/NTEGRATION
3-5 SPAFIELD STREET
LONDON EC1R 4QB
+44 (0) 20 7183 8610
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DATE
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ENERGY AND SUSTAINABILITY STATEMENT
STATION YARD, TWICKENHAM

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3-5 SPAFIELD STREET
LONDON EC1R 4QB
+44 (0) 20 7183 8610
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DOCUMENT STATUS

PROJECT
Station Yard, Twickenham

PROJECT NO.
561

CLIENT
Solum Regeneration (Twickenham) LLP
33 Foley Street
London
W1W 7TL

IN CONJUNCTION WITH
Wimshurst Pelleriti
The Mews
6 Putney Common
SW15 1HL

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CONTENTS

EXECUTIVE SUMMARY

This Energy Assessment and Sustainability Statement has been prepared by Integration Consultancy Limited in support of the planning application for the proposed 5/6 storey development on the land adjacent to Station Yard, Twickenham, to create 46 new residential units in the London borough of Richmond upon Thames

Energy and Sustainability Achievements
In terms of energy and sustainability this development achieves:

- **50.0% improvement in carbon dioxide (CO_2) emissions** over the Target Emission Rate outlined in the national Building Regulations 2013.
- **Renewable energy deployment meeting 47% of the CO_2 emissions** associated with the development's regulated energy demand**.**

The London Plan has zero carbon residential development at its core with a minimum of 35% below Part L (2013). The financial contribution to achieve these targets, as shown in the tables below, will be circa **£90,621** based on the 5 residential units sampled as part of this exercise.

In relation to the London Plan's Lean, Clean and Green energy structure, the scheme achieves 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 excellent air quality and a low heat demand. The proposed "Be Lean" design elements have been shown to achieve a **5.5%** 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 a central Air Source Heat Pumps system for space heating and hot water. The proposed "Be Green" design has been shown to achieve an additional **44.4%** reduction compared to Building Regulations 2013.

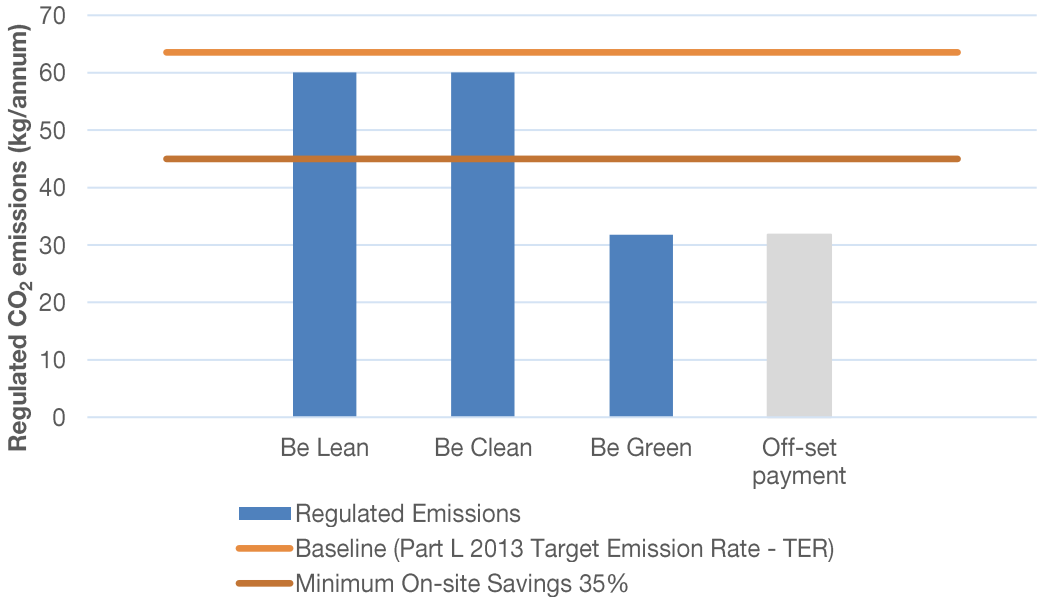


Figure 1: Summary of the scheme's regulated energy use as compared to the CO_2 emission baseline and target of 35% below Part L

The table below shows the regulated and unregulated energy use (pro rata for 46 residential units based on the 5 sample units modelled).

	Carbon dioxide emissions for residential units (Tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Baseline: Part L 2013 (Building Regulations) Compliance	63.54	31.56
After “Be Lean” (energy demand reduction)	60.04	31.56
After “Be Clean” (heat network / CHP)	60.04	31.56
After “Be Green” (renewable energy)	31.80	31.56

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)	3.51	5.5%
Savings from "Be Clean" (heat network / CHP)	0.00	0.0%
Savings from "Be Green" (renewable energy)	28.24	44.4%
Cumulative on site savings	31.74	50.0%
Annual savings from off-set payment	31.80	
Cumulative savings for off-set payment	954	
Payment (£60 per CO_2 tonne)	£ 90,621	

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

Low flow taps, showers, WCs and (where fitted) dishwashers / washing machines will be used where possible in order to meet the **water use 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.

The site has good public transportation links being close to Twickenham Station achieving a high PTAL score of 5 (public transport access levels). The scheme also has dedicated secure cycle storage for 55 cycles to encourage zero energy/emission transportation and a large extensive green terrace.

Overall, using the Richmond Sustainable Construction Checklist, the scheme scores an “A” rating as demonstrated in the supplementary checklist document.

1 INTRODUCTION

Integration Consultancy Limited has been appointed to undertake an Energy and Sustainability Assessment in support of the full planning application for the proposed 5/6 storey development on the land adjacent to Station Yard, Twickenham, to create 46 new residential units in the London borough of Richmond upon Thames. The report is one of several that accompany the planning application and should be read in conjunction with these documents.

The importance of developing a robust well-considered energy and sustainability strategy cannot be overstated. This strategy sets out the roadmap for the entire project and ultimately the success of the strategy will translate into 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 on the land adjacent to Station Yard, Twickenham in the London borough of Richmond upon Thames. The site has good public transportation links particularly to Twickenham Station and achieves a high PTAL score of 5 (public transport access levels).

Figure 2: Site Location

PROPOSED DEVELOPMENT OVERVIEW

The proposed development comprises 5/6 storeys which create 46 new residential units. The ground floor is home to a 55-cycle store.

Figure 3: Proposed development scheme (ground floor plan)

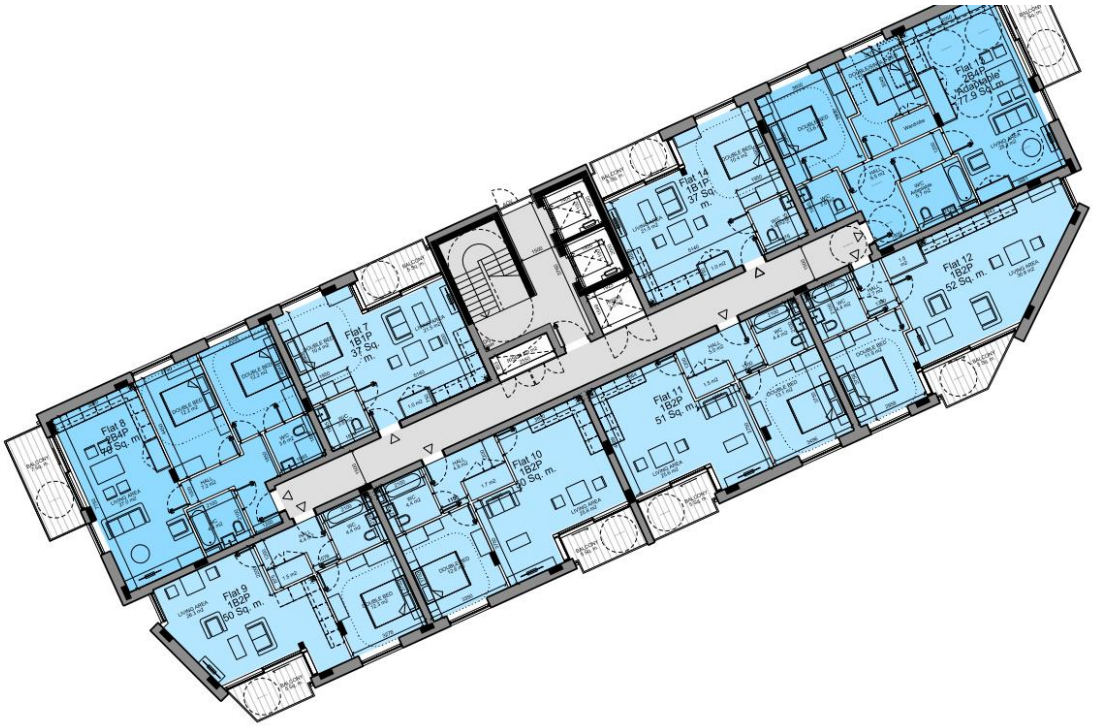


Figure 4: Proposed development scheme (floor 1-4 typical plan)

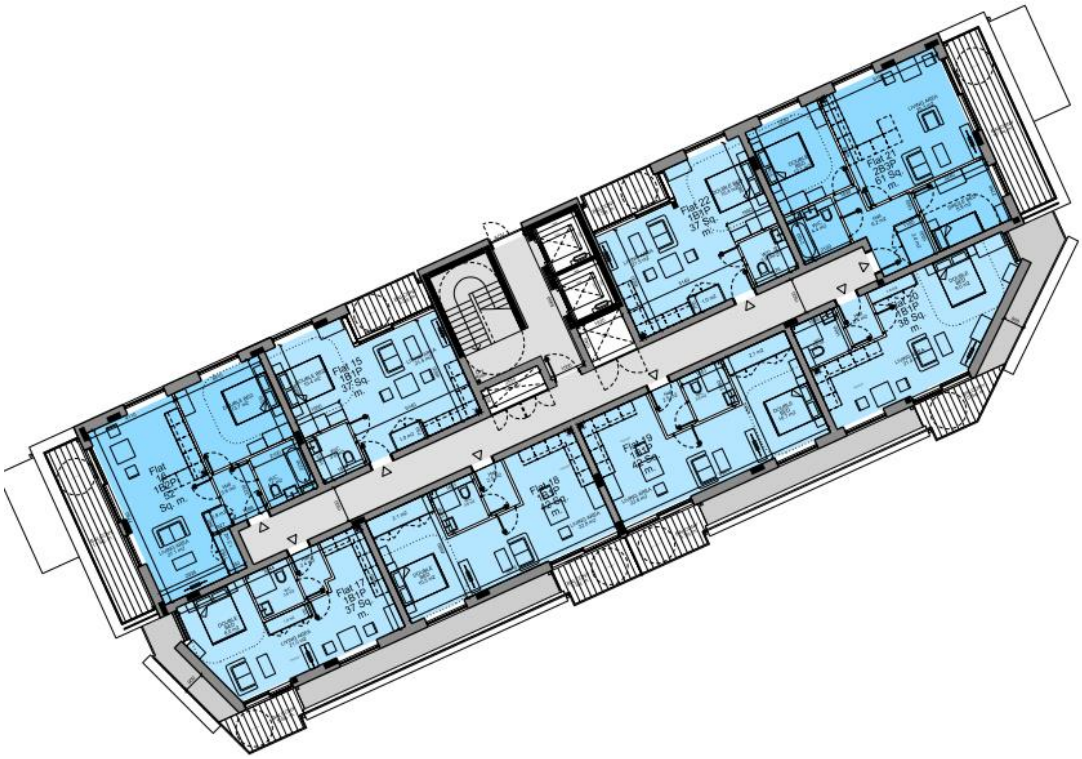


Figure 5: Proposed development scheme (floor 5)

The energy assessment contemplates a representative sample of accommodation. The details of the proposed accommodation modelled are summarised below.

Accommodation	Area (m^2)
Flat 2 (ground)	52
Flat 13 (floor 1-4)	79
Flat 11 (floor 1-4)	51
Flat 7 (floor 1-4)	38
Flat 17 (floor 5)	37

Table 3: Summary of sampled residential units modelled

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 35% below Part L (2013). As an ambition, the scheme uses the main London Plan / GLA energy target of zero carbon residential.

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 POLICY REVIEW

NATIONAL PLANNING POLICY FRAMEWORK (NPPF)

Section 10 of the NPPF relates to the challenge of climate change and flooding. Of particular relevance is paragraph 95 which supports the move to a low carbon future and states that local planning authorities should:

- plan for new developments in locations and ways which reduce greenhouse gas emissions;
- actively support energy efficiency improvements to existing buildings; and
- when setting any local requirement for a building's sustainability, do so in a way consistent with the Government's zero carbon buildings policy and adopt nationally described standards. (NB: The Government since withdrew the commitment to zero carbon homes).

The Government introduced an 'optional' housing standard related to water consumption in Building Regulations Part G which requires the consumption of wholesome water in a new dwelling not to exceed 110 litres per person per day.

LONDON PLAN 2016

Regional policy in London is controlled by The Greater London Authority and is set out in The London Plan adopted in March 2016. The Plan sets out policy and guidance in the London context and identifies a number of objectives related to improving London as a workplace and living place. Additional guidance is provided by "Energy Planning, Greater London Authority guidance on preparing energy assessments" (March 2016).

The dominant condition stipulated in terms of energy and sustainability is for all major developments to achieve at least a 35% reduction in regulated carbon dioxide emissions beyond the minimum targets stated in Part-L 2013 of the Building Regulation.

For major residential accommodation developments, the London Plan has adopted "Zero Carbon" from 1st October 2016. The remaining regulated carbon dioxide emissions to 100% are to be off-set through a cash-in-lieu contribution to the local borough to secure delivery of carbon dioxide savings elsewhere.

In addition, The London Plan states that all major development proposal will seek to reduce carbon dioxide emissions by at least 20 per cent through the use of on-site renewable energy generation wherever feasible.

The concept of sustainable development is cardinal to all policies within the London Plan which covers areas such as Places, People, Economy, Response to Climate Change, Transport, and Living Places and Spaces. Chapter 5 of the London Plan sets out a range of policies in relation to climate change, including climate change mitigation and adaptation, waste, aggregates, contaminated land and hazardous substances.

Key policies within the London Plan applicable to the proposed development are:

POLICY 5.2 -MINIMISING CARBON DIOXIDE EMISSIONS

Planning Decisions

A Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

1 Be lean: use less energy

2 Be clean: supply energy efficiently

3 Be green: use renewable energy

B The Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the

Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

Residential Buildings:

Year	**Improvement on 2010 Building Regulations**
2016 – 2031	Zero carbon (from 1 October 2016)

C Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy.

D As a minimum, the energy assessment should include the following details:

a) calculation of the energy demand and carbon dioxide emissions covered by Building Regulations and, separately, the energy demand and carbon dioxide emissions that are not covered by the Building Regulations at each stage of the energy hierarchy

b) proposal to reduce carbon dioxide emissions through the energy efficient design of the site, building and services

c) proposals to further reduce carbon dioxide emissions through the use of decentralised energy where feasible, such as district heating and cooling and combined heat and power (CHP).

d) proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies.

E The carbon dioxide reduction targets should be met on-site. Where it is clearly demonstrated that the specific targets cannot be fully achieved on-site, any shortfall may be provided off-site or through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

POLICY 5.7 – RENEWABLE ENERGY

5.42 There is a presumption that all major development proposals will seek to reduce carbon dioxide emissions by at least 20 per cent through the use of on-site renewable energy generation wherever feasible.

The London Plan states that "This approach will also help ensure that the development industry in London is prepared for the introduction of 'Nearly Zero Energy Buildings' by 2020" (as required by the European Energy Performance of Buildings Regulation which requires periodic review of Building Codes to ensure cost optimal review of energy efficiency standards and that all new buildings are 'nearly zero energy buildings' by 2020).

The "Energy Planning, Greater London Authority guidance on preparing energy assessments" (March 2016), provides the definition of Zero Carbon:

ENERGY PLANNING. Greater London Authority guidance on preparing energy assessments (March 2016)

Definition

5.3 'Zero carbon' homes are homes forming part of major development applications where the residential element of the application achieves at least a 35 per cent reduction in regulated carbon dioxide emissions (Beyond Part L 2013) on-site. The remaining regulated carbon dioxide emissions, to 100 per cent, are to be off-set through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere (in line with policy 5.2E).

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

5.3 – Sustainable Design & Construction

This provides guidance on issues related to air pollution and minimum emission standards for combustion plant.

5.3 – Sustainable Design & Construction

Emissions standards have been developed based on the latest technology, viability and the implication for carbon dioxide emissions of any abatement measures to reduce the NOx and PM10 emissions from the plant. The emission standards are provided in Appendix 7 and target minimum standards. Plant proposed within developments is to comply with these standards, in addition to the development meeting the overall 'air quality neutral' benchmarks.

- 5.6 – Decentralised Energy in Development Proposals
- 5.8 – Innovative Energy Technologies
- 5.9 – Overheating & Cooling

This section states that Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the cooling hierarchy.

- 5.15 – Water Use & Supplies

This provides additional guidance on water consumption:

5.15 – Water Use & Supplies

5.61 Residential development should be designed so that mains water consumption would meet a target of 105 litres or less per head per day, excluding an allowance of 5 litres or less per head per day for external water use. This reflects the 'optional requirement' set out in Part G of the Building Regulations.

LONDON BOROUGH OF RICHMOND UPON THAMES (LOCAL PLAN JULY 2018)

The London Borough of Richmond Upon Thames has adopted a new Local Plan which sets out the requirements in terms of energy and sustainability.

A Sustainable Future

1. Minimise and mitigate the effects of climate change by requiring high levels of sustainable design and construction including reductions in carbon dioxide emissions by minimising energy consumption, promoting decentralised energy and the use of renewable energy as well as requiring high standards of water efficiency.

2. Promote and encourage development to be fully resilient to the future impacts of climate change in order to minimise vulnerability of people and property; this includes by risk of flooding, water shortages, subsidence and the effects of overheating.

3. Optimise the use of land and resources by ensuring new development takes place on previously developed land, reusing existing buildings and encouraging remediation and reuse of contaminated land.

4. Reduce or mitigate environmental impacts and pollution levels (such as air, noise, light, odour, fumes water and soil) and encourage improvements in air quality, particularly along major roads and areas that already exceed acceptable air quality standards.

5. Ensure local environmental impacts of development are not detrimental to the health, safety and the amenity of existing and new users or occupiers of a development or the surrounding area.

6. Promote safe and sustainable transport choices, including public transport, cycling and walking, for all people, including those with disabilities.

7. Encourage improvements to public transport, including quality and connectivity of transport interchanges, and support the use of Smart City technology and practices.

8. Promote sustainable waste management through minimising waste and providing sufficient land for the reuse, recycling and treatment of waste, and minimise the amount of waste going to landfill in line with the West London Waste Plan.

9. Support sustainable growth of the visitor economy for the benefit of local communities and promote the borough as an attractive and inviting place to visit and enjoy.

10. Conserve and enhance the borough's unique historic and cultural assets that are connected by the River Thames.

11. Create attractive and pleasant environments and spaces that promote active and healthy lifestyles, including recognising their benefits to residents' social life and their economic benefits to the borough's centres.

POLICY LP 17 – Green Roofs and Walls

Green roofs and/or brown roofs should be incorporated into new major developments with roof plate areas of 100sqm or more where technically feasible and subject to considerations of visual impact. The aim should be to use at least 70% of any potential roof plate area as a green / brown roof.

POLICY LP 20 - Climate Change Adaption

A. The Council will promote and encourage development to be fully resilient to the future impacts of climate change in order to minimise vulnerability of people and property.

B. New development, in their layout, design, construction, materials, landscaping and operation, should minimise the effects of overheating as well as minimise energy consumption in accordance with the following cooling hierarchy:

1. minimise internal heat generation through energy efficient design

2. reduce the amount of heat entering a building in summer through shading, reducing solar reflectance, fenestration, insulation and green roofs and walls

3. manage the heat within the building through exposed internal thermal mass and high ceilings

4. passive ventilation

5. mechanical ventilation

6. active cooling systems (ensuring they are the lowest carbon options).

Policy LP 21 - Sustainable drainage

C. The Council will require the use of Sustainable Drainage Systems (SuDS) in all development proposals. Applicants will have to demonstrate that their proposal complies with the following:

1. A reduction in surface water discharge to greenfield run-off rates wherever feasible.

2. Where greenfield run-off rates are not feasible, this will need to be demonstrated by the applicant, and in such instances, the minimum requirement is to achieve at least a 50% attenuation of the site's surface water runoff at peak times based on the levels existing prior to the development.

Policy LP 22 - Sustainable Design and Construction

A. Developments will be required to achieve the highest standards of sustainable design and construction to mitigate the likely effects of climate change. Applicants will be required to complete the following:

1. Development of 1 dwelling unit or more, or 100sqm or more of non-residential floor space (including extensions) will be required to complete the Sustainable Construction Checklist SPD. A completed Checklist has to be submitted as part of the planning application.

2. Development that results in a new residential dwelling, including conversions, change of use, and extensions that result in a new dwelling unit, will be required to incorporate water conservation measures to achieve maximum water consumption of 110 litres per person per day for homes (including an allowance of 5 l/p/d for external water consumption).

3. New non-residential buildings over 100sqm will be required to meet BREEAM ‘Excellent’ standard.

4. Proposals for change of use to residential will be required to meet BREEAM Domestic Refurbishment 'Excellent' standard (where feasible).

Sustainable Construction Checklist Guidance Document (January 2016)

The Council’s Development Management Plan (policy DM SD 1) as well as the adopted London Plan (2015) require a 35% reduction in carbon dioxide emissions beyond Building Regulations 2013.

All developments are encouraged to ensure that 1 in 5 parking spaces (both active and passive) provide an electrical charging point.

SUMMARY OF KEY POLICY REQUIREMENTS

1. 'Zero Carbon' residential with 35% improvement in regulated CO_2 emissions over the Target Emission Rate (TER) outlined in the national Building Regulations 2013.
2. Development proposals should incorporate renewable energy technology. A 20% contribution to the annual energy demand of the entire scheme should be targeted where feasible.
3. Residential development should be designed so that mains water consumption would meet a target of 105 litres or less per head per day, excluding an allowance of 5 litres or less per head per day for external water use.
4. Green roofs and/or brown roofs should be incorporated into new major developments.

3 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 space efficient, 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.	✓ Very low carbon emissions (50% below part L 2013) ✓ MHVR with heat recovery bypass for assisted summer time night-cooling when required. ✓ Air tightness of 3 compared to building regulation 5 carbon emissions. ✓ Central ASHP system for heating and hot water.
GREEN INFRASTRUCTURE /BIODIVERSITY London will be the world's first National Park City, where more than half of its area is green and where the network of green infrastructure is managed to benefit all Londoners.	✓ Large extensive green roof (see Figure 6)
NOISE Londoners' quality of life will be improved by reducing the number of people adversely affected by noise and promoting more quiet 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. ✓ Excellent public transportation links (PTAL 5) ✓ 55 cycle spaces to encourage zero energy/emission transportation. ✓ ASHP mean no combustion on site.
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)

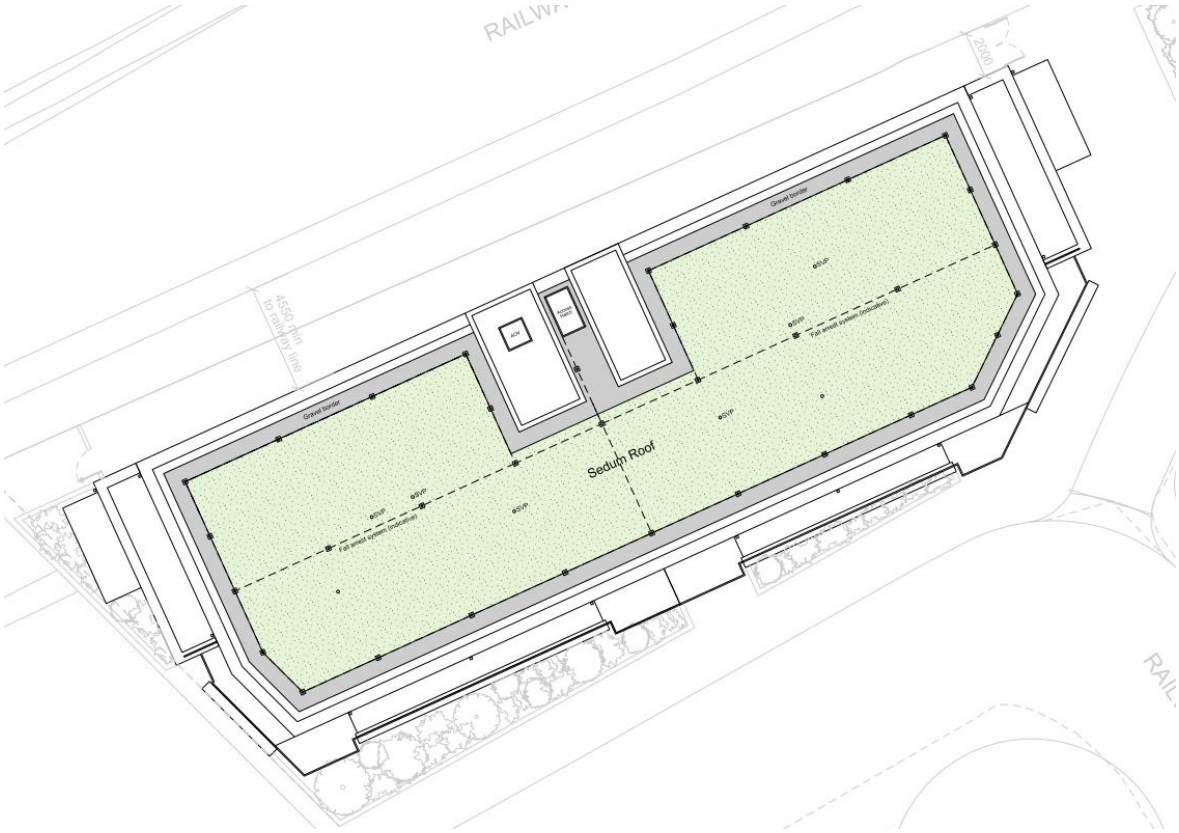


Figure 6: Green Roof location

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.

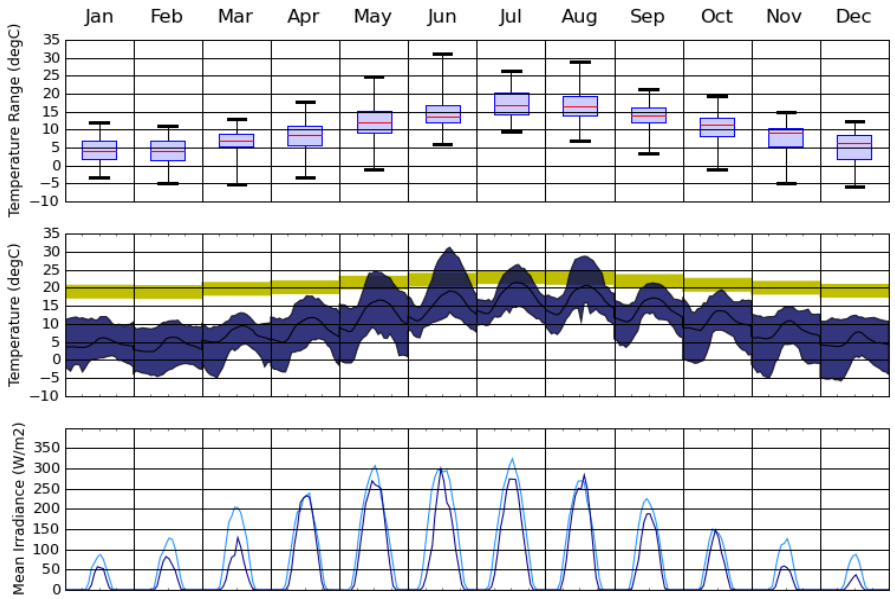


Figure 7: Average historic climate data for London

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.

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 exposed thermal mass, natural ventilation will reduce high internal daily temperature fluctuations and minimise the overheating risk in the summer. Therefore, occupant comfort can be maintained without reliance on mechanical cooling systems.

The modest unit area, depth and obstruction free layout allows for good single-sided natural ventilation potential. Around half of the units benefit from dual aspect windows and cross-flow ventilation potential.

South facing units have large balcony overhangs which provide important external solar shading for the largest glazed areas.

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. 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 central high-efficiency commercial air source heat pumps system in conjunction with underfloor heating.

Fresh air will be provided with 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 8: 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.
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.	✓ Low G-values on exposed (non-shaded) south facing windows (0.4) ✓ 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.	✓ Generally good natural ventilation potential ✓ ~50% of units have opportunity for cross-flow ventilation ✓ Green roof to reduce summer heat gains
5. MECHANICAL VENTILATION	✓ MVHR with summer bypass
6. ACTIVE COOLING Ensuring they are the lowest carbon options.	✓ No

Table 6: Cooling and overheating hierarchy application

The scheme has used the Overheating checklists in the design process as provided in the GLA Guidance on preparing Energy Assessment. These are intended to assist designers to identify potential overheating risks in residential accommodation early in the design process. Please refer to the Appendix for the completed Checklists.

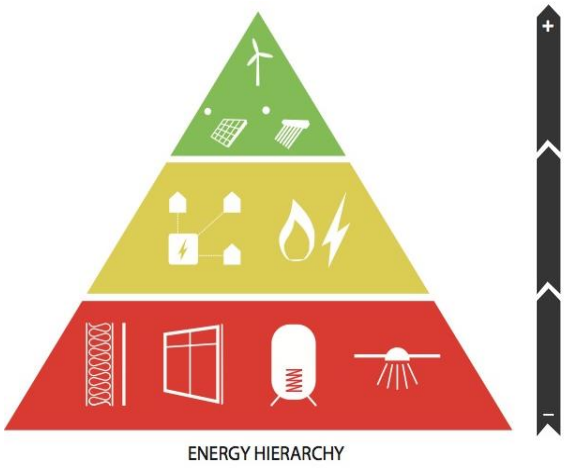
From the Checklists and the SAP calculations, the proposed development is considered to have a relatively low overheating risk.

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.

4 ENERGY CALCULATIONS

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 9: 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 Stroma for SAP 2012

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.

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 for each residential unit modelled. “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 ($kg.CO_2/m^2/yr.$)
Flat 2 (Ground)	52	27.71
Flat 13 (floor 1-4)	79	24.61
Flat 11 (floor 1-4)	51	23.95
Flat 7 (floor 1-4)	38	29.96
Flat 17 (floor 5)	37	31.70

Table 8: Summary of Baseline “notional” building performance for the sampled residential units

"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)	-	0.13	-
Roof	0.13 (0.20)	-	0.13	-
Windows	1.40 (2.0)	0.63	1.4 (0.8 frame factor)	0.63 (0.4 on south exposed windows)
External Doors	1.0	-	1.0	-
External Glazed Doors	1.2	-	1.2	-
Air Tightness	5.0 m³/m²/h (10)		3.0 m³/m²/h	
Thermal Bridging	Accredited details		Default details or better	
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 screed above insulation	
Heating control	Time and temperature zone control.		Time and temperature zone control.	
Lighting	100% low energy lighting		100% low energy lighting	
Ventilation type	Natural with extract fans		Mechanical Ventilation with Heat Recovery (MVHR) for individual units (Envirovent slimline 150 or better)	

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.)
Flat 2 (Ground)	52	27.71	26.50
Flat 13 (floor 1-4)	79	24.61	22.48
Flat 11 (floor 1-4)	51	23.95	22.30
Flat 7 (floor 1-4)	38	29.96	29.38
Flat 17 (floor 5)	37	31.70	30.49

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 shows that the proposed development is located away from existing or potential heat networks (see Appendix B). Therefore, connection to third party heat networks are not considered viable for this development. However, a central system has been proposed which could connect to a more efficient heat network should one arise in the future.

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. Compared with using centrally generated grid supplied electricity, CHP can offer a more efficient and economic method of supplying energy demand, due to the utilisation of the heat which is normally rejected to the atmosphere from central generating stations, and by reducing network distribution losses due to local generation and use. It is not a renewable energy technology but installed in the appropriate manner there could be potential for overall energy, carbon and cost savings. CHP technology is also readily integrated into buildings providing that its spatial requirements and flue can be accommodated.

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 technology (air source heat pumps) is summarised below.

Air-Source Heat Pump

Air Source Heat Pumps ASHP 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 typically delivers 3-4kW of thermal energy for every 1kW of grid supplied electricity used (~3:1 ratio).

A central ASHP system is proposed to supply space heating and hot water requirements for all residential units. For example, a system connecting multiple Mitsubishi Ecodan CAHV-P500YA-HPB units. These units have an 311% efficiency when supplying water at 55°C.[1]

"Be Green" Total Carbon Emissions

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

Accommodation	Area (m^2)	Baseline TER ($kg.CO_2/m^2/yr.$)	LEAN DER ($kg.CO_2/m^2/yr.$)	GREEN DER ($kg.CO_2/m^2/yr.$)
Flat 2 (Ground)	52	27.71	26.50	13.96
Flat 13 (floor 1-4)	79	24.61	22.48	11.98
Flat 11 (floor 1-4)	51	23.95	22.30	12.06
Flat 7 (floor 1-4)	38	29.96	29.38	15.41
Flat 17 (floor 5)	37	31.70	30.49	15.91

Table 11: Be Green Regulated Residential Carbon Emissions

1 https://www.microgenerationcertification.org/installers-manufacturers/product-profile/?ID=422616&back=product_type_id%3D6770%26page%3D4%26limit%3D10%26manufacturer_id%3D96332

SUMMARY

Carbon Emissions Summary

	Carbon dioxide emissions (Tonnes CO_2 /annum)	
	Regulated	**Unregulated**
Baseline: Part L 2013 (Building Regulations) Compliance	63.54	31.56
After “Be Lean” (energy demand reduction)	60.04	31.56
After “Be Clean” (heat network / CHP)	60.04	31.56
After “Be Green” (renewable energy)	31.80	31.56

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)	3.51	5.5%
Savings from "Be Clean" (heat network / CHP)	0.00	0.0%
Savings from "Be Green" (renewable energy)	28.24	44.4%
Cumulative on site savings	31.74	50.0%
Annual savings from off-set payment	31.80	
Cumulative savings for off-set payment	954	
Payment (£60 per CO_2 tonne)	£ 90,621	

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

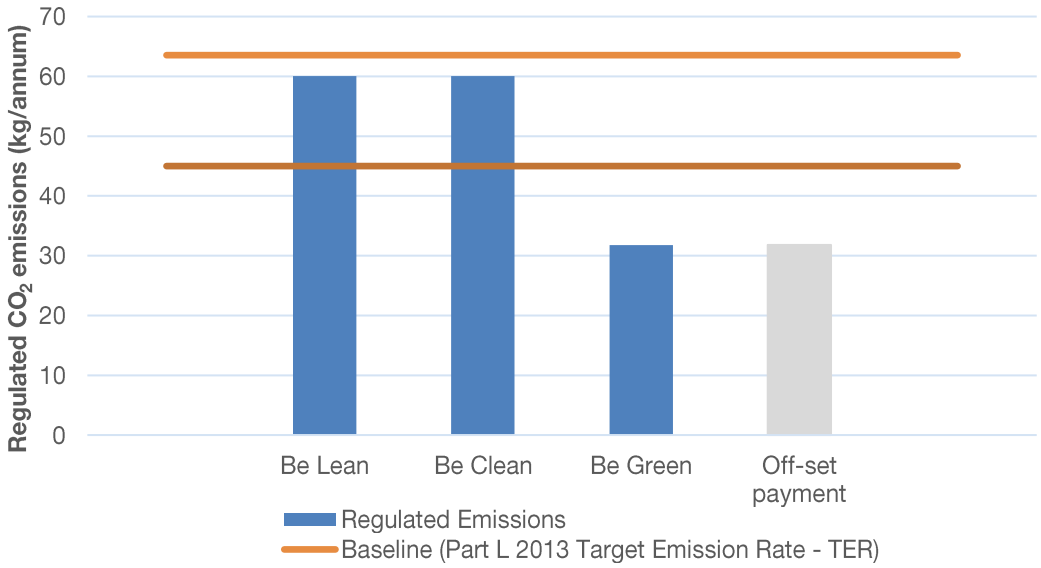


Figure 10: Summary of residential carbon savings for the energy hierarchy method of assessment.

The total regulated “Be Lean” CO_2 emissions is 63.54 tonnes.CO_2/yr, whereas the total regulated “Be Green” CO_2 emissions are 31.8 tonnes.CO_2/yr. The annual renewable energy contribution equates to **47%** of the total carbon emissions.

Low flow taps, showers, WCs and (where fitted) dishwashers / washing machines will be used where possible in order to meet the **water use 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.

The site has good public transportation links being only 50m away from South Harrow Tube achieving a **PTAL score of 5** (public transport access levels). The scheme also has **55-cycle storage** to encourage zero energy/emission transportation and a **large green roof**.

Overall, using the Richmond Sustainable Construction Checklist, the scheme scores an A rating as demonstrated in the supplementary checklist document.

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	Yes
	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)?	Yes
	Are residents likely to be at home during the day (e.g. students)?	Yes
Dwelling aspect	Are there any single aspect units?	Yes
Glazing ratio	Is the glazing ratio greater than 25%?	No
	If yes, is this to allow acceptable levels of daylighting?	NA
	Single storey ground floor units	Yes
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)?	Yes
	Will green roofs be provided?	Yes partial sedum
	Will other green or blue infrastructure be provided around buildings for evaporative cooling?	Yes on roof
Materials	Have high albedo (light colour) materials been specified?	Facades are red brick. Roof will be low temperature (evapotranspiration) extensive green roof
Dwelling aspect	% of total units that are single aspect	~50%
	% single aspect with N / NE / NW orientation	~50%
	% single aspect with S / SE / SW orientation	~50%
	% single aspect with W orientation	0%
Glazing ratio	N . NE . NW	18%
	E	26%
	S / SE / SW	19%
	W	26%
Window opening	Window opening	All windows are openable except flat 8
	What is the average percentage of openable area for the windows?	40% approx.
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)?	Ground floor flats
Shading	Is there any external shading?	Yes (balcony provide horizontal overhang to large south facing glazing).
	Is there any internal shading?	Yes
Glazing specification	Is there any solar control glazing	Yes G-value ~0.40 on all south and west non shaded elements)
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?	Yes
	What is the flow/return temperature?	Supply will be circa 50°C.
	Have horizontal pipe runs been minimised?	Yes
	Do the specifications include insulation levels in line with the London Heat Network Manual	Yes

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

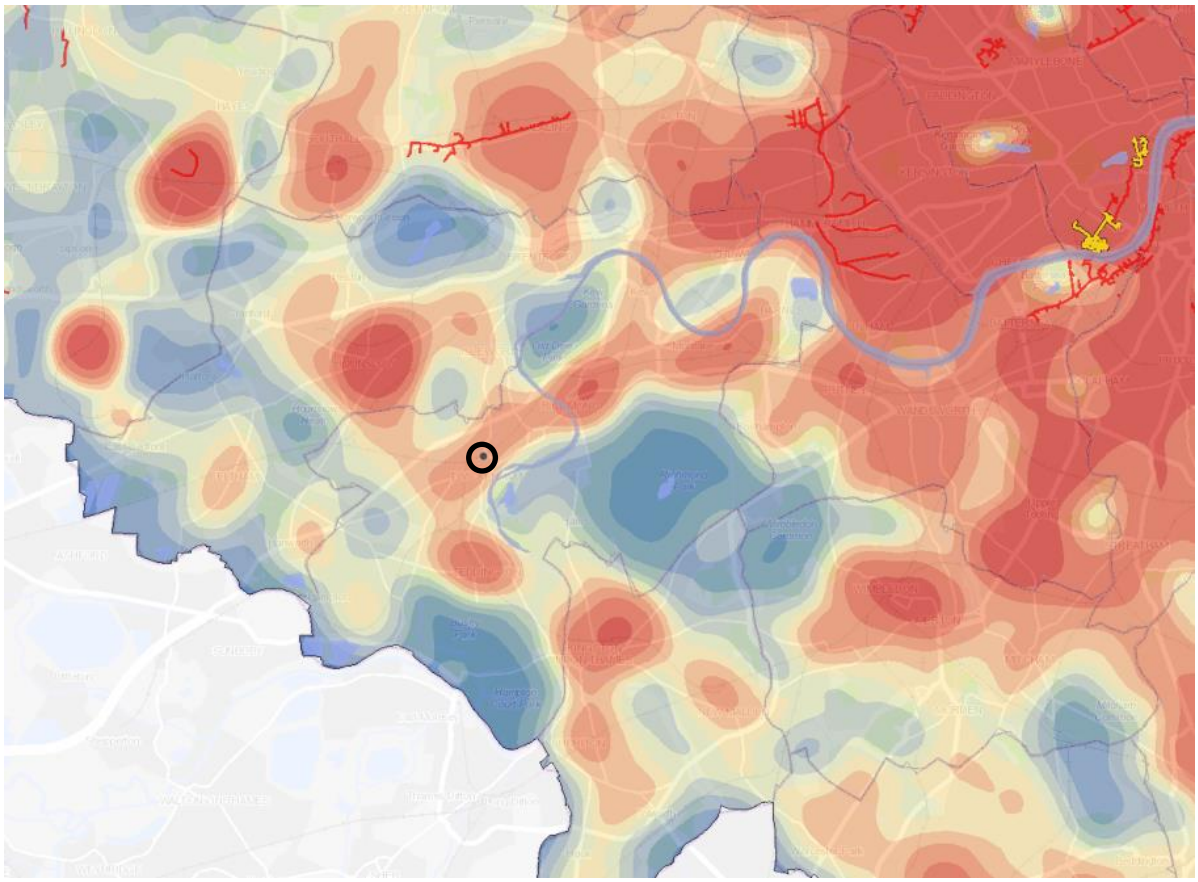


Figure B1: London Heat Map tool showing the location of the site and proposed heat networks (red lines) and existing networks (yellow lines)

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 CO2 performance especially in consideration of current and future grid carbon factors. Lower cost compared to GSHP. **CONCLUSION: CONSIDERED FEASIBLE**
Solar Thermal Collectors	Roof-mounted solar thermal panels providing hot water heating	Roofs have good potential for solar thermal energy collection. Solar hot water collectors would provide a significant proportion of domestic hot water demand of the development. However, the roof has the potential for valuable amenity/utility space. **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. However, as a policy priority, the roof has been designated as a green roof. **CONCLUSION: NOT CONSIDERED FEASIBLE**
Biomass Heating	Biomass-fired community heating system.	Biomass heating is an established technology but has high maintenance requirements, fuel storage and delivery issues and is a source of increase in pollution, notably particulates (PM10), SO_2 and NO_X emissions. **CONCLUSION: NOT CONSIDERED FEASIBLE**

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

APPENDIX C: SAMPLE SAP CALCULATIONS – BLOCK COMPLIANCE

Block Compliance WorkSheet: Block

User Details

Assessor Name: **Stroma Number:**
Software Name: Stroma FSAP **Software Version:** Version: 1.0.4.18

Calculation Details

Dwelling	DER	TER	DFEE	TFEE	TFA
Flat 2 (Ground)	13.96	27.71	43.4	45.5	52.02
Flat 13 (floor 1-4)	11.98	24.61	40.7	45.5	78.68
Flat 11 (floor 1-4)	12.06	23.95	30.1	32.4	50.56
Flat 7 (floor 1-4)	15.41	29.96	42.6	42.6	38.22
Flat 17 (floor 5)	15.91	31.7	44.8	47.2	37

Calculation Summary

Total Floor Area	256.48
Average TER	26.93
Average DER	13.48
Average DFEE	40.03
Average TFEE	42.73
Compliance	Pass
% Improvement DER|TER	49.94
% Improvement DFEE|TFEE	6.32

APPENDIX D: SAMPLE SAP CALCULATIONS – "BE GREEN" REGULATIONS COMPLIANCE REPORT

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.18
Printed on Thursday, November 7, 2019 at 11:32:23 AM

Project Information:

Assessed By: ()
Building Type: Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE
Total Floor Area: 52.02m²
Site Reference : Station Yard
Plot Reference: Flat 2 (Ground)
Address : Station Yard, Twickenham, TW1 4LJ

Client Details:

Name: WP Architects
Address : The Mews, 6 Putney Common, London, SW15 1HL

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity (c)
Fuel factor: 1.55 (electricity (c))

Target Carbon Dioxide Emission Rate (TER)	27.71 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	13.96 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	45.5 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	43.4 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	3.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Community heating schemes - Heat pump

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

6 Controls

Space heating controls	Charging system linked to use of community heating, TRVs	OK
Hot water controls:	No cylinder thermostat	
	No cylinder	

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Regulations Compliance Report

7 Low energy lights		
Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK
8 Mechanical ventilation		
Continuous supply and extract system		
Specific fan power:	0.75	
Maximum	1.5	OK
MVHR efficiency:	88%	
Minimum	70%	OK
9 Summertime temperature		
Overheating risk (South East England):	Medium	OK
Based on:		
Overshading:	Average or unknown	
Windows facing: South East	12.31m²	
Windows facing: South East	4.77m²	
Windows facing: South West	3.18m²	
Ventilation rate:	4.00	
Blinds/curtains:	None	
10 Key features		
Air permeablility	3.0 m³/m²h	
Community heating, heat from electric heat pump		

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