NORCUTT ROAD, TWICKENHAM

Energy Report

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EXECUTIVE SUMMARY

An Energy Strategy has been carried out for the proposed development at *75 Norcutt Road, Twickenham, London, TW2 6SR*. The proposed development includes the construction of a five-storey building to provide residential accommodation. This report will form part of the planning submission to the London Borough of Richmond Upon Thames and relates to a full planning application.

This report establishes how the site will achieve compliance with Building Regulations and Local Authority requirements. This has been achieved by following best practice procedures of the London Plan's Energy Hierarchy: be lean (improved building performance); be clean (centralised heating and cooling systems); and be green (use of low or zero carbon technologies).

In line with the GLA Energy Assessment Guidance (October 2018), the new SAP 10 carbon emissions factors have been used to present the results within the report. The carbon factors are 0.210kgCO_2/kWh for natural gas and 0.233kgCO_2/kWh for grid electricity. However, the results using SAP 2012 have also been presented within the report for illustration purpose only, as specified in the GLA Guidance.

Reducing carbon dioxide emissions through lean measures

To maximise the energy efficiency of the development and thus reduce the energy demands, the following design principles and features have been incorporated:

- Building fabric elements and glazing specifications significantly improved to the Building Regulation requirements.
- Reduced air permeability compared to maximum required standards.
- Specification of efficient heating services and control systems.
- Energy efficient lighting through the development.

It was identified through the modelling undertaken, that a 3.48tn/yr (19.9%) reduction in CO_2 emissions for the residential units could be achieved over the baseline emissions via the implementation of the energy efficient design aspects. This percentage reduction is in accordance to GLA guidance on preparing energy assessments

Reducing carbon dioxide emissions through clean measures

The inclusion of a site wide heating system was investigated. Potential options at the site included either connection to an area wide low carbon heat distribution network, a site wide heat network or a Combined Heat and Power (CHP) system. It was considered that the installation of either of these options was not practical. Further information is provided in Section 3.

Reducing carbon dioxide emissions through green measures

A low or zero carbon (LZC) technology feasibility study was completed as part of this Energy Strategy which compared the feasibility of different technologies based on the energy demand of the development. Based on this, it was identified that the most appropriate technology to meet its sustainability and energy targets, is the installation of Photovoltaic Panels to comply with the energy requirements to achieve at least 20% renewables for the site. It is proposed to install PV panels for a total peak of 17.3kWp. This is about 86m^2, based on installing 52 PV panels.

Based on the robust approach to the energy hierarchy, the development has exceeded the required sustainability and energy targets. The proposed strategy achieves a site wide total reduction of the regulated carbon dioxide emissions of 39.8% over Building Regulations 2013 Part L1A. Moreover, the development achieves a total reduction of 20% of its regulated emissions through the use of renewables on site.

Table 1 illustrates the reductions in CO_2 emissions for the proposed dwellings including both regulated and unregulated emissions. Regulated emissions alone are covered by Part L; and include emissions associated with fixed components of the building (i.e. fixed lighting, ventilation, space heating and water heating). Unregulated emissions are not covered by Part L and include emissions associated with plug-in appliances (i.e. cooking and appliances, catering and computing).

	Carbon dioxide emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Baseline: Part L 2013 of the Building Regulations Compliant Development	17.48	8.49
Be lean: After energy demand reduction	14.01	8.49
Be green: After renewable energy	10.52	8.49

Table 1: Carbon dioxide emissions after each stage of the Energy Hierarchy for domestic buildings

In Table 2 the carbon dioxide savings after each step of the energy hierarchy are presented. The savings in absolute values are calculated, for each tier, from the previous stage of the energy hierarchy. However, all savings in percentages (%) are reported against the baseline carbon emissions in order to evaluate the percentage saving against the baseline.

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	**(%)**
Be lean: Savings from energy demand reduction	3.48	19.9
Be green: Savings from renewable energy	3.49	20
Cumulative on site savings	**6.96**	**39.8**
Carbon shortfall	10.52	
	(Tonnes CO_2)	
Cumulative savings for off-set payment	315.6	
Cash-in-lieu contribution	£18,936	

Table 2: Regulated carbon dioxide savings from each stage of the Energy Hierarchy for domestic buildings

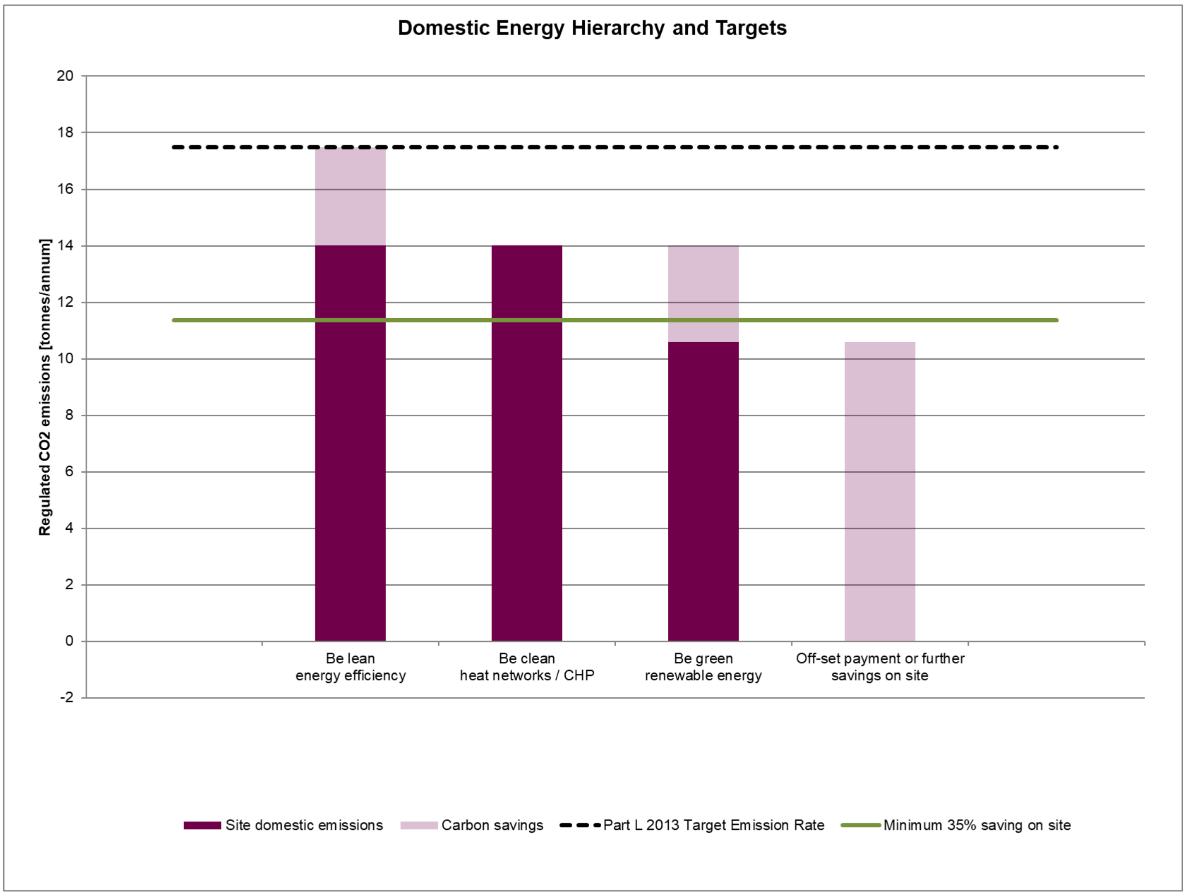

Figure 1: Step reduction in regulated CO_2 emissions for domestic buildings

As shown in Table 2 and Figure 1, a 100% carbon dioxide saving cannot be achieved on site for the domestic buildings. In order to meet ‘Zero Carbon’, total onsite carbon dioxide emissions of 10.52 $tnCO_2$/yr must be offset, according to GLA Guidance. By multiplying the annual remaining carbon emissions with the assumed lifetime of the development’s services (30 years) the cumulative shortfall has been calculated as 315.6 $tnCO_2$/yr. Finally the required cash-in-lieu contribution is £18,936 based on the carbon dioxide offset price (£60/tn) set by Richmond Council.

Contents

Tables

Figures

Appendix

1 INTRODUCTION

1.1.1 RPS Consulting Services Ltd (RPS) was commissioned by *Leek Real Estate (No.1) Ltd* to undertake an Energy Strategy and produce a statement for a proposed development at 75 Norcutt Road, Twickenham, London, TW2 6SR. This report will form part of the planning submission to the London Borough of Richmond upon Thames and relates to a full planning application.

1.1.2 This report outlines the scheme and current planning context and assesses likely energy demands of the development prior to consideration of low and zero carbon technology options. The report concludes with the proposed energy strategy.

1.1.3 This Energy Report comprises:

- A scheme overview.
- A review of the planning context.
- An energy assessment of the project, following the energy hierarchy.
- A presentation of results and recommendations.

1.2 Scheme Overview

1.2.1 The scheme consists of the demolition of the light industrial building and the replacement with a residential development comprising of 15 dwellings.

Figure 2: South elevation of the proposed development

1.3 Purpose of the Energy Assessment

1.3.1 The report has been written in accordance with the planning requirements of an Energy Strategy. A summary of the policy requirements relevant to energy consumption within the development are provided in Section 2 of the report.

1.3.2 The method preferred by London Borough of Richmond upon Thames towards the site wide energy strategy is the adoption of a hierarchical approach which ensures that the energy requirements and associated emissions are reduced as far as possible before applying renewable energy options. Section 3 of this report detail the steps taken to follow the energy hierarchy (be lean, be clean, be green). Section 4 details how the different measures implemented have followed best practice principles to mitigate overheating. A summary of findings and a suggested approach for the development is presented in Section 5.

2 REGULATIONS & POLICIES

2.1.1 The relevant authority for this site is Richmond Council. The requirements of this Council and other relevant planning authorities have been taken into account within this feasibility study. The key policy framework applicable to the energy aspects of the development is outlined below.

2.2 National Level Policies

National Planning Policy Framework

2.2.1 The National Planning Policy Framework (NPPF) was published in February 2019, and replaced the first NPPF published in March 2012. The NPPF set out the Government's planning policies for England and how these are expected to be applied. The NPPF is designed to make the planning system less complex and more accessible; to protect the environment and promote sustainable growth. It provides a framework within which local people and their respective councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

2.2.2 At the heart of the NPPF is a presumption in favour of sustainable development (paragraph 11). The three dimensions of sustainable development can be defined as the economic, social and environmental.

2.2.3 Plans should provide a framework for addressing housing needs and other economic, social and environmental priorities; and a platform for local people to shape their surroundings. Strategic policies should set out an overall strategy for the pattern, scale and quality of development.

2.2.4 The NPPF (paragraph 150) states that new development should be planned for in ways that avoid increased vulnerability to the range of impacts arising from climate change; and help to reduce greenhouse gas emissions. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

2.2.5 The NPPF aims to strengthen local decision making, with the use of decision-taking in a positive way, as a means of fostering the delivery of sustainable development.

2.2.6 Finally, the NPPF (paragraph 16) also highlights that plans should be prepared with the objective of contributing to the achievement of sustainable development and in a way that is aspirational but deliverable.

Building Regulations Part L

2.2.7 Building Regulations are statutory instruments that seek to ensure that the policies set out within any relevant UK legislation are carried out. Building regulations approval is required for the majority of building work carried out in the United Kingdom.

2.2.8 Part L of these regulations covers the requirements with respect to the conservation of fuel and power in all building types. It controls the insulation values of building fabric elements and openings, the air permeability of the structure, the heating efficiency of heating, ventilation and air conditioning systems together with hot water storage and lighting efficiency. It also sets out the requirements for calculating the carbon dioxide emissions and the Carbon Emission Targets for each building type.

2.2.9 Part L 2013 is split into four sections:

- L1A New Dwellings.
- L1B Existing Dwellings.
- L2A New Buildings other than Dwellings.
- L2B Existing Buildings other than Dwellings.

2.2.10 This development needs to comply with Part L1A.

2.3 Regional Level Policies

London Plan

2.3.1 Planning policy for London is set out in the Mayor's London Plan 2016; this sets out an integrated social, economic and environmental framework for future development of Greater London. The London Plan contains a number of policies relating to energy; those most relevant to the energy assessment of new developments are detailed below.

Policy 5.2 Minimising Carbon Dioxide Emissions

2.3.2 Development proposals should make the fullest contribution to minimising carbon dioxide emissions. All new development will have to achieve zero carbon for residential development and a 35% improvement over 2013 Part L Building Regulations for commercial developments.

2.3.3 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.

2.3.4 All carbon dioxide emissions savings should be achieved in accordance with the following energy hierarchy:

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

2.3.5 Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emission reductions are to be met within the framework of the energy hierarchy. The calculation within the energy assessment should include the energy demand and carbon dioxide emissions covered by the Building Regulations; and, separately, the energy demand and carbon dioxide emissions from any other part of the development. This includes plant, equipment, cooking or appliances that are not covered by the Building Regulations at each stage of the energy hierarchy.

Policy 5.6 Decentralised Energy in Development Proposals

2.3.6 Development proposals should evaluate the feasibility of connection to a Decentralised Energy heating system and Combined Heat and Power (CHP) systems. In cases where a new CHP system is appropriate, development proposals should also examine opportunities to extend the system beyond the site boundary to adjacent sites.

2.3.7 Major development proposals should select energy systems in accordance with the following hierarchy:

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

Policy 5.7 Renewable Energy

2.3.8 The Mayor seeks to increase the proportion of energy generated from renewable sources and expects that the projections for installed renewable energy capacity outlined in the Climate Change Mitigation and Energy Strategy and in supplementary planning guidance, will be achieved in London. Within the framework of the energy hierarchy (see Policy 5.2), there is a presumption that all major development proposals will seek to reduce carbon dioxide emissions by at least 20% through the use of on-site renewable energy generation wherever feasible.

2.3.9 Development proposals should seek to utilise renewable energy technologies such as: biomass heating; cooling and electricity; renewable energy from waste; photovoltaics; solar water heating; wind and heat pumps. All renewable energy systems should be located and designed to minimise any potential adverse impacts on biodiversity, the natural environment and historical assets, and to avoid any adverse impacts on air quality.

Policy 5.9 Overheating and Cooling

2.3.10 Major development proposals should reduce potential overheating and reliance on air conditioning systems through consideration of principles of the following cooling hierarchy:

- Minimise internal heat generation through energy efficient design.
- Reduce the amount of heat entering a building during summer months through orientation, shading, albedo, fenestration, insulation and green roofs and walls.
- Manage the heat within the building through exposed internal thermal mass and high ceilings.
- Use passive ventilation.
- Use mechanical ventilation.
- Use active cooling systems (ensuring they are the lowest carbon options).

2.3.11 Major development proposals should demonstrate how the design, materials, construction and operation of the development would minimise overheating and also meet its cooling needs. New development in London should also be designed to avoid the need for energy intensive air conditioning systems as much as possible.

Greater London Authority guidance on preparing energy assessments

2.3.12 On October 2018 GLA issued a guidance on preparing energy assessments. This guidance note provides further detail on how to prepare an energy assessment to accompany strategic planning applications as set out in London Plan Policy 5.2. The purpose of an energy assessment is to demonstrate that climate change mitigation measures comply with London Plan energy policies, including the energy hierarchy.

2.3.13 The energy assessment must fully address requirements in Policies 5.2 to 5.9 inclusive and, recognising the integrated nature of London Plan policies, take account of relevant design, spatial, air quality, transport and climate change adaptation policies in the Plan.

2.3.14 The GLA expects all major development proposals to maximise on-site renewable energy generation. This is regardless of whether a 35 per cent target has already been reached through earlier stages of the energy hierarchy. In particular, solar PV should be maximised on roof spaces.

2.4 Local Level Policies – Richmond Council

2.4.1 The London Borough of Richmond Upon Thames requirements regarding energy are, in the main, reflecting those highlighted in the London Plan. The Council adopted the Local Plan on 3rd July 2018 and sets out policies and guidance for the development of the borough over the next 15 years. The policies as set out in this Local Plan follow the approach of the presumption in favour of sustainable development. The relevant proposed policies are outlined below.

Local Plan (adopted July 2018)

Policy LP 20

Climate Change Adaptation

2.4.2 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.

2.4.3 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:

- minimise internal heat generation through energy efficient design
- reduce the amount of heat entering a building in summer through shading, reducing solar reflectance, fenestration, insulation and green roofs and walls
- manage the heat within the building through exposed internal thermal mass and high ceilings
- passive ventilation
- mechanical ventilation
- active cooling systems (ensuring they are the lowest carbon options).

<u>Policy LP 22</u>

Sustainable Design and Construction

2.4.4 Developments will be required to achieve the highest standards of sustainable design and construction in order to mitigate against climate change. Applicants will be required to comply with the following:

- Development of 1 dwelling unit or more, will be required to comply with the Sustainable Construction Checklist SPD.
- 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 litres or less per person per day for external water consumption).

Reducing Carbon Dioxide Emissions

2.4.5 Developers are required to incorporate measures to improve energy conservation and efficiency as well as contributions to renewable and low carbon energy generation. Proposed developments are required to meet the following minimum reductions in carbon dioxide emissions:

- All new major residential developments (10 units or more) should achieve zero carbon standards in line with London Plan policy.
- All other new residential buildings should achieve a 35% reduction.

2.4.6 This should be achieved by following the Energy Hierarchy:

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

Decentralised Energy Networks

2.4.7 The Council requires developments to contribute towards the Mayor of London target of 25% of heat and power to be generated through localised decentralised energy (DE) systems by 2025. The following will be required:

- All new development will be required to connect to existing DE networks where feasible.
- This also applies where a DE network is planned and expected to be operational within 5 years of the development being completed.
- Applicants are required to consider the installation of low, or preferably ultra-low, NOx boilers to reduce the amount of NOx emitted in the borough.
- Local opportunities to contribute towards decentralised energy supply from renewable and low-carbon technologies will be encouraged where appropriate.

2.5 Policy summary

2.5.1 In conclusion, compliance with a number of national, regional and local policy standards is required for the proposed domestic buildings. These are presented in Table 3 below:

Policy Level	Standard	Buildings
National Policies	National Planning Policy Framework	All dwellings
	Building Regulations Part L1A	
Regional Policies	The Greater London Authority – The London Plan	
Local Policies	London Borough of Richmond upon Thames – Local Plan	

Table 3: Summary of applicable policies

3 ENERGY MODELLING

3.1.1 The Standard Assessment Procedure (SAP) is the Government's recommended system for the energy rating of residential dwellings. It is a tool which enables qualified energy assessors to calculate the energy demand and the CO_2 emissions of a dwelling. The energy demand calculated using the SAP methodology is relative to the Regulated Emissions which include the energy consumed to power space heating, domestic hot water, ventilation and internal lighting systems. The unregulated emissions (i.e. cooking and appliances) are calculated using BREDEM (BRE Domestic Energy Model).

3.1.2 The proposed development consists of 15 new build residential units. For the purpose of this report, 7 dwelling types have been identified for the whole development as can be seen on Table 4 below. The energy and CO_2 emissions reduction have been calculated for these dwelling types and the results have been multiplied by the cumulative floor area for the particular dwelling type in question to give the related CO_2 emissions.

Unit	Dwelling type	Modelled Floor Area (m^2)	Bedrooms	Number of units
Flat 1	Type 1	102.37	3B 5P	1
Flat 10	Type 2	61.8	2B 3P	3
Flat 3	Type 3	53.27	1B 2P	3
Flat 4	Type 4	52.24	1B 2P	3
Flat 5	Type 5	63.98	2B 3P	3
Flat 14	Type 6	88.95	3B 4P	1
Flat 15	Type 7	85.84	3B 4P	1
		TOTAL for the development		**15**

Table 4: Dwelling types for SAP calculations

3.1.3 Grid electricity has significantly decarbonised since the last update of Part L in April 2014 and in July 2018 the Government published updated carbon emission factors (SAP 10) demonstrating this. The impact of these new emission factors is significant in that technologies generating on-site electricity (such as gas-engine CHP) will not achieve the carbon savings they have to date. Therefore, GLA has decided that from January 2019 and until central Government updates Part L with the latest carbon emission factors, planning applicants are encouraged to use the SAP 10 emission factors for referable applications when estimating CO_2 emission performance against London Plan policies. This will ensure that the assessment of new developments better reflects the actual carbon emissions associated with their expected operation. As a result, results both under SAP2012 and SAP10 are presented in this report, but only the results using SAP10 methodology are used to demonstrate compliance with London Plan and Local Authority requirements.

3.1.4 The results of the indicative calculations should not be used for any other purpose other than those for which they are intended (namely as a basis for this energy statement). Formal assessments will be required at a later stage of the development process to satisfy Building Control requirements.

3.1.5 The proposed energy strategy approach is based on a recognised structure of reduction in carbon dioxide emissions through:

1. Reducing the building energy consumption (Be Lean) by optimising the design and construction of the building to ensure less energy is required.
2. Supplying the energy required in an efficient manner (Be Clean).
3. Supplying the energy from Low Zero Carbon and Renewable Energy Sources (Be Green).

Figure 3: The three stages of the Energy Hierarchy

3.1.6 On the whole, it becomes more expensive to implement both carbon reduction and sustainability measures the further along the design process, as the opportunities available diminish. This highlights the importance of early consideration of these measures within the design process.

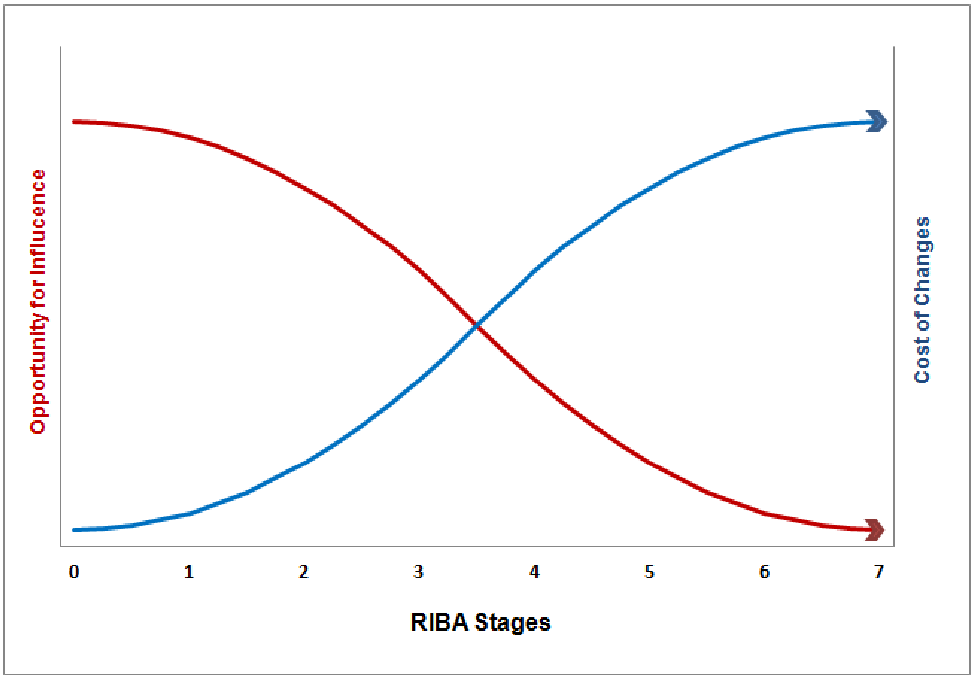

Figure 4: Opportunities to reduce CO_2 emissions and associated cost during the construction phases

3.1.7 A passive, well insulated envelope will last for the life of the building; with this being difficult to upgrade once building work is complete. The services installed within the building have a shorter life span and can be replaced or upgraded at a later date, when their lifetime will have expired and new more efficient services will be available. Once the most efficient building envelope and services are provided, the installation of Low and Zero Carbon technologies should be considered.

3.1.8 The design for this project will attain a final carbon emission rating that goes beyond the one required to comply with Part L1A 2013 of the Building Regulations and Domestic Building Services Compliance Guide 2013; in line with the requirements of the Energy Hierarchy which Richmond Council follows for all new developments.

3.2 Baseline scenario

3.2.1 In order to establish the baseline carbon dioxide emissions for the proposed development, the Government-approved software SAP2012 was used to model the dwellings.

3.2.2 The baseline scenario assumes the minimum values required to meet Building Regulation 2013 Part L1A. When determining this baseline, it is assumed that the heating would be provided by gas boilers and that any active cooling would be provided by electrically powered equipment, in accordance to GLA's Guidance.

3.2.3 The modelling undertaken identified the total CO_2 emissions across the site as 25.98 $tnCO_2/yr$. This is broken down to 17.48 $tnCO_2/yr$ from regulated emissions (covered by Building Regulations) and 8.49 $tnCO_2/yr$ from unregulated emissions (cooking and other plug-in appliances). A breakdown of the carbon dioxide emissions per energy use is presented in Table 5. The total baseline CO_2 emissions for the development are illustrated in Table 6.

Baseline CO_2 emissions for domestic buildings	SAP 2012 Total CO_2 (Tonnes CO_2/year)	SAP 10 Total CO_2 (Tonnes CO_2/year)
Heating	9.77	9.50
Auxiliary	0.58	0.26
Lighting	2.24	1.00
Domestic Hot Water	6.91	6.72
Total (regulated)	19.50	17.48
Unregulated	17.43	8.49
Total	**36.94**	**25.98**

Table 5: Baseline CO_2 emissions per energy use for domestic buildings

	Total regulated emissions (Tonnes CO_2/year)	CO_2 Savings (Tonnes CO_2/year)	Percentage saving (%)
Part L 2013 baseline	17.48		

Table 6: Site wide regulated carbon dioxide emissions and savings

3.3 Energy Saving Measures (Lean)

3.3.1 Energy demand reduction within the building can be utilised to improve compliance with Part L1A 2013. This development has been reviewed to maximise both passive and active design measures to reduce the energy demand within the building.

3.3.2 Optimisation of building layout and orientation has been considered as far as reasonably practicable. Internal shading devices are anticipated to be installed where required by incoming tenants to mitigate any excessive summer solar gains.

Building Fabric

3.3.3 To reduce the CO_2 emissions of the development, it is important to minimise the heat losses through the building fabric. In order to achieve this, U-values for all building fabric elements and openings have been specified to exceed the levels required by Building Regulations. In addition, heat losses from infiltration have been minimised and a low air permeability target has been set. The details of these measures are summarised in the Table 7 below.

Element	Proposed values	Maximum values under Part L1A 2013
Roof	0.12 W/m²K	0.20 W/m²K
External wall	0.16 W/m²K	0.30 W/m²K
Party walls (between dwellings and unheated areas)	0.16 W/m²K	0.30 W/m²K
Party walls (between dwellings)	0.0 W/m²K	0.20 W/m²K
Ground floor	0.12 W/m²K	0.25 W/m²K
Windows	0.9 W/m²K	2.00 W/m²K
Personnel doors	1.1 W/m²K	2.00 W/m²K
Air permeability	3 m³/hm²@50Pa	10 m³/hm²@50Pa

Table 7: Passive design energy saving measures

3.3.4 The source of natural daylight has been efficiently incorporated into the development by ensuring the occupied areas are south facing, where possible to maximise the use of natural daylight and reduce reliance on artificial lighting.

3.3.5 The proposed south, west and east facing windows will have a g-value of 0.55, while the north facing windows a g-value of 0.45.A frame factor of 0.7 has been assumed for all windows.

3.3.6 As no detailed design has been carried out at this stage it is not possible to assess all construction details for thermal bridging. For the purpose of this report, the following construction details (Table 8) have been assumed to be present and meet Accredited Construction Details standards, were available. Table 8 presents all Ψ values currently assumed per junction.

Junctions	SAP Ref	Junction detail	Ψ Value
Junctions with an external wall	E2	Other lintels (including other steel lintels)	0.30
	E3	Sill	0.04
	E4	Jamb	0.05
	E5	Ground floor (normal)	0.16
	E20	Exposed floor (normal)	0.32
	E21	Exposed floor (inverted)	0.32
	E7	Party floor between dwellings (in blocks of flats)	0.07
	E9	Balcony between dwellings, wall insulation continuous	0.02
	E24	Eaves (insulation at ceiling level - inverted)	0.24
	E14	Flat roof	0.08
	E15	Flat roof with parapet	0.28
	E16	Corner (normal)	0.09
	E17	Corner (inverted - internal area greater than external area)	-0.09
	E18	Party wall between dwellings	0.06
	E25	Staggered party wall between dwellings	0.12
Junctions with a party wall	P3	Intermediate floor between dwellings (in blocks of flats)	0.0
	P7	Exposed floor (normal)	0.16
	P8	Exposed floor (inverted)	0.24
	P4	Roof (insulation at ceiling level)	0.24

Table 8: Ψ values assumed

3.3.7 The high standard of specification for the building fabric has been used to provide passive energy saving solutions that significantly exceed the Building Regulation requirements.

Building Services

3.3.8 In addition to upgrading the insulation standards, it is important that the energy used within the building is used efficiently. Therefore, the building systems have been designed to optimise the efficiency of the systems by matching installed capacity to anticipated building demand. Items of equipment, which make up the building's mechanical building services installation, will be specified to achieve high annual energy efficiency in operation and will be regularly serviced to maintain their performance. Please note that all systems have efficiencies and controls which will meet or exceed the requirements of Part L1A:2013 Domestic Building Services Compliance Guide.

Building Services	**Residential units**	
Space heating systems	**Proposed values**	**Part L1A 2013 Limits**
Gas boiler - seasonal efficiency (%)	90%	>88%
Domestic hot water systems		
From Main System	90%	>88%
Air distribution systems		
Mechanical Ventilation with Heat Recovery (MVHR)	Efficiency 90% SFP 0.5W/ls	Efficiency >70% SFP < 0.7W/ls
Internal lighting systems		
Luminous efficacy – lumens per circuit watt	45	> 45 lm/W

Table 9: Summary of proposed building services and energy efficiency standards in Part L1A 2013

3.3.9 Space heating within the building will be provided by an energy efficient (90%) combi gas boiler with a very efficient heating control system (time and temperature zone control) for all individual dwellings. In addition, the inclusion of smart meters in the development is proposed, to support the growth of demand side response. This will help enhance understanding of the potential for turning off non-essential equipment or running some equipment at a lower capacity during times of peak demand.

3.3.10 Domestic hot water for the dwellings will be provided through the main heating system and the primary pipework will be fully insulated.

3.3.11 The air quality within the building is significantly influenced by the ventilation system specified. To ensure high air quality within the dwellings, a highly efficient Mechanical Ventilation with Heat Recovery (MVHR) system (90% efficiency) has been specified, with low specific fan power.

3.3.12 Electrical lighting also represents a significant energy use within a building. To maximise energy savings the installation of low energy lighting (LED etc.) across the development has been specified.

3.3.13 In addition to reducing the total energy consumption, it is equally important to be able to accurately measure the energy consumption and to allow for demand side response. Therefore in accordance to Building Regulations Part L the following provisions have been made:

- At least 90% of the estimated annual energy consumption of each fuel, to be assigned to the various end use categories (heating, lighting etc). This will be completed in accordance to CIBSE TM39 Building Energy Metering.
- The output of any renewable system to be separately monitored.

3.3.14 London faces energy challenges, including security of supply, ageing infrastructure, fuel poverty, and failure to align retail energy prices with wholesale costs. There are plenty of opportunities for developing and implementing more solutions in smart grid and local micro grid. The installation of smart meters is proposed for each dwelling in order to monitor operational energy consumption and carbon emissions. Connection to the smart grid is not feasible as there are no existing or planned smart grids in close proximity to the site as shown in Figure 5.

Figure 5: JRC Smart Electricity Systems and Interoperability's Smart Grid Project Map

3.3.15 According to GLA's Guidance on preparing energy assessments, the 'Be Lean' case should assume that the heating is provided by gas boilers (with an efficiency of 90% for residential) and that any active cooling would be provided by electrically powered equipment.

3.3.16 From the modelling undertaken, the total site wide carbon dioxide emissions, after the inclusion of improved building fabric and systems (i.e. lean measures) are estimated as **14.01 $tnCO_2$/yr**. This is presented in Table 10 below. This is a reduction of 3.48 $tnCO_2$/yr compared to the baseline scenario, which equates to an overall saving of 19.9% over the regulated emissions (Table 11).

CO_2 emissions after energy demand reduction (Be Lean) for domestic buildings				
	SAP 2012		SAP 10	
	Baseline Total CO_2 ($TonnesCO_2$/year)	Be Lean Total CO_2 ($TonnesCO_2$/year)	Baseline Total CO_2 ($TonnesCO_2$/year)	Be Lean Total CO_2 ($TonnesCO_2$/year)
Heating	9.77	5.73	9.50	5.57
Auxiliary	0.58	1.56	0.26	0.70
Lighting	2.24	2.24	1.00	1.00
Domestic Hot Water	6.91	6.92	6.72	6.73
Total (regulated)	19.50	16.45	17.48	14.01
Unregulated	17.43	17.43	8.49	8.49
Total	**36.94**	**33.88**	**25.98**	**22.50**

Table 10: CO_2 emissions after energy demand reduction for domestic buildings

	Total regulated emissions (Tonnes CO_2/year)	CO_2 Savings (Tonnes CO_2/year)	Percentage saving (%)
Part L 2013 baseline	17.48		
Be lean	14.01	3.48	19.9

Table 11: Site wide regulated carbon dioxide emissions and savings

3.3.17 In addition to carbon dioxide savings presented in the previous tables, the total energy demand for this building use is reported, in accordance with GLA guidance on preparing energy assessments. The figures reported are the delivered energy requirement at the point of uses and are not the energy consumption (i.e. energy consumed by plant).

Energy demand following energy efficiency measures (MWh/year)	
Space Heating	62.62
Hot Water	32.05
Lighting	4.31
Auxiliary	3.00
Unregulated	36.45

Table 12: Energy demand following energy efficiency measures

3.3.18 According to Building Regulations Part L1A 2013, the energy demand for space heating and cooling expressed in kilowatt-hours of energy demand per square metre per year (kWh/m^2/year) should also be reported. Table 13 presents the overall Fabric Energy Efficient Standard for the residential units. GLA guidance on preparing energy assessments has no specific targets for energy demand.

	Target Fabric Energy Efficiency (MWh/year)	Design Fabric Energy Efficiency (MWh/year)	Improvement (%)
Total	56.74	43.84	23

Table 13: Overall Fabric Energy Efficient Standard

3.4 Heating Infrastructure (Be Clean)

3.4.1 Connection to a decentralised energy network and the use of communal heating system is a recognised method of generating energy more efficiently. The London Plan Policy 5.6: 'Decentralised Energy in Development Proposals' requires development proposals to explore the opportunities to link into an existing or planned decentralised energy network using the London Heat Map tool. Where an existing decentralised energy network is not present, an assessment of the feasibility of establishing a decentralised energy system for the proposed development should be undertaken; including an assessment of the feasibility of a Combined Heat and Power (CHP) communal heating system. The following hierarchy on selecting an energy system has been followed:

1. Connection to an area wide heat network
2. Communal heating system
3. Individual heating system

Connection to an Area Wide Heat Network

3.4.2 Consideration was given to the possible connection to an existing or proposed area wide decentralised energy network. The London Heat Map tool is an interactive tool, using an interactive GIS system, which allows users to identify opportunities for decentralised energy projects in London. It builds on the 2005 London Community Heating Development Study. This tool details the existing and proposed major heat loads and supplies within London as well as existing and proposed heat distribution networks.

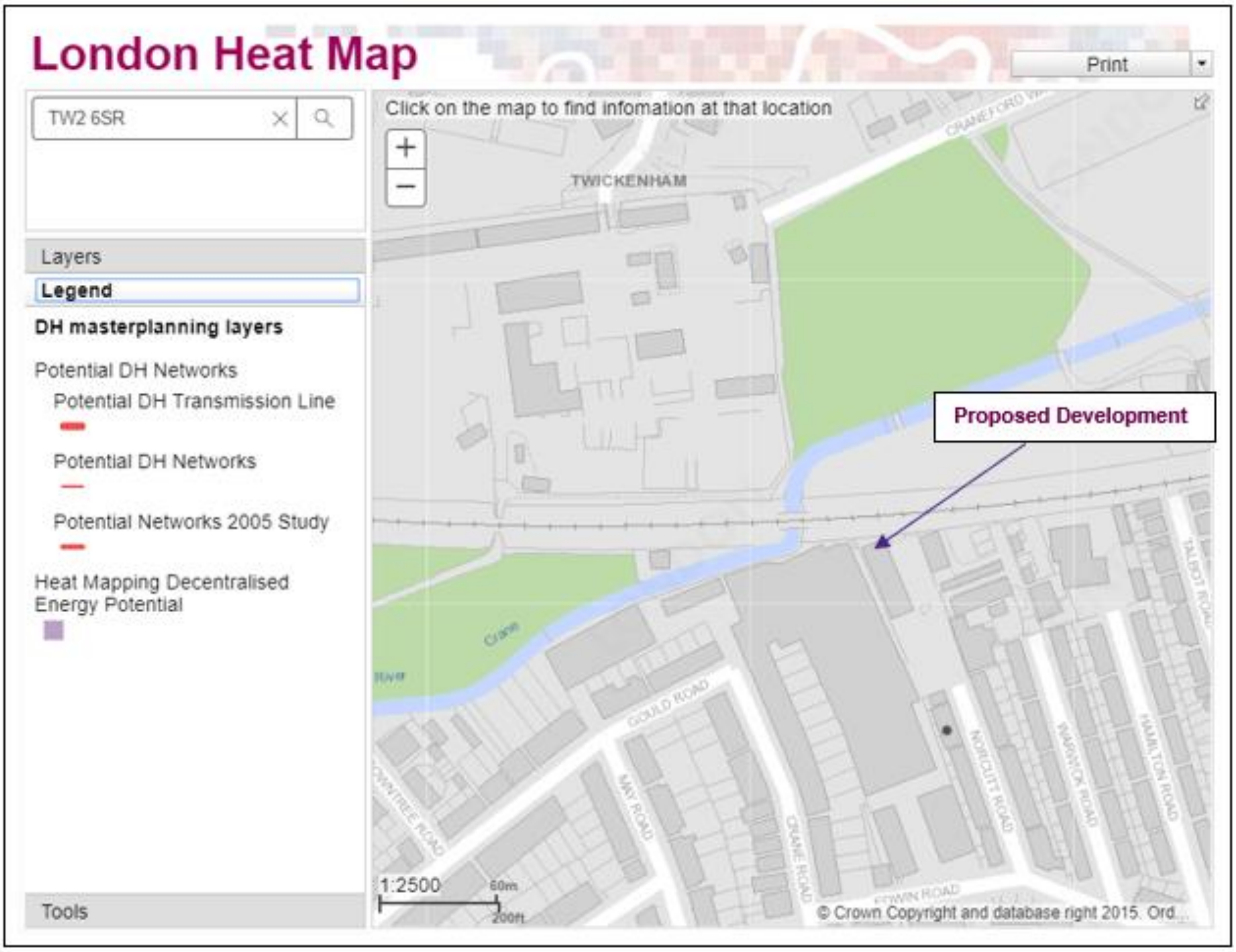

Figure 6: London Heat Map for the area

3.4.3 However, following a review of the London Heat Map, it has been established that there are currently no existing district heating networks located in the vicinity that the development could link to. It was also highlighted that the site is not located within a proposed network or focus area for future consideration of heat distribution networks.

3.4.4 In addition, the Richmond Council’s Policy LP22 recognises that new developments are required to connect to planned district heat networks which are expected to be operational within 5 years of the development being completed. Based on the currently available London Heat Map information and the absence of a Council’s energy masterplan showing any potential networks or priority areas, connection to an area wide district heating system has not been considered further.

Communal Heating System

3.4.5 Consideration was given to the allowance of a communal heating system via a single energy centre. As illustrated in Figure 6 the development is not within an area that will be supplied by a district heating network in future (only individual existing houses surround the development).

3.4.6 In addition, due to site constraints which would affect the building envelope, amenity areas, cycle & car parking spaces and landscape design this option has not been considered further. An individual heating system for each dwelling has been proposed, which is more appropriate for low density buildings.

3.5 Low and Zero Carbon Technologies (Green)

3.5.1 This section discusses the feasibility of using low and zero carbon (LZC) technologies for the proposed scheme. The London Plan, which the London Borough of Richmond upon Thames comes under, aspires that all major developments reduce their carbon dioxide emissions by at least 20% through the use of on-site renewable energy generation, where feasible.

3.5.2 In order to address the planning requirement for the integration of LZC technologies on site, the installation of solar thermal panels, photovoltaics, wind turbines, biomass and heat pumps was investigated.

LZC Technology	CO_2 savings	Capital cost	Considerations
Photovoltaic panels	Medium	Medium	Due to the availability of suitable roof space, PV panels have been incorporated into the design.
Solar thermal panels	Low	Medium	This technology is most suited to houses and therefore not practical for flats.
Air source heat pumps	Medium	Medium	This is a very effective technology (efficiencies up to 450%) to provides simultaneously heating and cooling to the non-domestic unit.
Ground source heat pumps	Medium	High	This technology requires further investigation into the soil conditions. GSHP tend to have high capital cost. Therefore, this technology has not been considered further.
Wind turbines	Low	High	This technology is not deemed appropriate due to low efficiency and high capital cost.
Biomass	High	High	This technology is not deemed appropriate due to close proximity to residential areas and may cause air quality issues.

Table 14: Summary of LZC technologies

3.5.3 These technologies meet all requirements as defined by Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC. In addition, their use is recommended by the London Plan. Full details for these technologies can be found in Appendix A.

3.5.4 After taking into consideration a number of different factors, including local authority requirements, land use, potential noise impacts and available space within the development, it was concluded that the best strategy for this development is the installation of 17.3kWp (in total) of photovoltaic panels, which equal to around 52 PV panels. These need to be located on the flat roof of the building, at 30°, facing south as illustrated in Figure 7.

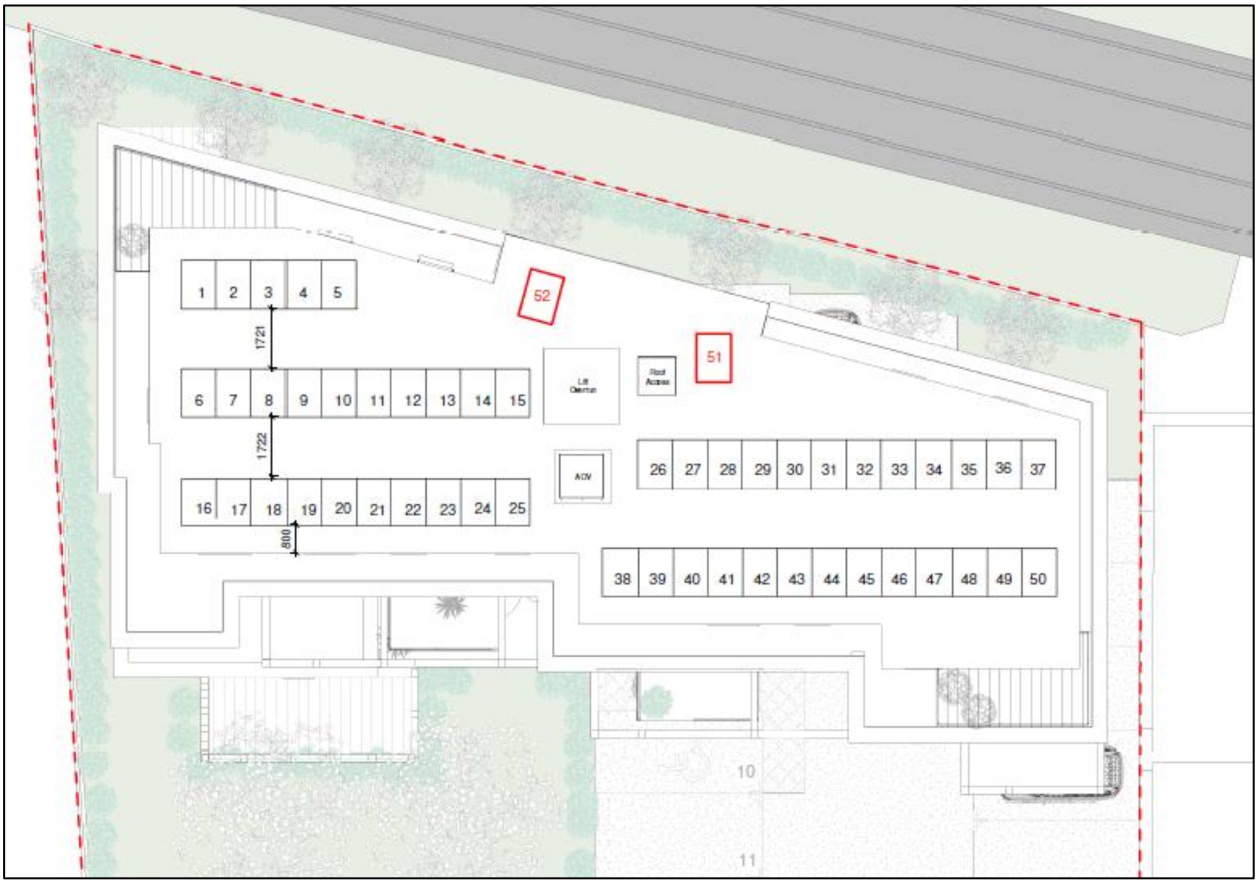

Figure 7: Roof plan showing location of PV panels

3.5.5 Photovoltaics (PV) panels are an established form of renewable technology which converts solar energy into electricity. The electricity is fed into an inverter which converts it from a direct current supply to an alternating current supply, which can then be used to supply the demands within the dwelling.

3.5.6 Upon consideration of the LZC technology, the modelling identified that a further reduction of 3.49 $tnCO_2$/yr has been achieved for the regulated emissions. The total CO_2 emissions for the development after the incorporation of the LZC technologies are illustrated in Table 15. This equates to a 20% reduction in CO_2 over regulated emissions compared to the baseline measures scenario in accordance with GLA, which equates to an overall saving of 39.8% (Table 16). The maximum available roof area has been utilised in accordance with the GLA and the overall carbon dioxide savings compared to the baseline emissions are presented in Table 16.

CO_2 emissions after LZC Technologies (Be Green) for domestic buildings						
	SAP 2012			SAP 10		
	Baseline Total CO_2 ($TnCO_2$/year)	Be Lean Total CO_2 ($TnCO_2$/year)	Be Green Total CO_2 ($TnCO_2$/year)	Baseline Total CO_2 ($TnCO_2$/year)	Be Lean Total CO_2 ($TnCO_2$/year)	Be Green Total CO_2 ($TnCO_2$/year)
Heating	9.77	5.73	5.73	9.50	5.57	5.57
Auxiliary	0.58	1.56	1.56	0.26	0.70	0.70
Lighting	2.24	2.24	2.24	1.00	1.00	1.00
Domestic Hot Water	6.91	6.92	6.92	6.72	6.73	6.73
Photovoltaic	-	-	-7.76	-	-	-3.49
Total (regulated)	19.50	16.45	8.69	17.48	14.01	10.52
Unregulated	17.43	17.43	17.43	8.49	8.49	8.49
Total	**36.94**	**33.88**	**26.12**	**25.98**	**22.50**	**19.01**

Table 15: CO_2 emissions after LZC for domestic buildings

	Total regulated emissions (Tonnes CO_2/year)	CO_2 Savings (Tonnes CO_2/year)	Percentage saving (%)
Part L 2013 baseline	17.48		
Be lean	14.01	3.48	19.9
Be green	10.52	3.49	20
Overall Savings		6.96	39.8

Table 16: Site wide regulated carbon dioxide emissions and savings

4 COOLING AND OVERHEATING

4.1.1 The section below details how the different measures implemented have followed the London Plan Cooling Hierarchy developed in Policy 5.9: ‘Overheating and Cooling’ and the requirements detailed in the adopted Local Plan of the London Borough of Richmond Upon Thames (Policy LP20).

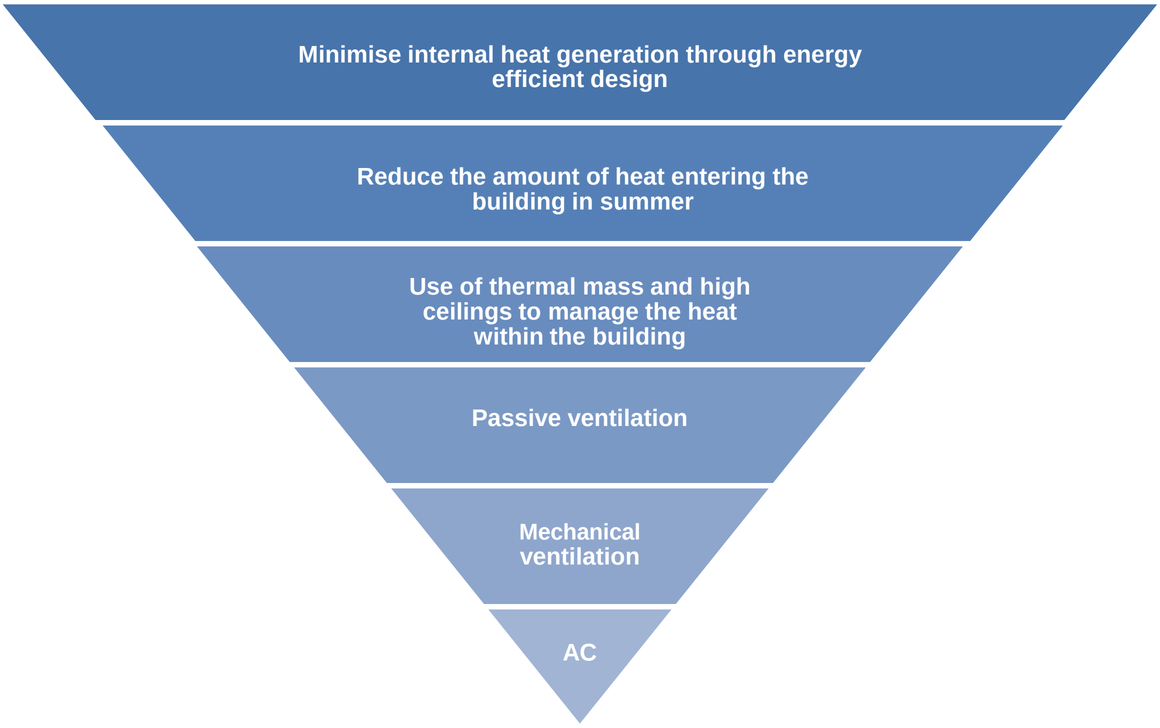

Figure 8: Cooling Hierarchy

4.1.2 New development proposals should demonstrate how the design, materials, construction and operation of the development would minimise overheating and also meet its cooling needs. Therefore, all new developments should also be designed to avoid the need for energy intensive air conditioning systems as much as possible. Taking this into account the flowing measures have been implemented into design:

- Passive Design
  - Avoid designing large rooms with small openings.
  - Use materials with high surface reflectivity to the sun’s radiation.
  - Use carefully designed shading measures, including balconies, louvers, internal or external blinds, shutters, trees and vegetation.
  - Allow for high insulation standards, exceeding Building Regulations requirements, for all building fabric elements and openings

  - Minimise internal heat gains by using low energy equipment, including energy efficient lighting.
  - Specify High efficiency appliances.
- Passive ventilation
  - Design the building and its internal layout to enable passive ventilation, including openable windows.
  - Allow for cross ventilation, where possible.
- Mechanical ventilation
  - High efficiency Mechanical Ventilation with Heat Recovery (MVHR) will be provided for the dwellings.
  - Extract fans for the kitchens & bathrooms.

4.1.3 In order to identify at an early stage whether there is likely to be an overheating risk, a desktop analysis was carried for the proposed development.

4.1.4 Overheating is not fully assessed by carbon dioxide emission models; therefore it is encouraged to undertake dynamic thermal modelling to ensure that a development does not overheat. As a result, a detailed overheating assessment has been carried out for this development, where dynamic modelling is carried out, in accordance with the guidance and data sets in CIBSE Guide TM49 'Design Summer Years for London'. In addition, compliance with CIBSE Guide TM52 'The Limits of Thermal Comfort: Avoiding Overheating in European Buildings' and CIBSE Guide TM59 'Design Methodology for the Assessment of Overheating Risk in Homes', was targeted as these are the recognised standard on predicting overheating in buildings.

4.1.5 A detailed overheating assessment was carried out by RPS and it is part of this planning application, although this is not a specific validation requirement. The assessment concludes that all living rooms, kitchens and bedrooms within the assessed dwellings pass the CIBSE TM59 criteria. Although it is not mandatory further analysis was carried out to communal corridors and to all dwelling types for warmer and future weather data.

5 CONCLUSIONS

5.1.1 This energy strategy has been produced in line with the Energy Hierarchy. Carbon dioxide emission savings have been achieved through the following step process. The specified 'Be Lean' measures include improved building fabric and high specification systems. Moreover, 'Be Clean' measures on site include the installation of a CHP on site or connection to a decentralised energy system. As explained in Section 3.3, the use of decentralised energy or CHP was deemed not to be appropriate for this project. The remaining carbon dioxide savings have been achieved through the inclusion of renewable energy technologies 'Be Green'. All specifications assumed for the purpose of this Energy Report as presented in Appendix A.

5.1.2 In conclusion, based on the measures outlined in the report, the development achieves both its sustainability and energy targets. The proposed strategy includes high insulation standards, very efficient building services, individual combi gas boilers and 17.3 kWp of photovoltaics on the flat roof of the building. It has been confirmed that a 39.8% improvement on 2013 Building Regulations will be achieved and 20% of the total CO_2 emissions reduction of this development will be achieved by the incorporation of a low or zero carbon technology onsite.

5.1.3 The reduction in total carbon dioxide emissions and savings at each stage of the Energy Hierarchy process are provided in Table 17. The table presents the site wide regulated CO_2 emissions.

	Total regulated emissions (Tonnes CO_2/year)	CO_2 Savings (Tonnes CO_2/year)	Percentage saving (%)
Part L 2013 baseline	17.48		
Be lean	14.01	3.48	19.9
Be green	10.52	3.49	20
		CO_2 savings off-set (Tonnes CO_2)	
Offset		10.52	

Table 17 Site wide regulated carbon dioxide emissions and savings

5.1.4 Moreover, in order to achieve compliance with Part L1A 2013, the actual Dwelling Emissions Rating (DER) for every dwelling, must be less than the Target Emissions Rating (TER) allowed under Building Regulations. The overall performance of the proposed development against Part L1A 2013 carbon dioxide requirements is presented in Table 18 below.

	Average Part L Target emissions ($kgCO_2/m^2yr$)	Average Dwelling emissions ($kgCO_2/m^2yr$)	Improvement (%)
Block Compliance	56.74	43.84	22.73

Table 18 Building Regulations Part L1A results

5.1.5 The modelling undertaken shows that Building Regulations Part L1A 2013, London Plan 2018 and local authority planning requirements have been met with respect to energy and CO_2 reduction.

Appendix A Analysis of Low and Zero Carbon Technologies

Solar Thermal

Solar thermal generates energy for the provision of domestic hot water; this system typically works in tandem with a conventional boiler in the event that the hot water demand cannot be solely met by the renewable technology. The two types of solar thermal technology suitable for inclusion are flat plate collectors and evacuated tubes; with the latter typically being more efficient. The panels are most efficient when they face south at 30°.

Solar thermal is mostly suited to houses. Providing solar panels and associated pipework to each flat within the main block would not be a practical approach. For non-residential buildings, they should only be considered for buildings with high hot water demand, like hotels and gyms.

Wind Turbines

Wind technology is now a well established technology for the generation of electricity in large scale projects. Small scale wind projects within built up areas however is less common.

The lower uptake of wind turbines in urban settings is due to the reduced efficiency of smaller scale turbines as a result of the high surface roughness reducing wind speeds. Furthermore, it is likely that the surrounding buildings will create turbulence and locally reduce near surface wind speeds thus further reducing the potential of good wind speeds. In addition, wind turbines integrated on buildings might cause other problems, like vibrations.

Photovoltaic panels

The photovoltaic panel converts free solar energy directly into electricity. The electricity produced is on direct current (DC). Therefore, inverters are used to convert the output into alternating current (AC) for connection to the building's supply board. The electricity generated can either be used to supply communal (landlord) areas or for individual dwellings, the latter configuration tending to be more complex and costly owing to the need for multiple meters.

The panels are most efficient when they face south at 30°. Photovoltaic panels should not be considered in cases with significant overshadow (i.e. next to taller buildings)

Heat Pumps

A heat pump is a machine that moves heat from one location (the 'source') at a lower temperature to another location (the 'sink' or 'heat sink') at a higher temperature using mechanical work or a high-temperature heat source. There are two main categories of heat pumps, the Ground Source Heat Pump (GSHP) and the Air Source Heat Pump (ASHP). They operate very similarly; the difference is on the source of the heat.

Several options are possible for a GSHP, depending on local geology and hydrology. Various types of ground source heat pump arrangements are available including: vertical boreholes, horizontal coils and slinky coils, e.g. around perimeter of building.

The ASHP is an alternative system of the GSHP but they operate with the same physics. Their only difference is that the ASHP uses the ambient outdoor air to provide the low grade source heat instead of the ground. Owing to the greater seasonal variation in air temperatures, air-source heat pumps are unable to provide year-round heating requirements alone; hence they operate less efficiently, the running costs are higher and CO_2 savings lower than for a ground source heat pump.

The main advantage of a heat pump over a conventional heating system is that very high efficiencies can be achieved; typically up to around 400% compared to 90% for a modern gas boiler.

Biomass

Biomass is a term used to describe all plant and animal material. A range of biomass material can be burnt to generate energy including wood, straw, poultry litter and energy crops such as willow or poplar. Biomass material is considered carbon neutral if the fuel comes from a sustainably managed source.

The primary disadvantage for any biomass installation is that it requires large amounts of fuel storage (which will need to be fed by deliveries of biomass fuel). Developments that use biomass need to secure constant delivery of wood chips or wood pellets, from a local supplier. Finally biomass requires a suitable flue design to address air quality issues.

LZC technology	Basic Technical Information	Technical, Environmental and Economic implications/considerations	Suited Application	Site specific comment	Further analysis
Solar thermal	Solar collectors (flat plate or tube) transfer energy into liquid to a closed loop twin coil hot water cylinder	+ Government grants available (RHIs) + Can meet a significant proportion of the DHW demand - Efficiency effected by site factors shading, orientation and roof/ground space - Requires considerable hot water demand all year round to be financially beneficial	Domestic and commercial applications with high annual hot water load; leisure centers, canteens, washrooms	Most suited to houses and not practical for flats.	NO
Wind turbine	Turbine/generator converts wind energy to electrical power.	+ Allows on site generation of renewable electricity - Can create structural, vibrations and noise implications - Not suited for urban environments - Electricity generation varies due to wind speed - Generally payback over 20 years	Large sized turbines in non-urban or offshore locations	Not appropriate due to low efficiency and high capital cost.	NO
Photovoltaic	Converts sunlight to electrical power.	+ Allows on site generation of renewable electricity + Generally payback between 7-12 years + Low maintenance requirements	Applicable to all buildings with limited solar shading and available roof	Due to the availability of suitable roof space, PV panels have been incorporated into the design.	YES

		- Efficiency effected by site factors – shading, orientation and roof/ground space			
Air source heat pump (ASHP)	ASHP capture heat from the outside air and transfer the heat directly to the air inside the building or transferring the heat to a liquid medium that can be pumped around the building.	+ Lower installation cost that ground source heat pump + Can provide heating and cooling + Government grants available (RHIs) - COP is lower during the heating season - Can restrict distribution strategies	Wide range of building types particularly buildings designed to have low temperature heat emitters. Combines well with cooling systems	Effective technology (efficiencies up to 550%) to provide simultaneously heating and cooling Not appropriate for the flats.	NO
Ground source heat pump (GSHP)	GSHP capture heat from the ground and transfer the heat to a liquid medium that can be pumped around the building.	+ More heat is supplied to the building than energy is consumed by the heat pump + COP is much better than air source heat pumps + Government grants available (RHIs) - Requires area for ground collector or borehole - High initial capital cost - Can restrict distribution strategies - Subject to soil conditions	Wide range of building types particularly buildings designed to have low temperature heat emitters and sufficient space for necessary ground works	Further investigation is required to the soil conditions. GSHP tend to have high capital cost. Therefore, this technology has not been considered further.	NO
Biomass	Uses biomass as a fuel source for space heating and hot water.	+ Government grants available (RHIs) + Renewable source of heating - Requires large fuel storage capacity - Generally a large capital cost - Potential issue with air quality especially in urban areas	Building/site with sufficient access and storage facilities. Local supply of fuel	Due to close proximity to residential areas, may not be appropriate due to air quality issues.	NO

Table A1: LZC Technologies Matrix

Appendix B Domestic Overheating Checklist

Section 1 - Site features affecting vulnerability to overheating		Yes or No
Site location	Urban – within central London or in a high density conurbation	no
	Peri-urban – on the suburban fringes of London	Yes
Air quality and/or Noise sensitivity – are any of the following in the vicinity of buildings?	Busy roads / A roads	No
	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)?	No
Dwelling aspect	Are there any single aspect units?	No
Glazing ratio	Is the glazing ratio (glazing: internal floor area) greater than 25%?	Yes
	If yes, is this to allow acceptable levels of daylighting?	Yes
Security - Are there any security issues that could limit opening of windows for ventilation?	Single storey ground floor units	Yes
	Vulnerable areas identified by the Police Architectural Liaison Officer	No
	Other	No

Section 2 - Design features implemented to mitigate overheating risk		Please respond
Landscaping	Will deciduous trees be provided for summer shading (to windows and pedestrian routes)?	Yes
	Will green roofs be provided?	Yes
	Will other green or blue infrastructure be provided around buildings for evaporative cooling?	No
Materials	Have high albedo (light colour) materials been specified?	No
Dwelling aspect	% of total units that are single aspect	0%
	% single aspect with N / NE / NW orientation	0%
	% single aspect with E orientation	0%
	% single aspect with S / SE / SW orientation	0%
	% single aspect with W orientation	0%
Glazing ratio - What is the glazing ratio (glazing; internal floor area) on each facade?	N / NE / NW	26%
	E	10.40%
	S / SE / SW	29%
	W	11.30%
Daylighting	What is the average daylight factor range?	1.17-5.97
Window opening	Are windows openable?	Yes/No
Window opening	What is the average percentage of openable area for the windows?	42.90%
Window opening - What is the extent of the opening?	Fully openable	5.4% (90 degree - doors)
	Limited (e.g. for security, safety, wind loading reasons)	37.495% (30 degree - windows)
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)?	No
Shading	Is there any external shading?	Yes balconies / screens
	Is there any internal shading?	Yes blinds
Glazing specification	Is there any solar control glazing?	Yes
Ventilation - What is the ventilation strategy?	Natural – background	n/a
	Natural – purged	n/a
	Mechanical – background (e.g. MVHR)	Yes
	Mechanical – purge	n/a
	What is the average design air change rate	n/a
Heating system	Is communal heating present?	No
	What is the flow/return temperature?	n/a
	Have horizontal pipe runs been minimised?	n/a
	Do the specifications include insulation levels in line with the London Heat Network Manual	n/a

Appendix C Performance Specifications for Building Fabric and Services

Feature	Description	Technical Values
External walls		0.16 W/m²K
Party walls (flats and unheated areas)		0.16 W/m²K
Party walls (between dwellings)	Fully filled cavity with sealed edges	0.0 W/m²K
Ground and upper floors		0.12 W/m²K
Roofs		0.12 W/m²K
Windows		0.9 W/m²K
Doors		1.1 W/m²K
Air permeability		3 m³/m²h @50Pa
Ventilation	MVHR	SFP=0.5 W/l*s; Heat exchanger efficiency η= 90%
Heating System		High efficiency combi gas boilers η= 90%
Hot Water System	From Main System	
Lighting		100% efficient
LZC Technologies	Monocrystalline PV panels	17.3 kWp on about 86 m²

Table A2 Performance Specifications for Building Fabric and Services