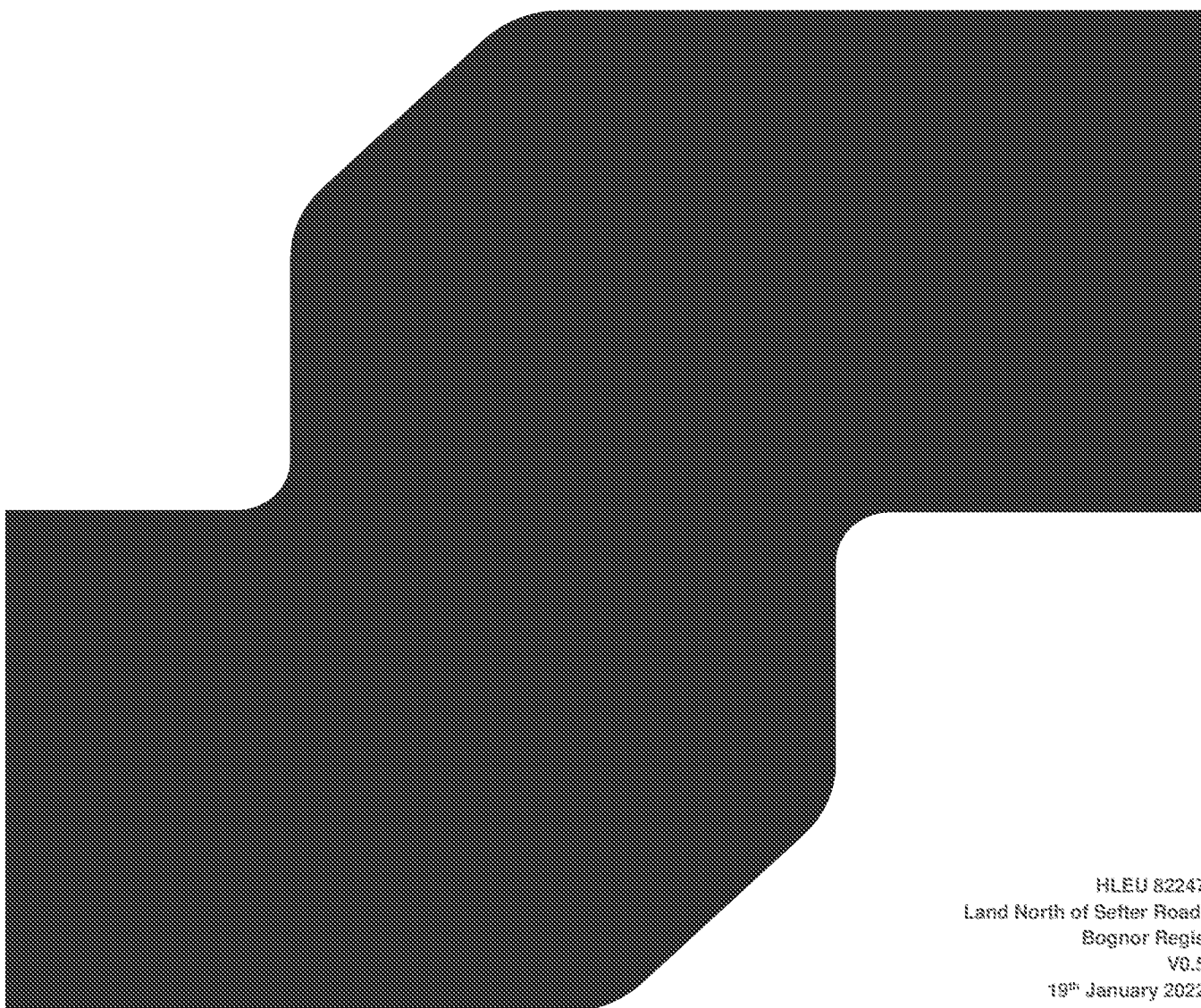


LAND NORTH OF SEFTER ROAD, BOGNOR REGIS

Energy Report



HLEU 82247
Land North of Sefter Road,
Bognor Regis
V0.5
19th January 2022

Document status					
Version	Purpose of document	Authored by	Reviewed by	Approved by	Date
0.1	Draft	AM	AV	AV	27 th February 2020
0.2	Final	AM	AV	AV	4 th April 2020
0.3	Final	AM	AV	AV	7 th April 2020
0.4	Final	AM	AV	AM	29 th November 2021
0.5	Final	AM	AV	AM	19 th January 2021

This report was prepared by RPS within the terms of its engagement and in direct response to a scope of services. This report is strictly limited to the purpose and the facts and matters stated in it and does not apply directly or indirectly and must not be used for any other application, purpose, use or matter. In preparing the report, RPS may have relied upon information provided to it at the time by other parties. RPS accepts no responsibility as to the accuracy or completeness of information provided by those parties at the time of preparing the report. The report does not consider any changes in information that may have occurred since the publication of the report. If the information relied upon is subsequently determined to be false, inaccurate, or incomplete then it is possible that the observations and conclusions expressed in the report may have changed. RPS does not warrant the contents of this report and shall not assume any responsibility or liability for loss whatsoever to any third party caused by, related to, or arising out of any use or reliance on the report howsoever. No part of this report, its attachments or appendices may be reproduced by any process without the written consent of RPS. All enquiries should be directed to RPS.

Prepared by:

Prepared for:

RPS

Taylor Wimpey UK Ltd

Alex Mozaffari
 Technical Director – Energy & Sustainability

Racheal Gardner
 Design & Planning Executive

RPS | Consulting UK & Ireland
 20 Farringdon Street
 London, EC4A 4AB, United Kingdom

Taylor Wimpey Southern Counties,
 Colvedene Court, Wessex Business Park,
 Colden Common, Hampshire, SO21 1WP

EXECUTIVE SUMMARY

An Energy Strategy has been carried out for the proposed development at Land North of Sefter Road, Bognor Regis. The proposed development includes the creation of 250 dwellings of which 175 dwellings are private housing and 75 dwellings are affordable housing.

This report establishes how the site will achieve compliance with Condition 28 (Application Ref: P/134/16/OUT), that 10% of the energy demand to be provided by renewable energy technology(ies).

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).

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 the development can reduce its CO₂ by 1.6% When compared to the Notional building.

Reducing carbon dioxide emissions through clean measures

The inclusion of a site wide heating system was investigated. However, there are no existing district heating network in the area. In addition, the new Carbon factor encourages new development to move away from gas CHP. The thermal energy demand of this scheme will therefore be provided by energy efficient boilers, and as such district heating option has not been considered as viable.

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 200 kWp of PV panels. This amount of PV panels will provide approximately 160,000 kWh of electricity for the development, which is 10% of the total energy demand.

Based on the robust approach to the energy hierarchy, the development has met the required sustainability and energy targets. The proposed strategy achieves a site wide total reduction of the regulated carbon dioxide emissions of 24.7% over Part L1A Building Regulations 2013.

Table 1 illustrates the reductions in CO₂ emissions for the proposed development including both regulated and unregulated emissions. Regulated emissions alone are covered by Part L; and include

ENERGY REPORT

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	380.356	21
Be lean: After energy demand reduction	374.768	21
Be clean: N/A	374.768	21
Be green: After renewable energy	286.245	21

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	5,588	1.5
Be clean: Savings from heat network	0	0
Be green: Savings from renewable energy	88,523	23.6
Cumulative on-site savings	94,111	24.7

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

Contents

EXECUTIVE SUMMARY	i
Reducing carbon dioxide emissions through lean measures	i
Reducing carbon dioxide emissions through clean measures	i
Reducing carbon dioxide emissions through green measures	i
1 INTRODUCTION	1
1.2 Scheme Overview	1
2 REGULATIONS & POLICIES	3
2.2 National Level Policies	3
2.3 Planning Condition 28	7
2.4 Policy summary	7
2.5 Baseline scenario	9
2.6 Energy Saving Measures (Lean)	10
2.7 Heating Infrastructure (Be Clean)	14
2.8 Low and Zero Carbon Technologies (Green)	14
3 CONCLUSIONS	17

Tables

Table 1: Carbon dioxide emissions after each stage of the Energy Hierarchy for domestic buildings	ii
Table 2: Regulated carbon dioxide savings from each stage of the Energy Hierarchy for domestic buildings	ii
Table 3. Summary of applicable policies	7
Table 4. Baseline CO2 emissions per energy use for domestic buildings	10
Table 5. Passive design and fabric values	11
Table 6. Summary of proposed building services and energy efficiency standards in Part L1A and L1A 2013	12
Table 7. CO2 emissions after energy demand reduction for domestic buildings	13
Table 8. Site wide regulated carbon dioxide emissions and savings	14
Table 9. Summary of L2C technologies	15
Table 10. CO2 emissions after L2C for domestic buildings	16
Table 11. Site wide regulated carbon dioxide emissions and savings	16

Figures

Figure 1. Planning Layout.....	1
Figure 2. The three stages of the Energy Hierarchy	8

ENERGY REPORT

Figure 3. Opportunities to reduce CO2 emissions and associated cost during the construction phases9

Appendix A Analysis of Low and Zero Carbon Technologies

Appendix B SAMPLE SAP Reports

1 INTRODUCTION

- 1.1.1 RPS Consulting Services Ltd (RPS) was commissioned by *Taylor Wimpey UK Ltd* to undertake an Energy Strategy and produce a statement for a proposed development at Land North of Sefter Road, Bognor Regis. This report seeks to discharge planning condition 28 pursuant to Outline planning permission ref: P/134/16/OUT.
- 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:
- The 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 A residential development comprising up to 280 dwellings (including affordable homes) is proposed for the site under the Outline planning consent. The proposed layout of the development is shown in Figure 1.



Figure 1. Planning Layout

- 1.2.2 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.

- 1.2.3 The method preferred by Arun District Council 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. Sections 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 Arun District Council. The requirements of this Council and other relevant planning authorities have been considered 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 July 2021, and replaced earlier versions. 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 8). 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 152) states that the planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure.
- 2.2.5 The NPPF (paragraph 154) 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.
- 2.2.6 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.
- 2.2.7 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.

Arun Local Plan Policy ECC SP1

Policy ECC SP1

Adapting to climate change

The Council will support development which is located and appropriately designed to adapt to impacts arising from climate change such as the increased probability of tidal and fluvial flooding; water stress; health impacts as a result of extreme temperatures and a decline in the quality of habitats and richness of biodiversity.

In order to achieve this, development must be designed to take account of the following issues:

- a. Location (in relation to flood risk and vulnerability to coastal erosion);
- b. Water efficiency;
- c. Shade, cooling, ventilation, solar gain;
- d. Connectivity to the green infrastructure network;
- e. Layout and massing;
- f. Resilience of buildings and building materials to extreme weather events; and
- g. Capacity of drainage systems and incorporation of Sustainable urban Drainage Systems (SuDS)

Arun Local Plan Policy ECC SP2

Policy ECC SP2

Energy and climate change mitigation

All new residential and commercial development (including conversions, extensions and changes of use) will be expected to be energy efficient and to demonstrate how they will:

- a. Achieve energy efficiency measures that reflect the current standards applicable at the time of submission;
- b. Use design and layout to promote energy efficiency; and
- c. Incorporate decentralised, renewable and low carbon energy supply systems, for example small scale renewable energy systems such as solar panels.

All major developments⁽⁴⁷⁾ must produce 10% of the total predicted energy requirements from renewable or low carbon energy generation on site, unless it can be demonstrated that this is unviable. Energy efficiency measures will be taken into consideration when the total predicted energy requirements are calculated. The Council will consider 'allowable solutions' where it is clearly demonstrated that the provision of on site renewable or low carbon energy generation is unviable or not feasible.

Where planning permission is required to retrofit energy efficiency measures into existing development, schemes will be permitted, subject to the Design and Built Heritage policies.

In assessing the achievement of these standards the Council will consider:

- Site constraints;
- Technical viability;
- Financial viability; and
- Delivery of additional benefits.

Arun Supplementary Planning Document (Adopted 25 January 2021)

K.02 Water and Material Management

- Applies the waste and water hierarchies.
- Re-uses and/or recycles materials arising from demolition and remediation works.
- Provides adequate space and opportunities for managing waste on-site where viable. Waste compactors and de-watering systems can help reduce waste volumes.
- Targets potable water consumption of <110l/person/day through the incorporation of high efficiency fixtures and fittings and grey and rainwater harvesting systems to reduce demand on local water supplies.

- Includes infrastructure for monitoring water consumption and leak detection. Leak detection will also reduce risk of localised flooding.

K.03 Adapting to Climate Change

- Demonstrate the ability to cope with rising temperatures as for a projected climate change scenario as per UKCP 2018, applied to modelling outlined in K.06.
- Reviews material selection to ensure durability to withstand projected climate change temperatures.
- FRA (refer to section K.04) makes allowances for climate change in accordance with advice from ADC, the EA and other relevant flood risk management authorities.
- Has adaptive capacity (or potential for it) designed in for buildings and their systems and resilience measures e.g., ensuring critical plant is located above ground level.

Building Regulations Part L

- 2.2.8 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.
- 2.2.9 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.
- 2.2.10 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.
- 2.2.11 This development needs to comply with Part L1A New Dwellings.

2.3 Planning Condition 28

- 2.3.1 Before development commences a scheme identifying the principles to be incorporated into detailed building design as the means of energy conservation, together with on-site energy renewable devices, shall be submitted to and agreed with the Local Planning Authority. Such scheme as is submitted shall seek as a target the provision of on-site renewable energy which will generate an estimated 10% of annual energy requirements of the buildings granted planning permission. In determining the provision of on-site energy generation account will be taken of the impact on the viability of the development. Such scheme as is approved will be implemented in accordance with the scheme.

Reason: In accordance with Policy ECC SP2 of the Arun Local Plan. It is considered necessary for this be a pre-commencement condition as sustainability goes to the heart of the approval.

2.4 Policy summary

- 2.4.1 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.

Table 3. Summary of applicable policies

Policy Level	Standard	Buildings
National Policies	National Planning Policy Framework	All buildings
	Building Regulations Part L1A	New Dwellings
Local Policies	Arun Local Plan Policy ECC SP1	Development
	Arun Local Plan Policy ECC SP2	Development
	Arun Design Guide (Draft)	Development

- 2.4.2 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 CO₂ 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).

- 2.4.3 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).

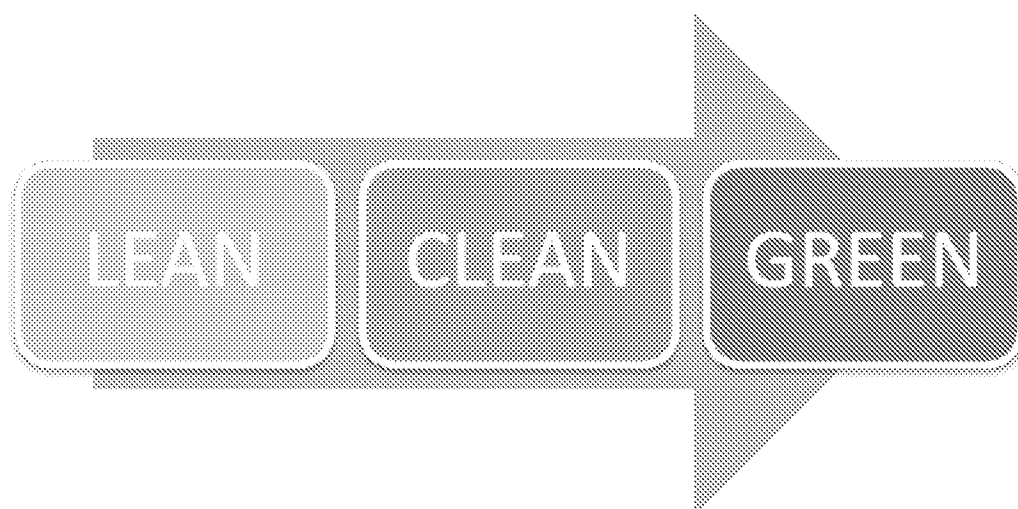


Figure 2. The three stages of the Energy Hierarchy

- 2.4.4 Overall, 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.

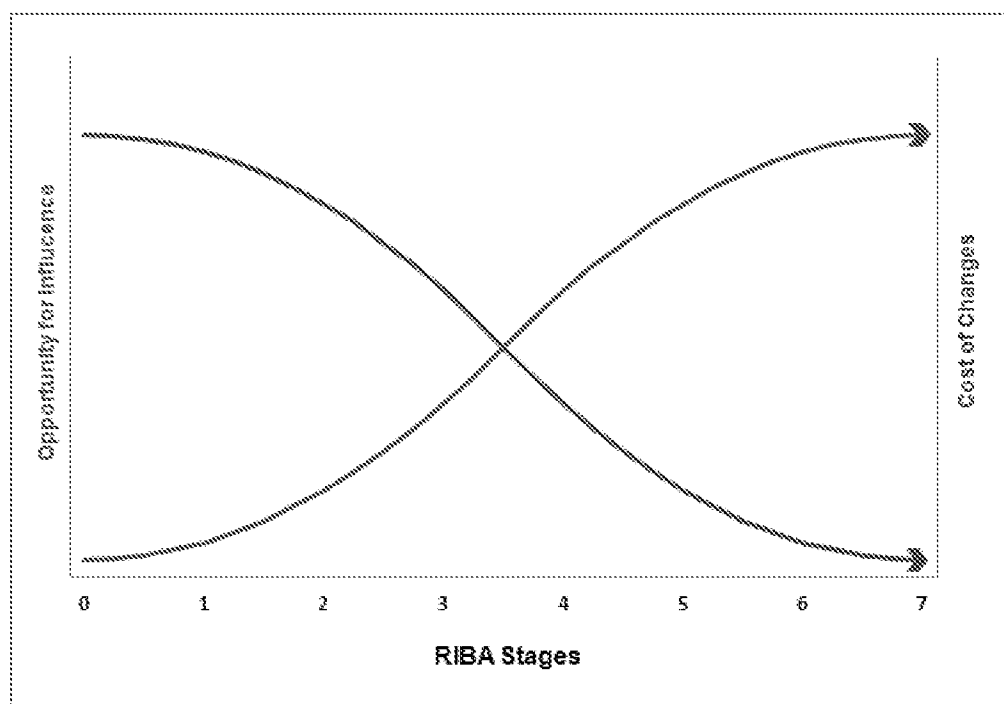


Figure 3. Opportunities to reduce CO2 emissions and associated cost during the construction phases

- 2.4.5 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.

2.5 Baseline scenario

- 2.5.1 In order to establish the baseline carbon dioxide emissions for the proposed development, the Government-approved software SAP2012 was used to model the dwellings.
- 2.5.2 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 with GLA's Guidance.
- 2.5.3 The results of the SAP 2012 calculations should be compared with the new Carbon factor for electricity.
- 2.5.4 The modelling undertaken identified the total CO₂ emissions across the site as 401.356 tn p.a.

This is broken down to 380.356 t_nCO₂/yr. from regulated emissions (covered by Building Regulations) and 21 t_nCO₂/yr. from unregulated emissions (cooking and other plug-in appliances). A breakdown of the carbon dioxide emissions per energy use is presented in Table 4.

Table 4. Baseline CO₂ emissions per energy use for domestic buildings

Baseline CO₂ emissions for domestic buildings	
	Total CO₂ (Tonnes CO₂/year)
Heating	194.555
Auxiliary	9.731
Lighting	47.167
Domestic Hot Water	128.902
Cooling	0
Total (regulated)	
Unregulated	21
Total	401.356

2.6 Energy Saving Measures (Lean)

- 2.6.1 Energy demand reduction within the building can be utilised to improve compliance with Part L1A/ L2A 2013. This development has been reviewed to maximise both passive and active design measures to reduce the energy demand within the building.
- 2.6.2 The site location and weather were accounted for in the energy modelling using the local weather file, in accordance with Part L Building Regulations. The site is not deemed to be located in an area with characteristics of a microclimate that would deviate from the local weather file.
- 2.6.3 The building layout and orientation has been set to avoid having any occupied spaces facing north by the architect. In order to maximise solar gains in the winter to reduce heating and lighting load requirements all occupied spaces (i.e., offices) face east, south or west.

Building Fabric

- 2.6.4 To reduce the CO₂ 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 Table 5.

Table 5. Passive design and fabric values

Element	Proposed values(W/m ² K)	Maximum values under Part L1A 2013(W/m ² K)
Roof	0.10 W/m ² K	0.20 W/m ² K
External wall	0.17 W/m ² K	0.30 W/m ² K
Party walls (between dwellings and unheated areas)	0.17 W/m ² K	0.30 W/m ² K
Party walls (between dwellings)	0.00 W/m ² K	0.20 W/m ² K
Exposed floor	0.12 W/m ² K	0.25 W/m ² K
Windows	1.40 W/m ² K	2.00 W/m ² K
Personnel doors	1.1 W/m ² K	2.00 W/m ² K
Air permeability	5 m ³ /hm ² @50Pa	10 m ³ /hm ² @50Pa

- 2.6.5 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.
- 2.6.6 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. The thermal mass that the lightweight building frame provides is considered appropriate to the building use, due to the majority of the internal area being untreated.

Building Services

- 2.6.7 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.

Table 6. Summary of proposed building services and energy efficiency standards in Part L1A and L1A 2013

Building Services	Residential units
Space heating systems	Proposed values
Communal Gas Boilers	94.3%
Domestic hot water systems	
Communal Gas Boilers	94.3%
Distribution systems	
Radiators	
Internal lighting systems	
Luminous efficacy – lumens per circuit watt	> 45 lm/W

Space heating within the building will be provided by an energy efficient (94.3%) communal gas boilers with a very efficient heating control system (time and temperature control) for all dwellings/ building. 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.

- 2.6.8 Domestic hot water for the entire building will be generated by the main heating system.
- 2.6.9 Electrical lighting also represents a significant energy use within a building. To maximise energy savings the installation of low energy lighting (LED) across the development has been specified.
- 2.6.10 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:

ENERGY REPORT

- 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 with CIBSE TM39 Building Energy Metering.
- The output of any renewable system to be separately monitored
- In buildings with a total useful area greater than 1000m², automatic meter reading and data collection facilities will be provided.

2.6.11 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 448.168 tnCO₂/yr. This is presented in Table 7 and Table 8. This is a reduction of 5.358 tnCO₂/yr. compared to the baseline scenario, which equates to an overall saving of 1.18 % over the regulated emissions.

Table 7. CO₂ emissions after energy demand reduction for domestic buildings

CO₂ emissions after energy demand reduction (Be Lean) for domestic buildings		
	Baseline Total CO₂ (TonnesCO₂/year)	Be Lean Total CO₂ (TonnesCO₂/year)
Heating	194.555	186.270
Auxiliary	9.731	9.731
Lighting	47.167	47.166
Domestic Hot Water	128.902	131.600
Cooling	0	0
Total (regulated)		
Unregulated	21	21
Total	401.356	395.768

Table 8. Site wide regulated carbon dioxide emissions and savings

	Total regulated emissions (Tonnes CO ₂ /year)	CO ₂ Savings (Tonnes CO ₂ /year)	Percentage saving (%)
Part L 2013 baseline	401.356		
Be lean	395.768	5.588	1.5

2.7 Heating Infrastructure (Be Clean)

Connection to a decentralised energy network and the use of communal heating system is a recognised method of generating energy more efficiently. The inclusion of a site wide heating system was investigated. However, there are no existing district heating network in the area. In addition, the new Carbon factor encourages new development to move away from gas CHP. The thermal energy demand of this scheme will be provided by energy efficient boilers, and as such district heating option has not been considered as viable.

2.8 Low and Zero Carbon Technologies (Green)

- 2.8.1 This section discusses the feasibility of using low and zero carbon (LZC) technologies for the proposed scheme. Planning Condition 28 requires that an estimated 10% of annual energy requirements of the development is generated by on-site renewable energy. The integration of LZC technologies on site, the installation of solar thermal panels, photovoltaics, wind turbines, biomass and heat pumps were investigated for this development.

Table 9. Summary of LZO technologies

LZO Technology	CO ₂ savings	Capital cost	Considerations
Photovoltaic panels	Medium	Medium	Proposed. 10% of the total energy demand by PV panels
Solar thermal panels	Low	Medium	Not Recommended.
Air source heat pumps	Medium	Medium	Not Recommended. Not enough roof area. Noise issues.
Ground source heat pumps	Medium	High	Not feasible.
Wind turbines	Low	High	Not feasible
Biomass	High	High	Not feasible

- 2.8.2 These technologies meet all requirements as defined by Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources.

After taking into consideration several 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 PV panels to provide 10% of the energy demand of the development.

- 2.8.3 Upon consideration of the LZO technology, the modelling identified that a further reduction of 99.146 tCO₂/yr. has been achieved for the regulated emissions. The total CO₂ emissions for the development after the incorporation of the LZO technologies are illustrated in 10 and Table 11. This equates to a 22.12% reduction in CO₂ over regulated emissions compared to the Notional building.

Table 10. CO₂ emissions after LZC for domestic buildings

CO ₂ emissions after LZC Technologies (Be Green) for domestic buildings				
	Baseline Total CO ₂ (TonnesCO ₂ /year)	Be Lean Total CO ₂ (TonnesCO ₂ /year)	Be Clean Total CO ₂ (TonnesCO ₂ /year)	Be Green Total CO ₂ (TonnesCO ₂ /year)
Heating	194.555	186.270	186.270	186.270
Auxiliary	9.731	9.731	9.731	9.731
Lighting	47.167	47.166	47.166	47.166
Domestic Hot Water	128.902	131.600	131.600	131.600
PV Panels	0	0	0	0
CO ₂ reduction by Photovoltaics	0	0	0	-88.523
Total (regulated)	380.356	374.768	374.768	286.245
Unregulated	21	21	21	21
Total	401.356	395.768	395.768	307.244

Table 11. Site wide regulated carbon dioxide emissions and savings

	Total regulated emissions (Tonnes CO ₂ /year)	CO ₂ Savings (Tonnes CO ₂ /year)	Percentage saving (%)
Part L 2013 baseline	380.356		
Be lean	374.768	5.588	1.5%
Be clean	374.768	0	0%
Be green	286.245	88.523	23.6
Overall Savings		94.111	24.7%

3 CONCLUSIONS

- 3.1.1 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 Green' measures on site include the installation of PV panels on site to provide 10% of the energy demand of the development.
- 3.1.2 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, and installation of Photovoltaic panels. It has been confirmed that and 24.7% of the total CO₂ emissions reduction of this development will be achieved by the incorporation of a low or zero carbon technology onsite, and thereby exceeding the planning permission requirement that 10% of the energy demand to be provided by PV panels.
- 3.1.3 The reduction in total carbon dioxide emissions and savings at each stage of the Energy Hierarchy process are provided in Tables 10 and 11.

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 CO₂ 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 350-400% 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		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		NO

ENERGY REPORT

Photovoltaic	Converts sunlight to electrical power.	+ Allows on site generation of renewable electricity + Generally payback between 7-12 years + Low maintenance requirements - Efficiency effected by site factors – shading, orientation, and roof/ground space	Applicable to all buildings with limited solar shading and available roof	YES
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	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	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	NO

Table A1: LZC Technologies Matrix

Appendix B

SAMPLE SAP Reports