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DATE
21 AUGUST 2019

ENERGY AND SUSTAINABILITY STATEMENT

KENTISH TOWN CINEMA, 187 KENTISH TOWN ROAD
LONDON NW1 8PD

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DOCUMENT STATUS

PROJECT
Kentish Town Cinema, 187 Kentish Town Road, London, NW1 8PD

PROJECT NO.
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CLIENT
Vabel
531 Highgate Studios
53-79 Highgate Road,
London
NW5 1TL

IN CONJUNCTION WITH

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CONTENTS

EXECUTIVE SUMMARY

This Energy Assessment and Sustainability Statement has been prepared by Integration Consultancy Limited in support of the proposed Kentish Town Cinema development in the London Borough of Camden. This scheme includes a 2-storey extension comprising 4 new-build residential units (3rd and 4th floors) and within the retained structural elements 8 residential units on the 1st and 2nd floor as well as a 64-seat cinema and bar areas on the ground floor.

Please note that the new-build extension areas fall under Part L1 A of UK Building regulation 2013. The residential areas and commercial areas in the existing structure are designated as Part L1B and Part L2B respectively.

This document supersedes the historic energy-related planning documents (Energy and Sustainability Statement dated 10 June 2015 by Premier Assessors and the document entitled Code for Sustainable Homes Pre-Assessment Report dated November 2010 by Premier Assessors).

A separate Sustainability Plan will be produced in addition to this document, which will include the Sustainability Proforma, in accordance with the Section 106 agreement.

New Build Energy Achievements
In terms of energy this development achieves:

- **53.4% improvement in carbon dioxide (CO_2) emissions** for new build areas over the Target Emission Rate outlined in the national Building Regulations 2013 compared to the Camden planning target of **29.2**%.
- **51% of carbon emissions met by onsite renewable energy generation** for new build areas as compared to the target of 20%.

In relation to the London Plan's Lean, Clean and Green energy structure, the new build areas achieve the following:

High-Efficiency Building (*Be lean*).
The scheme uses high performance building fabric, passive low energy design, low energy building services systems and energy efficiency lighting. Mechanical Ventilation with Heat Recovery (MVHR) is also used to ensure high air quality and a low heat demand. The proposed "Be Lean" design elements have been shown to achieve a 4.6% reduction in CO_2 emissions compared to Building Regulations 2013.

Local Renewable Energy (*Be Green*):
Following a Low and Zero Carbon (LZC) Technology feasibility study it is proposed to provide 4kW kWpeak of solar photovoltaic (PV) modules located at roof level and individual Air Source Heat Pumps units to provide heating. The proposed "Be Green" design has been shown to achieve an additional 48.8% reduction compared to Building Regulations 2013.

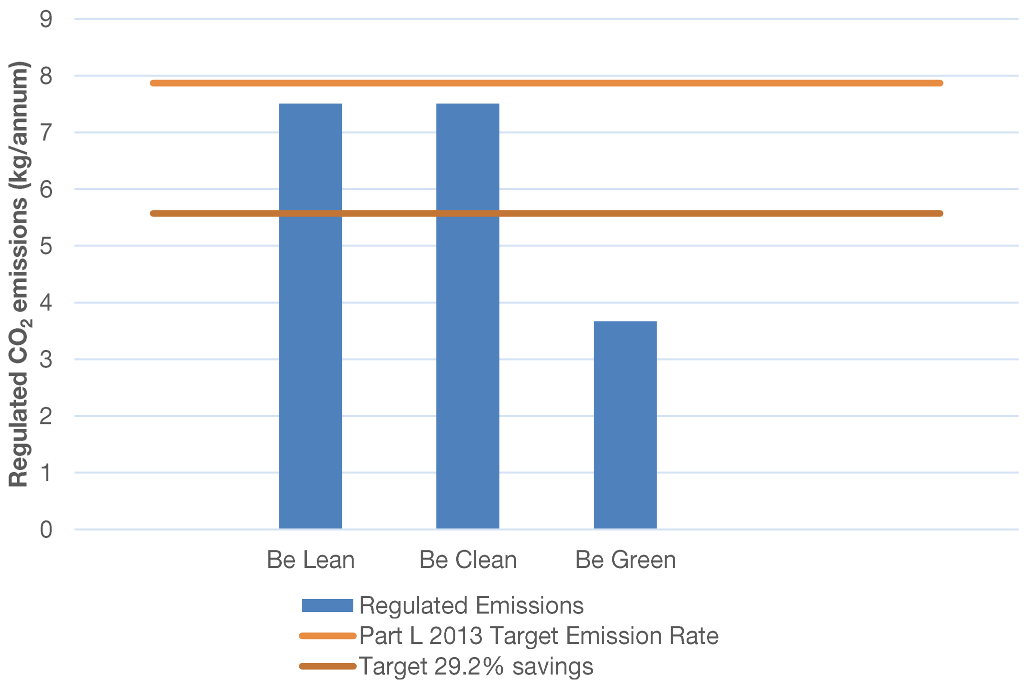


Figure 1: Summary of the scheme's regulated energy use as compared to the CO_2 emission baseline & target of 29.2% below Part L

The table below shows the regulated and unregulated energy use for the new build areas.

	Carbon dioxide emissions for residential units (Tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Baseline: Part L 2013 (Building Regulations) Compliance	7.87	4.00
After "Be Lean" (energy demand reduction)	7.51	4.00
After "Be Clean" (heat network / CHP)	7.51	4.00
After "Be Green" (renewable energy)	3.67	4.00

Table 1: Total regulated CO_2 emissions after each stage of the Energy Hierarchy

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

	Regulated residential carbon dioxide savings	
	(Tonnes CO_2 /annum)	**(%)**
Savings from "Be Lean" (energy demand reduction)	0.36	4.6%
Savings from "Be Clean" (heat network / CHP)	0.00	0.0%
Savings from "Be Green" (renewable energy)	3.84	48.8%
Cumulative on site savings	4.20	53.4%

Table 2: Total regulated CO_2 emissions savings after each stage of the Energy Hierarchy.

Sustainable Retrofitting

In terms of energy saving features for the residential areas designated as Part L1B and commercial areas designated as Part L2B, the scheme will employ a high sustainable energy strategy. The refurbished residential units will use the same individual mechanical ventilation with heat recovery MVHR units as per the new build units and the same air source heat pumps (ASHP) for all space heating and hot water heating needs.

The commercial cinema area also uses ASHP for heating requirement and a dedicated air handing unit complete with heat recovery. Where possible the existing fabric will be upgraded for example upgrading existing windows to new double glazing.

Low Water Use

The scheme will achieve 105 litres or less per head per day water use using low-flow taps, showers, WCs (excluding an allowance of 5 litres or less per head per day for external water consumption).

Clean Travel

The site has good public transportation links achieving the highest possible PTAL score of 6b (public transport access levels). The scheme also has cycle storage for 24 bicycles to encourage zero energy/emission transportation. The residents' entrance is via a green courtyard.

Residents also benefit from a dedicated terrace, accessed from the 3rd floor, with a dedicated planted area also on the 3rd floor terrace.

1 INTRODUCTION

Integration Consultancy Limited has been appointed to undertake an Energy and Sustainability Assessment in support of the proposed Kentish Town Cinema development in the London Borough of Camden. This scheme includes a 2-storey extension comprising 4 new-build residential units (3rd and 4th floors) and in the retained structural elements 8 residential units on the 1st and 2nd floor as well as a 64-seat cinema and bar areas on the ground floor.

The new build extension areas fall under Part L1 A of UK Building regulation 2013. The residential areas and commercial areas in the existing structure are designated as Part L1B and Part L2B respectively.

Please note this document supersedes the historic energy-related planning documents (Energy and Sustainability Statement dated 10 June 2015 by Premier Assessors and the document entitled Code for Sustainable Homes Pre-Assessment Report dated November 2010 by Premier Assessors). A separate Sustainability Plan will be produced in addition to this document, which will include the Camden Sustainability Proforma, in accordance with the Section 106 agreement.

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

Underpinning the energy strategy is the 'Be Lean', 'Be Clean' and 'Be Green' design framework which has been widely adopted (e.g. in the London Plan).

1. ‘Be lean’ (energy demand minimisation through 'passive' and 'active' design measures)
2. ‘Be clean’ (efficient energy supply via decentralised heatwork/CHP)
3. ‘Be green’ (renewable energy generation where feasible)

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

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

THE DEVELOPMENT SITE

The site is located at 187 Kentish Town Road, London, NW1 8PD in the London Borough of Camden. The site has good public transportation links achieving the highest possible PTAL score of 6b (public transport access levels).

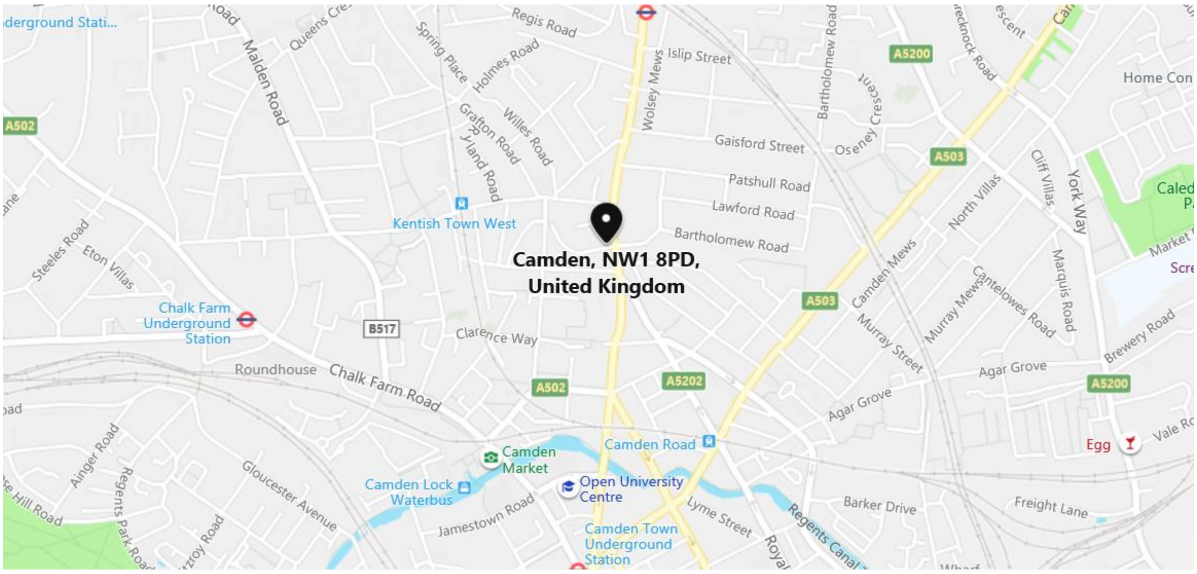


Figure 2: Site Location

PROPOSED DEVELOPMENT OVERVIEW

The proposed development includes a 2-storey extension comprising 4 new-build residential units (3rd and 4th floors) and in the existing structure 8 residential units (1st and 2nd floor) as well as a 64-seat cinema and bar areas on the ground floor. The scheme also has cycle storage for 24 bicycles to encourage zero energy/emission transportation. The residents' entrance is via a green courtyard. Residents also benefit from dedicated terrace, accessed from the 3rd floor, with a dedicated planted area also on the 3rd floor terrace.

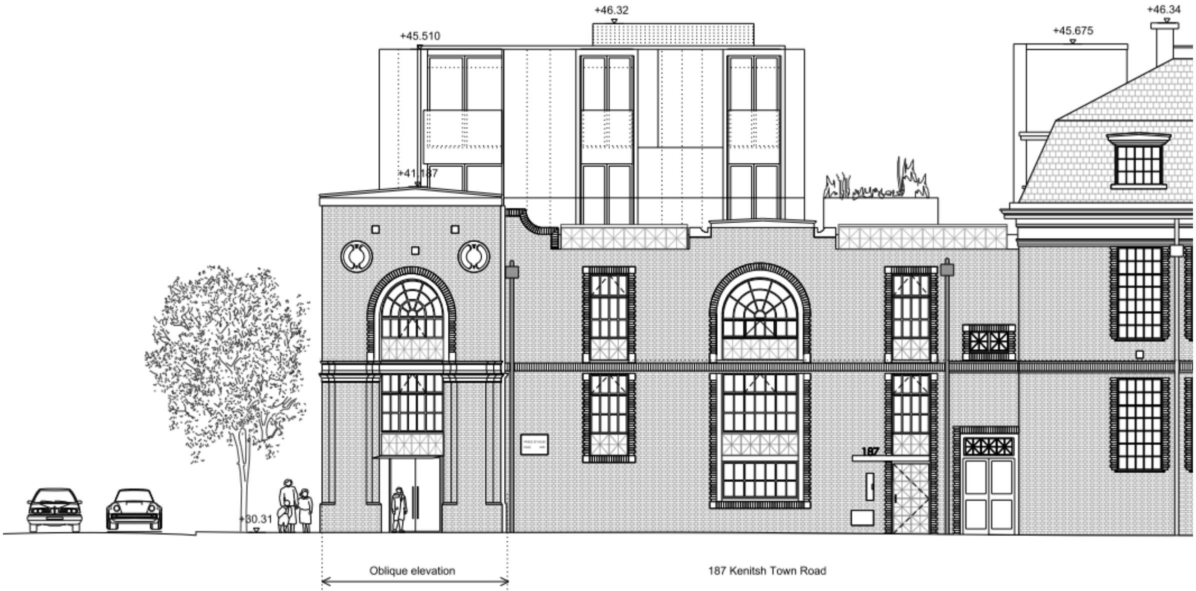


Figure 3: Proposed development scheme

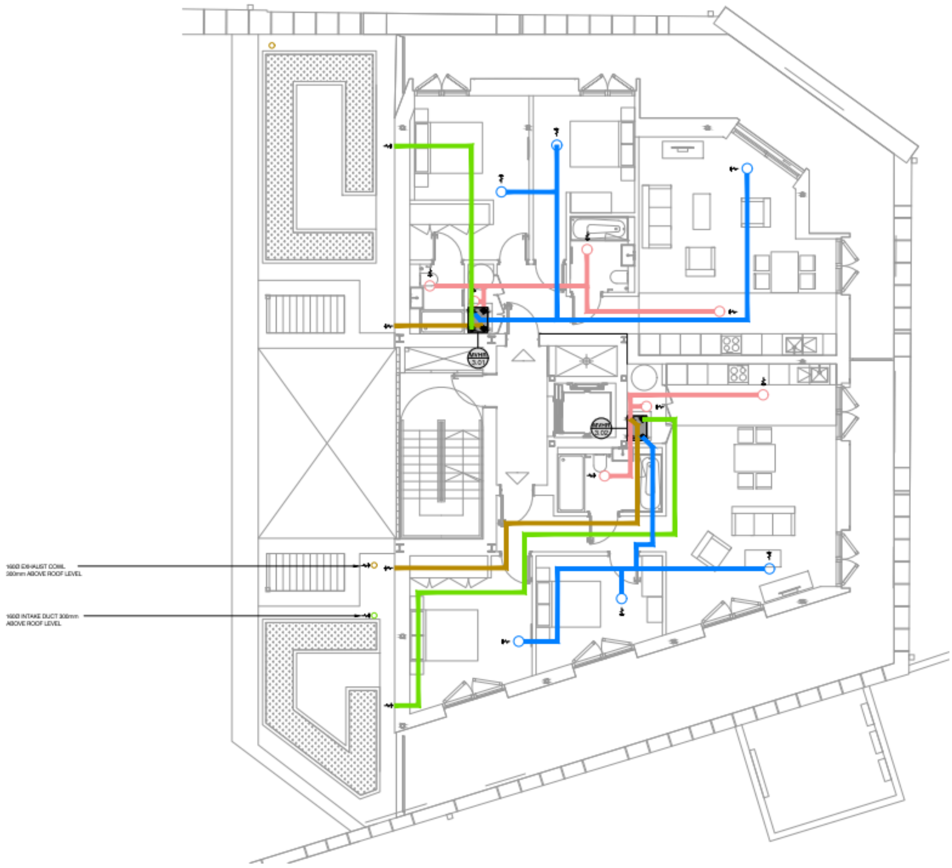


Figure 4: Residential units– Floor 3 (units 3.1 to 3.2) showing proposed mechanical ventilation with heat recovery

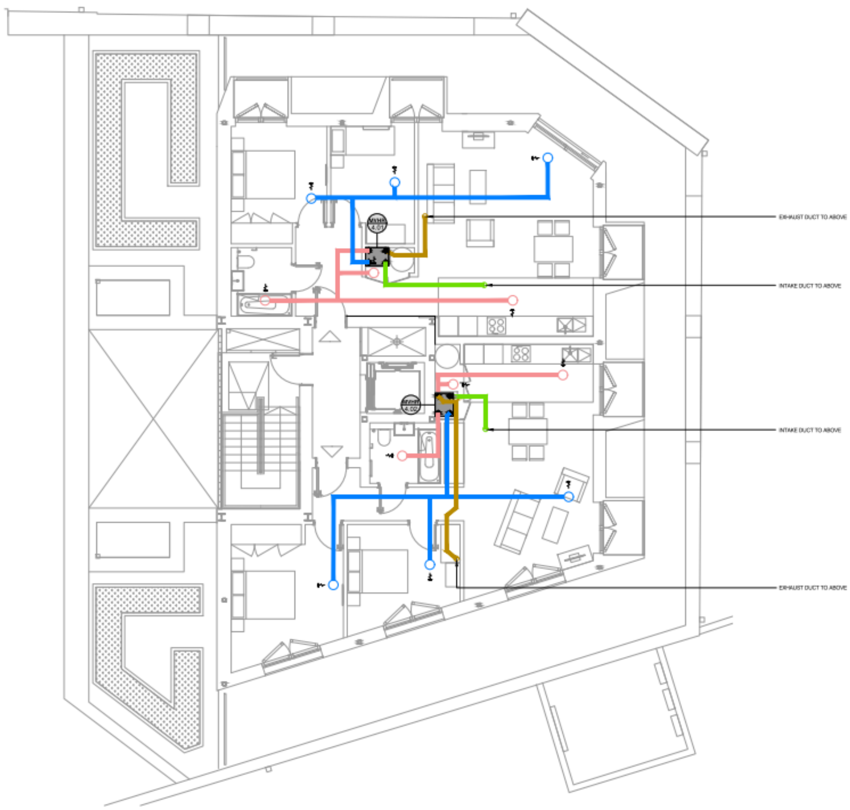


Figure 5: Residential units– Floor 4 (units 4.1 to 4.2) showing proposed mechanical ventilation with heat recovery

The details of the proposed new build accommodation modelled are summarised below.

Accommodation	Area (m^2)
Unit 3.1	80.1
Unit 3.2	78.4
Unit 4.1	69.6
Unit 4.2	71.0

Table 3: Summary of residential new build units

ENERGY AND SUSTAINABILITY ASPIRATIONS

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

Zero residential CO_2 emissions with a minimum of 29.2% below Part L (2013).

Local Renewable Energy: The development aims to meet or surpass the London Plan target of 20% of CO_2 emissions associated with the development's regulated energy demand to be met by renewable energy systems where feasible.

2 DESIGN APPROACH

SUSTAINABILITY DESIGN APPROACH AND STRATEGY

Sustainability is integral to the design, construction, operation and performance of the proposed development. We adopt the definition of Sustainable Development as defined by the Sustainable Design and Construction Supplementary Planning Guidance (SPG - April 2004): “Development that meets the needs of the present generation without compromising the ability of future generations to meet their own social, economic and environmental needs”.

This development aims to create high quality, functional accommodation that support health and well-being as well as social and environmental development whilst at the same time addressing key long-term issues such as those capture by the Mayor’s strategic targets as set out below.

The proposal actively addresses each aspect and is summarised as follows:

Mayor’s Strategic Targets **(Sustainable Development)**	**Sustainability Strategy** **(How the proposed development contributes to Mayor’s Targets)**
CLIMATE CHANGE AND ENERGY (CO_2 EMISSIONS) London will be a zero carbon city by 2050, with energy efficient buildings, clean transport and clean energy. By 2050 London to have 2GW of solar PV installation.	✓ Low carbon emissions ✓ MHVR with heat recovery bypass for assisted summer time night-cooling when required. ✓ Solar PV and ASHP ✓ Smart meters for energy monitor with guidance documentation for occupants including energy benchmarks.
GREEN INFRASTRUCTURE /BIODIVERSITY London will be the world’s first National Park City, where more than half of its area is green, where the natural environment is protected, and where the network of green infrastructure is managed to benefit all Londoners.	✓ Terrace and courtyard with dedicated planted areas
NOISE Londoners’ quality of life will be improved by reducing the number of people adversely affected by noise and promoting more quiet and tranquil spaces.	✓ High air tightness and MVHR reduces noise for occupants.
AIR QUALITY Contribute to the achievement of EU limit values for air pollution	✓ Mechanical ventilation with heat recovery (MVHR) offers a means for occupants to filter fresh air. ✓ Fresh air taken at higher levels where pollution concentrations will be lower. ✓ Excellent public transportation links (PTAL 6b) ✓ Cycle spaces to encourage zero energy/emission transportation. ✓ ASHP to eliminate production of local pollutants (e.g. NOx PMs)
WASTE / RECYCLING London will be a zero waste city. By 2026 no biodegradable or recyclable waste will be sent to landfill and by 2030 65 per cent of London’s municipal waste will be recycled.	✓ Dedicated waste storage and segregation area ✓ Construction, demolition and excavation waste recycling requirement in contractor specification (construction waste management plan).

Table 4: Sustainability strategy in relation to Mayor’s Strategic Targets (May 2018)

Aspects related to water use are summarised below:

Additional sustainable development Issues	Sustainability Strategy
WATER USE On average Londoners use approximately 167 l/p.day (litres of potable water per person per day). This is 14% more than the England and Wales average, despite London already being in one of the driest parts of the country. Part G of building regulation requires 125 l/p.day and 110 l/p.day where required by planning condition such as in London (105 litres or less per head per day excluding an allowance of 5 litres or less per head per day for external water consumption)	✓ Low flow taps, showers, WCs and (where fitted) dishwashers / washing machines as required in line, where possible, to meet the target of 105 litres or less per head per day excluding an allowance of 5 litres or less per head per day for external water consumption.

Table 5: Water strategy

CLIMATE ANALYSIS

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

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

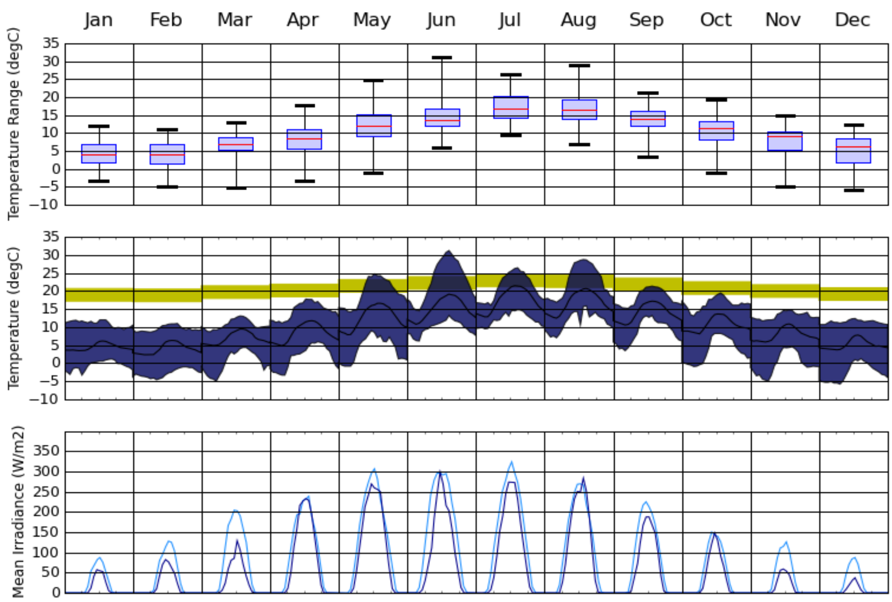


Figure 6: Average historic climate data for London

BUILDING FABRIC PERFORMANCE & INSULATION

High levels of insulation are proposed as summarised later in this section. The thermal performance of all exposed elements equals or exceeds the minimum requirements for Building Regulations 2013. This will significantly reduce energy consumption and ensure optimum occupant comfort all year round by retaining heat in the winter and reducing heat gains in the summer.

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

AIR TIGHTNESS & INFILTRATION

A high target air-permeability rate has been selected as summarised later in this section. The key to achieving high levels of airtightness is the build quality of construction. Testing procedures shall be performed in accordance with the recommendations set out in CIBSE TM 23 and the ATTMA TS1.

THERMAL BRIDGING

Minimising thermal bridging is an important aspect of the design. The approach to limiting thermal bridging is to implement Accredited or similar high standard to all elements of the construction where feasible (e.g. sills, lintels, jambs, and party floors between dwellings).

www.planningportal.co.uk/info/200135/approved_documents/74/part_l_-_conservation_of_fuel_and_power/6

NATURAL VENTILATION & THERMAL MASS

Daytime natural ventilation is essential to remove excess heat during the summer months and enables the provision of high air quality. When used in combination with thermal mass, natural ventilation will reduce high internal daily temperature fluctuations and minimise the overheating risk in the summer. Therefore, occupant comfort can be maintained without reliance on mechanical cooling systems.

The main living areas are dual aspect to encourage good cross flow ventilation and support night cooling ventilation strategies. As the residential areas are above ground level, they do not have security as a particular concern and air quality is relatively high compared to the ground level.

SOLAR EXPOSURE AND DAYLIGHT

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

The site has excellent access to solar energy and natural daylight, as there are no surrounding buildings that cause excessive overshadowing. This makes the roof highly suitable for solar energy harvesting.

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

ACTIVE BUILDING SERVICES SYSTEMS

All building services systems will be in accordance with, and where possible exceed, the energy minimum requirements of efficiency outlined in the Building Service Compliance Guide 2013.

In the residential areas, the heating and hot water distribution will be provided via a high-efficiency individual air source heat pumps in conjunction with underfloor heating. In the commercial areas heating and cooling is provided by an air source heat pump.

Fresh air will be provided by high-efficiency mechanically ventilation with heat recovery as per Building Regulations Part F System 4. The system will have a summer bypass to support night-time free cooling of thermal mass.

Figure 7: Typical domestic MVHR system.

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

COOLING AND OVERHEATING

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

Hierarchy Measure	Application to proposed development
1. MINIMISE INTERNAL HEAT GAINS Minimise internal heat generation through energy efficient design.	✓ Low energy LED lighting. ✓ No centralised plant with heat network
2. MINIMISE EXTERNAL HEAT GAINS Reduce the amount of heat (from solar irradiation and high outside air temperatures) that can enter the building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls.	✓ High level of insulation ✓ Internal blinds with light coloured external facing surfaces (with high reflective properties).
3 & 4 HEAT MANAGEMENT AND PASSIVE VENTILATION Manage heat within the building through exposed internal thermal mass and high ceilings as well as natural ventilation strategies such as night cooling, the stack effect and promotion of cross-flow ventilation.	✓ Good natural ventilation and cross flow potential
5. MECHANICAL VENTILATION	✓ MVHR with summer bypass
6. ACTIVE COOLING Ensuring they are the lowest carbon options.	✓ In commercial areas only.

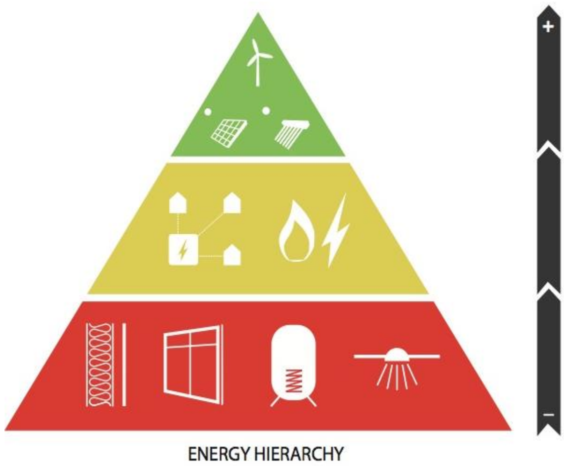
Table 6: Cooling and overheating hierarchy application

From the tables above, in the appendix and the SAP calculations, the proposed development is not considered to have a high overheating risk.

3 ENERGY CALCULATIONS INTRODUCTION

ENERGY DESIGN APPROACH – THE ENERGY HIERACHY

The energy hierarchy, as referred to in the London Plan and illustrated below, sets out a three-stage approach to strategic decision-making for the reduction of energy and associated carbon emissions.



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

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

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

Figure 8: Energy Hierarchy Methodology

This approach aims to reduce the energy consumption and consequent carbon emissions of the development while maintaining quality and without compromising occupant wellbeing and comfort.

This is achieved by developing design strategies that respond to the opportunities and challenges of the site within the context of the local climate and environment as well as implementing a highly-efficient energy infrastructure that integrates on-site renewable energy sources.

The incorporation of appropriate passive and active energy efficiency measures can significantly reduce energy demands. These measures are often integral to the building form and fabric and cannot be readily remedied or retrofitted once the building has been constructed.

The augmentation of these design strategies begins by identifying site-specific challenges and opportunities, considering the microclimate, location and surroundings and applying them to the building form, façade and orientation.

BASELINE – TARGET EMISSION RATES (TER)

Energy demand and annual carbon emissions are calculated using BRE accredited energy compliance software SBEM for the non-domestic areas and Stroma for SAP 2012[1] for the residential areas.

The amount of carbon emission reductions achieved by the proposed scheme is compared to the notional Target Emission Rate (TER) which forms the baseline comparison target. This notional building/dwelling is produced by the energy model and intends to replicate the actual building in terms to area, form, orientation and usage. The fabric parameters and system efficiencies for this notional building meets and, in some parts, exceeds the minimum requirements for compliance with Part L of the 2013 Building Regulations as summarised in the table below.

[1] October 2013 updated June 2014 to include RdSAP 2012 and with minor corrections December 2014.

4 NEW BUILD RESIDENTIAL

BASELINE

For dwellings, as part of the 2013 Part L (Part L1A) of the building regulations, the Target Fabric Energy Efficiency (TFEE) sits alongside TER. The TFEE is the minimum fabric energy performance requirement for a new dwelling. The Dwelling Fabric Energy Efficiency (DFEE) rate is the actual fabric energy performance of the new dwelling. The DFEE must not exceed the TFEE. It is expressed as the amount of energy demand in kWh/(m^2.year). The TFEE is 15% higher than the notional FEE and so if the actual dwelling is constructed entirely to the notional dwelling specifications it will meet the fabric energy efficiency targets. However, the notional dwelling is not prescriptive and specifications can be varied provided that the TFEE rate is achieved or bettered. To prevent poor performance of individual elements, limiting fabric values are retained in Table 2 of approved document L1A and limiting building services efficiencies are set out in the Domestic Building Services Compliance Guide.

The residential Notional Building baseline requirements are:

Element	**Building Regulations 2013 for domestic**	
	U Value	**G Value**
External Walls	0.18	-
Floor	0.13	-
Roof	0.13	-
Windows	1.4	0.63
External Opaque Doors	1.0	-
External Glazed Doors	1.2	-
Air Tightness	5.0 m3/m2/h @50Pa	
Liner thermal transmittance	Standardised Psi values SAP Appendix R	
Size of building	Same as proposed dwelling	
Opening areas (windows and doors)	Same as actual dwelling up to 25% of total floor area	
Ventilation type	Natural with extract fans	
Air-conditioning	None	
Heating source	Mains Gas (89.5% SEDBUK 2009)	
Heating emitters and controls	Radiators. Time and temperature zone control. Weather compensation.	
Hot water storage	Gas boiler heated. Thermostat control. 150 litres. Separate time control.	
Lighting	100% low energy lighting	
Thermal Mass parameter (TMP)	Medium (250kJ/m2K)	

Table 7: Notional Dwelling (Building) Specification (Table 4 SAP 2012)

The first step of the analysis provides the baseline notional building CO_2 emissions. The “Be Lean”, “Be Clean” and “Be Green” scenarios are presented subsequently for comparison.

The CO_2 emission associated with regulated energy consumption are given below. “Regulated” energy means space heating, hot water, cooling, lighting, pumps and fans. Sample output from the software is presented in the Appendix for reference.

Accommodation	**Area (m^2)**	**TER ($kg.CO_2/m^2/yr.$)**
Unit 3.1	80.1	24.8
Unit 3.2	78.4	23.98
Unit 4.1	69.6	29.09
Unit 4.2	71.0	27.85

Table 8: Summary of Baseline “notional” building performance for the new build residential.

"BE LEAN"

As part of the "Be Lean" approach, seeking to minimise energy demand, the building fabric has been specified to meet or exceed the minimum fabric parameters outlined in Part L of the Building Regulation 2013 as per table below.

Element	Building Regulations 2013 Notional Building (limit)		Enhanced Building Fabric Improvement for the proposed development	
	U Value (W/m²K)	G Value	U Value (W/m²K)	G Value
External Walls	0.18 (0.3)	-	0.15	-
Ground Floor	0.13 (0.25)	-	NA	-
Roof	0.13 (0.20)	-	0.13	-
Windows	1.40 (2.0)	0.63	1.4	0.63
Wall to Halls / lobby	-	-	0.2	-
External Doors	1.2	-	1.4	-
Air Tightness	5.0 m³/m²/h (10)		5.0 m³/m²/h	
Thermal Bridging	Accredited details		Accredited details or similar where possible (e.g. jambs, sills, lintels and corners)	
Air-conditioning	None		None	
Heating source	Mains Gas (89.5% SEDBUK 2009)		Mains Gas (89.5% SEDBUK 2009)	
Heating emitters	Radiators		Underfloor heating with pipes in floor build-up above insulation	
Heating control	Time and temperature zone control.		Time and temperature zone control and weather compensation	
Lighting	100% low energy lighting		100% low energy lighting	
Ventilation type	Natural with extract fans		Individual Mechanical Ventilation with Heat Recovery (MVHR) Nuaire MRXBOXAB-ECO-3 (vertical)	

Table 9: Proposed development and baseline comparison "Notional" SAP building

"Be Lean" Total Carbon Emissions

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

Accommodation	Area (m²)	TER (kg.CO_2/m²/yr.)	LEAN DER (kg.CO_2/m²/yr.)
Unit 3.1	80.1	24.8	23.31
Unit 3.2	78.4	23.98	22.81
Unit 4.1	69.6	29.09	27.93
Unit 4.2	71.0	27.85	26.90

Table 10: "Be Lean" Residential Regulated Emissions

"BE CLEAN"

Connection to Third-Party Heat Networks

Connection to heat networks has been stated as a priority for London Plan. The London Heat Map is available to help determine feasibility. This map suggests that the proposed development is located > 1km away from heat networks (see Appendix). Therefore, connection to third party heat networks are not considered viable for this development especially considering the overall small area of the development.

Gas Fired Combined Heat and Power (CHP)

Combined heat and power (CHP) systems are available for individual houses, group residential units and small non-domestic premises. Large commercial CHPs are also now relatively common in premises which have a simultaneous demand for heat and electricity for long periods, such as hospitals, recreational centres, hotels and multi-residential and mix-use developments.

Whilst MicroCHP units are available for small developments CHP is not generally recommended and GLA guidance suggests following need not install CHP:

- Small-medium residential development (less than 500 apartments)
- Non-domestic developments with a simultaneous demand for heat and power less than 5000 hours per annum (offices/schools)

Therefore, CHP is not considered a viable option.

“BE GREEN”

A renewable energy feasibility exercise has been carried out in order to determine the most viable option(s) that may allow the proposal to achieve the renewable energy target of 20% CO_2 reduction relative to the overall energy demand requirements. The study is summarised in the Appendix. The viable technologies, solar PV and Air Source Heat Pumps, are summarised below.

Photovoltaics

Solar photovoltaic (PV) modules convert sunlight into electricity. PV is distinct from other renewable energy technologies since it has no moving parts to be maintained and is silent. PV systems can be incorporated into buildings in various ways such as on sloped or flat roofs, in facades, atria and as shading devices.

There has been significant deployment of roof-mounted PV in the UK as costs have fallen dramatically as a result of growing global uptake and continue to fall. Typical module efficiencies of crystalline PV, which is now the dominate form of PV, are between 15-22% and improve incrementally year on year as manufacturing develops.

A particular advantage of solar PV over other types of low and zero carbon technologies, is that the running costs and maintenance requirements are very low.

Due to the available roof area of the proposed development, a solar PV system would be a suitable technology for deployment.

It is proposed that the photovoltaic panels are located on the roof and orientated south and positioned away from shadow-casters on the roof to allow for good energy generation. The panels will be installed with a tilt angle of up to 30° to allow for self-cleaning (via rainfall).

An installed capacity of **4kW** has been proposed which makes the most of the available roof space whilst allowing for equipment required for the cinema ventilation and ASHP external units.

Air-source Heat Pumps

Air Source Heat Pumps operate by extracting heat energy from the surrounding air and transferring that energy in the form of higher-grade heat into a building using underfloor heating or radiator systems or through an all air system.

An electrical heat pump can deliver 3-4kW of thermal energy for every 1kW of grid supplied electricity used (3:1 ratio). Generally, these systems require very low maintenance.

Heat pump technology will work well with the proposed solar PV installation.

Heat Pumps will provide 100% heating and hot water heating in residential areas and the ground floor commercial area which include a cinema and associated bar/seating area.

"Be Green" Total Carbon Emissions

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

This includes **4kW solar PV** and **Individual ASHPs PUHZ 5kW units with 170 litre cylinders**.

Accommodation	Area (m^2)	Baseline TER ($kg.CO_2/m^2/yr.$)	LEAN DER ($kg.CO_2/m^2/yr.$)	GREEN DER ($kg.CO_2/m^2/yr.$)
Unit 3.1	80.1	24.8	23.31	11.63
Unit 3.2	78.4	23.98	22.81	10.92
Unit 4.1	69.6	29.09	27.93	14.03
Unit 4.2	71.0	27.85	26.90	12.74

Table 11: Be Green Regulated Residential Carbon Emissions

5 SUMMARY

Carbon Emissions Summary

	Carbon dioxide emissions (Tonnes CO_2 /annum)	
	Regulated	Unregulated
Baseline: Part L 2013 (Building Regulations) Compliance	7.87	4.00
After "Be Lean" (energy demand reduction)	7.51	4.00
After "Be Clean" (heat network / CHP)	7.51	4.00
After "Be Green" (renewable energy)	3.67	4.00

Table 12: Summary of Residential "Be Green" Carbon Emissions and Baseline Comparison

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

	Regulated carbon dioxide savings	
	(Tonnes CO_2 /annum)	(%)
Savings from "Be Lean" (energy demand reduction)	0.36	4.6%
Savings from "Be Clean" (heat network / CHP)	0.00	0.0%
Savings from "Be Green" (renewable energy)	3.84	48.8%
Cumulative on site savings	4.20	53.4%

Table 13: Residential regulated CO_2 emissions savings after each stage of the Energy Hierarchy.

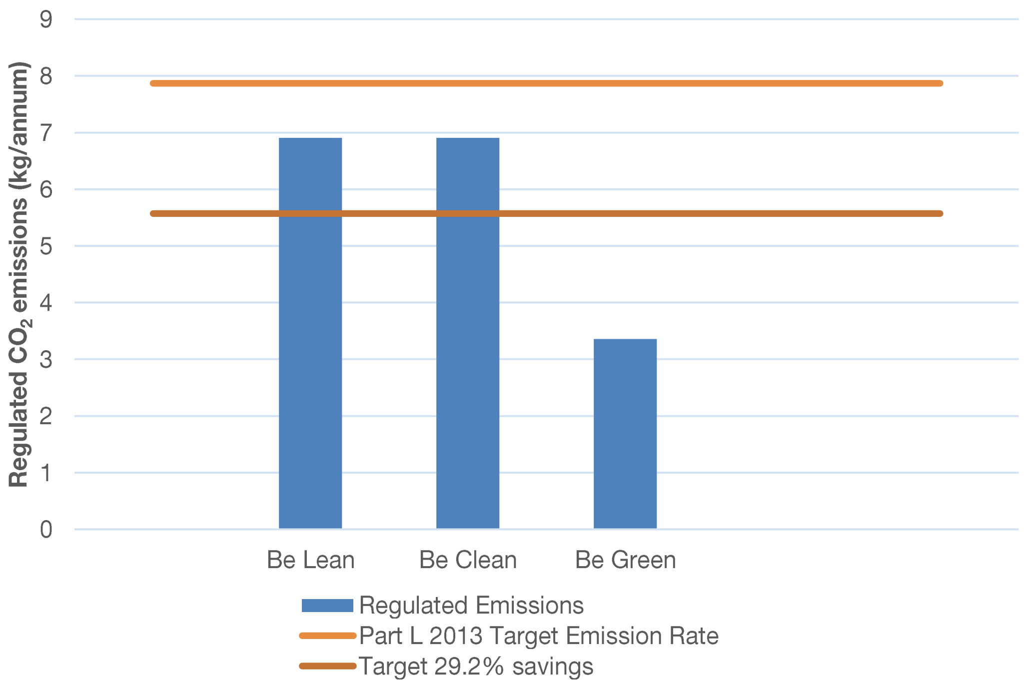


Figure 9: Summary of residential carbon savings for the energy hierarchy method of assessment.

The total regulated “Be Lean” CO_2 emissions is 7.51 tonnes.CO_2/yr, whereas the total regulated “Be Green” CO_2 emissions are 3.66 tonnes.CO_2/yr. The annual renewable energy contribution equates to **51%** of the total carbon emissions.

In terms of energy saving features for the residential areas designated as Part L1B and commercial areas designated as Part L2B, the scheme will employ a high sustainable energy strategy. The refurbished residential units will use the same individual mechanical ventilation with heat recovery MVHR units as per the new build units and the same air source heat pumps (ASHP) for all space heating and hot water heating needs. The commercial cinema area also uses ASHP for heating requirement and a dedicated air handing unit complete with with heat recovery. Where possible the existing fabric will be upgraded for example upgrading existing windows to new double glazing.

The scheme also will achieve 105 litres or less per head per day water use using Low flow taps, showers, WCs will be used (excluding an allowance of 5 litres or less per head per day for external water consumption).

The site has good public transportation links achieving the highest possible PTAL score of 6b (public transport access levels). The scheme also has cycle storage for 24 bicycles to encourage zero energy/emission transportation. The residents’ entrance is via a green courtyard. Residents also benefit from dedicated terrace, accessed from the 3rd floor, with a dedicated planted area also on the 3^{rd} floor terrace.

APPENDIX A: OVERHEATING CHECKLISTS

Section 1 - Site features affecting vulnerability to overheating		**Yes or No**
Site location	Urban – within central London or in a high-density conurbation	Yes
	Peri-urban – on the suburban fringes of London	No
Air quality and/or Noise sensitivity – are any of the following in the vicinity of buildings?	Busy roads / A roads	Yes
	Railways / Overground / DLR	No
	Airport / Flight path	No
	Industrial uses / waste facility	No
Proposed building use	Will any buildings be occupied by vulnerable people (e.g. elderly, disabled, young children)?	No
	Are residents likely to be at home during the day (e.g. students)?	Yes
Dwelling aspect	Are there any single aspect units?	No
Glazing ratio	Is the glazing ratio (glazing: internal floor area) greater than 25%?	No
	If yes, is this to allow acceptable levels of daylighting?	NA
	Single storey ground floor units	No
Security - Are there any security issues that could limit opening of windows for ventilation?	Vulnerable areas identified by the Police Architectural Liaison Officer	No
	Other	No

Table A1: Domestic Overheating Checklist Section 1 (GLA Guidance on preparing Overheating Checklist)

Section 2 - Design features implemented to mitigate overheating risks		Response
Landscaping	Will deciduous trees be provided for summer shading (to windows and pedestrian routes)?	No due to height
	Will green roofs be provided?	No
	Will other green or blue infrastructure be provided around buildings for evaporative cooling?	Yes planting courtyard and in dedicated area on the terrace.
Dwelling aspect	% of total units that are single aspect	0%
	% single aspect with N / NE / NW orientation	0%
	% single aspect with S / SE / SW orientation	0%
	% single aspect with W orientation	0%
Window opening - What is the extent of the opening?	Fully openable	Yes
	Limited (e.g. for security, safety, wind loading reasons)	No
Security	Where there are security issues (e.g. ground floor flats) has an alternative night time natural ventilation method been provided (e.g. ventilation grates)?	NA
Shading	Is there any external shading?	No
	Is there any internal shading?	Yes internal blinds
Glazing specification	Is there any solar control glazing	No
Ventilation - What is the ventilation strategy?	Natural – background	Yes
	Natural – purge	Yes
	Mechanical – background (e.g. MVHR)	Yes MHVR
	Mechanical – purge	Yes the option for mechanical ventilation boost is possible and a heat recovery bypass is specified.
	What is the average design air change rate	4, Air changes per hour during hot weather
Heating system	Is communal heating present?	No
	What is the flow/return temperature?	Supply will be a maximum of 40°C. The ASHP units will also operate in weather compensation mode to ensure the supply temperature is as low as possible and the efficiency of the ASHP units are as high as possible for any given outside air temperature.
	Have horizontal pipe runs been minimised?	Yes due to specification of individual heating units
	Do the specifications include insulation levels in line with the London Heat Network Manual	NA

Table A2: Domestic Overheating Checklist Section 2 (GLA Guidance on preparing Overheating Checklist)

APPENDIX B: HEAT NETWORK STUDY

The output from the London Heat Map tool is given below.

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

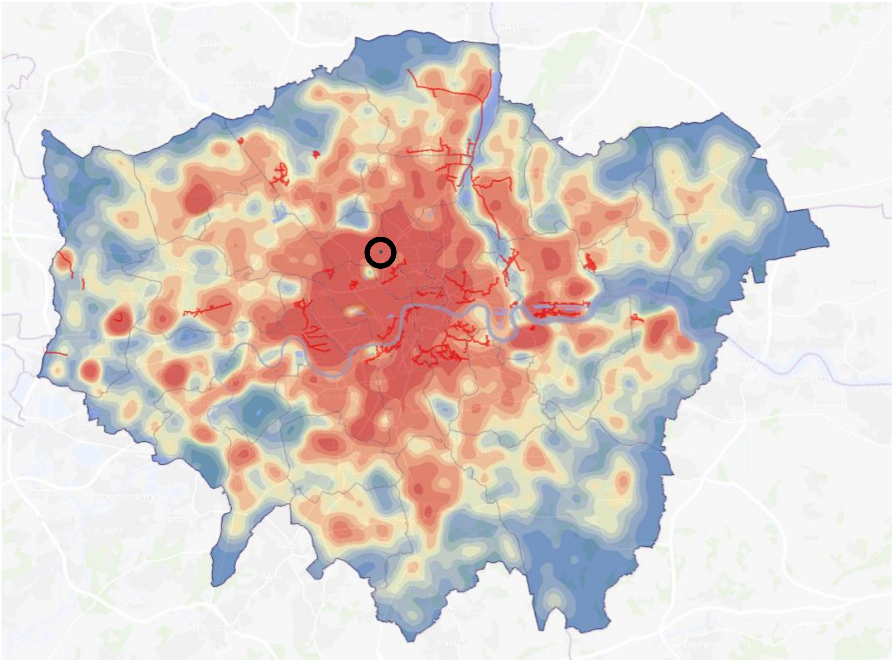


Figure B1: London Heat Map tool showing the location of the site and heat use density

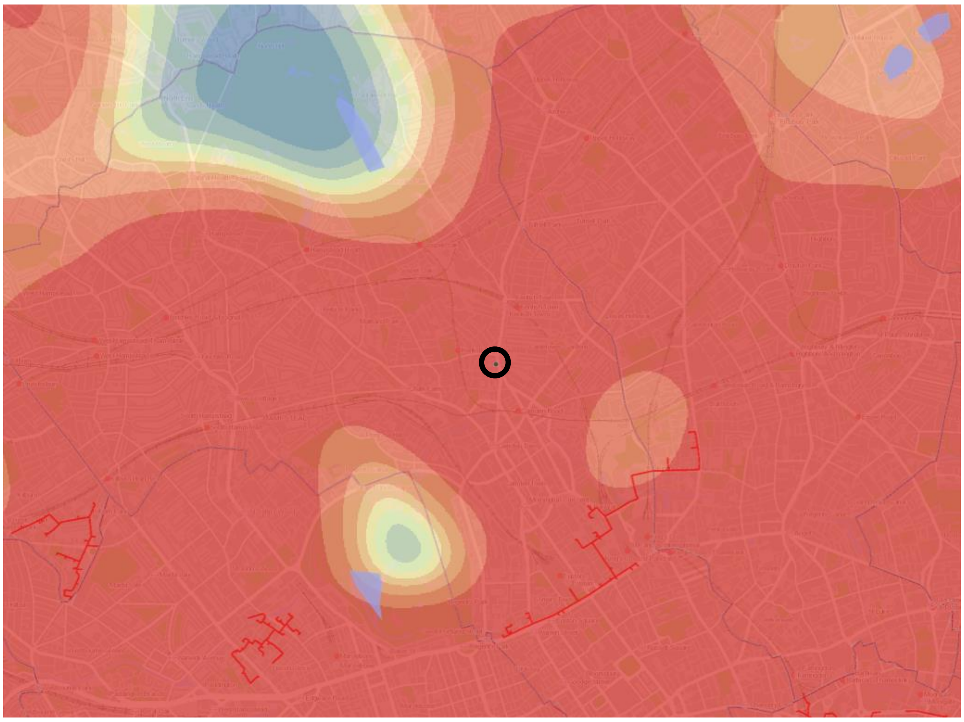


Figure B2: London Heat Map tool showing proposed heat networks (red lines).

APPENDIX C: TECHNOLOGY FEASIBILITY STUDY SUMMARY

The overall summary of the low-carbon and renewable energy feasibility exercise is presented below.

Technology		Assessment / Viability
Wind Power	Wind turbine installed on the roof of the development.	Due to the proximity to residential areas, the high cost per kW for smaller building-mounted turbines and the impacts in terms of visual noise and shadow flicker, wind turbines are not considered a viable technology for the development. **CONCLUSION: NOT CONSIDERED FEASIBLE**
Ground Source Heat Pumps	Open or closed loop GSHP system requiring extraction of ground water and / or deep boreholes.	Low maintenance and no external visual or noise impact. However, there are space restrictions and significant investment is required especially for schemes employing bore holes. **CONCLUSION: NOT CONSIDERED FEASIBLE**
Air Source Heat Pumps	Electric powered external plant providing heating and hot water	Low maintenance. Good carbon performance with latest grid carbon intensities. Lower efficiency for higher temperature centralised supply systems. Suitable for commercial areas as can also provide cooling when required. **CONCLUSION: CONSIDERED FEASIBLE**
Solar Thermal Collectors	Roof-mounted solar thermal panels providing hot water heating	Roofs have good potential for solar thermal energy collection. However, hot water demand is met by ASHP and PV modules are favoured due to the low maintenance requirements. **CONCLUSION: NOT CONSIDERED FEASIBLE**
Solar Photovoltaic Panels	Roof mounted Photovoltaic panels (PV) provide electricity directly to the development, exporting any surplus production to the grid.	Roofs have good potential for solar power generation. PV has low maintenance requirements. PV electricity is clean and zero-carbon and will offset carbon intensive grid power. **CONCLUSION: CONSIDERED FEASIBLE**
Biomass Heating	Biomass-fired community heating system.	Biomass heating is an established technology but has high maintenance requirements, fuel storage and delivery issues and is a source of increase in pollution, notably particulates (PM10), SO_2 and NO_X emissions. **CONCLUSION: NOT CONSIDERED FEASIBLE**

Table C1: Summary of Low and Zero Carbon Study Analysis Results

APPENDIX D: SAMPLE SAP CALCULATIONS – BLOCK COMPLIANCE

BLOCK COMPLIANCE
Calculation Type: New Build (As Designed)

Energy Calculations Ltd

Block Reference	000450	Issued on Date	21/08/2019
Block Name	Kentish town 3.1-3.2-4.1-4.2		
Assessor Details	Mr. Matthew Carter, Energy Calculations Limited, Tel: 01754 761035, mcarter@energycalculations.co.uk	Assessor ID	7869-0001
Client			

Block Compliance Report - DER

Block Reference: 000450		Block Name: Kentish town 3.1-3.2-4.1-4.2		
Property-Assessment Reference	Multiplier	Floor Area (m^2)	DER ($kgCO_2/m^2$)	TER ($kgCO_2/m^2$)
013077-003 - Green	1	80.1	11.63	24.80
013078-003 - Green	1	78.44	10.92	23.98
013079-003 - Green	1	69.6	14.03	29.09
013080-003 - Green	1	71	12.74	27.85
Totals:	4	299.14	49.32	105.73
Average DER = 12.27 $kgCO_2/m^2$			PASS	
Average TER = 26.31 $kgCO_2/m^2$				

Block Compliance Report - DFEE

Block Reference: 000450		Block Name: Kentish town 3.1-3.2-4.1-4.2		
Property-Assessment Reference	Multiplier	Floor Area (m^2)	DFEE ($kWh/m^2/yr$)	TFEE ($kWh/m^2/yr$)
013077-003 - Green	1	80.1	41.75	46.65
013078-003 - Green	1	78.44	40.73	43.53
013079-003 - Green	1	69.6	51.16	57.27
013080-003 - Green	1	71	49.97	53.85
Totals:	4	299.14	183.60	201.29
Average DFEE = 45.62 $kWh/m^2/yr$			PASS	
Average TFEE = 50.01 $kWh/m^2/yr$				

APPENDIX E: SAMPLE "BE GREEN" COMPLIANCE REPORT

BUILDING REGULATION COMPLIANCE
Calculation Type: New Build (As Designed)

Energy Calculations Ltd
SAP • CODE • SBEM • DESIGN

Property Reference	013077	Issued on Date	21/08/2019
Assessment Reference	003 - Green	Prop Type Ref	
Property	3.10, 187, Kentish Town Road, LONDON, NW1 8PD		

SAP Rating	91 B	DER	11.63	TER	24.80
Environmental	92 A	% DER<TER	53.10		
CO_2 Emissions (t/year)	0.65	DFEE	41.75	TFEE	46.65
General Requirements Compliance	Pass	% DFEE<TFEE	10.50		

Assessor Details	Mr. Matthew Carter, Energy Calculations Limited, Tel: 01754 761035, mcarter@energycalculations.co.uk	Assessor ID	7869-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Electricity		
Fuel factor	1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	24.80	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	11.63	$kgCO_2/m^2$	Pass
	-13.17 (-53.1%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	46.65	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	41.75	$kWh/m^2/yr$	
	-4.9 (-10.5%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	$m^3/(h.m^2)$ @ 50 Pa	
Maximum	10.0	$m^3/(h.m^2)$ @ 50 Pa	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Heat pump with radiators or underfloor - Electric Mitsubishi ECODAN 5kW PUHZ-W50VHA-BS	

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

BUILDING REGULATION COMPLIANCE
Calculation Type: New Build (As Designed)

Energy Calculations Ltd
SAP • CODE • SBEM • DESIGN

Secondary heating system	None		
5 Cylinder insulation			
Hot water storage	Measured cylinder loss: 1.32 kWh/day Permitted by DBSCG 2.03		Pass
Primary pipework insulated	Yes		Pass
6 Controls			
Space heating controls	Time and temperature zone control		Pass
Hot water controls	Cylinderstat		Pass
	Independent timer for DHW		Pass
7 Low energy lights			
Percentage of fixed lights with low-energy fittings	100	%	
Minimum	75	%	Pass
8 Mechanical ventilation			
Continuous supply and extract system			
Specific fan power	0.50		
Maximum	1.5		Pass
MVHR efficiency	90	%	
Minimum	70	%	Pass

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature		
Overheating risk (Thames Valley)	Slight	Pass
Based on:		
Overshading	Average	
Windows facing North	7.26 m², No overhang	
Windows facing North East	5.45 m², No overhang	
Windows facing East	3.63 m², No overhang	
Air change rate	6.00 ach	
Blinds/curtains	None	

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

Type	U-value		
Filled Cavity with Edge Sealing	0.00	W/m²K	Pass

Air permeability and pressure testing

3 Air permeability			
Air permeability at 50 pascals	5.00 (design value)	m³/(h.m²) @ 50 Pa	
Maximum	10.0	m³/(h.m²) @ 50 Pa	Pass
10 Key features			
Party wall U-value	0.00	W/m²K	
Photovoltaic array	1.00	kW	

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

THERMAL BRIDGING

Calculation Type: New Build (As Designed)

Energy Calculations Ltd
SAP ♦ CODE ♦ SBEM ♦ DESIGN

Property Reference	013077	Issued on Date	21/08/2019
Assessment Reference	003 - Green	Prop Type Ref	
Property	3.10, 187, Kentish Town Road, LONDON, NW1 8PD		

SAP Rating	91 B	DER	11.63	TER	24.80
Environmental	92 A	% DER<TER	53.10		
CO_2 Emissions (t/year)	0.65	DFEE	41.75	TFEE	46.65
General Requirements Compliance	Pass	% DFEE<TFEE	10.50		

Assessor Details	Mr. Matthew Carter, Energy Calculations Limited, Tel: 01754 761035, mcarter@energycalculations.co.uk	Assessor ID	7869-0001
Client			

	Junction detail	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E2 Other lintels (including other steel lintels)	Table K1 - Approved	0.300	8.31	2.49	
External wall	E3 Sill	Table K1 - Approved	0.040	7.11	0.28	
External wall	E4 Jamb	Table K1 - Approved	0.050	18.40	0.92	
External wall	E7 Party floor between dwellings (in blocks of flats)	Table K1 - Approved	0.070	34.47	2.41	
External wall	E14 Flat roof	Table K1 - Default	0.080	18.00	1.44	
External wall	E16 Corner (normal)	Table K1 - Default	0.180	12.50	2.25	
External wall	E17 Corner (inverted – internal area greater than external area)	Table K1 - Default	0.000	5.00	0.00	
External wall	E18 Party wall between dwellings	Table K1 - Default	0.120	7.50	0.90	

Total:	10.70	W/mK:
Y-Value:	0.111	W/m²K: