SYNTEGRA
CONSULTING

Squirrels Trading Center, Viveash Close, Hayes, UB3 4RZ

Energy Strategy Report

May 2022

Ref: 22-8770

Quality Standards Control

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Revision	Initial	Rev A	Rev B	Rev C
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Abbreviations

ASHP:	Air Source Heat Pump
BER:	Building Emission Rate
CO_2:	Carbon Dioxide
CHP:	Combined Heat and Power
CSH:	Code for Sustainable Homes
DHW:	Domestic Hot Water
ESR:	Energy Strategy Report
GHG:	Green House Gas
GSHP:	Ground Source Heat Pump
GLA:	Great London Authority
HVAC:	Heating, Ventilation, and Air Conditioning
IES VE:	Integrated Environmental Solutions Virtual Environment
KWp:	Kilo Watt Power
KWh:	Kilo Watt Hour
LZC:	Low Zero Carbon
MVHR:	Mechanical Ventilation Heat Recovery
MCS:	Microgeneration Certification Scheme
NPPF:	National Planning Policy Framework
NCM:	National Calculation Methodology
OSM:	Open Street Map
PV:	Photovoltaic
SBEM:	Simplified Building Energy Modelling
SFP:	Specific Fan Power
TER:	Target Emission Rate

1.0 Executive Summary

This Energy Strategy Report demonstrates the predicted energy performance and carbon emissions of the proposed development located in **Squirrels Trading Center, Viveash Close, Hayes, EB3 4RZ**. The presented figures in this study are based on the most updated information provided by the design team (i.e. **the Architect**). The development will comprise of a **new-build 113 residential Flats** and a **Commercial unit on the ground floor.** The overall analysis took into consideration the national building regulations (i.e. **Part L 1A and 2A**) and the local policy requirements. Based on the study assumptions, the project shall comply with the council local polices and buildings regulations.

1.1 Buildings Policy Requirements

The national building regulations require buildings to comply with the energy efficiency requirements. This shall be accomplished through capping the project carbon emissions below the regulated target. In addition to the above, the **Hillingdon** local council requires new developments to incorporate sustainable design and construction measures. The table below summarises the best practice building regulations and local policy requirements the assessment adopted for the development.

Policy:	Requirement	Compliance Check
Part L 1A & 2A (Criterion 1)	*The calculated CO_2 emissions rate for the buildings (i.e. BER) must not be greater than the Target CO_2 Emissions Rate (i.e. TER).*	*The project achieved criterion 1 through the Be-Lean stage, by measures of improving fabric thermal performance and efficient building services.*
GLA Best Practice requirements (for new buildings)	*Major developments meet the carbon emission reduction requirements a **35%** carbon reduction against Building Regulations Part L 2013 with the remaining emissions, up to 100%, to be offset through a contribution to the Council's Carbon Offset facilities.*	*The proposed development is considered as a major development (non-domestic > 2500 m^2).* *The proposed scheme has achieved a **35%** carbon reduction over Building Regulation **Part L2 A** 2013 TER via efficient energy measures and improved envelope thermal performance.*
	Monitor, verify and report on energy performance at be Seen Stage.	*The Smart Meters are recommended to be installed to monitor the actual in-use energy consumption to minimize the performance gap.*
London Bourgh of Hillingdon Local plans for climate change	*The council Local Plan will promote sustainable, high-quality design and construction and alternative energy supplies.*	*The project makes the best use of improved thermal performance fabric materials. In addition to incorporating energy efficiency measures.*

Table 1: Building National and Local Policy Requirements.

1.2 Assessment Methodology and Strategies

The adopted methodology to mitigate the development CO_2 emissions is in alignment with the best practice Efficient Energy Hierarchy Guidance. Models and simulation assumptions have been carried out using IES VE simulation software which complies with the National Calculation Methodologies. The development building has been assessed using the best practice energy hierarchy strategies (i.e. GLA minimum 35% energy category improvement) which by default demonstrates Part L compliance.

Table 2 below explains the Energy Hierarchy stages and the suggested taken strategies to help the proposed development achieve the required carbon targets.

Stages	Strategies
BE LEAN Carbon Efficient Design (minimising energy demand)	• Improved fabric U-values beyond Part L 1A & 2A requirements. • Energy efficient lighting fittings (i.e. LED). Further information could be found in the Be Lean Section.
BE CLEAN (Availability of CHP and communal heating systems)	• Analysis for local CHPs and communal heating systems been assessed. Further information could be found in the Be Clean Section.
BE GREEN On-site renewable technologies (i.e. ASHP, PVs, etc)	• Efficient Building services by using ASHP. Further information will be presented in Be Green section below.
BE SEEN In-use monitoring	• The Smart Meters are recommended to be installed to monitor the actual operational energy use, to manage it effectively and mitigate the performance gap.

Table 2: Best practice Energy Hierarchy to achieve 35% reductions over Part L requirement.

	Domestic Unit *($KgCO_2/m^2$.annum)*	**Non-Domestic Unit** *($KgCO_2/m^2$.annum)*
Notional TER	*20.44*	*21.6*
Baseline BER	*20.71*	*19.0*
Be-Lean BER *(15% reduction)*	*18.45*	*17.5*
Be-Clean BER	*18.45*	*17.5*
Be-Green BER *(35% reduction)*	*17.79*	*14.1*
CO_2 Shortfall *(tCO_2.annum)*	*148.8*	*16.3*
Net Zero offset Fund *(Shortfall*95£/tCO_2*30 years)*	***£ 424,316***	***£ 46,481***

The table above explains the carbon emissions per each stage of the energy hierarchy and the final required carbon offset fund to be net-zero.

1.3 Assessment Results

1.1.1. Residential Flats

The new build residential block has been simulated under four conditions to analyse the improvements hierarchy. The first simulation assessed the flats under the same notional building specifications. The function of this first simulation is to generate the regulated carbon target (TER) and the actual Dwelling Emission Rate (DER). The second calculation analysed the carbon reductions achieved after improving the building fabric thermal performance by adopting improved thermal U-value (i.e. Be Lean). The third stage of simulation assessed the effectiveness of adopting a CHP (i.e. Be Clean stage). The fourth simulation analysed the carbon reductions after considering renewable technologies as an effective design measure to achieve the **35%** reductions beyond **Part L1A** requirements (i.e. Be Green).

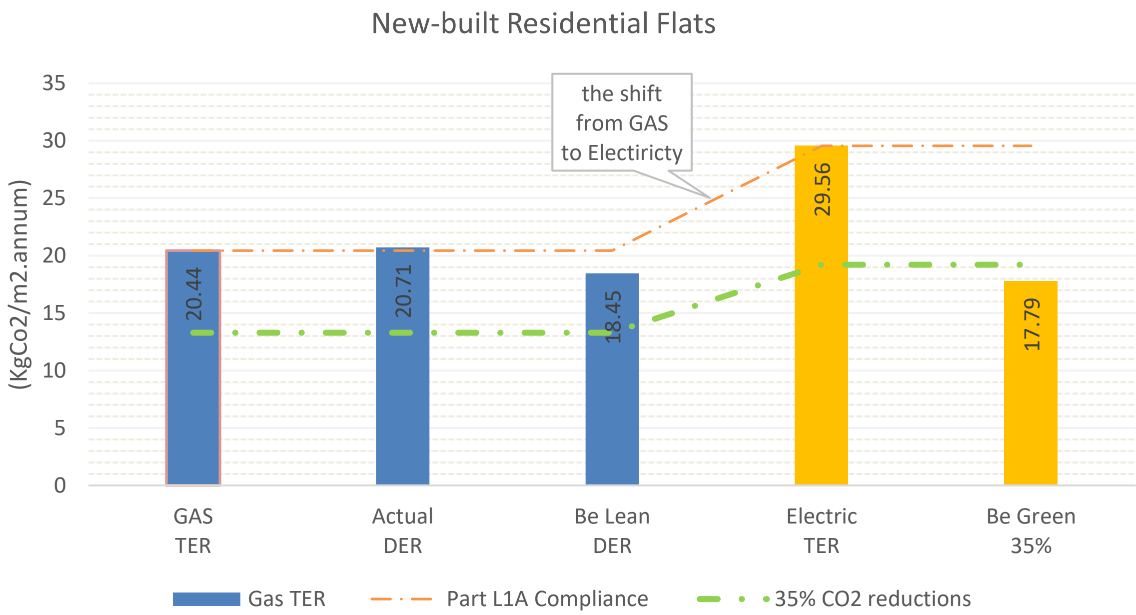


Chart 1: Domestic Carbon Emissions after each stage of the proposed strategy

Results show that the actual building Baseline BER almost comply with the regulated target emissions rate TER (i.e. PL1A Compliance), please refer to appendix A for detailed SAP reports calculations. Improving the fabric thermal performance (i.e. U-values) and implementing efficient building services are analysed in the following stage of simulation. Results of the revised simulation showed reductions in the building DER, achieved compliance with Part L1A criterion 1, and the required **10%** passive reductions. Further analysis carried out to examine the impact of adopting a community heating system examined in the third stage of simulations. Further info will be found in Be-Clean section. Finally, Implementing an ASHP as the main heating system improved the project rating and managed to make the project fully comply with GLA requirements and meet the **35%** reductions. Please refer to appendix A for further related SAP calculations.

1.1.2. Commercial Non-domestic Unit

The new build commercial unit has been simulated under four conditions to analyse the improvements hierarchy. The first simulation assessed the unit under the same notional building specifications. The function of this first simulation is to generate the regulated carbon target (TER) and the actual Building Emission Rate (BER). The second calculation analysed the carbon reductions achieved after improving the building fabric thermal performance by adopting improved thermal U-value (i.e. Be Lean). The third stage of simulation assessed the effectiveness of adopting a CHP (i.e. Be Clean stage). The fourth simulation analysed the carbon reductions after considering renewable technologies as an effective design measure to achieve the **35%** reductions beyond **Part L2A** requirements (i.e. Be Green).

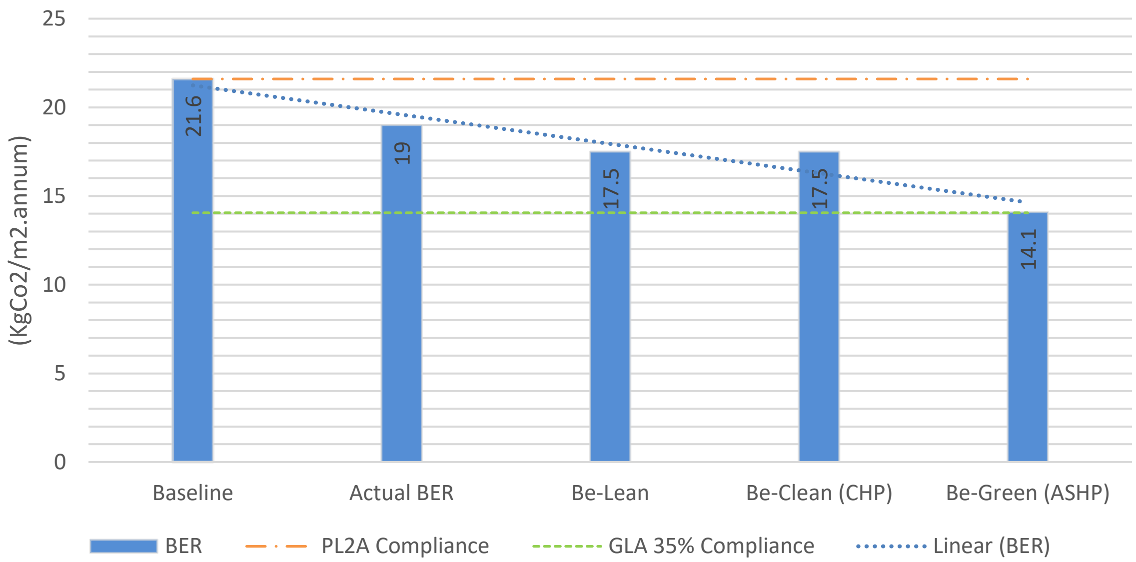


Chart 2: Non-Domestic Carbon Emissions after each stage of the proposed strategy

Results show that the actual building Baseline BER complies with the regulated target emissions rate TER (i.e. PL2A), please refer to appendix A for detailed SAP reports calculations. Improving the fabric thermal performance (i.e. U-values) and implementing efficient building services are analysed in the following stage of simulation. Results of the revised simulation showed reductions in the building DER and overshot the required **15%** passive reductions. Further analysis carried out to examine the impact of adopting a community heating system examined in the third stage of simulations. Further info will be found in Be-Clean section. Finally, Implementing **ASHP** as the main heating system improved the project rating and managed to make the project fully comply with GLA requirements and meet the **35%** reductions. Please refer to appendix A for further related SAP calculations.

Introduction

This energy strategy statement (ESR) focuses on the energy strategies studied for the proposed scheme. The report presents how the annual energy consumption and related carbon emissions will be minimised to meet the regulated targeted carbon emissions **(i.e. PL 1A & 2A TER)**. Furthermore, the report explains how to reach the required energy targets to achieve **35%** carbon reductions for the development.

The assessed development is located in **London Bourgh of Hillingdon, West London, England.** The project site is in a close proximity to **Hayes and Harlington** station. The development proposal has a total built up area of a **8368.9** m^2 **new-build residential flats** and a **1156.7** m^2 **commercial unit on the basement and ground floor** located at **Squirrels Trading Center, Viveash Close, Hayes, EB3 4RZ.**

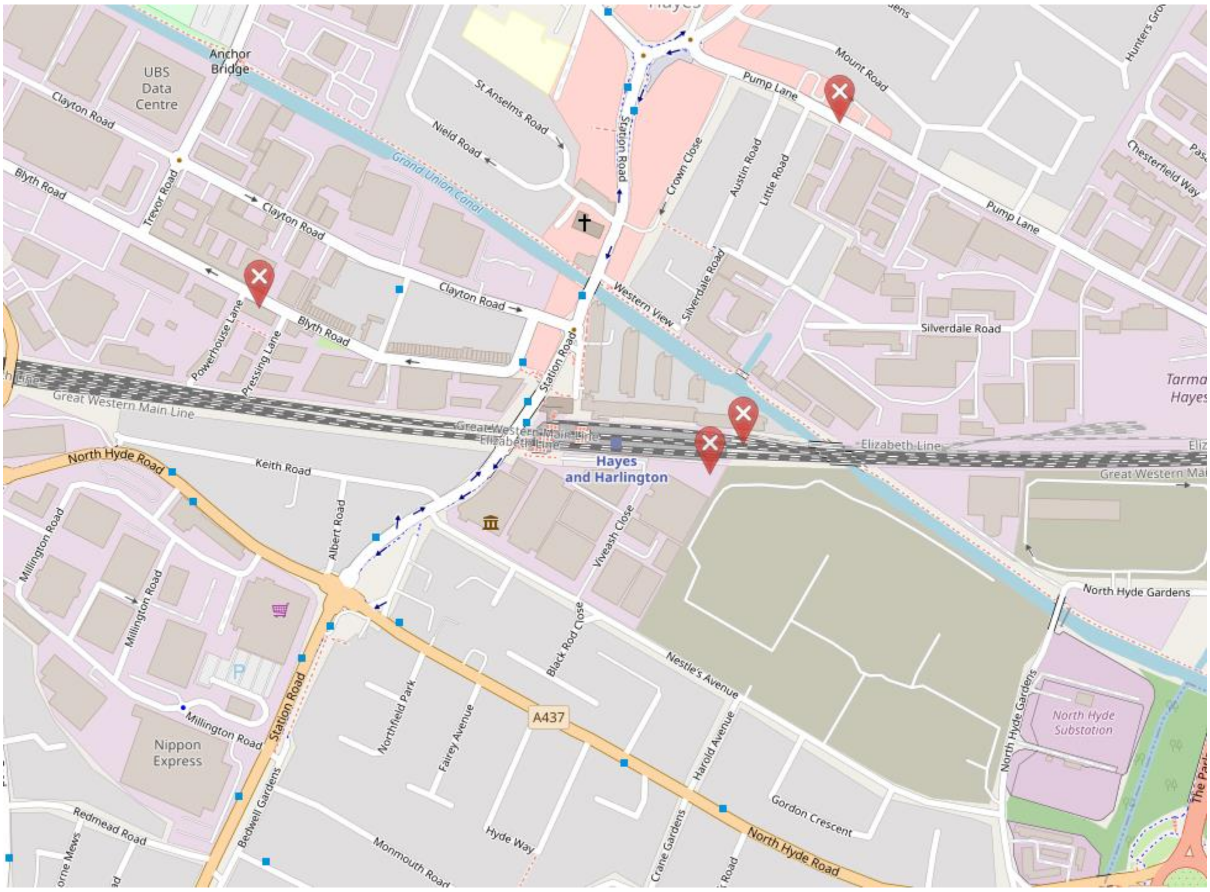


Figure 1: OSM urban view map of the Site Location

The domestic and non-domestic sector plays an important role in the UK economy, both as a direct (and indirect) employer and generator of output, and in providing other sectors, such as retailers and financial and business services, with a critical factor of production – the physical location from which to do business. This ESR report analyses the project using research and policies guidance to make sure this major development is built up to achieve positive economic, social and environmental impacts.

Planning Policy

1.1 National Planning Policy Framework (NPPF, February 2021)

The National Planning Policy Framework is a key part of our reforms to make the planning system less complex and more accessible. These actions been taken for the purpose of protecting the environment and promoting a sustainable growth of the built environment.

1.2 The GLA Best Practice Energy Strategies for guidance only (e.g., London Plan 2021)

Policy SI 2 Minimising greenhouse gas emissions

Major developments should be net zero-carbon. This means reducing the overall embodied greenhouse gas emissions and operational carbon emissions. In addition to minimising both annual and peak energy demands in accordance with the following energy hierarchy:

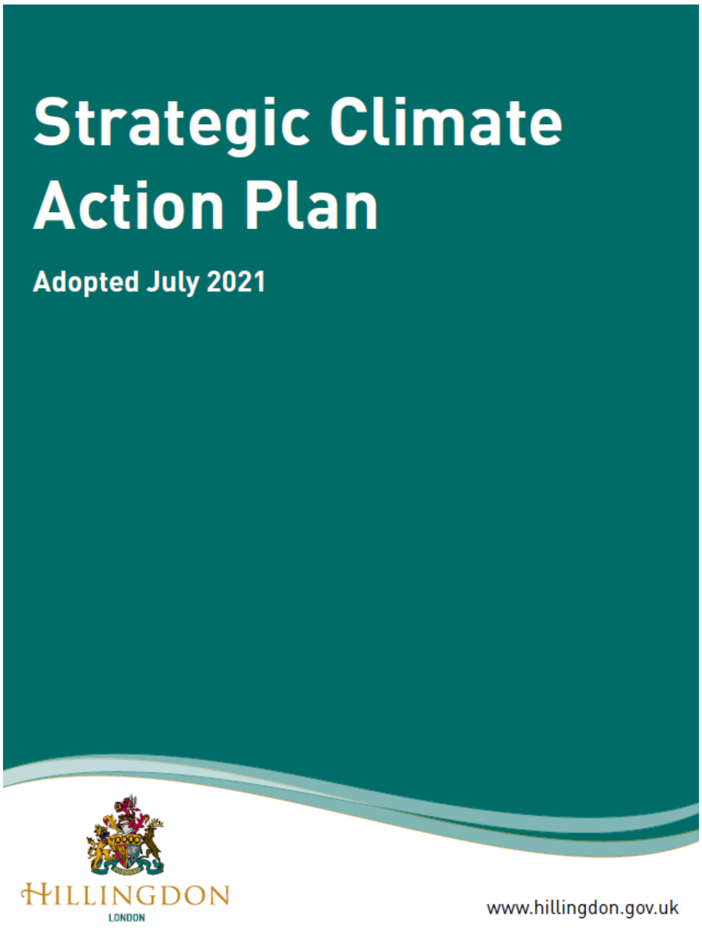
1) **Be Lean:** make buildings use less energy and manage demand during operational phases.
2) **Be Clean:** exploit local energy supply resources (i.e. District and communal heating) to deliver energy efficiently.
3) **Be Green:** exploring opportunities for renewable energy resources by producing, storing and using renewable energy on-site.
4) **Be Seen:** monitor, verify and report on energy performance (Part L Criteria 4 and 5).

Policy SI 2 Minimising greenhouse gas emissions

A. Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.
B. A minimum on-site reduction of at least **35 per cent** beyond Building Regulations is required for major development. **Residential development** should achieve **10 per cent**, and **non-residential** development should achieve **15 per cent** through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:

1) through a cash in lieu contribution to the borough's carbon offset fund, or
2) off-site provided that an alternative proposal is identified, and delivery is certain.

1.3 London Borough of Hillingdon.



Core Strategy (Updated and adopted July 2021)

Local Council Strategy (Updated and adopted 2020)
CLIMATE CHANGE LOCAL TARGET: Delivering net zero carbon major development.

C3 Building Better Places

C3.1	To use the development plan system to ensure all new major development will be zero carbon.
C3.2	To consider new planning policies to ensure all non major new development is also zero carbon.
C3.3	To ensure no new development is built in high and medium flood risk areas unless absolutely necessary and only then when flood risk management is properly understood and mitigated in accordance with council flood policy.
C3.4	To ensure all new development is environmentally responsible, including protecting existing designations and sites of interest.
C3.5	To ensure all new development contributes and supports the goal of sustainable transportation, such as the promotion of public transport, cycling or EV charging.
C3.6	To ensure that wherever possible during development, existing trees are retained. Where they cannot be retained, new trees should be planted to facilitate carbon gain.
C3.7	To identify and promote opportunities for the increased provision of allotments.

Theme 3 Commentary

Building better places

Our planning policies stem from national and regional policies. The London Plan takes a firm stance on new development with regards to climate change.

Many of the policies outlined above are therefore already part of the planning framework which developers must respond to; however, they are reproduced here to ensure this strategic plan is comprehensive in identifying the principal issues concerning climate action.

Innovative approaches to new development mean it doesn't just have to be zero carbon but can assist with providing a net reduction.

Helping to avoid unwanted impacts

Another recurring theme in the consultation response related to the constant change to the built environment, in particular the loss of gardens and green space in residential properties.

An example raised repeatedly by residents related to the widespread paving over gardens to create parking spaces or driveways.

This type of activity can cause water to enter the drainage system more quickly, which can lead to an increase local flooding.

We want to use our leadership role to assist residents in making sustainable choices on their own properties. We will use the planning system to deliver sustainable solutions but where planning permission is not required, we want people to understand the implications for their choices and to seek out more suitable forms of solutions; for example, this could involve using certain types of permeable paving, collecting rainwater and allowing water to be stored in natural spaces.

Some of these solutions can have added benefits, for example the use of water butts can help recycle water to be reused in water the garden or increased areas of green space can promote and support wildlife.

C6	Climate change adaptation and mitigation
C6.1	To develop a climate change adaptation and mitigation action plan.
C6.2	To put in place a water efficiency strategy for all Council operations (such as green space watering, depot operations and corporate buildings) then monitor, record and report year on year savings.
C6.3	To ensure the council's flood resilience and management work incorporates a changing climate and that the council's own land and property decisions consider the need to make space for water.
C6.4	To run a campaign to get residents involved and sharing ideas with the council to find solutions for climate mitigation and adaptation in the community.
C6.5	To investigate opportunities to integrate environmental improvements into existing buildings for example, living walls, green roofs, habitat walls, bird, and bat boxes.
C6.6	To run an annual campaign to raise awareness of the impacts of reducing green spaces, paving over gardens and increasing hardstanding.

C7	Carbon offsetting
C7.1	To develop an offset strategy to develop local solutions to any remaining residual carbon emissions from council operations.
C7.2	To develop a tree and green space management strategy that supports and accounts for the offsetting objectives and commitments.
C7.3	To promote carbon reduction practices and carbon offsetting opportunities for businesses and communities, linked to measures to tackle climate change in Hillingdon.
C7.4	Understand and increase current carbon sequestration through increased planting and changes to green space management.
C7.5	Increase the number of trees, particularly in urban areas to complement objectives to improve air quality and promote urban wildlife.
C7.6	To exploit opportunities to increase carbon sequestration to maximise opportunities for biodiversity and flood risk management.

Assessment Methodology

1.1 The Energy Hierarchy

The energy hierarchy is a classification of different methods to improve energy performance in a parallel sequence. This includes primarily a focus on reducing energy use by avoiding unnecessary consumption, to then improving the efficiency of energy systems to minimise loss. This is followed by exploiting renewable energy sources and low carbon energy solutions for energy needs. Finally, any remaining demand can be catered for by conventional fuel sources and carbon offsetting solutions.

The Energy Strategy adopts a set of principles to guide design development and decisions regarding energy, balanced with the need to optimise environmental and economic benefits. The following hierarchy should be used to assess applications:

- **BE LEAN** – By using less energy and considering the further energy efficiency measure in comparison to the baseline building.
- **BE CLEAN** – By supplying energy efficiently. Clean energy use looks at further carbon dioxide emission savings over the lean building by taking into consideration the use of decentralise energy (e.g. CHP, District Heat Networks).
- **BE GREEN** – By integrating renewable energy into the scheme which can further reduce the carbon dioxide emission rate.
- **BE SEEN –** By monitoring, verifying, and reporting on energy performance to use energy mode effectively.

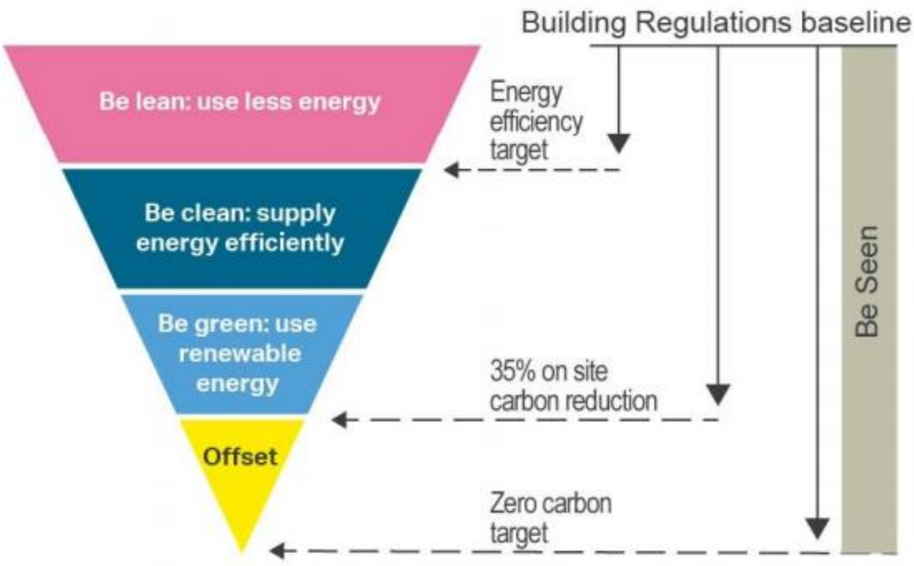


Figure 2: GLA Energy Hierarchy

1.2 Modelling strategy.

The Government approved software, **SAP 2012** and **IES VE 2021,** has been utilised to carry out the project compliance simulations **(i.e., SAPS** and **SBEM)** according to the National Calculation Methodology (NCM). Simulated Models are built to assess the actual building BER against the notional building TER. The notional building used to determine carbon dioxide targets (TER) is the same size and shape as the actual buildings, constructed to concurrent regulated specifications (i.e. **Part L1A and 2A**).

The actual building has been modelled entirely to the notional building specifications in order to meet the carbon targets and the limiting fabric and buildings services parameters. However, for differences in fabric design and glazing areas, actual buildings sometimes are expected to exceed the notional TER. Therefore, further improvements to the actual building parameters (e.g. fabric, HVAC, lightings, renewables) are made to meet the required compliance targets. The approved document (i.e. **Part L**) however encourages developers to vary the specification provided the same overall level of carbon dioxide emissions is achieved or bettered. It is important to note that SBEM is not intended to be used a building design tool but to inform the designers design decisions.

Syntegra received architectural drawings and project relevant documents. Received information is used to undertake the ultimate energy assessments and supporting the modelling assumptions. The document references are listed in the table below.

No.	Document Name	Format	Received Date
1	PL-(03) - 001_03	dwg	*04-04-2022*
2	PL-(03) - 099_04	dwg	*04-04-2022*
3	PL-(03) - 100_04	dwg	*04-04-2022*
4	PL-(03) - 101_04	dwg	*04-04-2022*
5	PL-(03) - 110_03	dwg	*04-04-2022*
6	PL-(03) - 111_03	dwg	*04-04-2022*
7	PL-(05) - 500_01	dwg	*04-04-2022*
8	PL-(05) - 501_01	dwg	*04-04-2022*
9	PL-(05) - 502A_01	dwg	*04-04-2022*
10	PL-(05) - 502B_01	dwg	*04-04-2022*

Table 3: Energy assessment document list

BASELINE - Target Emission Rate (TER) & Actual Building Rate (BER)

The baseline (known as Target Emission Rate), as calculated in line with the Building Regulation 2013, is the maximum amount of carbon dioxide a non-residential development is allowed to emit. The Target Emission Rate (TER) includes carbon dioxide emissions which are covered by Part L2 of the Building Regulations, known as regulated emissions (space and water heating, ventilation, lighting, pumps, fans & controls). The baseline energy uses and resulting CO_2 emissions rates of the development have been assessed using the Government approved software (**SAP 2012** & **IES VE 2021**). This run of simulation assessed the **flats** and **church** models under the same notional building specifications. The function of this first run is to generate the regulated carbon target (TER) and the actual building emission rate (BER). Part L specifications are used for the first run of simulation. Part L figures are stated by the NCM modelling guide to limit the fabric thermal heat loses.

The baseline regulated CO_2 emissions for the development are presented in the tables below:

❖ BASELINE

Model Name	CO_2 Emissions *($KgCO_2/m^2$.annum)*	
	TER	*BER*
Domestic	*20.44*	*20.71*
Non-domestic	*21.6*	*19.0*

Table 4: Regulated Energy Use and Carbon Emissions TER at Baseline

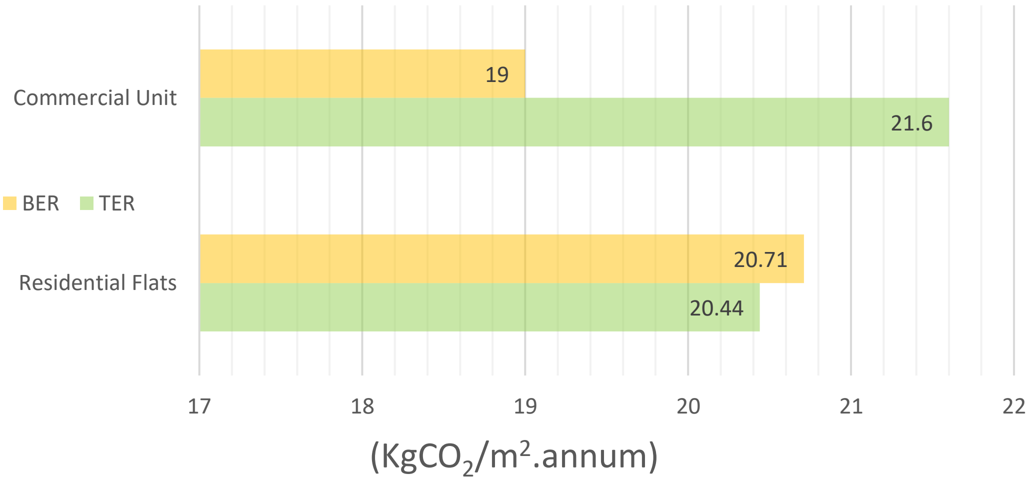


Chart 3: Notional Building TERs for the new build commercial and residential flats

The results of the first run showed that, actual buildings BERs for the domestic units is slightly beyond complying with the regulated target emissions rate (TER), however the baseline for the commercial unit has complied, Chart 3. Therefore, further improvements to the model assumptions are carried out in the following section (i.e. Be-lean) to achieve the required 10% and 15% passive reductions.

BE LEAN - Energy Efficient Design

This section outlines the project condition analysis and energy efficient measures taken in order to minimise the building's energy demand. The analysis helps reducing the energy use and CO_2 emissions further than the Baseline results and achieving TER compliance (Building Regulations 2013 **Part L 1A& 2A** compliance).

1. Site location

Figure 3: 3D urban view map of the site location (Google 3D)

The proposed project site is located in **Squirrels Trading Center, Viveash Close, Hayes, EB3 4RZ,** in the London borough of Hillingdon. A non-domestic and domestic mix of buildings is currently occupying the site. The local surrounding areas are currently being developed into residential and commercial developments. The surrounding urban buildings are generally high rising lying with up to ten storeys commercial buildings in the major vicinity.

2. Site weather and Microclimate

The local weather microclimate usually influences buildings' energy performance. Urban design has a significant impact on microclimate and outdoor thermal comfort. Several studies in different climate regions have concluded that ventilation and shade are crucial to improve urban thermal comfort. Often the thermal conditions are improved as a consequence of good urban design including exist of proper shade and sufficient ventilation. This in turn leads to decreased occurrence of heat stress and heat-related diseases as well as grown performance of both mental and physical tasks.

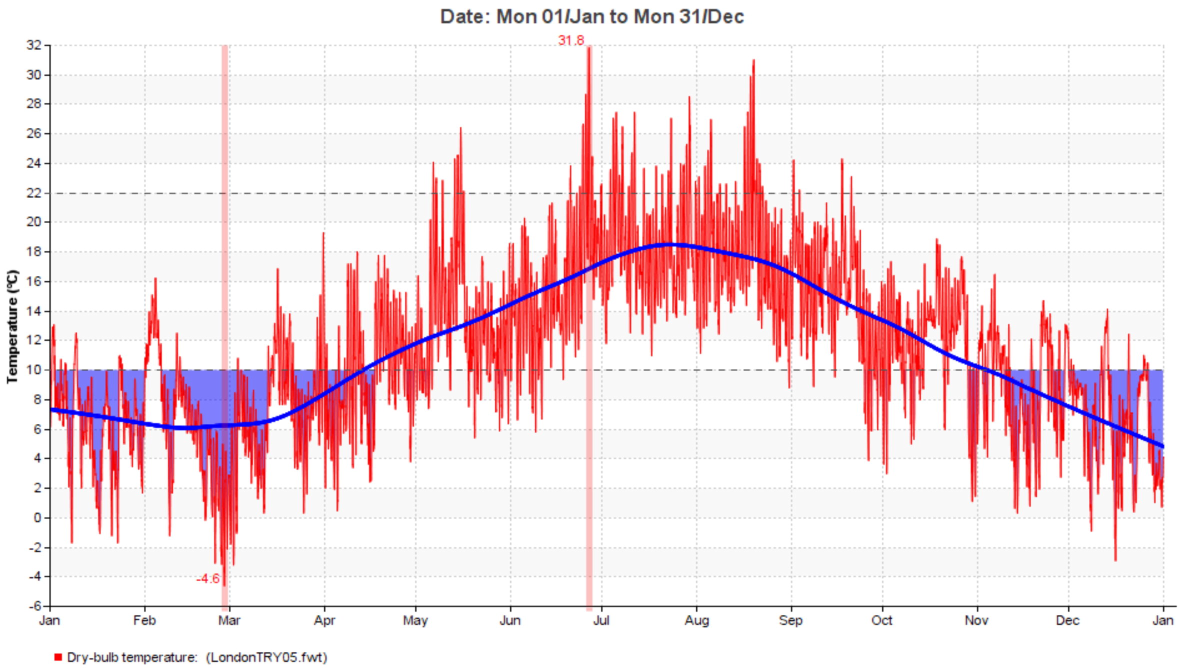


Figure 4: IES Annual Dry Bulb Temperature according to London weather file TRY05.fwt

The nearest weather station is in London, and this will be used for thermal and energy simulations. Figure 4 represents the annual dry bulb temperature in London City. Maximum temperatures can reach up to 31.8 C in late Jun, and minimum temperatures can reach down to -4.6C in late Feb. The buildings in this location are generally low rise, and the site is not expected to suffer from the Urban Heat Island effects.

The site's landscape also affects the energy demand of a building. Vegetation, landform, and any existing buildings can provide shade to a new development. For instance, if located to the south of the building, deciduous trees can be advantageous, providing shade in the summer but allowing sunshine through in the winter when they lose their leaves. However, any tree used for energy conservation should be considered as part of a much larger landscape.

3. Building Orientation, layout, and form

Building layout, orientation and form can influence many key features of the development. The design should provide for an effective use of space and appealing layout, with opportunities to benefit from natural daylight balanced with achieving solar gain without overheating. In general, a higher thermal performance can be achieved by limiting the surface area to volume ratio as this minimises heat loss through the wall area.

It should be noted that where the building footprint is extremely tight, for example in a city centre location, then the building form and orientation may have to be dictated by the available space and not by implementation of best practice measures. Invariably, planning constraints and/or the functional relationships of specific areas will result in some measure of deep planning, thus reducing the opportunity for natural ventilation.

Planning the internal layout of buildings and space to maximise the benefits of solar gain and minimise the disadvantages is essential. Spaces where overheating would be critical can be placed on the north side of the building or overhangs used to protect from excessive solar gain.

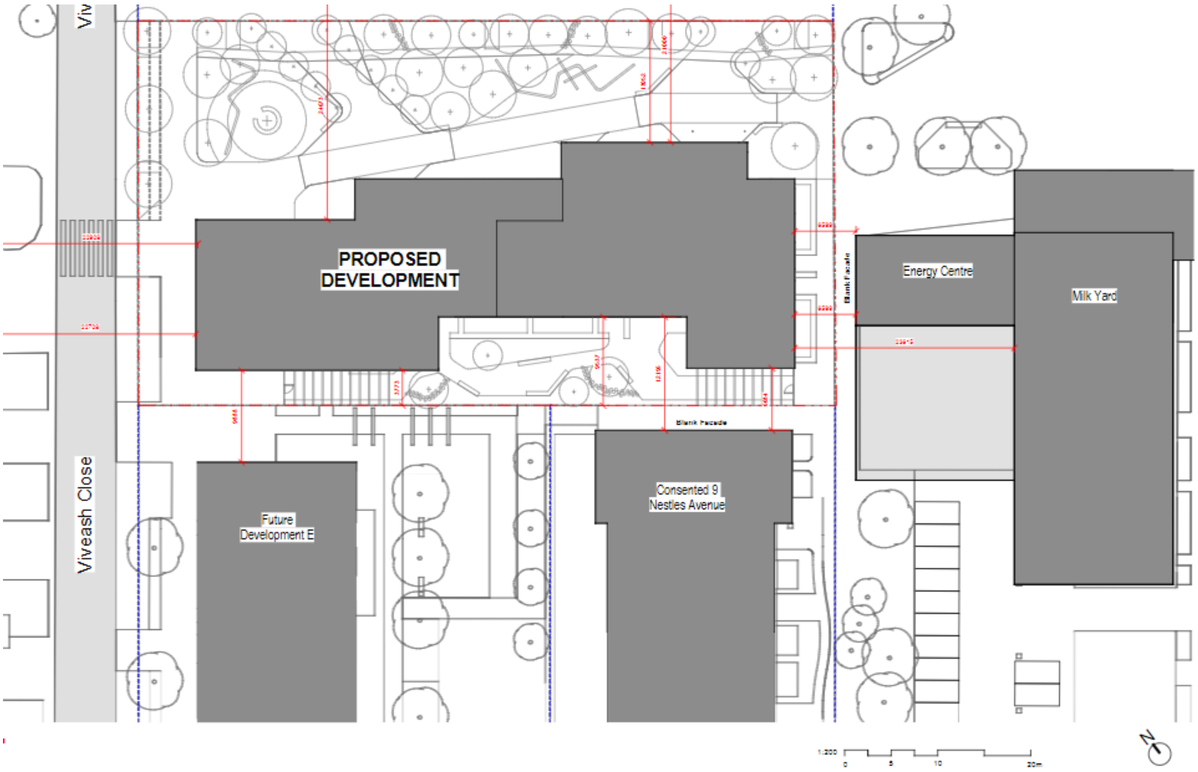


Figure 5: Proposed Building site.

The primary length of the building runs roughly from North-West to South-East; with the largest elevations facing North-West and South-East. The Southeast facing rooms although not fully facing South, expected to benefit from some pre-heating that may occur in the early hours of the morning as the sun rises.

4. Building Design – Energy Efficiency Design Measures

- **Enhancing Building Fabric Thermal Performance**

At the 'BE LEAN' stage of the energy hierarchy, energy efficient building elements have been incorporated into the model. The heat loss of different building element is dependent upon their U-value, air permeability, and thermal bridging Y-values. Therefore, better U-values and air permeability figures than the minimum values set in the **Part L1A** & **2A** 2013 have been suggested in this stage of simulation. Table 5 below presents the different U-values used for both the **domestic** and **Non-domestic**. The **Part L1A** and **2A** figures are used for the first run of simulation (i.e. Baseline). Part L1A figures are stated by the NCM modelling guide to limit the fabric thermal heat loses. Be lean U-values are the improved values beyond Part L requirements to improve the new build energy performance. The overall figures mentioned in the table below are the assumptions for the second run of simulation.

Building Type		Domestic Residential flats		Non-Domestic commercial Unit	
Category Specification		Part L 1A Notional	Be-lean Improved values	Part L 2A Notional	Be-lean Improved values
U-value	*Wall*	*0.18*	*0.14*	*0.26*	*0.14*
(W/m^2 K)	*Window*	*1.40*	*1.00*	*1.60*	*1.20*
	Floor	*0.13*	*0.13*	*0.22*	*0.13*
	Roof	*0.13*	*0.13*	*0.18*	*0.13*
	Doors	*1.20*	*1.00*	*1.60*	*1.60*
Air Permeability *($m^3/h.m^2$ at 50 Pa)*		*5.00*	*3.00*	*5.00*	*3.00*

Table 5: Domestic and Non-domestic Proposed fabric and building Elements

The building is adopting the following measures for the fabric thermal performance:

- Enhanced envelope U-values - to reduce the building's heating loses and demand.
- Providing a well-sealed envelope to minimise the infiltration of cold winter air and warm air in summer - to reduce the building's heating and cooling requirement.
- Minimising thermal bridging by using accredited construction details to reduce the building's heating and cooling requirement.
- Adopting a window to wall ratio that prioritizes daylight but controls solar gain and glare – to reduce electric lighting energy consumption while mitigating overheating.
- Providing exposed thermal mass to provide passive cooling – suppresses summertime overheating to acceptable levels without the need for high energy consuming and expensive to run and maintain mechanical cooling systems.

5. Building occupancy type

The building occupancy type is dependent on the NCM building type. **A1**, **D1 Residential and retail** building type has been identified for the building. Accordingly, the occupancy capacity and profiles, internal gains are following each space identified activity.

6. Daylighting and Solar Shading Strategy

The scheme benefits from the usage of solar performance glazing. The glazing specification is carefully selected to ensure the internal environment is pleasant on all orientations by varying the g-value. In addition, all spaces contain internal 50% translucent blinds to limit daylight, reducing the effective g-value further still. Please refer to appendix A BRUKL baseline calculations.

7. Ventilation strategy

Natural Ventilation + Heat Recovery Ventilation

All spaces will utilise trickle and boost ventilation via heat recovery unit that utilise the warm exhausted air to pre-heat the incoming supply air. This helps to significantly reduce the heat loss of the building where ventilation is the highest heat demand. The output from the building model confirms that upgrading the building fabric alone will result in the building meeting the Part L Notional Building Requirements as follows

The following table demonstrates the reduction in CO_2 emissions from the energy efficiency measures mentioned above.

❖ BE LEAN STAGE

Building Type	Notional TER *($KgCO_2/m^2$.annum)*	Actual BER *($KgCO_2/m^2$.annum)*	BER at BE-LEAN *($KgCO_2/m^2$.annum)*	Carbon Savings *(%)*
Domestic flats	*20.44*	*20.71*	*18.45*	***9.74%***
Non-Domestic	*21.6*	*19.0*	*17.5*	***20.00%***

Table 6: Regulated Carbon Emissions (BER) at Be Lean Stage

At the 'BE LEAN' stage of the energy hierarchy, energy efficient building elements have been incorporated into the model. The heat loss of different building element is dependent upon their U-value, air permeability, and thermal bridging Y-values.

Be Lean – Active Design Measures

The table below shows the applied 'Be Lean' active design measures incorporated within the design to demonstrate the energy strategy approach.

No.	Measure	Explanation
1	**Heat recovery ventilation**	The ventilation strategy utilises heat recovery ventilation as part of a mixed-mode ventilation strategy that is deployed to maximise energy efficiency. Duct insulated, Rigid duct, Specific Fan Power (SFP) 0.3 W/l/s, Heat Exchanger Efficiency 85% has been applied for this assessment.
2	**On-demand control to teaching spaces**	The room by room heating and lighting controls ensure that energy efficiency is maximised in almost all spaces where the amount of air delivered is variable to suit the space.
3	**Local heat network**	Heating for the building is provided by a building wide heat network which features reduced flow and return temperatures, reducing thermal losses and space heat gain as comparted to a traditional system. Due to the nature of the LTHW local heat network should a community heat network connection become available to the site in the future, the proposed system is compatible for connection and the connection points in place.
4	**Variable speed pumping**	Variable speed pumping on all secondary circuits reduces energy consumption associated with distribution significantly.
5	**Lighting Efficiency**	The proposed light fittings shall be 100% energy efficient fittings (i.e., LED lightings) for the lighting loads calculations. The model assumptions and specifications is aligned with the approved document PL 1&2 and should be reviewed by electric engineers at later detailed design stages.

Table 6: Active Design Measures adopted at Be Lean Stage

BE CLEAN – CHP & Decentralised Energy Networks

The Energy Hierarchy encourages the use of local CHP system and connection to District Heating systems to reduce CO_2 emissions further.

7.1 Decentralised Energy Network

District and community heating systems are favoured because they offer:

- Potential economies of scale in respect of efficiency and therefore reduced carbon emissions;
- Greater potential for future replacement with Low or Zero Carbon (LZC) technologies.

The feasibility of connecting into an existing heating network or providing the building with its own combined heat and power plant has been assessed alongside the **London Heat Map,** see the figure 6 below, as part of this assessment. The map identifies that the site is located near a proposed district heating network. The nearest proposed heat network is roughly 447 m away from the project site address. This has been demonstrated from the London Heat Map (http://www.londonheatmap.org.uk).

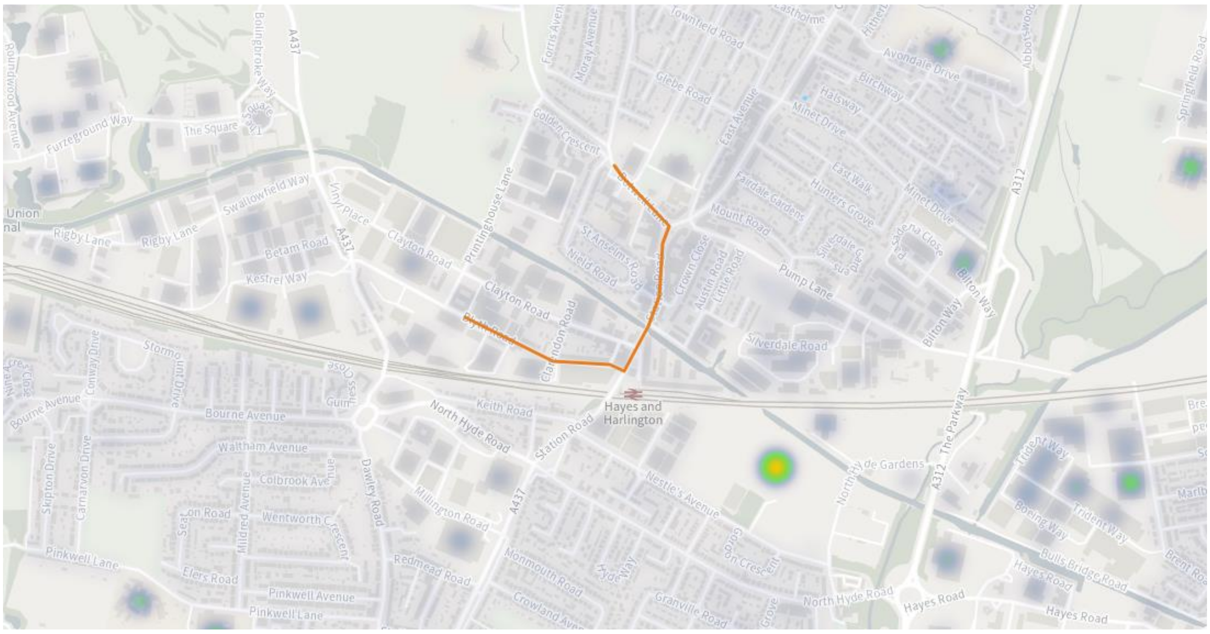


Figure 6: London Heat Map near the site

It is proposed for this development to utilise air source heat pump installations to provide a low temperature heating network within the building to be used for heating and hot water within the residential units. In order to further maximise efficiency, reduce energy losses associated with domestic hot water circulation and mitigate the inherent risk of corridor overheating associated with residential units, it is proposed to incorporate Heat Interface Units (HIUs) within each unit.

7.2 Combined Heat and Power (CHP)

The Energy Hierarchy identifies the combined heat and power (CHP) as a method of producing heat and electricity with much lower emissions than separate heat and power. Also, it encourages the creation of district heating systems supplied by CHP. The implementation of a CHP strategy should be decided according to good practice design. Key factors for the efficient implementation of the CHP system are:

- Development with high heating load for most of the year.
- CHP operation based on maximum heat load for minimum 10 hours per day.
- CHP operation at maximum capacity of 90% of its operating period.

To ensure that CHP is financially viable it is essential that the unit is selected to meet the base heat load and that this load is maintained over a large proportion of the day (a figure of 14 – 17 hours per day is often quoted subject to the load profiles and gas and electricity prices) to ensure that the additional costs (maintenance) associated with running a CHP unit can be recovered. This needs to run the CHP plant, as far as possible continuously makes the building load profile of prime importance when reviewing the viability of such solutions and in particular the summertime heat load profile. To enable the CHP plant to run continuously when it is operating, a thermal store is often used so that excess CHP capacity can be used

Generally, developments consist of at least 50 residential units would obtain the benefits of the micro CHP system, however the new London air quality legislations discourage using CHPs for their air pollution impact. Therefore, the implementation of a CHP has not been considered of this development design strategy, see table 7 below. In addition, if the design team shall require installing this technology, further information regarding the local system storage space will be needed.

❖ BE CLEAN STAGE

Building Type	BER at Be Lean ($KgCO_2/m^2$.annum)	BER at BE-CLEAN ($KgCO_2/m^2$.annum)	Carbon Savings at Be-Clean stage
Domestic	*18.45*	*18.45*	***0.0 %***
Non-domestic	*17.5*	*17.5*	***0.0 %***

Table 7: Regulated Carbon Emissions at Be Clean Stage

- **Cooling Hierarchy**

Policy SI 4 of the London Plan outlines a hierarchy of measures which should be followed in order to reduce the demand for cooling within the development. These have been included as follows:

Multiple strategies have been considered for this development to reduce the cooling demand and the overheating risks.

- ✓ Firstly, **internal heat loses shall be reduced through energy efficient design** during design development. It will include minimising duct lengths and adopting pipe configurations which minimise heat loss (e.g., twin pipes).
- ✓ Minimising Internal Heat Gains – DHW circulation pipe recommended to been eliminated in the communal areas of the development.
- ✓ Reducing Solar Gains – As stated previously, low G-Values have been targeted and blinds have been implemented in order to minimise solar gains.
- ✓ Thermal Mass – Thermal mass is being incorporated though the floor slabs, external walls and roof however further investigation will be undertaken as to the design of these finishes to try to capitalise on the thermal massing wherever possible, so as to help regulate the internal temperature.
- ✓ Lastly, a **mix of passive ventilation and mechanical extraction strategies will be adopted with extract fans in wet rooms** (e.g., toilets, and food preparation) to remove the hot humid air and help free cooling.

BE GREEN – Renewable Energy Appraisal

In this section the viable renewable energy technologies that could reduce the development's CO_2 emissions are examined. In determining the appropriate renewable technology for the site, the following factors are considered.

- Renewable energy resource or fuel availability of the LZC technology on the site.
- Implementation with regards the overall M&E design strategy for building type.
- Capital, operating and maintenance cost available for the project.
- Planning Permission form the local council.
- Available Grants.

The table below summarises the various low zero carbon technologies considered for the projects, and we have identified that **Air Source Heat Pumps (ASHP) and Photovoltaic (PV)** would be the most appropriate option in this development.

The Government has outlined its ambitions for residential and non-domestic developments to be delivered to a zero-carbon standard. It is anticipated that zero carbon development will be realised predominantly through energy efficiency measures and the use of on-site low or zero carbon energy and connected heat. However, it is recognised that it will be difficult to deliver all the carbon savings necessary to meet zero carbon standards on site through these measures alone.

Technology Name:	Carbon Payback	Feasibility
Photovoltaic (PV)	High	**HIGH**
Air Source Heat Pumps (ASHP)	High	**HIGH**
Biomass	High	**Medium**
Wind Power	Low	**Medium**
Hydro Power	None	**Medium**
Solar Thermal	Low	**High**
Ground Source Heat Pumps (GSHP)	Medium	**LOW**

Table 8: Feasibility Study of LZC Technologies

8.1 Non-feasible Technology

- **Ground Source Heat Pumps (GSHP)**

Ground source heat pump would be a feasible option to meet the space heating requirements, however, it requires ground space for bore holes to extract the ground heat in order to be utilized for space heating requirements. However, this has not been discounted due to unknown ground conditions/ contamination statues and expensive CAPEX cost for investigating.

- **Solar Thermal**

The use of solar thermal for this development would be limited to domestic hot water only. The use of solar thermal for space heating would not be practical as it is not required when solar thermal is at its most effective during the summer months. Moreover, according to the scheme scale the expected carbon offset from the system is generally lower compared to other LZC technologies.

- **Hydro power**

There is a river (river Medway) within the development site proximity. However, small-scale hydroelectric will not be studied any further because of the location and the spatial limitations of the development.

- **Wind Power**

Wind turbines need extensive planning requirements, and they are only feasible at consistent wind speed. Moreover, there is no available wind grid located near the project location (http://www.renew-reuse-recycle.com/noabl.pl?n=503). Hence this option has been discounted.

Squares surrounding the central square correspond to wind speeds for surrounding grid squares. Power generated is related to windspeed by a cubic ratio. That means if you halve the windspeed, the power goes down by a factor of 8 (which is 2 x 2 x 2). A quarter of the windspeed gives you a 64th of the power (4 x 4 x 4). As a rough guide, if your turbine is rated at producing 1KW at 12m/s then it will produce 125W at 6m/s and 15W at 3m/s.

Please note that bear in mind that the NOABL windspeed dataset used here is a model of windspeeds across the country, assuming completely flat terrain. It isn't a database of measured windspeeds. Other factors such as hills, houses, trees and other obstructions in your vicinity need to be considered as well as they can have a significant effect. If you're thinking about installing a wind turbine, you should perform your own windspeed measurements using an anemometer to determine what the actual figures are.

- **Biomass**

A biomass system designed for this development would be fueled by wood pellets which have a high energy content. However, a biomass system would not be an appropriate technology for the site for the following reasons:

A. The burning of wood pellets releases substantially more NOx emissions when compared to similar gas boilers. As the development is situated within an urban area, the installation of a biomass boiler would further impact on the air quality in this area.
B. Pellets would need to be transported from local pellet suppliers, which causes carbon emissions to the air.
C. Site doesn't have an adequate storage space impacting layout and logistics arrangements.

However, if a biomass system is considered at further detailed design stage, local suppliers can be found near the site as shown in the map below (http://biomass-suppliers-list.service.gov.uk).

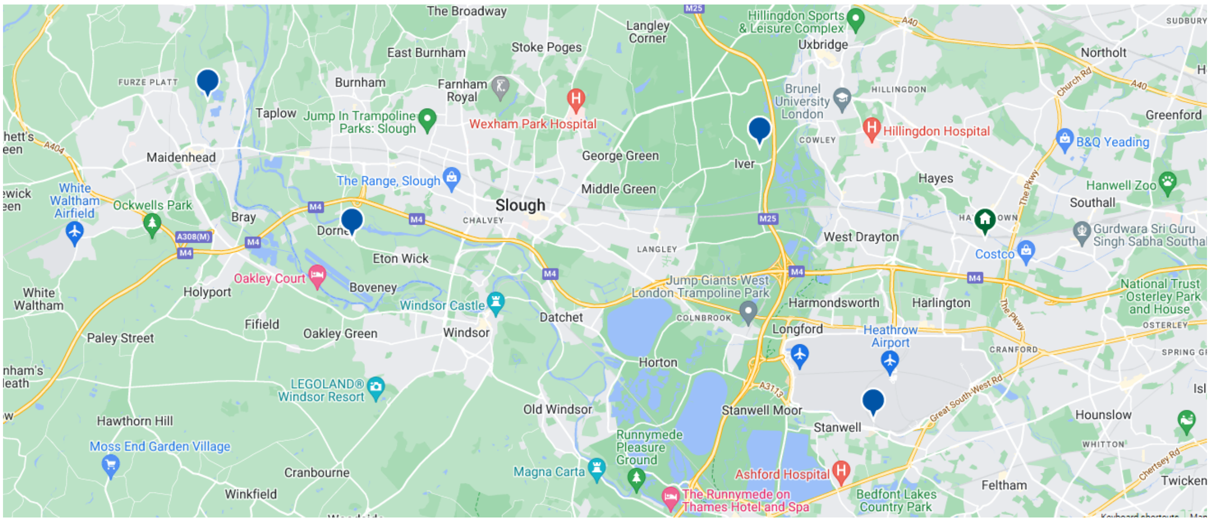


Figure 3: Biomass suppliers locations proximity to the project location.

Company name	Postcode	Contact	Fuel Supplied	Telephone
LC Energy Ltd	TW6 3FD	www.lcenergy.co.uk info@lcenergy.co.uk	Chip	08448751320
Fuel Chip Ltd	SL0 9LA	www.fuelchip.co.uk sales@fuelchip.co.uk	Chip	01753657280
Practicality Brown Ltd	SL0 9LA	www.pracbrown.co.uk sales@pracbrown.co.uk	Chip	01753 652022
Maydencroft Limited	SL4 6QB	www.maydencroft.co.uk info@maydencroft.co.uk	Chip	01462420851
Graftingardeners Ltd	KT22 0DN	www.graftingardeners.co.uk info@graftingardeners.co.uk	Chip, Firewood	02081237653
Mole Valley Farmers Ltd	SL6 8SP	www.molevalleyfarmers.com mvp.admin@molevalleyfarmers.com	Pellets	01769 575674
The Crown Estate	SL5 8AZ	www.windsorgreatpark.co.uk john.deakin@thecrownestate.co.uk	Chip	01753847504
LC Energy Ltd	SL5 8AZ	www.LCEnergy.co.uk INFO@LCENERGY.CO.UK	Chip	01483209360
AMP Biomass Fuel Ltd	WD6 5PH	www.ampcleanenergy.com hello@ampcleanenergy.com	Chip	+448001577331
TRAFALGAR CASES LTD	WD4 8HS	www.trafalgarcases.co.uk sales@trafalgarcases.co.uk	Firewood	01923261155

Table 9: Local Biomass suppliers contact details

8.2 Proposed Technology

- **Air Source Heat Pumps**

An ASHP, specified **BS EN 14511-3,** can meet the space heating demands on site efficiently in comparison with gas boilers. Although this low carbon technology consumes electricity to operate, due to higher efficiency the heat output is much greater. Therefore, it has been suggested for the space heating, and hot water demand. The design stage specifications used for energy calculations are in the table below. However, the ASHP was proposed only for simulation, detailed ASHP specifications will be provided by a mechanical engineer during the design development. The system must be certified under the Microgeneration Certification Scheme (MCS).

ASHP Air Distribution system recommended minimum standards.

In order to limit air leakage, ventilation ductwork should be made and assembled so as to be reasonably airtight. Ways of meeting this requirement would be to comply with the specifications given in:

i. B&ES DW/144[43]. Membership of the B&ES specialist ductwork group or the Association of Ductwork Contractors and Allied Services is one way of demonstrating suitable qualifications, or

ii. British Standards such as BS EN 1507:2006[44], BS EN 12237:2003[45] and BS EN 13403:2003[46].

In order to limit air leakage, air handling units should be made and assembled so as to be reasonably airtight. Ways of meeting this requirement would be to comply with Class L2 air leakage given in BS EN 1886:2007[47].

The specific fan power of air distribution systems at the design air flow rate should be no worse than in Table 35 for new and existing buildings. Specific fan power is a function of the system resistance that the fan has to overcome to provide the required flow rate. BS EN 13779 Table A8 provides guidance on system pressure drop. To minimise specific fan power it is recommended that the 'low range' is used as a design target.

Where the primary air and cooling is provided by central plant and by an air distribution system that includes the additional components listed in Table 36, the allowed specific fan powers may be increased by the amounts shown in Table 36 to account for the additional resistance.

A minimum controls package should be provided in new and existing buildings as in Table 37.

Ventilation fans driven by electric motors should comply with European Commission Regulation No 327/2011 implementing Directive 2009/125/EC with regard to ecodesign requirements for fans driven by motors with an electric input power between 125 W and 500 kW.

Figure 4, Air Distribution System Specs (Non-Domestic Building Services Compliance Guide)

Given the proposed LZC technologies on the site (i.e., **ASHP**), the overall CO2 reduction at BE GREEN stage can be calculated as shown below.

Building	**TER** ($KgCO_2/m^2$.annum)	**BER at BE-GREEN** ($KgCO_2/m^2$.annum)	**Carbon Savings at Be-Green**
Domestic	*29.56*	*17.79*	***39.82%***
Non-domestic	*21.6*	*14.1*	***35%***

Table 11: Regulated Carbon Reduction at Be-Green Stage

Conclusion

This report assesses the predicted energy performance and carbon dioxide emissions of the proposed development at **Squirrels Trading Center, Viveash Close, Hayes, EB3 4RZ.**

Based on the information provided by the design team, the study has been done on the **new build 113 residential flats and a commercial unit on the basement and ground floor**. The study results showed that **efficient thermal performance building fabric and heating systems** are keys to achieve building regulations compliance. Moreover, ASHP technology proved to be a major measure to achieve the **35%** reductions beyond **Part L** requirements. The carbon savings from each stage are shown in the chart below. Given the total cumulative carbon savings, the proposed development shall meet the planning requirements on the site and the designed excellent ratings.

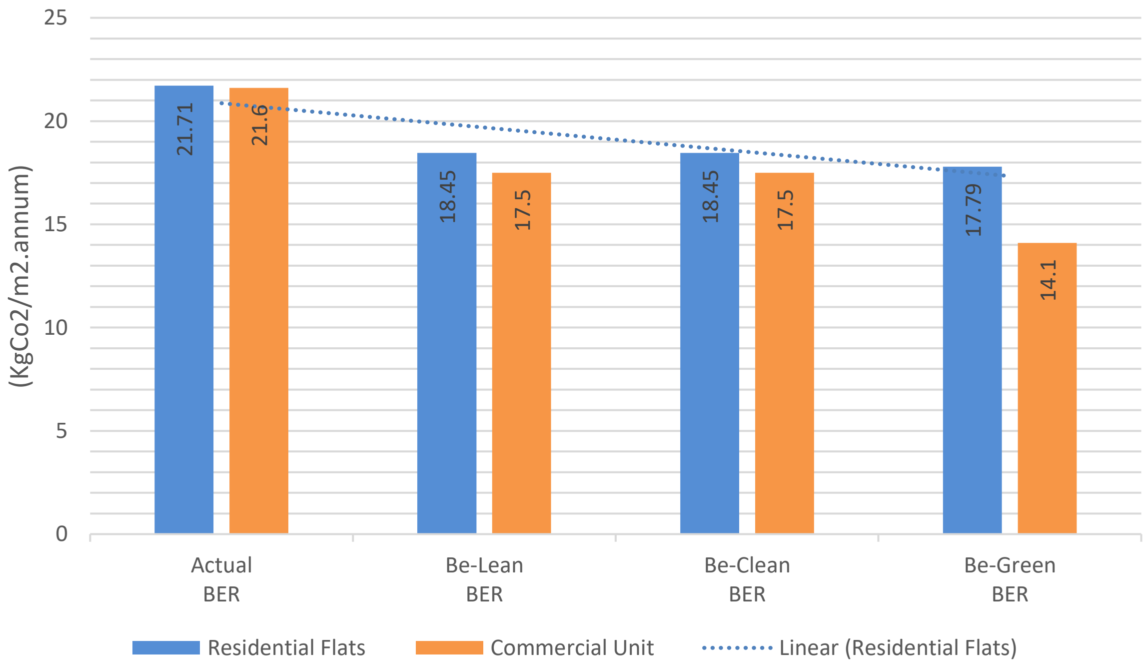


Chart 4: Carbon Emissions Reductions after each stage of the Energy Hierarchy

❖ Development Overall Carbon Savings

Building	TER ($KgCO_2/m^2$.annum)	BER at BE-GREEN ($KgCO_2/m^2$.annum)	Carbon Savings at Be-Green
Domestic	*20.71*	*17.79*	***39.82%***
Non-domestic	*21.6*	*14.1*	***35%***

Table 12: Overall Regulated Carbon Reduction

Appendix – BRUKL Reports

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Baseline

As designed

Date: Tue Apr 12 16:41:38 2022

Administrative information

Building Details

Address: London, Postcode

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.b.0

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: SG

Telephone number: 01184028520

Address: , Reading, RG1 8LG

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	21.6
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	21.6
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	19
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.26	0.26	"LF000000_W2"
Floor	0.25	0.22	0.22	"LF000000_F"
Roof	0.25	0.18	0.18	"SH000005_C"
Windows***, roof windows, and rooflights	2.2	1.6	1.6	"LF000001_W6_O0"
Personnel doors	2.2	2.2	2.2	"RS000000_W3_O0"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- Gas Boiler

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.86	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

1- SYST0000-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	-
Standard value	N/A	N/A

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Lift Lobby	-	95	-	18
Lift Lobby	-	95	-	90
Residential Bin Store	95	-	-	18
Lift Lobby	-	95	-	31
Riser	95	-	-	10
Store	95	-	-	10
Residential Bin Store	95	-	-	41
Substation	95	-	-	21
Commercial	-	95	22	1562
Commercial Bin Store	95	-	-	15
Essential Services	95	-	-	18
West Entrance + Foyer	-	95	-	65
Cycle store	95	-	-	174
Lift 4	-	95	-	17
Lift 3	-	95	-	17
Stairs	-	95	-	35
Lift Lobby	-	95	-	19
Stairs	-	95	-	33
Lift Lobby	-	95	-	104
Lift 1	-	95	-	17
Lift 2	-	95	-	17
GF-Corridor	-	95	-	41
Lift	-	95	-	21
Stairs	-	95	-	36

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Circulation	-	95	-	30
Shade	95	-	-	951
Store	95	-	-	69

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Commercial	NO (-68.8%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	1156.7	1156.7
External area [m^2]	1501.3	1501.3
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	5	6
Average conductance [W/K]	482.07	460.82
Average U-value [W/m^2K]	0.32	0.31
Alpha value* [%]	18.02	42.14

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
14	**A1/A2 Retail/Financial and Professional services**
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
63	**B8 Storage or Distribution**
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
23	**Residential spaces**
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	26.54	25.7
Cooling	0	0
Auxiliary	1.98	0.78
Lighting	10.39	18.25
Hot water	31.57	29.83
Equipment*	77.87	77.87
TOTAL**	**70.47**	**74.56**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	107.48	129.98
Primary energy* [kWh/m^2]	108.84	124.7
Total emissions [kg/m^2]	19	21.6

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	73.3	34.2	26.5	0	2	0.77	0	0.86	0
	Notional	75.8	54.1	25.7	0	0.8	0.82	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	U_{i-Typ}	U_{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.26	"LF000000_W2"
Floor	0.2	0.22	"LF000000_F"
Roof	0.15	0.18	"SH000005_C"
Windows, roof windows, and rooflights	1.5	1.6	"LF000001_W6_O0"
Personnel doors	1.5	2.2	"RS000000_W3_O0"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

U_{i-Typ} = Typical individual element U-values [W/(m²K)]

U_{i-Min} = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	5

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Squirrels- Be Green

As designed

Date: Fri May 06 10:27:19 2022

Administrative information

Building Details

Address: London, Postcode

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.b.0

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: SG

Telephone number: 01184028520

Address: , Reading, RG1 8LG

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	19.2
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	19.2
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	14.1
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.14	0.14	"LF000000_W2"
Floor	0.25	0.13	0.13	"LF000000_F"
Roof	0.25	0.13	0.13	"SH000005_C"
Windows***, roof windows, and rooflights	2.2	-	-	"No external windows/rooflights"
Personnel doors	2.2	2.2	2.2	"RS000000_W3_O0"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	3

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- ASHP

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	3	-	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

1- SYST0001-DHW

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	Hot water provided by HVAC system	-
Standard value	N/A	N/A

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Lift Lobby	-	95	-	18
Lift Lobby	-	95	-	90
Residential Bin Store	95	-	-	18
Lift Lobby	-	95	-	31
Riser	95	-	-	10
Store	95	-	-	10
Residential Bin Store	95	-	-	41
Substation	95	-	-	21
Commercial	-	95	22	1562
Commercial Bin Store	95	-	-	15
Essential Services	95	-	-	18
West Entrance + Foyer	-	95	-	65
Cycle store	95	-	-	174
Lift 4	-	95	-	17
Lift 3	-	95	-	17
Stairs	-	95	-	35
Lift Lobby	-	95	-	19
Stairs	-	95	-	33
Lift Lobby	-	95	-	104
Lift 1	-	95	-	17
Lift 2	-	95	-	17
GF-Corridor	-	95	-	41
Lift	-	95	-	21
Stairs	-	95	-	36

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Circulation	-	95	-	30
Shade	95	-	-	951
Store	95	-	-	69

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Commercial	NO (-68.9%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	1156.7	1156.7
External area [m^2]	1501.3	1501.3
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	6
Average conductance [W/K]	319.14	460.82
Average U-value [W/m^{2}K]	0.21	0.31
Alpha value* [%]	27.22	42.14

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
14	**A1/A2 Retail/Financial and Professional services**
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
63	**B8 Storage or Distribution**
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
23	**Residential spaces**
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	5.67	8.68
Cooling	0	0
Auxiliary	1.98	0.94
Lighting	10.39	18.25
Hot water	9.05	10.06
Equipment*	77.87	77.87
TOTAL**	**27.09**	**37.92**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	91.19	130.04
Primary energy* [kWh/m^2]	83.15	113.5
Total emissions [kg/m^2]	14.1	19.2

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	54.7	36.5	5.7	0	2	2.68	0	3	0
	Notional	75.9	54.1	8.7	0	0.9	2.43	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	U_{i-Typ}	U_{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.14	"LF000000_W2"
Floor	0.2	0.13	"LF000000_F"
Roof	0.15	0.13	"SH000005_C"
Windows, roof windows, and rooflights	1.5	-	"No external windows/rooflights"
Personnel doors	1.5	2.2	"RS000000_W3_O0"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

U_{i-Typ} = Typical individual element U-values [W/(m²K)]

U_{i-Min} = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	3

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Squirrels- Be Lean

As designed

Date: Tue Apr 12 16:53:44 2022

Administrative information

Building Details

Address: London, Postcode

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.b.0

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: SG

Telephone number: 01184028520

Address: , Reading, RG1 8LG

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	21.6
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	21.6
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	17.5
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.19	0.19	"LF000000_W2"
Floor	0.25	0.13	0.13	"LF000000_F"
Roof	0.25	0.17	0.17	"SH000005_C"
Windows***, roof windows, and rooflights	2.2	-	-	"No external windows/rooflights"
Personnel doors	2.2	2.2	2.2	"RS000000_W3_O0"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- Gas Boiler

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

1- SYST0000-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	-
Standard value	N/A	N/A

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Lift Lobby	-	95	-	18
Lift Lobby	-	95	-	90
Residential Bin Store	95	-	-	18
Lift Lobby	-	95	-	31
Riser	95	-	-	10
Store	95	-	-	10
Residential Bin Store	95	-	-	41
Substation	95	-	-	21
Commercial	-	95	22	1562
Commercial Bin Store	95	-	-	15
Essential Services	95	-	-	18
West Entrance + Foyer	-	95	-	65
Cycle store	95	-	-	174
Lift 4	-	95	-	17
Lift 3	-	95	-	17
Stairs	-	95	-	35
Lift Lobby	-	95	-	19
Stairs	-	95	-	33
Lift Lobby	-	95	-	104
Lift 1	-	95	-	17
Lift 2	-	95	-	17
GF-Corridor	-	95	-	41
Lift	-	95	-	21
Stairs	-	95	-	36

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Circulation	-	95	-	30
Shade	95	-	-	951
Store	95	-	-	69

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Commercial	NO (-68.9%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	1156.7	1156.7
External area [m^2]	1501.3	1501.3
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	5	6
Average conductance [W/K]	347.05	460.82
Average U-value [W/m^2K]	0.23	0.31
Alpha value* [%]	25.03	42.14

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
14	**A1/A2 Retail/Financial and Professional services**
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
63	**B8 Storage or Distribution**
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
23	**Residential spaces**
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	21.47	25.7
Cooling	0	0
Auxiliary	1.98	0.78
Lighting	10.39	18.25
Hot water	29.83	29.83
Equipment*	77.87	77.87
TOTAL**	**63.67**	**74.56**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	97.9	129.98
Primary energy* [kWh/m^2]	100.55	124.7
Total emissions [kg/m^2]	17.5	21.6

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	62.8	35.1	21.5	0	2	0.81	0	0.91	0
	Notional	75.8	54.1	25.7	0	0.8	0.82	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.19	"LF000000_W2"
Floor	0.2	0.13	"LF000000_F"
Roof	0.15	0.17	"SH000005_C"
Windows, roof windows, and rooflights	1.5	-	"No external windows/rooflights"
Personnel doors	1.5	2.2	"RS000000_W3_O0"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)]

$U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	5