCY
Variable Refrigerant Flow (VRF)	Heating SCoP 3.09 (ASHP) Cooling SEER 5.79 (ASHP)
Central Air Handling Unit	SFP = 1.8 W/l/s Heat recovery 76%

Table 8 - 'Baseline' models' HVAC system specifications

5.4 Definition of Parameters used for 'Lean' case Building Model

This section of the report provides reference values for the parameters used in the 'Lean' case models in order to establish the energy consumption and CO_2 emissions of the development upon which further energy reduction measures will be applied as per the outlined energy hierarchy in the London Plan.

Construction parameters used as inputs to the energy model simulations have been assumed using data provided or approved by the architect and based upon the age of the building where data are not available.

5.4.1 Building Fabric Thermal Performance

EXPOSED ELEMENT	LEAN U-VALUE (W/m^{2}K)
External Wall	0.15
Floor	0.13
Roof	0.13
Glazing (Double Glazing)	1.20
Personnel Door	1.6

Table 9 – 'Lean' models' Elements U-Values

GLAZING ELEMENT	BASELINE BUILDING G-VALUE
Windows	0.3

Table 10 – 'Lean' models' Glazing Elements G-Values

5.4.2 Air Permeability

AIR PERMEABILITY	
m^3/(h.m^2) at 50 Pa	2.6

Table 11 – 'Lean' models' Air Permeability

5.4.3 Lighting

Lighting in the new buildings and extension to existing plots is LED with an efficiency of 1.2 W/m^2/100 lx in offices, efficacy of 110 lumens/W in toilets and 130 lumens/W in corridors and elsewhere. Automated controls include occupancy detection in offices and toilets and daylight linked dimming in offices.

5.4.4 HVAC systems

The primary HVAC system is a VRF system. Fresh air is supplied to occupied areas by a central air handling unit with heat recovery.

The Table below presents efficiencies of the HVAC systems used for the 'Lean' case thermal model.

HVAC SYSTEM	EFFICIENCY
Variable Refrigerant Flow (VRF)	Heating SCoP 3.45 (ASHP) Cooling SEER 5.60 (ASHP)
Central Air Handling Unit	SFP = 1.35 W/l/s Heat recovery 83.6%

Table 12 – 'Lean' models' HVAC system specifications

5.5 IES results for the Carbon Dioxide emissions of the 'Lean' building

Following the inclusion of demand reduction measures, the following CO_2 emissions has been achieved at the Lean Stage for the proposed development.

NEW BUILDINGS AND EXTENSION TO EXISTING PLOTS	CARBON DIOXIDE EMISSIONS (TONNES CO_2 PER ANNUM)		PERCENTAGE SAVINGS (%)
	REGULATED	UNREGULATED	
Baseline Building: Part L 2021 of the Building Regulations Compliant Development	45.5	77.95	-
After Energy Demand Reduction (Be Lean)	34.2	77.95	25%

Table 13 - Carbon Dioxide Emissions after 'Lean' stage of energy hierarchy

6.0 Cooling & Overheating

The nature and location of the proposed development reduces the number of opportunities to minimise cooling demand via passive design measures. The building is located within an air quality management area (AQMA) due to high levels of local air pollution. A natural ventilation solution would utilise air intakes at lower levels where air pollution levels are higher; therefore, to ensure acceptable air quality and support the health of occupants, a mechanical ventilation scheme has been incorporated within the design to have fresh air intakes at the roof level where air quality is less impacted by ground level activities/contaminants and air can be filtered by air handling units.

Furthermore, the multi-tenant office nature of the buildings means that achieving cross flow ventilation is not realistic in many instances reducing the viability of a natural ventilation strategy.

A number of measures have been applied to the development in order to reduce potential overheating and reliance on air conditioning systems in accordance with the cooling hierarchy presented in policy SI 4 of London Plan:

- Reduce the amount of heat entering the building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure. It is also expected that external shading will form part of major proposals
    - The building orientation and location are limited by the site, but the glazing has been optimised and solar control glass specified to minimise unwanted solar gains.

- Minimise internal heat generation through energy efficient design: For example, heat distribution infrastructure within buildings should be designed to minimise pipe lengths, particularly lateral pipework in corridors of apartment blocks, and adopting pipe configurations which minimise heat losses e.g., twin pipes.
    - High efficacy LED luminaires will be employed within the building in order to reduce internal gains; pipe lengths will be minimised as part of the detailed design

- Provide passive ventilation: For example, through the use of openable windows, shallow floorplates, dual aspect units or designing in the 'stack effect' where possible.
    - As noted above, the local air quality prohibits the use of natural ventilation.

- Provide mechanical ventilation: Mechanical ventilation can be used to utilise 'free cooling' where the outside air temperature/enthalpy is below that in the building during summer months. This will require a by-pass on the heat recovery system for summer mode operation.
    - Mechanical ventilation sized to provide tempered fresh air only as the flow rates are not sufficient to provide any significant cooling for the building volume.

- Provide active cooling systems: The increased use of air conditioning systems is generally not supported, as these have significant energy requirements and, under conventional operation, expel hot air, thereby adding to the urban heat island effect. However, once passive measures have been prioritised if there is still a need for active cooling systems, such as air conditioning systems, these should be designed in a very efficient way and should aim to reuse the waste heat they produce.
    - Cooling to the densely occupied office areas will be supplied by heat pump systems, and mechanical ventilation with heat recovery.

6.1 Cooling Demand

The following table shows the total building cooling demand reduction for the extensions achieved by the measures specified above. As can be seen, the actual cooling demand is substantially lower than the notional building.

	AREA WEIGHTED AVERAGE NON-DOMESTIC COOLING DEMAND (MJ/m^2)	TOTAL AREA WEIGHTED NON-DOMESTIC COOLING DEMAND (MJ/YEAR)
Actual	311	706,354
Notional	412	1,011,070

Table 14 - Cooling demand following the incorporation of cooling hierarchy

6.2 Overheating risk

CIBSE TM52 determines that the PMV-PPD method is the method applicable to Highgate Studios case as it comprises mechanically ventilated and cooled buildings.

The method predicts thermal comfort vote or predicted mean vote (PMV) using 6 factors. Four of these factors are related to indoor environment such as air temperature, radiant temperature, air velocity, and moisture content. The other two factors are related to people activity (metabolism) and thermal insulation of their clothing.

Dynamic thermal modelling can predict indoor air temperature (and radiant temperature) subject to fixed inputs, for example, system capacity and input related to internal gains and weather data. The rest of PMV factors will be based on assumptions as suggested in the CIBSE TM 52 document. In absence of system sizing in this early design stage, the modelling is based on ideal system profiles capable of covering demand with ideal controls. The assumptions made for this modelling approach were taken from CIBSE Guide A Table 1.5 and are listed below in Table 14.

Factor	ASSUMPTION
Heating Set-point	21°C
Cooling Set-point	24°C
Clothing Thermal Insulation	0.6 CLO – 1.0 CLO for summer and winter, respectively
Activity Level	1.2 Met for light sedentary work
Nominal Air Velocity	0.15 m/s

Table 15 - PMV-PPD calculations' assumptions

The CIBSE weather files DSY1, DSY2, and DSY3 were used in this modelling approach. The query tool provided within the IES VE package was used to apply filters and check PMV output that is above 0.5 (corresponding to 10% dissatisfied people, PPD) according to suggested limits of Category II specified for new buildings or renovations (Table 2 in CIBSE TM 52 document). Figure 11 shows the IES VE filtering tool applied for Highgate Studios Block F occupied areas. As can be seen, the used ideal system along with the above used assumption has resulted in zero hours where PMV was above 0.5.

In this modelling approach, the following areas were the main focus in the assessment:

- Reception area where building personnel exist around the hour.
- Restaurant or café spaces.
- Office areas which are the main application of Highgate Studios buildings' spaces.

Other buildings areas (except voids, utility and machine rooms) have also been considered and also fulfilled the PMV-PPD limits with the above assumptions. This block is considered representative and applicable to the rest of the development. Further thermal modelling and analysis will be undertaken during detailed design to ensure thermal comfort levels are achieved throughout the development.

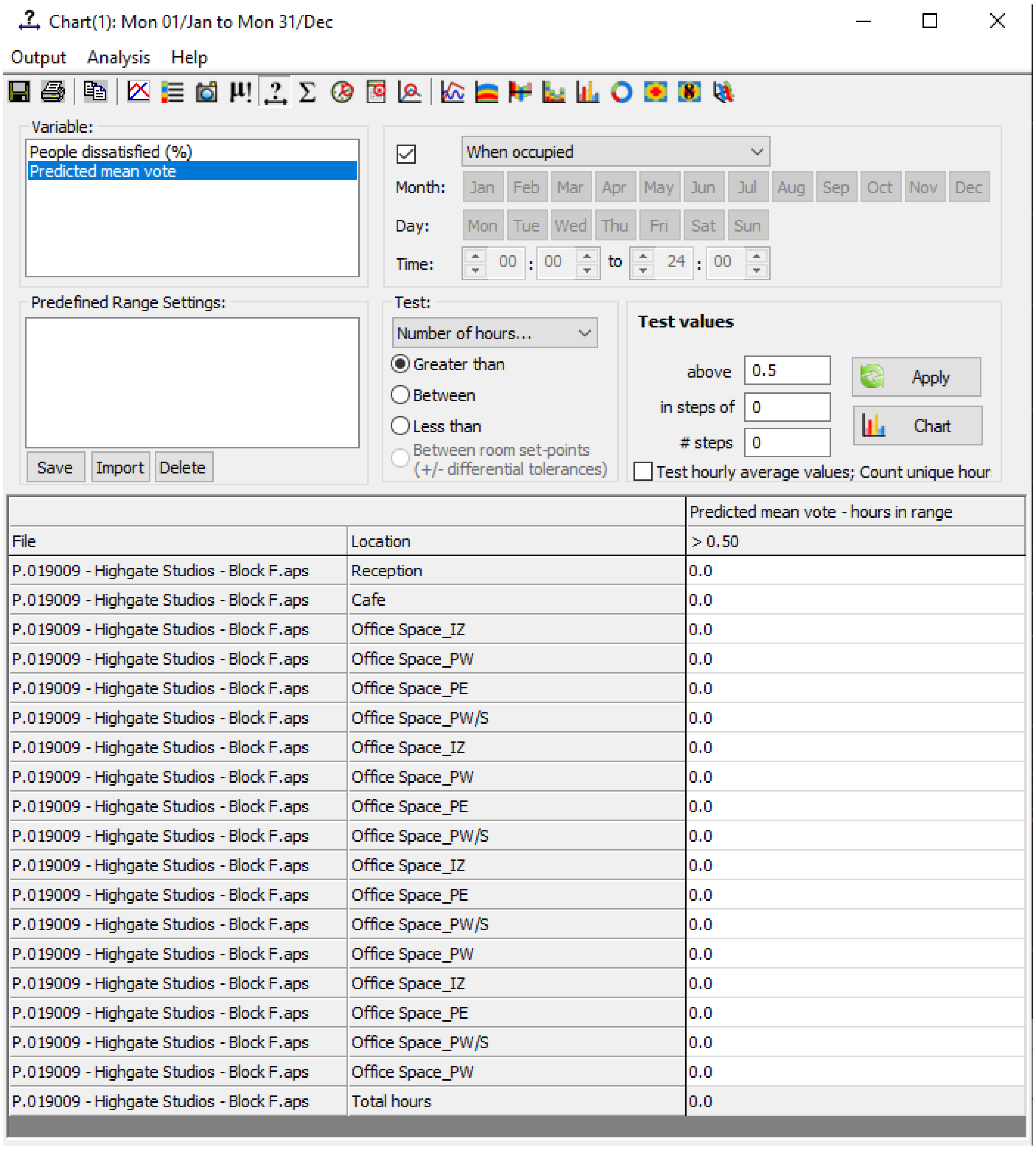


Figure 12 - IES VE query tool showing occurence of PMV hours ie., >0.5 in the building occupied areas

7.0 Clean: Decentralised Low / Zero Carbon Generation

For compliance with the London Plan, the proposed development is required to demonstrate a reduction in carbon dioxide emissions of 35% below the baseline building.

The following two options for decentralised energy will be investigated in this section of the report in order to analyse the estimated carbon dioxide savings through decentralised energy:

- Option 1: District heating
- Option 2: Combined heat and power (CHP)

7.1 District Heating

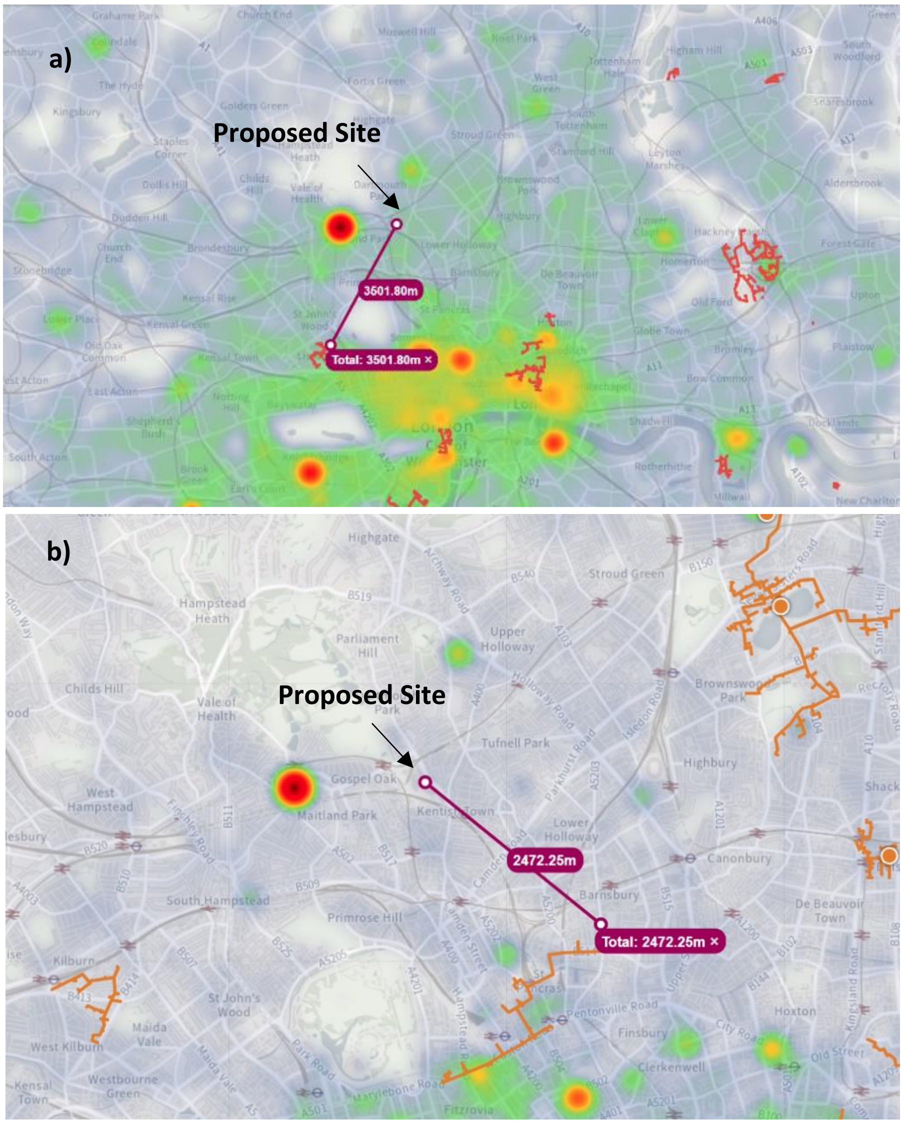


Figure 13 - London Heat Map with existing (a) and potential (b) district heating

The London Heat Map shows no existing district heating networks within close proximity to the proposed site. Therefore, connection to a heat network is not possible for the proposed development. Furthermore, creating a new heat network would not be feasible within the constraints of the site and the existing buildings and tenants in situ in existing buildings.

In addition to the London Heat Map, a local heat mapping study was reviewed, namely, *Camden Borough Wide District Heat Mapping Rev 03 (2015)*, the report was commissioned by the London Borough of Camden and written by Buro Happold. This study also shows the site is located outside any existing or proposed heat network areas.

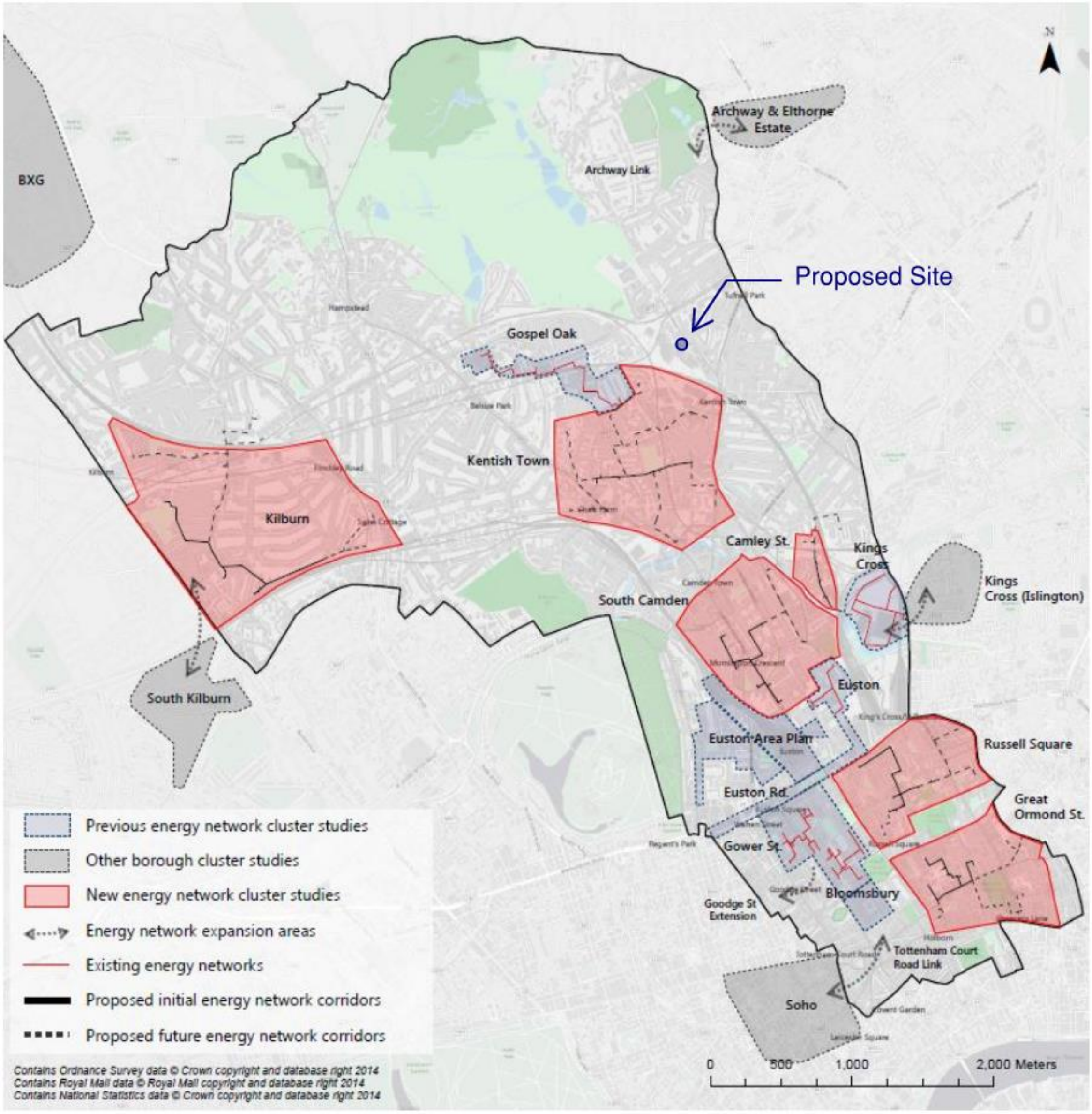


Figure 14 - Camden Heat Mapping Study

The London Borough of Camden was contacted to discuss heat network opportunities, at the time of writing no opportunities have been identified. The Borough responded to the enquiry, no project specific guidance was received, but the *London Heat Map* and *Camden Borough Wide District Heat Mapping Rev 03 (2015)* study were referenced as general guidance. See appendix for correspondence.

Provision for future connection to a heat network has been considered, including identification of indicative pipe routes and plant space for DH plate heat exchangers as shown below. This provision would allow a future heat network to connect to the LTHW element of the heating system.

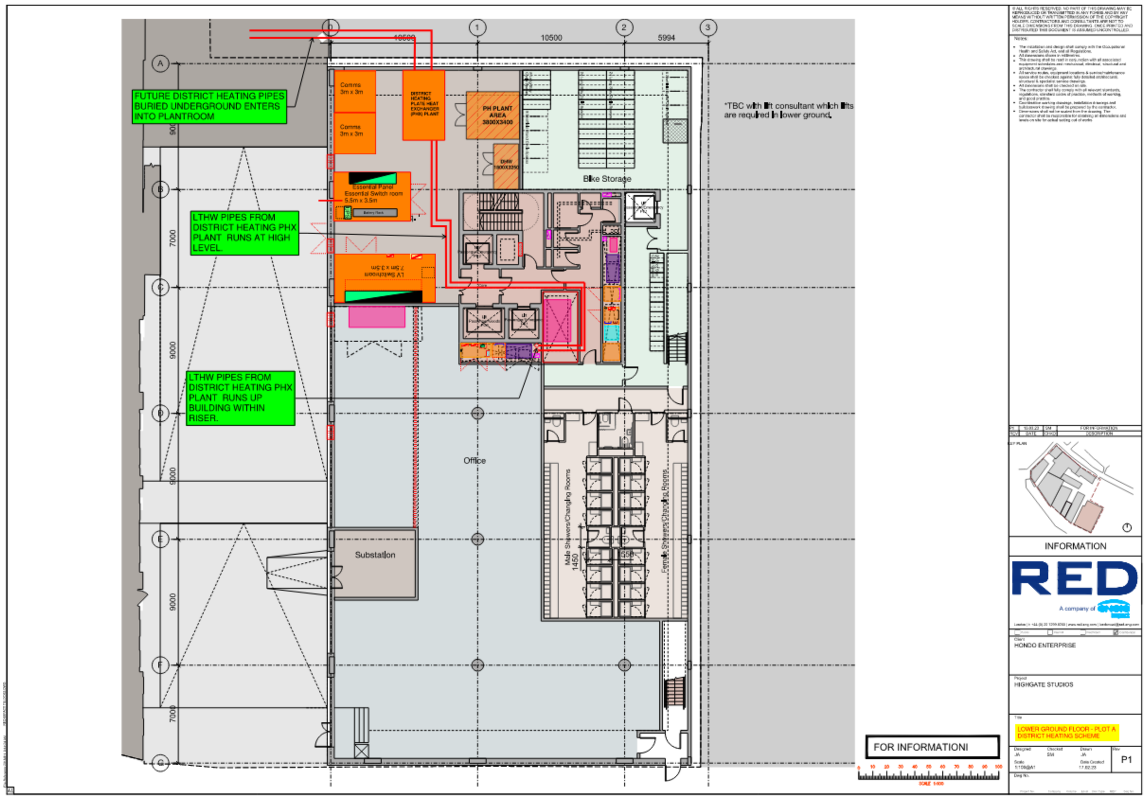


Figure 15 - Future District Heating Network Connection example

As district heating is not a short-term solution, Combined Heat and Power (CHP) will be investigated as an alternative solution to district heating.

7.2 Combined Heat & Power

As an alternative to Option 1 (District Heating), the development could incorporate Combined Heat and Power (CHP) engines as part of a decentralised energy concept.

The use of CHP results in the efficient use of fuel, which traditionally achieved primary energy savings of 30-45% compared with the conventional separate generation to achieve the same quantity of heat and power. Due to the efficiency of CHP, emissions to the environment have traditionally been 30% less than in separate generation of electricity and heat in the UK, however decarbonisation to the UK national grid over the last 10 years has seen a dramatic fall in carbon emissions from grid electricity and as such CHP no longer offers any carbon savings. Furthermore, burning fossil fuels on site would have a detrimental impact on local air quality and this area is already designated an Air Quality management Area (AQMA).

CHP is therefore deemed unfeasible for this project.

7.3 Conclusion

Table 13 below presents reductions in Carbon Dioxide emission for the 'Clean' models in comparison with the baseline models.

	CARBON DIOXIDE EMISSIONS (TONNES CO_2 PER ANNUM)		PERCENTAGE SAVINGS (%)
	REGULATED	UNREGULATED	
Baseline: Part L 2013 of the Building Regulations Compliant Development	45.5	77.95	-
After Energy Demand Reduction (Be Lean)	34.2	77.95	25%
After DH / CHP (Be Clean)	34.2	77.95	0%

Table 16 - Carbon Dioxide Emissions after the 'Clean' stage of the energy hierarchy

8.0 Green: Review of Low / Zero Carbon Technologies

The purpose of this section is to estimate site energy requirements and to analyse feasibility of each of the different Low/Zero carbon technologies for the site. Not all of these technologies will be appropriate; however, the most suitable one should be applied in order to meet the required energy and CO_2 reduction.

The local planning policy does not specifically require an LZC technology to be installed on this development.

8.1 Biomass

Biomass boilers provide heat with a very low resulting net carbon emission taken over the life cycle of the fuel; CO_2 emitted in the combustion process is nearly balanced by the CO_2 absorbed by photosynthesis during the growth of the biomass vegetation.

Embedded CO_2 emissions result from the processing and transportation of the fuel. Therefore, as part of a carbon reduction strategy a wood pellet or wood fuelled boiler would have a significant positive impact on CO_2 reductions.

Biomass fuel is generally regarded as a zero-carbon emission fuel over the lifetime of the plant material although there will be a residual carbon footprint related to collecting, processing and transporting the fuel. The Part L 2021 carbon emission factor for biomass wood pellets is 0.029 kg CO_2/kWh, around a quarter of mains gas (0.210 kg CO_2/kWh).

However, an overriding reason against using this type of technology is its high NO_X emissions and particle content of the exhaust gases from typical biomass units that may raise objections from the Environmental Agency and planning department. In London, where air quality is already of high concern, this is particularly problematic.

In light of the above considerations, and as the development is located in an Air Quality Management Area (AQMA), biomass boilers are deemed not a viable option for the proposed development.

8.2 Wind Turbines

Being an urban environment there are numerous buildings in close proximity to the site and these will cause turbulent air flow resulting in significantly reduced output from any wind turbines installed. This is likely to result in the wind turbines under performing and not delivering the required energy generation or carbon savings.

The size / number of wind turbines required to generate significant energy for the site in order to achieve required reduction in CO_2 emissions could not be realistically accommodated on this site.

8.3 Solar Domestic Hot Water

The application of solar panels is for the heating of domestic hot water and due to the low demand of hot water services in this building, there would be insufficient throughput to achieve a significant reduction in CO_2 emissions on this site. Available roof space would be better used for alternative sustainability initiatives.

8.4 Ground Source Heat Pumps

A Ground Source Heat Pump (GSHP) is a central heating and/or cooling system that pumps heat to or from the ground. During the winter season it uses the earth as a heat source, whereas during the summer season it can use the earth as a heat sink. The design increases the efficiency and reduces the operational costs of the heating and cooling systems by taking advantage of the moderate constant temperature in the ground.

Below a certain depth, the ground maintains a constant temperature of 10-12°C winter and summer. A heat pump extracts some of this energy and increases it to a temperature suitable for space heating; this is achieved by circulating water or glycol through either a horizontal matrix of PVC pipework or via a series of boreholes.

The ground source heat pump performance could be higher than the equivalent air source heat pump and, providing the flow and return water temperatures in the heating/cooling circuit can be kept relatively low, seasonal coefficients of performance (COP's) of 3.5 to 4.0 can be achieved.

Due to the decarbonisation of the UK national grid, and the corresponding drop in grid electricity carbon emissions factors over the last decade, heat pumps are becoming much more favourable solution in comparison to gas boilers as they achieve significant carbon savings now and these will improve as the grid decarbonises further.

For this development, there is insufficient space available for bore holes, as such air source heat pumps would be a preferred heat pump solution.

8.5 PV Solar Panels

Photovoltaic modules convert sunlight directly to DC electricity. They can be integrated into buildings in numerous ways including sloping and flat roofs, building façades, glass roof structures, and solar shading devices. There are mainly three types of PV cells: multi-crystalline silicon, amorphous silicon, and mono-crystalline silicon with the latter being the most efficient.

In order to generate energy from renewable sources, photovoltaic panels may be installed on the roofs of the proposed buildings. There are competing demands for roof space for building services plant, green roofs and high-quality outdoor spaces for building occupants. Significant areas have been allocated to PV and these shown on the roof layout below.

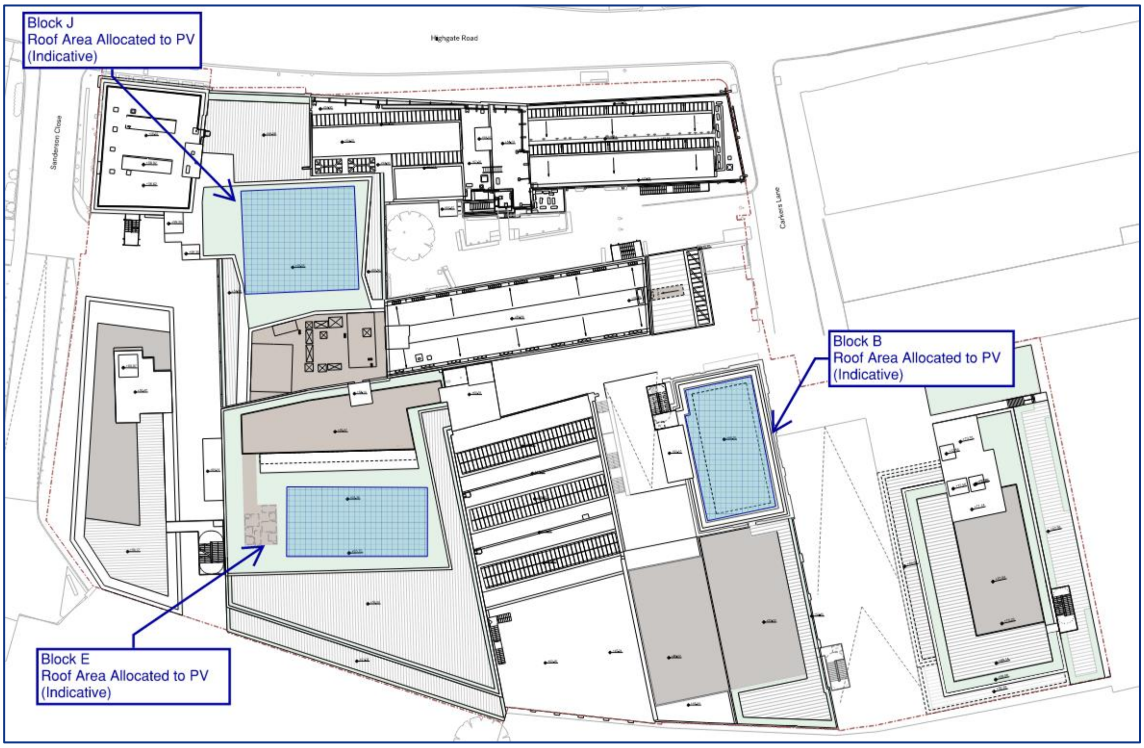


Figure 16 - Site roof plan identifying PV array locations

For three arrays with a combined total area of **250m^2** of mono-crystalline silicon panels installed across Plots B, E and J; with a module nominal efficiency of 17%, the annual energy generated by these arrays would be **34,620.78 kWh**.

As a result of grid displaced electricity, the energy harvested would represent an emission saving of **4.35 Tonnes CO_2 per annum.**

Photovoltaic solar panels are therefore being utilised as an LZC technology.

8.6 Air Source Heat Pumps

Liquid through the evaporator side of the Air Source Heat Pumps (ASHP) absorbs heat from the outside air which is then passed through a compressor where its temperature is increased. The higher temperature heat is then transferred at the condenser side of the ASHP to the heating and hot water circuits of the development.

There are two main types of air source heat pump systems:

- An air to water system which distributes the heat via a wet central heating system
- An air to air system which circulates the heat by fans to heat the development

A further variation to the main types of ASHP presented above is VRF (Variable Refrigerant Flow) units. VRF systems make use of a refrigerant as a cooling and heating medium and can modulate the flow to maximise efficiency. They can provide simultaneous heating and cooling, providing heat recovery by cooling one room and using this heat to heat another room.

In a VRF scheme, a large outdoor unit serves multiple indoor units. Each indoor unit uses an electronic liquid expansion valve to control its refrigerant supply to match the communal demand of the space it serves.

The efficiency of a VRF system is usually defined by the Coefficient of Performance (COP) which is the ratio of the electrical energy input versus the thermal (heating or cooling) energy output.

This scheme will utilise a hybrid VRF system, this utilises refrigerant from the condensers to the hybrid branch controller boxes and then uses water from these to the fan coil units. This significantly reduces the refrigerant charge within the system.

Air source heat pumps will provide LZC heating to the buildings, these will be located on the roofs of the plots.

9.0 Energy Consumption and CO_2 Emissions of the 'Green' Building

9.1 Proposed 'Green' Building IES Modelling Specification

This section of the report provides reference values for the parameters used in the 'Green' case models in order to establish the energy consumption and CO_2 emissions of the development upon which will be applied as per the outlined energy hierarchy in the London Plan.

9.1.1 Building Fabric Thermal Performance

EXPOSED ELEMENT	LEAN U-VALUE (W/m^{2}K)
External Wall	0.15
Floor	0.13
Roof	0.13
Glazing (Double Glazing)	1.20
Personnel Door	1.6

Table 17 - 'Green' models' Elements U-Values

GLAZING ELEMENT	BASELINE BUILDING G-VALUE
Windows	0.3

Table 18 – 'Green' models' Glazing Elements G-Values

9.1.2 Air Permeability

AIR PERMEABILITY	
m^3/(h.m^2) at 50 Pa	2.6

Table 19 - 'Green' models' Air Permeability

9.1.3 Lighting

Lighting in the new buildings and extension to existing plots is LED with an efficiency of 1.2 W/m^2/100 lx in offices, efficacy of 110 lumens/W in toilets and 130 lumens/W in corridors and elsewhere. Automated controls include occupancy detection in offices and toilets and daylight linked dimming in offices.

9.1.4 HVAC systems

The primary HVAC system is a VRF system. Fresh air is supplied to occupied areas by a central air handling unit with heat recovery.
The Table below presents efficiencies of the HVAC systems used for the 'Green' case thermal model.

HVAC SYSTEM	EFFICIENCY
Variable Refrigerant Flow (VRF)	Heating SCoP 3.45 (ASHP) Cooling SEER 5.60 (ASHP)
Central Air Handling Unit	SFP = 1.35 W/l/s, Heat recovery 83.6%

Table 20 – 'Green' models' HVAC system specifications

9.2 IES results for the Carbon Dioxide Emissions of the 'Green' building

	CARBON DIOXIDE EMISSIONS (TONNES CO_2 PER ANNUM)	
	REGULATED	UNREGULATED
Baseline: Part L 2021 of the Building Regulations Compliant Development	45.5	77.95
After Energy Demand Reduction (Be Lean)	34.2	77.95
After DH / CHP (Be Clean)	34.2	77.95
After renewables (Be Green)	28.2	77.95

Table 21 - Carbon Dioxide emissions after each stage of the energy hierarchy

	REGULATED CARBON DIOXIDE SAVINGS	
	TONNES OF CO_2 PER ANNUM	%
Savings from energy demand reduction (Be Lean)	11.3	25%
Savings from CHP (Be Clean)	0.0	0%
Savings from renewable energy (Be Green)	6.0	13%
Total cumulative savings	17.3	38%

Table 22 - Regulated Carbon Dioxide emission savings after each stage of the energy hierarchy

10.0 Air Quality Impacts

The development will not include any fossil fuel burning equipment, all regulated loads will be met using electricity.

ENERGY SOURCE	TOTAL PREDICTED RESIDENTIAL ENERGY USE (MWH/YEAR)	TOTAL PREDICTED NON-RESIDENTIAL ENERGY USE (MWH/YEAR)
Grid Electricity	0	819
Gas boilers (communal/individual)	0	0
Gas CHP	0	0
Connection to existing DH network	0	0

Table 23 - Air Quality Impacts Table

11.0 Flexibility & Peak Energy Demand

There are no gas or thermal demands for the site.

Peak electrical demand has been substantially reduced by the very high levels of performance of the buildings as detailed earlier in the report.

At this stage, negotiations are ongoing with the electricity Distribution Network Operator (DNO).

12.0 Conclusion

12.1 Refurbished Building

The executive summary show that the existing buildings are been refurbished in accordance wit the energy hierarchy and details the Lean & Green measures included within the proposals and the resulting carbon emissions.

12.2 New Build & Extensions

In Section 3.0, the relevant planning policies were addressed where it was determined that in order to comply with **The London Borough of Camden Local Plan (2017**) and **The London Plan (2021)**, the proposed new buildings (Plots A, F, and Pavilion), and the extension of existing buildings (Plots B2, E, and J) are required to demonstrate a minimum of 35% reduction in Carbon Dioxide emissions compared to the TER of the notional building and is recommended to achieve on-site reductions to achieve net zero (100% reduction).

In Section 4.0, a 'baseline' was established for the development using the energy models representing the CO_2 emission of the notional buildings for each new buildings and the extension of existing buildings. The following annual Carbon Dioxide emissions were estimated:

- Regulated Carbon Dioxide emissions: **45,464 kgCO_2 per annum**
- Building Emission Rate (BER): **3.5 kgCO_2 /m^2. annum**

In Section 5.0, the energy efficiency measures to be adopted for the proposed scheme ('Lean' case buildings) were presented and compared against the 'Baseline' buildings. The following annual Carbon Dioxide emissions were estimated for the proposed ('Lean' case) building, these measures **exceed** the **target 15%** emissions reduction by energy efficiency:

- Regulated Carbon Dioxide emissions: **34,161 kgCO_2 per annum**
- Building Emission Rate (BER)**: 2.6 kgCO_2 /m^2. annum**
- Reduction in CO_2 emissions: **25%**

In Section 7.0, the possibility of connecting the development to a decentralised energy scheme has been assessed. Two options were put forward, in Option 1 the possibility of connecting the proposed development to a potential or existing district heating scheme was investigated. At the time of preparing this statement, there were no existing or proposed networks within proximity of the site, therefore this was not deemed viable to pursue. In Option 2, the possibility of installing a CHP plant on-site was discussed. However, due to recent decarbonisation of the UK power grid, the low thermal base load of the development and the non-continuous nature of the base load, Option 2 was also deemed unviable.

In Section 8.0, on-site Low / Zero Carbon (LZC) technologies were assessed in order to investigate further measures to reduce the CO_2 emissions generated by the development to achieve the minimum 35% reduction in CO_2 emissions and target 100% reduction (net-zero) over the Baseline buildings. The proposed buildings incorporates two preferred renewable technologies;

i. Air source heat pumps
ii. Solar photovoltaic panels

In Section 9.0, energy consumption and Carbon Dioxide emissions were estimated for the proposed ('Green' case) buildings as follows:

- Regulated Carbon Dioxide emissions: **28,204 kg CO_2 per annum**

- Building Emission Rate (BER): **2.2 $kgCO_2$ /m^2. annum**
- Overall reduction in CO_2 emissions: **38%**

The proposed development **meets** the **35% minimum** threshold target of the planning condition as a result of efficient demand reduction measures and proposed M&E design. In order to achieve the 100% target reduction in CO_2 emissions a cash-in-lieu contribution of **£80,382** will be payable.

Appendix A – ‘Be Lean / Clean’ BRUKL

See ZIP file containing BRUKLs.

Appendix B – ‘Be Green’ BRUKL

See ZIP file containing BRUKLs.

Appendix C – Correspondence with council regarding District Heating

From: Kristina Smith <Kristina.Smith@camden.gov.uk>
Sent: Wednesday, April 12, 2023 4:17 PM
To: HANSON Olly (RED) <Oliver.Hanson@red-eng.com>
Cc: MORROW Stephen (RED) <stephen.morrow@red-eng.com>
Subject: FW: Planning Enquiry - Heat Networks - Highgate Studios (NW5 1TL)

Hello Olly,

Please find below information from the Council’s sustainability officer which I hope answers your question.

Many thanks,

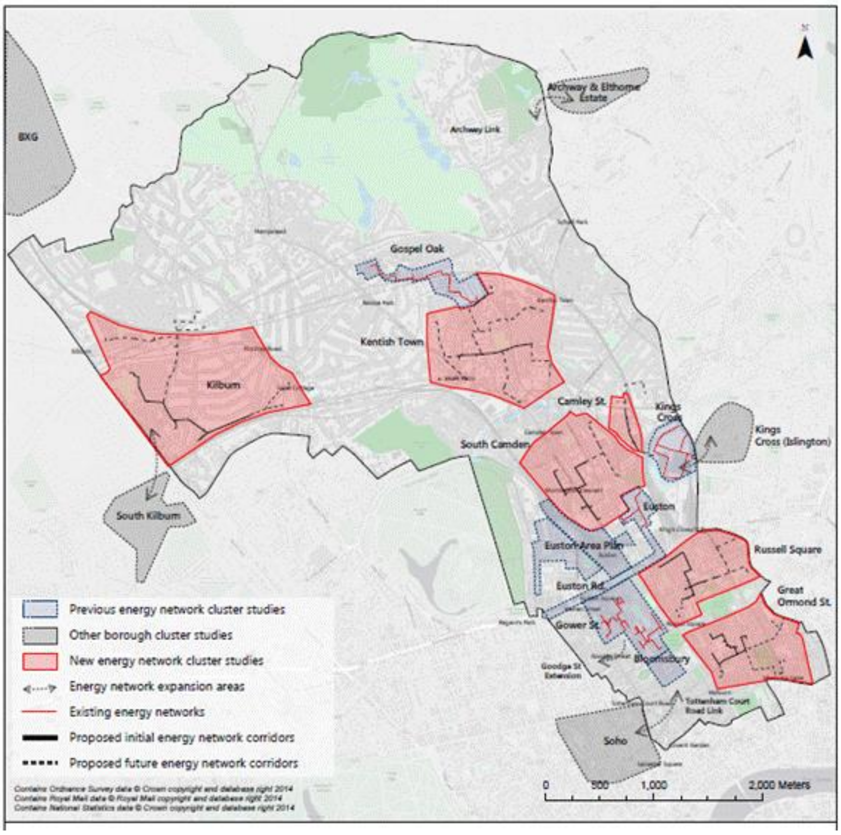
Kristina Smith
Principal Planning Officer

From: Katherine Frost <Katherine.Frost@camden.gov.uk>
Sent: 11 April 2023 16:17
To: Kristina Smith <Kristina.Smith@camden.gov.uk>
Cc: Christopher Winters <Christopher.Winters@camden.gov.uk>
Subject: RE: Planning Enquiry - Heat Networks - Highgate Studios (NW5 1TL)

Kristina

Apologies for the delay in responding.

In the first instance please refer to the Supplying low carbon energy page on the council website which includes the following map.



Any investigation should also consider the heat opportunities also included in the London heat map.

Kind regards

Katherine

Katherine Frost
Senior Sustainability Officer (Planning)

From: Oliver.Hanson@red-eng.com <Oliver.Hanson@red-eng.com>
Sent: 28 March 2023 17:12
To: Kristina Smith <Kristina.Smith@camden.gov.uk>
Cc: stephen.morrow@red-eng.com
Subject: RE: Planning Enquiry - Heat Networks - Highgate Studios (NW5 1TL)

Hi Kristina,

As per my email below, I’ve been looking to identify the relevant contact at Camden to discuss heat networks with, in relation to the Highgate studios development.
I spoke to the duty planning officer Adam Greenhalgh earlier today, who has referred me back to you.

Are you able to assist with my enquiry below or put me in contact with the relevant person at Camden Council?

Kind regards,

Olly Hanson
Associate

RED

t: +44 1869 254 400
m: +44 7557 391 689

From: HANSON Olly (RED)
Sent: Friday, March 24, 2023 5:48 PM
To: 'planning@camden.gov.uk' <planning@camden.gov.uk>
Subject: Planning Enquiry - Heat Networks - Highgate Studios (NW5 1TL) [Filed 24 Mar 2023 17:48]

Good afternoon,

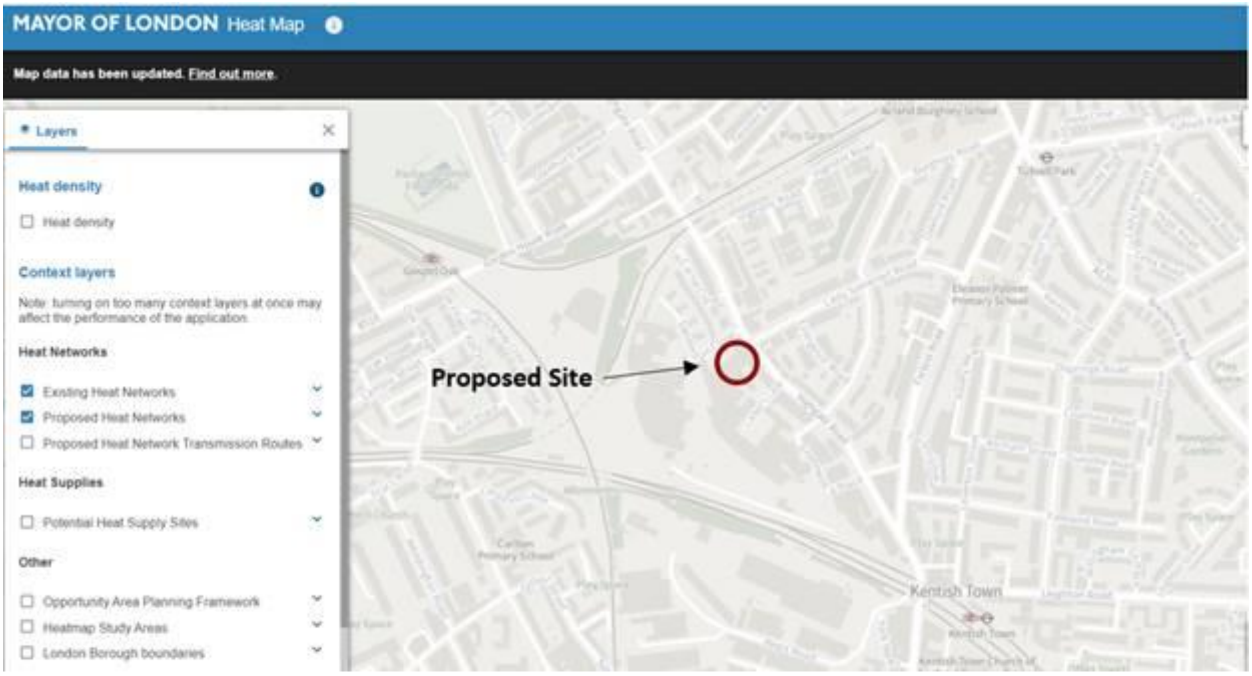
I'm following up on a call I made to the planning department earlier, for which I am awaiting a call back.

I am a sustainability consultant working on a GLA referable building refurbishment and extension development in the London Borough of Camden, the project will shortly be submitting a planning application.

The project includes the refurbishment and extension of existing offices and some new office space at Highgate studios. Highgate Rd, London NW5 1TL.

In order to comply with the GLA London Plan and local planning requirements, consideration is being made for connection to local district heating networks, and the feasibility of such will be included within the planning energy statement.

The Mayor of London's heat Map suggests there are **no existing networks** in the area, and **no proposed heat network** in this area as shown below.



I have also reviewed the Buro Happold report, "*Borough Wide Heat Demand and Heat Source Mapping (2015)",* which shows the site is outside any existing or proposed heat network areas.

Can you please confirm if there are any proposed heat networks in this area or specific heat network planning requirements for developments at this location?

I look forward to hearing from you.

Kind regards,

Olly Hanson
Associate

RED

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Appendix D – Hybrid VRF Datasheet

Air Conditioning

Simultaneous Heating and Cooling with Heat Recovery Outdoor Unit

World of Difference

R32

OUTDOOR UNITS		PURY-EM200YNW-A1	PURY-EM250YNW-A1	PURY-EM300YNW-A1	PURY-EM300YNW-A1 X 2HBC	PURY-EM350YNW-A1	PURY-EM350YNW-A1 X 2HBC	PURY-EM400YNW-A1	PURY-EM450YNW-A1	PURY-EM500YNW-A1
CAPACITY (kW)	Heating (nominal)	25.0	31.5	37.5	37.5	45.0	45.0	50.0	56.0	58.0
	Cooling (nominal)	22.4	28.0	33.5	33.5	40.0	40.0	45.0	50.0	56.0
	High Performance Heating (UK)	25.0	31.5	37.5	37.5	42.8	42.8	47.5	50.4	52.2
	COP Priority Heating (UK)	22.8	28.7	32.3	32.3	38.7	38.7	43.0	49.3	51.0
	Cooling (UK)	20.1	25.1	30.0	30.0	35.8	35.8	40.3	44.8	50.1
POWER INPUT (kW)	Heating (nominal)	6.23	8.84	10.46	9.93	13.10	12.16	13.88	15.77	17.45
	Cooling (nominal)	5.13	7.69	10.03	8.52	13.91	11.33	13.84	15.24	18.06
	High Performance Heating (UK)	7.54	10.70	14.33	13.60	17.95	16.66	16.10	18.29	20.24
	COP Priority Heating (UK)	6.23	8.84	10.46	9.93	13.10	12.16	13.46	15.30	16.93
	Cooling (UK)	2.98	4.46	5.82	4.94	8.07	6.57	9.00	9.91	11.74
COP / EER (nominal)		4.01 / 4.36	3.56 / 3.64	3.58 / 3.33	3.77 / 3.93	3.43 / 2.87	3.70 / 3.53	3.60 / 3.25	3.55 / 3.28	3.61 / 3.10
SCOP / SEER*		-	-	-	-	-	-	-	-	-
MAX No. OF CONNECTABLE INDOOR UNITS		30	37	45	45	35	35	40	45	50
MAX CONNECTABLE CAPACITY		50~150% OU Capacity	50~150% OU Capacity	50~150% OU Capacity	50~150% OU Capacity	50~150% OU Capacity	50~150% OU Capacity	50~150% OU Capacity	50~150% OU Capacity	50~150% OU Capacity
AIRFLOW (m³/min)	High	170	185	240	240	250	250	315	315	295
PIPE SIZE mm (in)	Gas	19.05 (3/4")	22.2 (7/8")	22.2 (7/8")	22.2 (7/8")	28.58 (1-1/8")	28.58 (1-1/8")	28.58 (1-1/8")	28.58 (1-1/8")	28.58 (1-1/8")
	Liquid	15.88 (5/8")	15.88 (5/8")	15.88 (5/8")	15.88 (5/8")	15.88 (5/8")	15.88 (5/8")	19.05 (3/4")	19.05 (3/4")	19.05 (3/4")
SOUND PRESSURE LEVEL (dBA)	Heating / Cooling	59.0 / 59.0	61.0 / 60.5	67.0 / 61.0	67.0 / 61.0	64.0 / 62.5	64.0 / 62.5	69.0 / 65.0	70.0 / 65.5	64.5 / 63.5
SOUND POWER LEVEL (dBA)	Heating / Cooling	78.0 / 76.0	80.0 / 78.5	86.5 / 80.0	86.5 / 80.0	83.0 / 81.0	83.0 / 81.0	88.0 / 83.0	89.0 / 83.0	84.0 / 82.0
WEIGHT (kg)		231	231	231	231	276	276	280	305	348
DIMENSIONS (mm)	Width	920	920	920	920	1240	1240	1240	1240	1750
	Depth	740	740	740	740	740	740	740	740	740
(1798mm without legs)	Height	1858	1858	1858	1858	1858	1858	1858	1858	1858
ELECTRICAL SUPPLY*1		380-415v, 50Hz	380-415v, 50Hz	380-415v, 50Hz	380-415v, 50Hz	380-415v, 50Hz	380-415v, 50Hz	380-415v, 50Hz	380-415v, 50Hz	380-415v, 50Hz
PHASE*1		Three	Three	Three	Three	Three	Three	Three	Three	Three
STARTING CURRENT (A)*1		8	8	8	8	8	8	8	8	8
NOMINAL SYSTEM RUNNING CURRENT (A)*1	Heating/Cooling [MAX]	9.9 / 8.2 [16.1]	14.1 / 12.3 [21.8]	16.7 / 16.0 [23.9]	15.9 / 13.6 [23.9]	21.0 / 22.3 [30.0]	19.5 / 18.1 [30.0]	22.2 / 22.1 [35.9]	25.2 / 24.4 [36.9]	27.9 / 28.9 [46.9]
GUARANTEED OPERATING RANGE (°C)	Heating / Cooling	-20~15.5 / -5~52	-20~15.5 / -5~52	-20~15.5 / -5~52	-20~15.5 / -5~52	-20~15.5 / -5~52	-20~15.5 / -5~52	-20~15.5 / -5~52	-20~15.5 / -5~52	-20~15.5 / -5~52
FUSE RATING (MCB sizes BS EN 60947-2) - (A)*1		1 x 20	1 x 25	1 x 25	1 x 25	1 x 32	1 x 32	1 x 40	1 x 40	1 x 50
MAINS CABLE No. Cores*1		4	4	4	4	4	4	4	4	4
CHARGE REFRIGERANT (kg) / CO_2 EQUIVALENT (t) R32 (GWP 675)		5.2 / 3.5	5.2 / 3.5	5.2 / 3.5	5.2 / 3.5	8 / 5.4	8 / 5.4	8 / 5.4	10.8 / 7.3	10.8 / 7.3
MAX ADDITIONAL REFRIGERANT (kg) / CO_2 EQUIVALENT (t) R32 (GWP 675)		13.5 / 9.1	13.5 / 9.1	15.5 / 10.5	15.5 / 10.5	15.5 / 10.5	15.5 / 10.5	19.5 / 13.2	19.5 / 13.2	19.5 / 13.2

Notes: *SEER/SCOP available separately in the 'City Multi VRF Seasonal Efficiency' document. Based on Ecodesign Lot 21/6 to EN14825 standard. *1 A separate power supply is required for each module. Where more than one figure is quoted there are multiple modules. Specification subject to change. R410A equivalent systems are also available - please contact your local sales office for further information.