Greengage

Brighter strategies
for greener projects

Client: Lazari Properties 2 Limited

Project: Brunswick Centre

Report: Energy Statement

QUALITY ASSURANCE

Issue/Revision:	Draft	Final
Date:	July 2023	July 2023
Comments:	Draft - for comments	Issued for Planning
Prepared by:	Pablo Correa	Pablo Correa
Authorised by:	Rodrigo Garcia Priego	Rodrigo Garcia Priego
File Reference:	552219pc06Jul23_DV01_Energy Statement	552219pc11Jul23_FV01_Energy Statement

CONTENTS

REFERENCES

Tables

Figures

1.0 EXECUTIVE SUMMARY

Greengage Environmental Ltd were commissioned by Cumming Group on behalf Lazari Properties 2 Limited to undertake this Energy Assessment for the proposed hotel development at the basement of Brunswick Centre in Bloomsbury, London, WC1N 1BS.

The energy strategy for Brunswick Centre has been developed in-line with the energy policies and aspirations of the Greater London Authority (GLA) and the Borough of Camden. The GLA Energy Hierarchy has been implemented and the estimated total cumulative regulated CO_2 savings are 36% measured against a Part L 2021 compliant scheme.

This report assesses the predicted energy performance and carbon dioxide emissions of the Proposed Development at Brunswick Centre, located in the Borough of Camden. The Proposed Development comprises the "the introduction of a subterranean hotel at lower ground floor level at the Brunswick Centre, with an ancillary entrance lobby located at ground floor level. The proposed hotel will provide a total of 207 bedrooms, and an ancillary F&B restaurant."

In line with the London Plan (2021)[1] Policy SI 2, and the updated Energy Assessment Guidance (2022), the development would need to achieve a 35% reduction in regulated CO_2 emissions on-site against a Building Regulations (Part L 2021)[2] compliant scheme. The Proposed Development has looked towards the transition to zero carbon and prioritised a building fabric and technology that promotes this. As such, the energy strategy is based on an all-electric system utilising air source heat pumps (ASHPs) for domestic hot water (DHW) generation and variable refrigerant flow (VRF) systems for space conditioning (heating and cooling). Mechanical ventilation with heat recovery is proposed to be installed in all occupied spaces to provide adequate fresh air whilst improving the efficiency of the system by reducing ventilation heat losses, as well as the impacts of noise and air pollution. Additionally, the development will incorporate a photovoltaic (PV) array on the roof as a means of on-site renewable electricity generation.

The methodology used to determine the expected operational CO_2 emissions for the development is in accordance with the London Plan's (2021) three-step Energy Hierarchy (Policy SI 2) and the CO_2 savings achieved for each step are outlined below:

1.1 BE LEAN – USE LESS ENERGY

The Proposed Development has prioritised a reduction in energy demands at the 'Be Lean' stage by specifying a series of passive and active measures that achieve that goal through a high-performance building fabric alongside the specification of highly energy efficient ventilation and lighting.

The 'Be Lean' measures proposed will result in an estimated reduction in regulated CO_2 emissions of 5.5 tCO_2/year, equating to a 9% reduction when compared to the Part L 2021 baseline emissions rate.

Significant energy efficiency improvements over Part L 2021 have been proposed in relation to the fabric, equipment and systems. However, domestic hot water (DHW) accounts for most of the proposals energy demand and the improvements proposed do not directly impact this demand. This resulted in a limited potential to reduce the carbon emissions in this type of building where DHW demand has such a significant impact on energy performance.

If the DHW consumption is excluded from the calculation, the emissions savings obtained in the rest of the energy uses from efficiency measures at the Be Lean stage would be 25%.

1.2 BE CLEAN – SUPPLY ENERGY EFFICIENTLY

As part of the 'Be Clean' stage of the energy assessment, the potential to connect to an existing or proposed decentralised energy network has been evaluated. It was concluded that no networks were within an appropriate distance for the Proposed Development to consider a connection.

Instead, a series of VRF systems are proposed as the most appropriate solution to provide efficient space heating and cooling to the Proposed Development, and a centralised system of air source heat pumps (ASHP) is specified for the domestic hot water generation. This type of domestic hot water system can facilitate the connection to any heat network brought forward in the future.

Further details about these systems are included in the 'Be Green' section.

1.3 BE GREEN – USE RENEWABLE ENERGY

The 'Be Green' appraisal concluded that the most appropriate low or zero carbon technology to be included in the development proposals are ASHPs for hot water generation and VRF systems for space conditioning. These technologies will also help promote a future transition to zero carbon being all electric systems. Additionally, the development will incorporate PV panels on the roofs as a means of on-site renewable electricity generation.

The 'Be Green' technologies are predicted to reduce the CO_2 emissions on-site by 16.1 tCO_2/year, equating to a 27% reduction over the Part L 2021 baseline case.

1.4 BE SEEN – MONITOR, VERIFY AND REPORT ENERGY PERFORMANCE

The final element of the strategy, 'Be Seen', involves the monitoring and reporting of energy performance post-construction to ensure that the actual carbon performance of the development is aligned with the Mayor's net zero carbon target. The development at Brunswick Centre will be designed with sub-metering to enable post construction monitoring.

Additionally, the 'Be Seen' methodology has been used to report on the predicted Energy Use Intensity (EUI) and space heating demand of the Proposed Development.

1.5 RESULTS

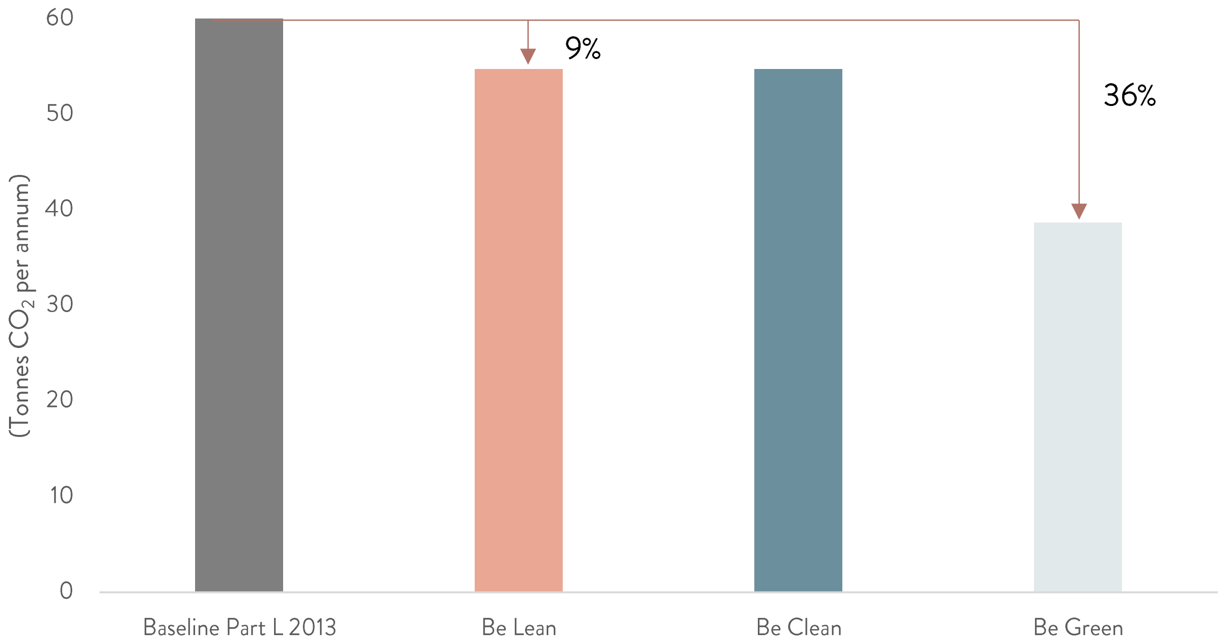
Regulated Carbon Dioxide Emissions and Savings

Table 1.1 and Figure 1.1 show the performance of the development at each stage of the Energy Hierarchy.

Table 1.1 Regulated carbon dioxide emissions and savings from each stage of the Energy Hierarchy.

	Total regulated emissions	CO_2 savings	Percentage saving
	(Tonnes CO_2 per annum)		(%)
Part L 2021 Baseline	60.3	-	-
Be Lean	54.8	5.5	9%
Be Clean	54.8	0	0%
Be Green	38.7	16.1	27%
Total Savings	-	**21.6**	**36%**
CO_2 savings off-set (Tonnes CO_2)			
Cumulative savings for off-set payment	1,161		
Cash in-lieu contribution (£) (at £95/ tonne)	£110,301		

Figure 1.1 Regulated carbon dioxide emissions and savings from each stage of the Energy Hierarchy.



The total estimated cumulative savings are 21.6 tCO_2/year, equating to a 36% reduction when compared to the Part L 2021 baseline.

Additionally, the Proposed Development reports on the predicted Energy Use Intensity (EUI) and space heating demand as introduced in the new GLA Energy Assessment Guidance (2022)[3].

Energy Use Intensity (EUI) and space heating demand

The EUI is a measure of the total energy consumed in a building annually. Including both regulated and unregulated energy. Table 1.2 below shows the EUI and space heating demand of the Proposed Development and the methodology used.

Table 1.2 EUI and space heating demand (predicted energy use) of the Proposed Development.

Building type	EUI	Space heating demand	EUI	Space heating demand	Methodology used
			Table 4 GLA guidance		
	(kWh/m^2/year) (excluding renewable energy)				
Hotel	99	8.2	55	15	'Be Seen' methodology

2.0 INTRODUCTION

This Chapter presents a description of the site and the development proposals, as well as the energy policy and regulatory framework that has influenced the design, and the methodology employed for the assessment of energy and carbon.

2.1 THE SITE

The basement where the proposed hotel will be developed is located in Brunswick Centre in Bloomsbury, London, WC1N 1BS, between Brunswick Square Gardens and Russell Square. Brunswick Centre is a Grade II listed building including residential apartments in two long, stepped structures, as well as retail units and leisure centres on the ground level and in the elongated open space between them. Its two-level underground car park is currently under-utilised and, unlike the rest of the structure, this area is considered to be of low heritage significance.

Figure 2.1 Aerial View of Brunswick Centre.

Figure 2.2 View of the Brunswick Centre (exterior).

Figure 2.3 View of the Brunswick Centre (interior).

Figure 2.4 Layout of the Proposed Development on the basement.

2.2 THE PROPOSED DEVELOPMENT

The Proposed Development is for "the introduction of a subterranean hotel at lower ground floor level at the Brunswick Centre, with an ancillary entrance lobby located at ground floor level. The proposed hotel will provide a total of 207 bedrooms, and an ancillary F&B restaurant."

The Development description is as follows:

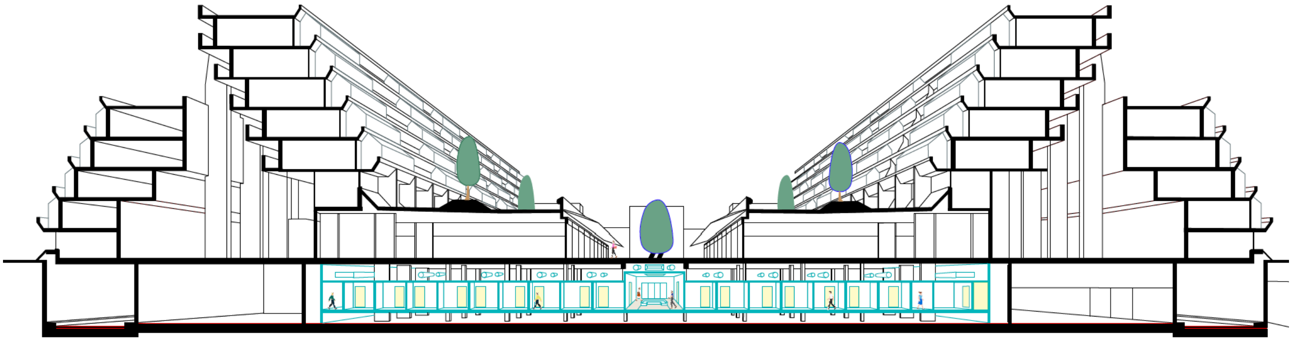
Planning Permission is sought for:

"Change of use of existing car parking at lower ground floor to hotel use, change of use of retail unit to ancillary hotel entrance at ground floor level, lowering of lower ground floor slab, installation of plant at roof and lower ground floor level, installation of PV panels at roof level, and associated works."

Listed Building Consent is sought for:

"Installation of walls and fit-out relating to proposed hotel use at lower ground and ground floor level, dismantling and reconstruction of lowered lower ground floor slab, strengthening of structural columns, installation of plant at roof and lower ground floor level, installation of PV panels at roof level, and associated works."

Figure 2.5 Concept section from Axiom Architects.



2.3 POLICY & REGULATORY FRAMEWORK

The strategy for the Proposed Development has been designed with consideration for all applicable national, regional and local planning policy, as well as to meet the various requirements of the Building Regulations related to conservation of fuel and power, ventilation, and providing a comfortable environment for building occupants.

This section summarises the main policy and regulatory requirements that have guided the development of the energy strategy presented in this report.

Relevant Policy: London Plan Policy SI2, SI3, SI4; Camden Local Plan Policy CC1.

Regional Policy - The London Plan (2021)[4]

Policy SI 2 Minimising greenhouse gas emissions

A. Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

   1. Be Lean: use less energy and manage demand during operation;
   2. Be Clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly;
   3. Be Green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site; and
   4. Be Seen: monitor, verify and report on energy performance.

B. 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.

C. 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.

D. Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.

E. Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e., unregulated emissions.

F. Development proposals referable to the Mayor should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.

Policy SI 3 Energy Infrastructure

Major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system:

1. The heat source for the communal heating system should be selected in accordance with the following heating hierarchy:
   a. Connect to local existing or planned heat networks;
   b. Use zero-emission or local secondary heat sources (in conjunction with heat pump, if required);
   c. Use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network); and
   d. Use ultra-low NOx gas boilers.
2. CHP and ultra-low NOx communal or district heating systems should be designed to ensure that they meet the requirements in Part B of Policy SI 1 Improving air quality.
3. Where a heat network is planned but not yet in existence the development should be designed to allow for the cost-effective connection at a later date.

Heat networks should achieve good practice design and specification standards for primary, secondary and tertiary systems comparable to those set out in the CIBSE/ADE Code of Practice CP1 or equivalent.

Policy SI 4 Managing heat risk

Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.

G. Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:

1. Reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure;
2. Minimise internal heat generation through energy-efficient design;
3. Manage the heat within the building through exposed internal thermal mass and high ceilings;
4. Provide passive ventilation;
5. Provide mechanical ventilation; and
6. Provide active cooling systems.

Local Planning Policy - Camden Local Plan

The London Borough of Camden Local Plan was adopted in 2017 and will cover the period from 2016-2031. In relation to energy, the Local Plan sets out the following policy:

Policy CC1: Climate change mitigation

Policy CC1 states that proposals should promote zero carbon development and requires all projects to reduce carbon emissions through the energy hierarchy. Major developments must demonstrate compliance with London Plan targets. The policy encourages energy efficiency improvements and retaining existing buildings when feasible. It also expects all developments to optimise resource efficiency and support decentralised energy networks.

Regulatory Requirements - The Building Regulations Part L (2021)[5]

The new Approved Document L: Conservation of fuel and power of Building Regulations was published in December 2021 and has come into effect on 15 June 2022 in England.

There are a number of changes incorporated into the new version of Part L, including:

- Updated carbon factors to reflect the decarbonisation of the electricity grid.
- Enhanced fabric performance requirements.
- On-site renewable generation included in the 'notional building' specification used to calculate the target emission rate (TER).

Guidance Documents - Energy Assessment Guidance (2022)[6]

GLA Energy Assessment Guidance 2022

The GLA have published in June 2022 an updated guidance for energy assessments which sets out the required format and structure of energy statements. Additionally, it reinforces policy, providing clarity on which aspects require immediate consideration.

This Energy Statement has been produced in-line with this guidance and demonstrates how the Proposed Development has been designed to accord with the GLA direction on energy performance.

3.0 METHODOLOGY

The sections below outline the methodology used in the assessment of the energy performance for the Proposed Development.

The methodology used to assess the proposed energy strategy has followed the London Plan's (2021) three-step Energy Hierarchy (Policy SI 2) and the Energy Assessment Guidance 2022 published by the GLA to report on regulated CO_2 savings compared against a Part L 2021 baseline.

On-Site Measures – Energy Hierarchy

The estimated annual energy consumption for the Proposed Development have been calculated using the National Calculation Methodology (NCM) and implemented through IES VE 2022 compliance software. The methodology calculates the regulated energy consumption associated with hot water, space heating and cooling, ventilation and lighting.

Baseline Calculation

In accordance with the latest GLA Energy Assessment Guidance 2022, to determine the CO_2 emissions baseline, the Target Emission Rate (TER) from the final proposed building specification (i.e., the results of the 'Be Green' stage) is used instead. For non-residential buildings the TER is multiplied by the floor area to provide the regulated CO_2 emissions.

The new Part L 2021 baseline for non-residential buildings includes low carbon heating, such as heat pumps and, therefore, achieving significant on-site carbon reductions beyond the baseline is more onerous.

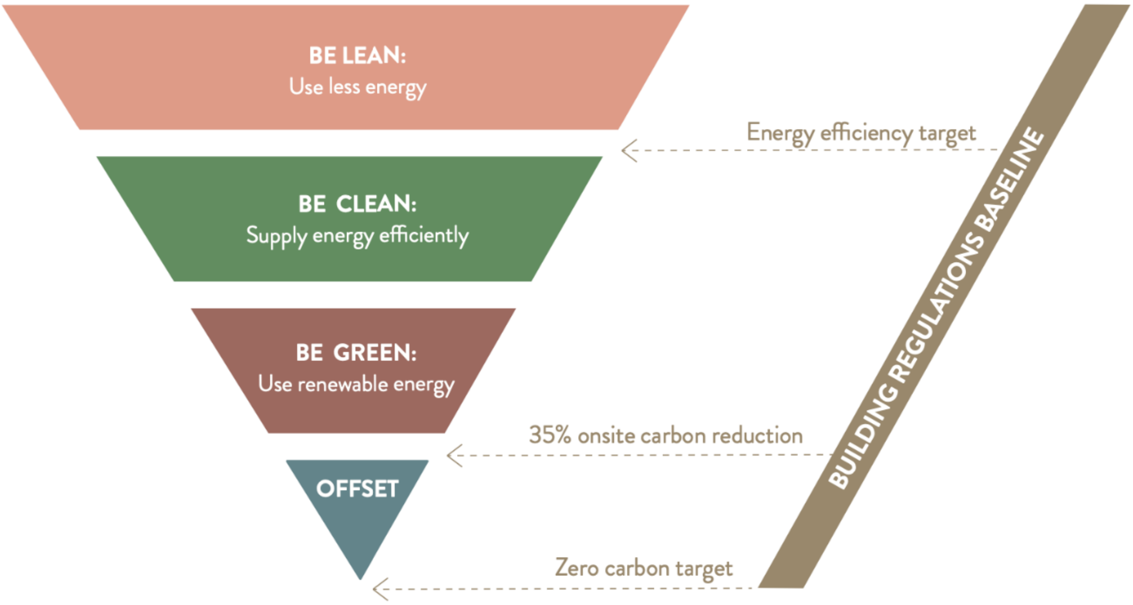
Energy Hierarchy

The Energy Hierarchy as outlined in the London Plan Policy SI 2 is as follows:

- Be Lean – demand for energy is reduced through a range of passive and active energy efficiency measures; as part of this step the Cooling Hierarchy is implemented and measures are proposed to reduce the demand for active cooling;
- Be Clean – measures for supplying the remaining energy demands as efficiently as possible, and exploring options for decentralised energy connection;
- Be Green – renewable technology opportunities are maximised for the development. Their uptake is based on feasibility and viability considerations, including their compatibility with the energy supply systems established earlier in the hierarchy.
- Be Seen – the processes for monitoring, verifying and reporting on energy performance.

The implementation of the Energy Hierarchy determines the total regulated carbon savings that can be feasibly and viably achieved on site. The percentage improvement against the baseline emissions is compared to the relevant targets for each element and in case of a shortfall, further reductions will be made through off-site measures.

Figure 3.1 The Energy Hierarchy.



4.0 BASELINE

This chapter outlines the modelling parameters and units selected for assessment in developing the energy performance model for the Proposed Development.

Carbon Emissions Baseline

The energy assessment will first establish the regulated CO_2 emissions baseline of the proposed development compliant with Part L 2021 of the Building Regulations. To determine this baseline, the Target Emission Rate (TER) from the final proposed building specification, i.e. the rate from the modelling results of the 'be green' stage of the energy hierarchy, is used. In some cases, this TER includes low carbon or renewable energy generation. The emission rate is then multiplied by the floor area to provide the total regulated CO2 emissions of the development in tonnes per annum.

Table 4.1 Carbon Dioxide Emissions at 'Baseline' Stage - Part L 2021 baseline.

	Carbon Dioxide Emissions (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 TER of the Proposed Development	60.3	25.9

5.0 BE LEAN – DEMAND REDUCTION

Target:

15% improvement on Building Regulations 2021 from energy efficiency measures alone (Policy SI 2 - London Plan 2021).

The proposals incorporate a range of passive and active design measures that will reduce the energy demand for space conditioning, hot water and lighting. Measures will also be put in place to reduce the risk of overheating. The regulated carbon saving achieved at this stage of the Energy Hierarchy is 9% over the Part L 2021 Baseline level only taking into account energy efficiency measures, i.e., excluding the proposed heating system and renewable energy.

The 15% improvement target is not achieved given the special characteristics of the proposed development, which will be located in an existing underground space where the opportunities for introducing passive measures are limited. It also needs to be considered that the domestic hot water consumption is much higher than any other energy use in this project and opportunities to reduce the demand for domestic hot water are also very limited in a hotel. This means that, while passive and energy efficiency measures have been maximised, reducing heating, cooling, auxiliary and lighting loads, the carbon emission reduction achieved at the 'Be Lean' stage is limited to 9% overall.

5.1 PASSIVE DESIGN MEASURES

In line with best practice, the Proposed Development has prioritised the design of an energy efficient building envelope. This approach ensures that the Proposed Development priorities long lasting energy efficiency measures and reduces the reliance on the ongoing operation and maintenance of the building by the occupant. It also ensures that the building is future proofed to facilitate the longevity of the building.

Efficient Building Envelope

Developing an efficient and consistent building envelope is a crucial first step in constructing buildings that are resilient, low-energy, and comfortable for occupants. This involves specifying suitable build ups for individual building elements, but also considering the detailing and interconnectivity of the building fabric to ensure that a consistent air and thermal barrier is created.

Considering the special characteristics of this site, in a basement and enclosed by other structures and occupied spaces, low U-values will be specified to walls and ceilings in contact with unconditioned spaces and structures, to the portion of roof exposed to external air, and to the ground floor. Thermal bridge heat losses will be minimised through the detailing of the junctions of thermal envelope elements. A low air permeability target of 3 $m^3/h/m^2$ @50Pa is also included as a passive measure.

The performance of the building envelope will be designed to achieve the values illustrated in the table below.

Table 5.1 Building fabric thermal performance.

Fabric Element	Proposed fabric performance	Building Regulations 2021 notional building performance
Roof U-value (W/m^2K)	0.12	0.15
Ground floor U-value (W/m^2K)	0.12	0.15
Walls to unconditioned U-value (W/m^2K)	0.15	0.18
Thermal bridging coefficient (W/m^2K)	10%	10%
Air permeability ($m^3/h/m^2$ @50Pa)	3	3

5.2 ACTIVE DESIGN MEASURES

Efficient Lighting

The development intends to incorporate low energy light fittings throughout. All light fittings will be specified as low energy lighting and will accommodate LED luminaires only. The bedrooms, corridors and public areas will have lighting with efficacy of 110 luminaire lumens per circuit-watt.

Automatic lighting controls will also be used where appropriate to further minimise energy consumption.

Mechanical Ventilation with Heat Recovery and VRF

Being a basement space, passive natural ventilation will not be a feasible solution to provide the required fresh air rates for air quality and preventing overheating. On the other hand, the floor area of the site and limited access to the exterior would not allow small, localised ventilation units to be used. Therefore, the strategy adopted will be a centralised mechanical ventilation system with energy recovery in conjunction with a series of variable refrigerant flow (VRF) units to provide comfort cooling to each space as needed. This solution will allow to minimise the active heating and cooling energy needed to condition the spaces.

Table 5.2 shows the typical efficiency parameters of the proposed systems, to be confirmed and further detailed in later stages of the design.

Consideration of waste water heat recovery (WWHR)

To reduce the DHW demand, the installation of a waste water heat recovery (WWHR) system has been considered. Based on experience from previous similar projects, the use of waste water heat recovery has been discounted for the following reasons:

- Maintenance impact: the heat recovery system fitted to the showers increases the probability of blockages, which may result in increased maintenance requirements.

- Additional pipework lengths to route the cold-water pipework through the waste water heat exchanger will incur in additional embodied carbon.
- The efficiency of the proposed ASHP system can also be affected by the WWHR system if high-temperature air-source heat pumps are used since this type of heat pumps work more efficiently when the temperature difference between the incoming cold water and the output hot water is larger. Therefore, if the temperature of the incoming hot water is increased, this would reduce the difference in temperature and could potentially increase the energy consumption.

Table 5.2 Proposed systems typical performance.

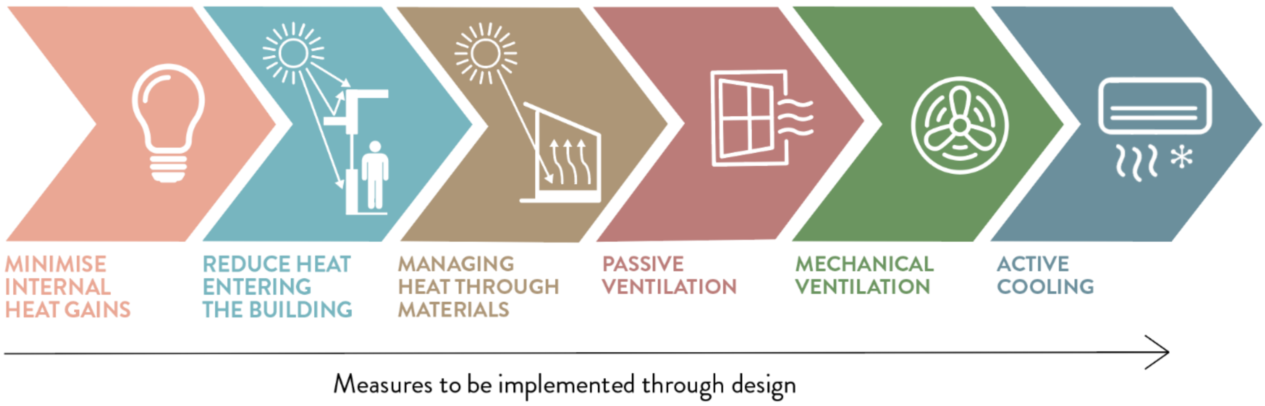
Systems	Performance	Building Area
Space heating & cooling		
Heating & cooling system	• VRF - SCOP: 4.50 (heating) / SEER: 12.50 (cooling)	Bedrooms, F&B areas and offices.
Ventilation		
Ventilation type and performance	• Centralised AHUs ○ Heat recovery efficiency: 90% ○ SFP: 1.8 W/l/s	All occupied spaces
Domestic Hot Water		
DHW system	• ASHP ○ SCoP: 3.470 ○ Storage volume: 6,300 litres ○ Standing losses: 0.002 kWh/(l·day) ○ Secondary circulation: 1000m, 7W/m losses, 200W pump power	All building

5.3 MINIMISING OVERHEATING

The potential risk of overheating will be mitigated by incorporating passive and active design measures, in line with the London Plan (2021) Policy SI 4 Managing heat risk, as follows.

The Cooling Hierarchy

Figure 5.1 Colling Hierarchy diagram



Minimising internal heat generation through energy efficient design

High-efficiency lighting and appliances are to be installed to minimise internal heat gains. Automatic lighting controls will be used throughout the building which aid in reducing electricity wastage and heat.

Hot water pipework will be insulated to reduce heat loss into the building space. This can also reduce hot water demand.

Reducing the amount of heat entering the building

Being a basement space, it will not receive solar gains.

Passive ventilation

Natural passive ventilation is not a feasible solution being a basement space.

Mechanical Ventilation

The mechanical ventilation strategy proposed will be able to provide a portion of the cooling requirements by mixing air at external temperature and return temperature as required, minimising the active cooling input to achieve the target comfort temperatures.

Active cooling systems

A high efficiency VRF cooling system is proposed to be installed to minimise the energy consumption for active space cooling. This solution allows recovering heat or 'coolth' from different zones of the building to minimise the energy input required for active cooling.

5.4 BE LEAN SUMMARY

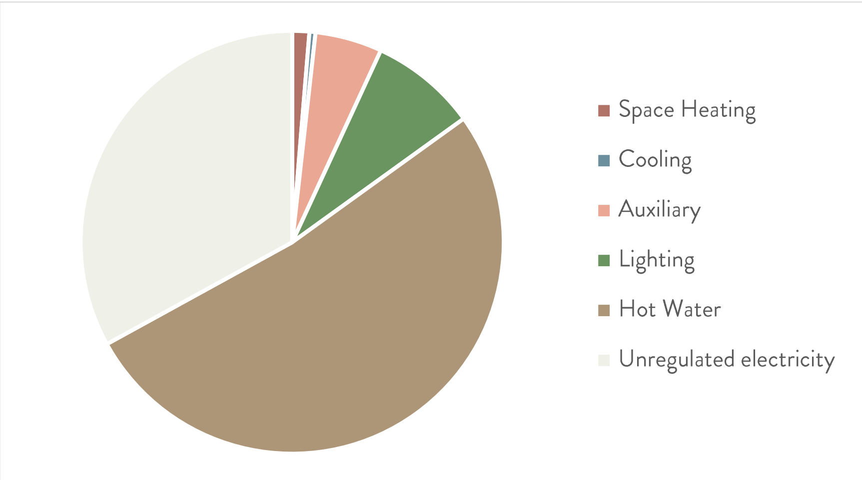
Energy Use

Table 5.3 below shows a breakdown of the energy use of the Proposed Development for the different uses.

Table 5.3 Energy use of the Proposed Development for the different uses (MWh/year).

Building Use	Space Heating	Cooling	Auxiliary	Lighting	Hot Water	Unregulated electricity
Hotel	7.4	2.6	28.9	46.1	293.2	186.3

Figure 5.2 Breakdown of the energy consumption of the Proposed Development for the different uses.



Reporting Energy Use Intensity (EUI) and space heating demand

The Energy Use Intensity (EUI) is a measure of the total energy consumed in a building annually including both regulated and unregulated energy. Development proposals should report the predicted EUI and space heating demand. The GLA Energy Assessment Guidance (2022) sets some recommended values that developments should aim to achieve (and improve where possible) depending on the building type. For hotels the recommended values are:

- EUI - 55 kWh/m^2/year; and
- Space heating demand - 15 kWh/m^2/year

The 'Be Seen' methodology has been used to estimate the EUI and space heating demand of the Proposed Development which are shown in Table 5.4 below (excluding the contribution from renewable energy).

Table 5.4 EUI and space heating demand (predicted energy use) of the Proposed Development.

Building type	EUI	Space heating demand	EUI	Space heating demand	Methodology used	Explanatory notes
			Table 4 GLA guidance			
	(kWh/m2/year) (excluding renewable energy)					
Hotel	99	8	55	15	'Be Seen' methodology	See following paragraph

Explanatory notes

The estimated EUI from the Proposed Development using the 'Be Seen' methodology is 99 kWh/m^2/year. An operational energy assessment following the CIBSE TM54 methodology has been undertaken in line with the 'Be Seen' guidance, however, given the stage of the design that the project is at, a number of assumptions had to be included in the assessment at this point. Additionally, some of the energy uses are difficult to estimate at design stage (e.g., catering, small power in bedrooms, and the proposed circadian lighting) and therefore the calculations rely on benchmark data that may overestimate some energy uses.

Because of this, the current calculated EUI of the Proposed Development is estimated to exceed the benchmark EUI for hotels included in Table 4 of the GLA guidance (i.e., 55kWh/m^2/year).

The assessment can be refined at a later design stage when more accurate information is available, and options can be explored at detailed design stage to improve the operational energy performance of the building and further reduce the EUI.

Be Lean results

Table 5.5 provides a comparison between the baseline buildings and the Proposed Development once energy efficiency measures have been applied, therefore demonstrating the energy savings achieved through energy efficiency measures.

Table 5.5 Carbon Dioxide Emissions at 'Be Lean' Stage.

	Total regulated CO_2 emissions	Regulated CO_2 savings	Percentage saving
	(Tonnes CO_2 per annum)		(%)
Part L 2021 Baseline	60.3	-	-
Be Lean	54.8	5.5	9%

The results at this stage demonstrate a 9% reduction when compared to the baseline emissions rate. Even if opportunities for including passive measures in a basement level development are limited, significant energy efficiency improvements over Part L 2021 have been proposed in relation to the fabric, equipment and systems. However, domestic hot water (DHW) accounts for most of the proposals energy demand and the improvements proposed do not directly impact this demand. This resulted in a limited potential to reduce the carbon emissions in this type of building where DHW demand has such a significant impact on energy performance.

If the DHW consumption is excluded from the calculation, the emissions savings obtained in the rest of the energy uses from efficiency measures at the Be Lean stage would be 25%.

6.0 BE CLEAN – HEATING INFRASTRUCTURE

This section reviews the options to connect to a decentralised energy network.

6.1 ENERGY SYSTEM HIERARCHY

The energy system for the development has been selected in accordance with the London Plan (2021) Policy SI 3 decentralised energy hierarchy. The hierarchy sets that energy systems should consider:

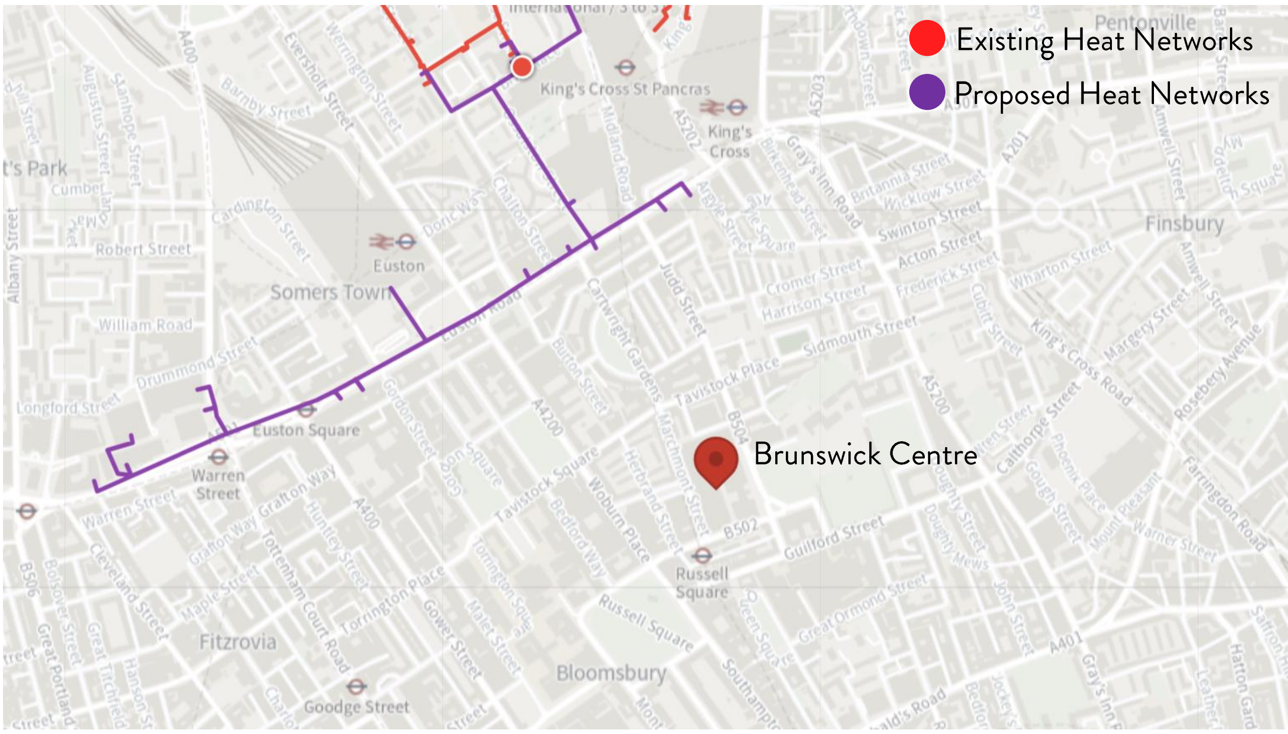
- Connection to local existing or planned heat networks;
- Using zero-emission or local secondary heat sources;
- Using low-emission combined heat and power (CHP); and,
- Communal heating and cooling.

In a communal energy system, energy in the form of heat, cooling, and/or electricity is generated from a central source and distributed via a network to surrounding buildings.

6.2 CONNECTION TO AN EXISTING NETWORK

The London Heat Map identifies existing and potential opportunities for decentralised energy projects in London. It builds on the 2005 London Community Heating Development Study. An excerpt from the London Heat Map can be seen on Figure 6.1, which highlights any existing and proposed district heating networks within the vicinity of the development. We observe that there are no heat networks adjacent to the Proposed Development site for a connection to be a feasible solution.

Figure 6.1 Excerpt from the London Heat Map.



Instead, a series of VRF systems will be proposed to provide space heating and cooling to the Proposed Development, and a central ASHP system for the hot water generation. Further details are included in the 'Be Green' section.

Future Connection to a Network

The centralised hot water system can facilitate connection to any heat network brought forward in the future. However, the commercial case for connection to them will need to be assessed in detail to ensure that district heating is a cost-effective solution and that the replacement of any existing systems represents a whole-life carbon benefit for the scheme.

6.3 BE CLEAN SUMMARY

'Be Clean' measures are not proposed for the development due to its scale and the lack of any nearby operational decentralised energy networks. Therefore, no further reductions in CO_2 emissions are represented at this stage.

7.0 BE GREEN – USE RENEWABLE ENERGY

Target:

35% overall improvement on Building Regulations 2013 (Policy SI 2 - London Plan 2021).

The renewable and low carbon technologies feasibility study identified that the most appropriate technologies are ASHPs for hot water generation and VRF systems for space conditioning. PV arrays on the roof of the adjacent residential structures will be incorporated as a means of on-site renewable electricity generation. These technologies are estimated to reduce the CO_2 emissions by 16.1 tCO_2/year, equating to a 27% reduction over the 2021 Baseline case at this stage. This results in a total estimated cumulative saving of 21.6 tCO_2/year and 36% reduction.

7.1 RENEWABLE & LOW CARBON TECHNOLOGIES FEASIBILITY STUDY

Methods for generating on-site low or zero carbon energy were assessed and considered alongside the measures at 'Be Lean' and 'Be Clean' stage. A range of technologies were considered, including:

- Biomass;
- Ground/water source heat pumps;
- Air source heat pumps;
- Wind energy;
- Energy Storage;
- Photovoltaic panels; and,
- Solar thermal panels.

In determining the appropriate technologies for the site, the following factors were considered:

- CO_2 savings achieved;
- Site constraints;
- Any potential visual impacts; and,
- Compatibility with the 'Be Lean' and 'Be Clean' stage proposals.

Renewable and Low Carbon Energy Appraisal

Table 6.1 below summarises the factors considered in determining the appropriate technologies for this project. This includes estimated capital cost, lifetime, level of maintenance and level of impact on external appearance. The final columns indicate the feasibility of the technology in relation to the site conditions ('10' being the most feasible and '0' being infeasible). It is important to note that the information provided is indicative and based upon early project stage estimates.

Table 7.1 Summary of renewables and low carbon technologies feasibility study.

Technology	Lifetime	O&M Impacts	Indicative Simple Payback	Planning Land Use, Noise Issues	Aesthetic Impact and Land Use	Site Feasibility	Export Potential for Heat or Energy	Comments
Biomass	20 yrs.	High	>20 yrs.	Med	High	3	6	Not proposed -burning of wood pellets releases high NOx emissions and there are limitations for their storage and delivery within an urban location.
PV	25 yrs.	Low	7-10 yrs.	Low	Med	9	8	Proposed.
Solar Thermal	25 yrs.	Low	10 yrs.	Low	Med	3	1	Not proposed - solar thermal array would require additional piping and hot water tanks, and panels would need to be placed close to the basement. It is not considered suitable for this site.
GSHP	20 yrs.	Med	>25 yrs.	Low	Low	1	1	Not proposed - the installation of ground loops is not possible in this site.
ASHP / VRF	30 yrs.	Med	>20 yrs.	High	Med	9	4	Proposed.
Wind	25 yrs.	Med	25 yrs.	High	High	2	8	Not proposed – Wind turbines located at the site will have a significant visual and noise impact on the building and adjacent area.

The feasibility study demonstrates that ASHPs, VRFs and PVs would be the most feasible renewable and low carbon technologies for the Proposed Development. A detailed assessment of these technologies is presented in the following section.

Detailed Assessment of ASHP

Air source heat pumps for domestic hot water generation work by absorbing heat from the air at a low temperature and transferring it to a liquid. Following this, the fluid passes through a heat exchanger into the heat pump, which raises the temperature and then transfers that heat to water stored in a hot water cylinder. The stored water is then circulated through distribution pipes as required for being used in showers and sinks.

Heat pumps are more efficient than other heating systems because the amount of heat they produce is higher than the amount of electricity they use. This depends on their Seasonal Coefficient of Performance (SCoP) which is the efficiency of the heat pump across the whole year.

ASHPs are considered a suitable technology for the development for the following reasons:

- It is a high efficiency system that can cater for the domestic hot water demand of the Proposed Development;
- Requires less capital cost than GSHP and other renewable technologies; and
- The location of the systems is flexible and therefore can be accommodated on different exterior spaces.

Table 7.2 summarises the technical data for the proposed ASHP and estimated CO_2 savings from the application of this technology.

Detailed Assessment of VRF system

Variable Refrigerant Flow (VRF) systems typically use heat pumps to provide space heating and cooling to a building. In these systems, the refrigerant passes through condenser units to indoor units and the technology alternates the refrigerant volume in a system to match the requirements of the building. They can serve multiple zones within the building with different cooling or heating requirements at the same time, recovering energy by moving heat or 'coolth' from spaces at different conditions. They operate similar to a multi-split system with individual indoor units where each unit determines the capacity it needs based on the indoor temperature and demanded temperature from the set point.

VRF is considered a suitable technology for the development for the following reasons:

- They give the users the opportunity to control individually different air conditioning zones at one time;
- It is a high efficiency system that can cater for the space heating and cooling demand of the Proposed Development; and
- Similarly to the ASHPs system, the location is flexible and can be accommodated on different exterior spaces.

Table 7.2 summarises the technical data for the proposed ASHP and estimated CO_2 savings from the application of this technology.

Table 7.2 Technical summary of VRF and ASHP systems.

VRF system (for space heating and cooling) & ASHP (for hot water)	
VRF: SCoP Space Heating	4.50
ASHP: SCoP Hot Water	3.47
Estimated energy use for space heating	7.4 MWh/yr
Estimated energy use for hot water	293.2 MWh/yr
Estimated space heating demand	34.3 MWh/yr
Estimated hot water demand	1,017.4 MWh/yr
Carbon savings	**3.5 tonnes CO_2/yr (6%)**

Furthermore, the following additional technical information in relation to the ASHP and VRF systems is provided:

- ASHP will be the primary and only domestic hot water system serving all areas;
- VRF will be the primary system for space heating and cooling serving all areas;
- Both systems will be utilising the latest inverter technology or of a similar standard. They comply with the minimum performance standards as set out in the Enhanced Capital Allowances (ECA) product criteria for the relevant ASHP and VRF technology (http://etl.decc.gov.uk);
- The contractor will install the heat pump equipment according to the above specs and will be MCS approved/certified as outlined in the Microgeneration Certification Scheme Heat Pump Product Certification Requirements document at: http://www.microgenerationcertification.org ;
- The performance of the heat pump system will be monitored post construction to ensure it is achieving the expected performance.

Detailed Assessment of Photovoltaics

Photovoltaics are considered a suitable technology for this development for the following reasons:

- The development has limited availability of exterior space being a basement, however the adjacent residential structures provide an area of roof space available for the installation of PV panels;
- PV arrays are easy to install and maintain when compared to other renewable systems;
- This technology has no impact on local air quality as well as no aesthetic impact on the building from the ground level;
- PV panels provide a significant CO_2 saving.

The PV system shall comprise 120.54 kWp of roof mounted arrays. This size of installation is currently considered the maximum feasible on the space allocated for PV on the roof, subject to change based on the detailed site analysis by the PV specialist at later design stages. The table below summarises the technical data for the proposed PV array and estimated CO_2 savings from the application of this technology.

Table 7.3 Technical Summary of PV Array

Type of roof	Flat roof
kWp of system	120.54 kWp
Panel Wattage	0.41 kW
Pitch of modules relative to horizontal	10°
Orientation	East 70° and West 250°
Area of PV array	574.1 m^2
Estimated annual output of system	100.87 MWh/year
Carbon savings	**12.5 tonnes CO_2/yr (21%)**

The PV installation would produce regulated CO_2 savings of 27% (16.1 tonnes CO_2/year) for the development.

An indicative area for the installation of the PV panels on the adjacent residential structure roof can be seen below in Figure 7.1.

7.2 BE GREEN SUMMARY

The reduction in regulated carbon emissions achieved through the implementation of renewable and low carbon technologies is 27% compared to the 2021 Baseline at this stage and 36% of total cumulative savings at all stages of the energy hierarchy. Table 7.4 below outlines the reduction in CO_2 emissions following the inclusion of 'Be Green' measures.

Table 7.4 Carbon Dioxide Emissions at 'Be Green' Stage.

	Total regulated CO_2 emissions	Regulated CO_2 savings	Percentage saving
	(Tonnes CO_2 per annum)		(%)
Part L 2021 Baseline	60.3	-	-
Be Lean	54.8	5.5	9%
Be Clean	54.8	0	0%
Be Green	38.7	16.1	27%

Figure 7.1 Location of the PV arrays on the roof of the adjacent residential structure (Source: PSH Consulting).

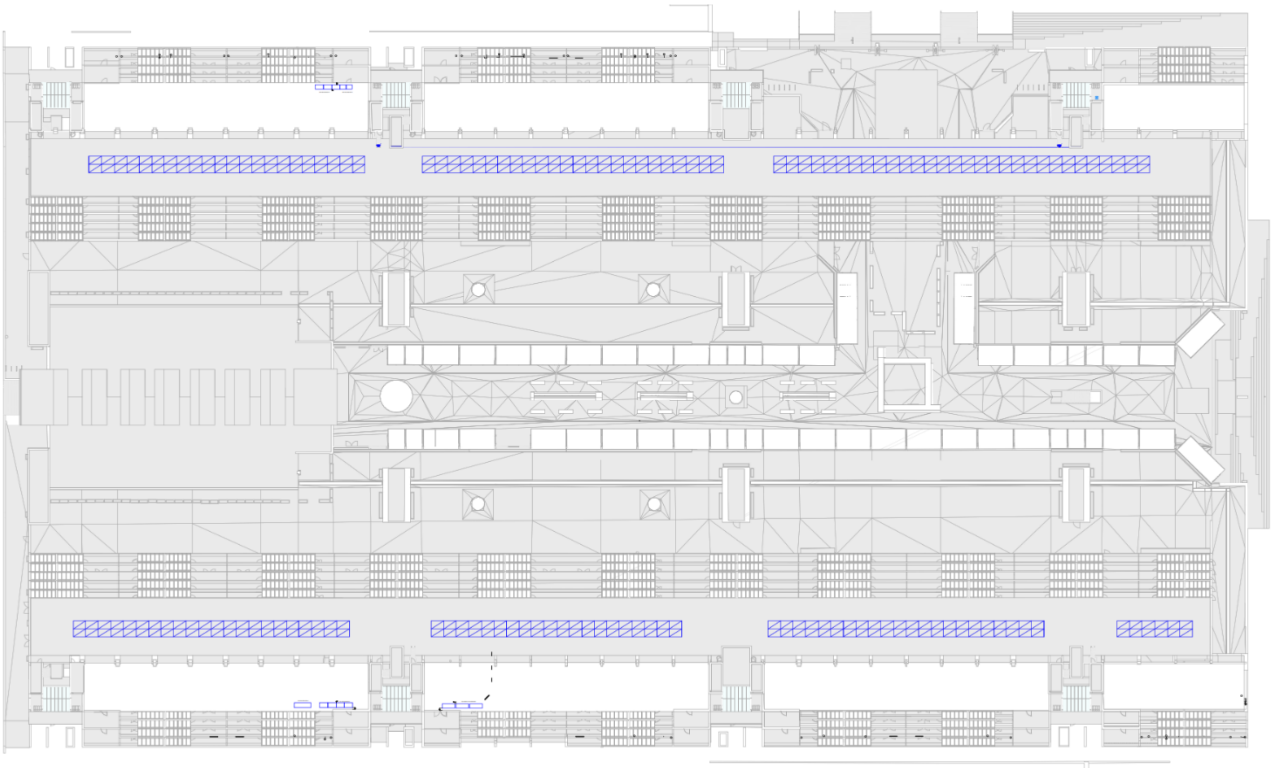


Figure 7.2 Illustration of the PV panel arrangement (Source: PSH Consulting).

8.0 BE SEEN – MONITOR, VERIFY AND REPORT ENERGY PERFORMANCE

The Mayor of London has declared a climate emergency and has set an ambition for London to be net zero-carbon. This means all new buildings must be net zero carbon. The Mayor's London Plan sets the targets and policies required to achieve this. It includes:

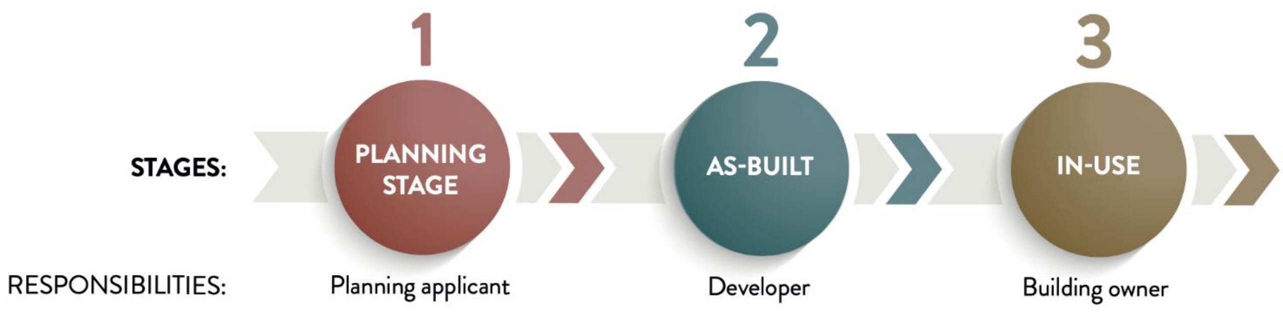
- A net zero-carbon target for all major developments. The Energy Assessment Guidance 2022 explains this requirement further.
- A requirement for all major development to 'Be Seen' i.e., to monitor and report its energy performance post-construction to ensure that the actual carbon performance of the development is aligned with the Mayor's net zero-carbon target. This guidance document explains how to meet this requirement.

To truly achieve net zero-carbon buildings we need to have a better understanding of their actual operational energy performance. Although Part L calculations and Energy Performance Certificates (EPCs) give an indication of the theoretical performance of buildings, it is well established that there is a 'performance gap' between design theory and measured reality.

Estimates of each of the performance indicators listed within the GLA's 'Be Seen' Energy Monitoring Guidance[7] document should be provided at the planning stage. These will be reported to the GLA using the 'Be Seen' spreadsheet.

Additionally, energy performance data will be provided to the GLA at the project completion based on the as-built design data, and annually for the first five years of occupation based on energy metered data, in line with the 'Be Seen' energy monitoring requirements.

Figure 8.1 'Be Seen' process and responsibilities.



9.0 SUMMARY

The energy strategy for the Brunswick Centre has been developed in-line with the energy policies and aspirations of the Greater London Authority (GLA) and the City of London. The GLA Energy Hierarchy has been implemented and the estimated regulated CO_2 savings are 9% at 'Be Lean' stage, 27% at 'Be Green' stage, and 36% cumulative savings measured against a Part L 2021 compliant scheme.

9.1 BE LEAN – USE LESS ENERGY

The Proposed Development has prioritised a reduction in energy demands at the 'Be Lean' stage by specifying a series of passive and active measures to reduce the demand for energy through a high-performance building fabric alongside the specification of highly energy efficient ventilation and lighting.

The 'Be Lean' measures proposed will result in an estimated reduction in regulated CO_2 emissions of 5.5 tCO_2/year, equating to a 9% reduction when compared to the 2021 Baseline emissions rate.

The target 15% reduction has not been achieved given the limitations for introducing further passive measures in a development at basement level and that DHW accounts for most of the proposal's energy demand. If the DHW consumption is excluded from the calculation, the emissions savings obtained in the rest of the energy uses at this stage would reach 25%.

9.2 BE CLEAN – SUPPLY ENERGY EFFICIENTLY

As part of the 'Be Clean' stage of the energy assessment, the potential to connect to an existing or proposed decentralised energy network has been evaluated. It was concluded that no networks were within an appropriate distance for the Proposed Development to seem connection. However, the hot water system could facilitate connection to any heat network brought forward in the future. This will need to be assessed in detail to ensure that the replacement of any existing systems represents a whole-life carbon benefit for the scheme.

9.3 BE GREEN – USE RENEWABLE ENERGY

The 'Be Green' appraisal concluded that most appropriate low or zero carbon technologies to be included are ASHPs for hot water generation and VRF systems for space conditioning. Additionally, the development will incorporate a PV array on the adjacent residential roofs as a means of on-site renewable electricity generation.

The 'Be Green' technologies are predicted to reduce the CO_2 emissions on-site by 16.1 tCO_2/year, equating to a 36% reduction over the 2021 Baseline case.

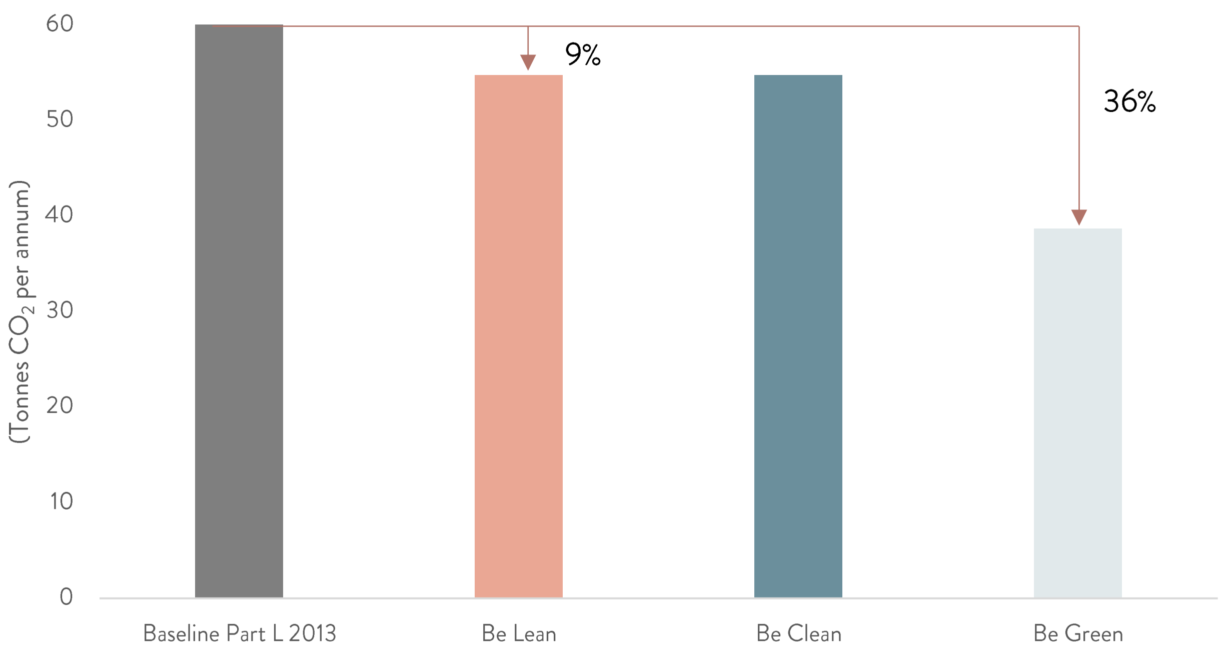
9.4 BE SEEN – MONITOR, VERIFY AND REPORT ENERGY PERFORMANCE

The final element of the strategy 'Be Seen' involves the monitoring and reporting of energy performance post-construction to ensure that the actual carbon performance of the development is aligned with the Mayor's net zero carbon target. The development at Brunswick Centre will be designed with sub-metering to enable post construction monitoring.

Table 9.1 Regulated carbon dioxide emissions and savings from each stage of the Energy Hierarchy.

	Total regulated emissions	CO_2 savings	Percentage saving
	(Tonnes CO_2 per annum)		(%)
Part L 2013 Baseline	60.3	-	-
Be Lean	54.8	5.5	9%
Be Clean	54.8	0	0%
Be Green	38.7	16.1	27%
Total Savings	-	21.6	36%
CO_2 savings off-set (Tonnes CO_2)			
Cumulative savings for off-set payment		1,161	
Cash in-lieu contribution (£) (at £95/ tonne)		£110,301	

Figure 9.1 Regulated carbon dioxide emissions and savings from each stage of the Energy Hierarchy.



9.5 CONCLUSIONS

Table 9.1 above demonstrates the performance of the development at each stage of the energy hierarchy. It summarises the implementation of the Energy Hierarchy for the proposed scheme and detail the CO_2 emissions and savings against the baseline scheme for each step of the hierarchy.

Overall, the Proposed Development has been designed to meet the energy policies and aspirations set out by the GLA and the City of London, which demonstrates the client and the design team's commitment to enhancing the sustainability of the scheme. The overall CO_2 emissions saving obtained including all the proposed measures is 36%, achieving the target minimum 35% reductions on site established by Policy SI 2 of the London Plan.

The 15% reduction target at the Be Lean stage has not been possible to achieve given the given the special characteristics of the proposed development, which will be located in an existing underground space where the opportunities for introducing passive measures are limited. It also needs to be considered that the domestic hot water consumption is the highest energy use in this project and opportunities to reduce demand for this use are also very limited. Therefore, the 9% obtained considering these limitations shows that the proposed efficiency measures are the most suitable for the project.

If the DHW consumption is excluded from the calculation, the emissions savings obtained in the rest of the energy uses from efficiency measures at the Be Lean stage would be 25%, and the overall reduction after the Be Green renewable energy systems would reach 100%.

The estimated energy use intensity (EUI) from the Proposed Development using the 'Be Seen' methodology is 99 kWh/m2/year, which exceeds the EUI for hotels included in Table 4 of the GLA guidance (i.e., 55kWh/m2/year). However, given the stage of the design, a number of assumptions had to be included in the assessment at this point, and some energy uses are difficult to estimate at this stage (e.g., catering, small power in bedrooms, and the proposed circadian lighting). Therefore, the calculations rely on benchmark data or conservative assumptions that may overestimate some energy uses. The assessment can be refined at a later design stage when more accurate information is available and measures can be explored to reduce the EUI.

APPENDIX A - BRUKL DOCUMENTS

BE LEAN BRUKL

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Premier Inn Brunswick - Be Lean

As designed

Date: Thu Jul 06 14:40:36 2023

Administrative information

Building Details

Address: Brunswick House, London,

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.20

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.20

BRUKL compliance module version: v6.1.e.1

Foundation area [m²]: 1000

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	11.06	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	10.05	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	120.31	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	109.39	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	First surface with maximum value
Walls*	0.26	0.15	0.15	B1000117:Surf[2]
Floors	0.18	0.12	0.12	B100011A:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.12	0.12	B100011A:Surf[1]
Windows** and roof windows	1.6	-	-	No windows, galzed doors, or roof windows in building
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	-	-	No personnel doors in building
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

* 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.

*** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m²K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	3

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- VRF+AHU (Be Lean)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.09	12.5	0	1.8	0.9
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

2- Comms split system (Be Lean)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.09	6.4	0	-	-
Standard value	2.5*	5	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

"No HWS in project, or hot water is provided by HVAC system"

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

General lighting and display lighting	**General luminaire**	**Display light source**	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
B1_Bike Store	110	-	-
B1_Bin Store	110	-	-
B1_Cellar	110	-	-
B1_Central St/Lounge Area	110	-	-
B1_Changing Room	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Comms	110	-	-
B1_Cupboard	110	-	-
B1_Cupboard	110	-	-
B1_Cupboard	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m^2]**
Standard value	95	80	0.3
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_F&B	110	100	1.5
B1_Harvesting Tank	110	-	-
B1_Kitchen & Food Store	110	-	-
B1_Linen	110	-	-
B1_Linen	110	-	-
B1_Linen	110	-	-
B1_Linen	110	-	-
B1_Linen	110	-	-
B1_Linen	110	-	-
B1_Luggage	110	-	-
B1_Office	110	-	-
B1_Plant	110	-	-
B1_Plant Circulation	110	-	-
B1_Reception	110	100	1.35
B1_Staircase	110	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
B1_Staircase	110	-	-
B1_Staircase	110	-	-
B1_Staircase	110	-	-
B1_Staircase	110	-	-
B1_Staircase	110	-	-
B1_Team Room	110	-	-
B1_Toilet	110	-	-
B1_UA Bedroom	110	-	-
B1_UA Bedroom	110	-	-
B1_UA Bedroom	110	-	-
B1_UA Bedroom	110	-	-
B1_UA Bedroom	110	-	-
B1_UA Bedroom	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
B1_Central St/Lounge Area	N/A	N/A
B1_Comms	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_F&B	N/A	N/A
B1_Kitchen & Food Store	N/A	N/A
B1_Office	N/A	N/A
B1_Reception	N/A	N/A
B1_Team Room	N/A	N/A
B1_UA Bedroom	N/A	N/A
B1_UA Bedroom	N/A	N/A
B1_UA Bedroom	N/A	N/A
B1_UA Bedroom	N/A	N/A
B1_UA Bedroom	N/A	N/A
B1_UA Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A

Regulation 25A: Consideration of high efficiency 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?	NO
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	5451	5451
External area [m^2]	14961.4	9497.9
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	1986.93	1466.1
Average U-value [W/m^2K]	0.13	0.15
Alpha value* [%]	9.04	10

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
100	**Hotels**
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	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	2.26	3.7
Cooling	0.48	0.92
Auxiliary	4.99	6.78
Lighting	8.46	10.1
Hot water	57.91	59.97
Equipment*	34.17	34.17
TOTAL**	**74.09**	**81.45**

* 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
Displaced electricity	*0*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	36.14	52.26
Primary energy [kWh_{PE}/m^2]	109.39	120.31
Total emissions [kg/m^2]	10.05	11.06

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] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	33.2	17.5	3.3	0.6	7.3	2.78	8.58	3.09	12.5
	Notional	54.2	20.2	5.4	1.2	9.5	2.78	4.63	----	----
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	0	893.2	0	51.9	0	2.78	4.78	3.09	6.4
	Notional	0	859.7	0	51.6	0	2.78	4.63	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	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

BE GREEN BRUKL

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Premier Inn Brunswick - Be Green

As designed

Date: Thu Jul 06 13:19:48 2023

Administrative information

Building Details

Address: Brunswick House, London,

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.20

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.20

BRUKL compliance module version: v6.1.e.1

Foundation area [m²]: 1000

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	11.06	
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	7.1	
Target primary energy rate (TPER), kWh_{PE}/m^2.annum	120.31	
Building primary energy rate (BPER), kWh_{PE}/m^2.annum	75.61	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.15	0.15	B1000117:Surf[2]
Floors	0.18	0.12	0.12	B100011A:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.12	0.12	B100011A:Surf[1]
Windows** and roof windows	1.6	-	-	No windows, galzed doors, or roof windows in building
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	-	-	No personnel doors in building
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

* 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.

*** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m²K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	3

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- VRF+AHU (Be Green)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.5	12.5	0	1.8	0.9
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

2- Comms split system (Be Green)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.1	6.4	0	-	-
Standard value	2.5*	5	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

"No HWS in project, or hot water is provided by HVAC system"

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

General lighting and display lighting	**General luminaire**	**Display light source**	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
B1_Bike Store	110	-	-
B1_Bin Store	110	-	-
B1_Cellar	110	-	-
B1_Central St/Lounge Area	110	-	-
B1_Changing Room	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Comms	110	-	-
B1_Cupboard	110	-	-
B1_Cupboard	110	-	-
B1_Cupboard	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_F&B	110	100	1.5
B1_Harvesting Tank	110	-	-
B1_Kitchen & Food Store	110	-	-
B1_Linen	110	-	-
B1_Linen	110	-	-
B1_Linen	110	-	-
B1_Linen	110	-	-
B1_Linen	110	-	-
B1_Linen	110	-	-
B1_Luggage	110	-	-
B1_Office	110	-	-
B1_Plant	110	-	-
B1_Plant Circulation	110	-	-
B1_Reception	110	100	1.35
B1_Staircase	110	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
B1_Staircase	110	-	-
B1_Staircase	110	-	-
B1_Staircase	110	-	-
B1_Staircase	110	-	-
B1_Staircase	110	-	-
B1_Team Room	110	-	-
B1_Toilet	110	-	-
B1_UA Bedroom	110	-	-
B1_UA Bedroom	110	-	-
B1_UA Bedroom	110	-	-
B1_UA Bedroom	110	-	-
B1_UA Bedroom	110	-	-
B1_UA Bedroom	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-

General lighting and display lighting

	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Ensuite Bedroom	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-
B1_Circulation	110	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
B1_Central St/Lounge Area	N/A	N/A
B1_Comms	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_F&B	N/A	N/A
B1_Kitchen & Food Store	N/A	N/A
B1_Office	N/A	N/A
B1_Reception	N/A	N/A
B1_Team Room	N/A	N/A
B1_UA Bedroom	N/A	N/A
B1_UA Bedroom	N/A	N/A
B1_UA Bedroom	N/A	N/A
B1_UA Bedroom	N/A	N/A
B1_UA Bedroom	N/A	N/A
B1_UA Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A
B1_Ensuite Bedroom	N/A	N/A

Regulation 25A: Consideration of high efficiency 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?	NO
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	5451	5451
External area [m^2]	14961.4	9497.9
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	1986.93	1466.1
Average U-value [W/m^{2}K]	0.13	0.15
Alpha value* [%]	9.04	10

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
100	**Hotels**
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	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	1.35	3.7
Cooling	0.48	0.92
Auxiliary	5.3	6.78
Lighting	8.46	10.1
Hot water	53.79	59.97
Equipment*	34.17	34.17
TOTAL**	**69.38**	**81.45**

* 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	18.33	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*18.33*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	36.14	52.26
Primary energy [kWh$_{PE}$/m^2]	75.61	120.31
Total emissions [kg/m^2]	7.1	11.06

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] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	0	893.2	0	51.9	0	4.02	4.78	4.1	6.4
	Notional	0	859.7	0	51.6	0	2.78	4.63	----	----
[ST] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	33.2	17.5	2	0.6	7.3	4.66	8.58	4.5	12.5
	Notional	54.2	20.2	5.4	1.2	9.5	2.78	4.63	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	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

REFERENCES

[1] *GLA, (2020), The New London Plan: Spatial Development Strategy for Greater London. Greater London Authority.*

[2] *HM Government, (2021), The Building Regulations 2010: Conservation of fuel and power. Approved Document. Part L. Volume 2: Buildings other than dwellings. [Available online]:* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1082463/ADL2_revised.pdf

[3] *GLA, (2022), Energy Assessment Guidance. [Available online]:* https://www.london.gov.uk/sites/default/files/gla_energy_assessment_guidance_june_2022_0.pdf

[4] *GLA, (2020), The New London Plan: Spatial Development Strategy for Greater London. Greater London Authority.*

[5] *HM Government, (2021), The Building Regulations 2010: Conservation of fuel and power. Approved Document. Part L. Volume 1: Dwellings.*

[6] *GLA, (2022), Energy Assessment Guidance.*

[7] *GLA, (2021), London Plan Guidance Documents. 'Be Seen' energy monitoring guidance. [Available online]:* https://www.london.gov.uk/sites/default/files/be_seen_energy_monitoring_london_plan_guidance_2021.pdf