chapmanbdsp

Unit 4, Silverdale Industrial Estate
Silverdale Road, Hayes
UB3 3BL

Energy Statement

Revision 02
October 2024
Ref: 62116

62116 – Unit 4, Silverdale Industrial Estate

Energy Statement

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Confidentiality and Third-Party Responsibility

Revision Table

Rev	Date	Section	Amendment(s)
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0 Executive summary

This Energy Statement has been prepared by chapmanbdsp to accompany a full planning application for the redevelopment of Unit 4, Silverdale Industrial Estate, Hayes to provide a data centre development. The application is submitted on behalf of Marvell Developments LLC.

It has been developed in response to the client brief, available Stage 2 (Scheme Design) MEP and architectural design information and discussions during the BREEAM Pre-Assessment meeting held with the design team on 09th of September 2024.

Sustainability meetings carried out to date:

- BREEAM Introduction – 17th July 2024
- Applicant's Sustainability Meeting -23rd July 2024
- BREEAM Workshop – 9th September 2024

The Proposed Development is for the *"Demolition of the existing building and structures on site, and all other associated site clearance works. Construction of a data centre building (Class B8) with plant at roof level with an emergency generator (1no.) and associated flue (provided within an external compound adjoining the data centre building), sprinkler tank and pumphouse, security guard house, and provision of one kiosk substation and MV Building. The development also comprises the construction of a new access and internal road and circulation areas, footpaths, provision of car and bicycle parking, hard and soft landscaping and other associated works and ancillary site infrastructure".*

The Proposed Development seeks to provide a development capable of year-round comfort with minimal energy consumption and resultant carbon emissions. Hillingdon Council requests that Policy DMEI 2: Reducing Carbon Emissions is followed for all developments. This includes:

A. All Developments are required to make the fullest contribution to minimising carbon dioxide emissions in accordance with London Plan targets.
B. All major development proposals must be accompanied by an energy assessment showing how these reductions will be achieved
C. Proposals that fail to take reasonable steps to achieve the required savings will be resisted. However, where it is clearly demonstrated that the targets for carbon emissions cannot be met onsite, the council may approve the application and seek an off-site contribution to make up for the shortfall.

As per item A, the Proposed Development's design has been developed in line with the Greater London Authority's (GLA) energy hierarchy, i.e. being 'lean, clean, green and seen', relevant National regulations, and the London Plan (2021) Stand-out targets include:

- A 15% reduction in regulated CO_2 emissions through energy efficiency measures alone (Be Lean), below those of a development compliant with Part L 2021 of the Building Regulations.
- A 35% reduction in regulated carbon emissions beyond Part L 2021 for non-residential development through on-site measures.
- Maximising the provision of on-site renewables and offsetting the outstanding carbon emissions through offsite measures via cash in lieu contribution.
- Monitoring and verifying predicted energy performance through GLA's online portal.

Additionally, the Proposed Development will target:

- Minimised overheating risk in line with CIBSE TM52 guidance.
- Achieving a minimum 'Excellent' rating under the Data Centres 2010 BREEAM assessment.

While the above targets form the overarching framework that is followed in the preparation of this statement, a recognition exists that under Part L 2021, it is more challenging for non-residential developments to achieve the carbon-saving requirements outlined in the London Plan 2021. This has been acknowledged by the cover note accompanying the updated Energy Assessment Guidance (June 2022). The cover notes states that:

"Initially, non-residential developments may find it more challenging to achieve significant on-site carbon reductions beyond Part L 2021 to meet both the energy efficiency target and the minimum 35 per cent improvement. This is because the new Part L baseline now includes low-carbon heating for non-residential developments but not for residential developments. However, planning applicants will still be expected to follow the energy hierarchy to maximise carbon savings before offsetting is considered."

It continues to advise that:

"Over time it is expected that performance against Part L 2021 will improve to enable these developments to achieve closer alignment with the energy efficiency targets and the minimum 35 per cent on-site improvement due to technological improvements and as costs come down. We will monitor this progress and may update the benchmarks to reflect these improvements as appropriate. In the intervening period, applicants should continue to aim to maximise on-site carbon reductions as far as possible."

It is therefore considering these guidelines that this statement reports on energy and carbon characteristics of the Proposed Development.

Energy Strategy Summary

'Be Lean' – Reduce energy demand

The design approach targets demand reduction measures first, giving priority to the optimisation of building fabric to reduce the need for energy use in the first instance. The objective is to have a building that is as energy-efficient (i.e. 'lean') as possible without relying on overly complicated systems or technologies to deliver low carbon performance. The typology and use case of the Proposed Development limits the scope of external glazing and opening enhancements which can be made. However, several improvements have been implemented across the fabric elements.

Key passive design features include:

- High levels of envelope insulation to reduce energy demand.
- Optimised façade design to mitigate overheating risk and reduce cooling demand whilst maximising daylight to reduce the use of artificial lighting.
- External solar shading with solar control glass to help reduce unwanted solar gains where present in staff areas.
- High levels of airtightness, reducing heat loss and mitigating drafts.

After the passive approach outlined above, the following energy-efficient plant is proposed:

- High-efficiency mechanical ventilation systems with heat recovery.
- Low energy lighting throughout with daylight and occupant detection, where possible.
- System controls and diagnostics systems to operate the building effectively.
- Metering and sub-metering to monitor energy use and by dwelling, enabling energy use and occupant behavioural learnings and subsequent adjustments to improve building energy demand post-occupancy.

Detailed dynamic modelling has demonstrated the optimised design can mitigate overheating in line with CIBSE TM52. Testing has confirmed that the strategy can mitigate overheating risk sufficiently during a 1 in 3-year heatwave that might occur in the 2020-2040 period (DSY1).

‘Be Clean’ – Supply energy efficiently

A study of London Heat Map was carried out to identify district energy networks in proximity to the Site. The study shows that the existing E.ON DGV network is approximately 3,400 meters away from the Proposed Development. It is not expected that the existing heat network will extend to the proximity of the Site. The nearest proposed Site is labelled as legacy and is around 471 meters away from the Site.

Due to the use type and systems installed in the data centre, it is not expected that large volumes of heat will be required for the Proposed Development.

‘Be Green’ – Maximise renewable energy

An Air Source Heat Pump (ASHP) system has been identified as the most efficient and appropriate technology for the scheme to supply cooling and heating, while the Domestic Hot Water (DHW) demand of the Proposed Development will be provided via instantaneous hot water heater. This will contribute as renewable technology for the Proposed Development. In addition, a PV array has been proposed on the roof of the Proposed Development to provide on-site renewable energy generation. The PV system covers an area of 39m^2. Additional details regarding the systems sizing can be found in Appendix 12.4.

‘Be Seen’ – Energy monitoring

Advancement and commercialisation of smart technologies present additional opportunities to manage and save energy. The following features will be considered during the detailed design to enable a successful energy monitoring process:

- Power, data and media infrastructure to deliver buildings which are smart enabled for future connectivity by occupants.
- Smart metering will support the operational energy monitoring requirements (be seen).

Predicted Carbon Emissions Summary

In summary, the Site proposals seek to maximise on-site carbon reductions in line with the GLA energy hierarchy, limiting energy use in the first instance and selecting energy-efficient plant and building services thereafter.

Overall, the Proposed Development could be expected to achieve a 12% reduction in regulated carbon emissions over Part L 2021. This overall figure breaks down into regulated carbon emissions reductions of 1% at the ‘Be Lean’ stage, and 11% at the ‘Be Green stage.

The breakdown in on-site savings is shown in Table 0-1 and Table 0-2.

	Carbon Dioxide Emissions for the Proposed Development (Tonnes CO_2 per annum)		
	Regulated	Unregulated	Total
Part L 2021 compliant building	173.5	452.2	625.8
Be Lean	168.1	452.2	620.3
Be Clean	168.1	452.2	620.3
Be Green	152.8	452.2	605.0

Table 0-1: CO_2 emissions of the Proposed Development at each stage of the energy hierarchy

	Regulated carbon dioxide savings for the Proposed Development	
	(Tonnes CO_2 per annum)	(%)
Be Lean: savings from energy demand reduction	5.5	3%
Be Clean: savings from heat network	0.0	0%
Be Green: savings from renewable energy	15.2	9%
Total Cumulative Savings	**20.7**	**12%**
Annual savings from off-set payment	152.8	-

Cumulative savings for off-set payment	4,585 tonnes CO_2
Cash in-lieu contribution (£)	434,604

Table 0-2: CO_2 savings for the Proposed Development at each stage of the energy hierarchy

The remaining regulated carbon dioxide emissions, to 100%, are to be offset through a cash-in-lieu contribution to Hillington Council. Hence, the remaining 152.8 tonnes of CO_2 per annum is to be paid through a cash in lieu-contribution of £434,604 as calculated by the GLA’s Part L 2021 carbon emission spreadsheet (Appendix 12.1).

In conclusion, through a combination of passive design measures and low-carbon systems design, the Proposed Development could be expected to achieve a 12% reduction in regulated carbon emissions over Part L 2021. This overall figure breaks down into regulated carbon emissions reductions of 3% at the ‘Be Lean’ stage, and 9% at the ‘Be Green’ stage. The remaining regulated carbon dioxide emissions, to 100 per cent, are to be offset through a cash-in-lieu contribution of £435,604 to Hillington Council.

1 Introduction

This Energy Statement has been prepared by chapmanbdsp to accompany a full planning application for the redevelopment of Unit 4, Silverdale Industrial Estate, Hayes to provide a data centre development. The application is submitted on behalf of Marvell Developments LLC.

The proposal is for the *"Demolition of the existing building and structures on site, and all other associated site clearance works. Construction of a data centre building (Class B8) with plant at roof level with an emergency generator (1no.) and associated flue (provided within an external compound adjoining the data centre building), sprinkler tank and pumphouse, security guard house, and provision of one kiosk substation and MV Building. The development also comprises the construction of a new access and internal road and circulation areas, footpaths, provision of car and bicycle parking, hard and soft landscaping and other associated works and ancillary site infrastructure".*

The following pages summarise the outcome of a collaborative design exercise carried out through RIBA stages 1-2 to address the requirements of national, regional, and local planning guidelines concerning the conservation of fuel and power, but also enable a holistic design that provides comfort and resilience to climate change throughout the life of the development.

1.1 Site location and the Proposed Development

The Site is located at Unit 4, Silverdale Industrial Estate, Silverdale Road, Hayes UB3 3BL.

The Proposed Development seeks to provide the following Gross External Area (GEA) values:

Use	Sq. meters
Ground Floor	944
First Floor	782
Roof penthouses	52
Security hut	27
Sprinkler Pumphouse	88
MV Building	21
Total GEA	**1,914**

Table 1-1: The GEA values of the Proposed development

For further details please refer to the Design and Access Statement.

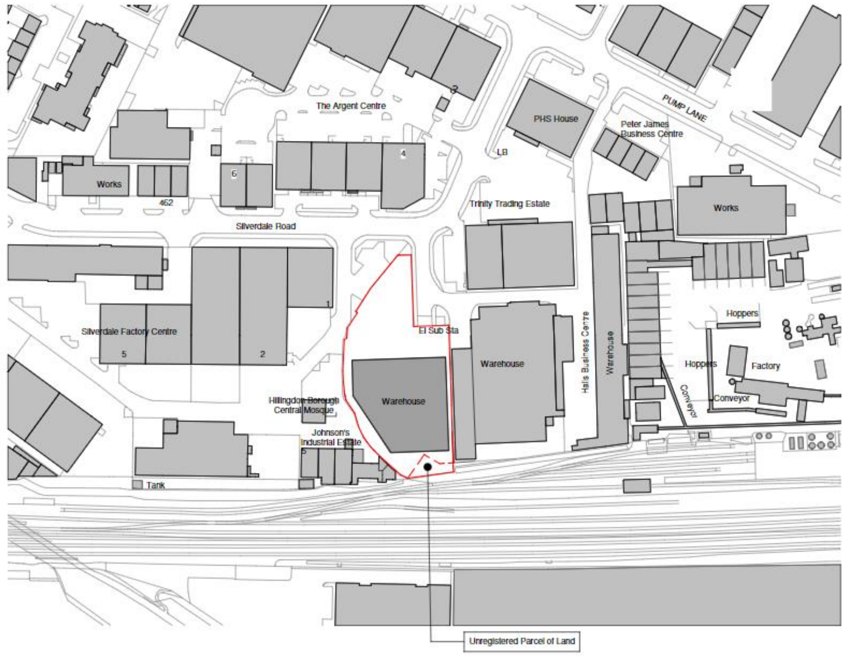


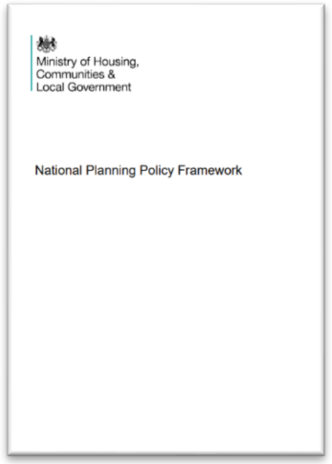
Figure 1-1: The Proposed Development Site and surrounding context (MCA Architects).

Figure 1-2: Illustrative views of the Proposed Development (MCA Architects).

Figure 1-3: Illustrative views of the Proposed Development (MCA Architects).

2 Sustainability drivers

2.1 National Planning Policy Framework (NPPF) (December 2023)



The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally-prepared plans for housing and other development can be produced. Planning law requires that applications for planning permission be determined in accordance with the development plan unless material considerations indicate otherwise. The NPPF must be taken into account in preparing the development plan and is a material consideration in planning decisions. Planning policies and decisions must also reflect relevant international obligations and statutory requirements.

The purpose of the NPPF is to contribute to the achievement of sustainable development. At a very high level, the objective of sustainable development can be summarised as meeting the needs of the present without compromising the ability of future generations to meet their own needs. Achieving sustainable development means that the planning system has three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways:

a) An economic objective – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure.

b) A social objective – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering a well-designed and safe built environment, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being.

c) An environmental objective – to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

This Energy Statement has been developed in line with the NPPF and alongside the suite of documents submitted as part of this application fulfils the requirements of the NPPF.

2.1.1 The Building Regulations Approved Document Part L 2021 (with 2023 amendments)

Part L of the Building Regulations is the mechanism by which the Government is driving reductions in the regulated CO_2 emissions from new buildings.

Part L2 2021 considers 12 sections which must be satisfied as follows:

Section 1: Calculating the target primary energy rate and target emission rate
The first section of the AD L2 states that "A new building must be built to a minimum standard of total energy performance. This is evaluated by comparing calculations of the performance of the 'actual building' against calculations of the performance of a theoretical building, called the 'notional building'. This must be carried out both at the design stage and when work is complete."

The energy performance of the notional building is described by the Target Primary Energy Factor ($kgCO_2/(m^2.yr)$) and by the Target Emission Rate ($kgCO_2/(m^2.yr)$). These two values shall be assessed using a calculation tool in the approved methodology. This can be either Simplified Building Energy Model (SBEM) or any other software approved under the Notice of Approval.

Section 2: Calculating the building primary energy rate and building emission rate
This section states that the same tool used to assess CO_2 emissions shall be used to assess the Target Primary Energy Rate – TPER, the Target Emission Rate – TER, the Building Primary Energy Rate – BPER, the Building Emission Rate – BER.

The above shall be assessed before works start using design values and when the work is complete using figures for the building as built, including any occurred changes and the measured tested air permeability.
At both stages the following must be achieved: BER<TER and the BPER<TPER

Section 3: Consideration of high-efficiency alternative systems
The building regulation asks to analyse the technical, environmental and economic feasibility of using high-efficiency alternative systems in the building design, before building work starts on a new non-domestic building. BCB – building control body shall be notified and the output available to be verified.

Section 4: Limiting heat gains and losses
The section focuses on U-values which shall be assessed using conventions and method set out in BR443, on Limiting standards for new or replacement elements and Limiting standards for renovated and retained elements which shall not be less than those specified in tables 4.1 & 4.2. These cover continuity of insulation, airtightness in existing buildings, limiting the effects of solar gains in summer, limiting heat losses and gains from building services.

Section 5: Minimum building services efficiencies and controls – general guidance
This section states that for each new fixed building service in a new or existing building, the efficiency shall not be lower than those stated in section 6 tables. Efficiencies shall be based on the appropriate test standard and the test data should be certified by a notified body.

Section 6: System specific guidance
This section sets out minimum standards for specific types of building services. These efficiencies are set out based on documented manufacturers' test data. Equipment should be designed, specified and installed with the aim of maximising its efficiency when installed.

Section 7: Air permeability and pressure testing
It is mandatory to meet the minimum standard for air permeability in new buildings. This should be supported with evidence, in particular that the test equipment has been calibrated using a UKAS-accredited facility. This shall be reported to the BCB – Building Control Body.

Section 8: Commissioning
Fixed building services must be commissioned with the aim of ensuring that no more fuel and power than reasonable is used and in-use performance is optimised. A commissioning manager shall be appointed for large complex buildings and their competency shall meet the minimum requirement set out under CIBSE Commissioning Code M.

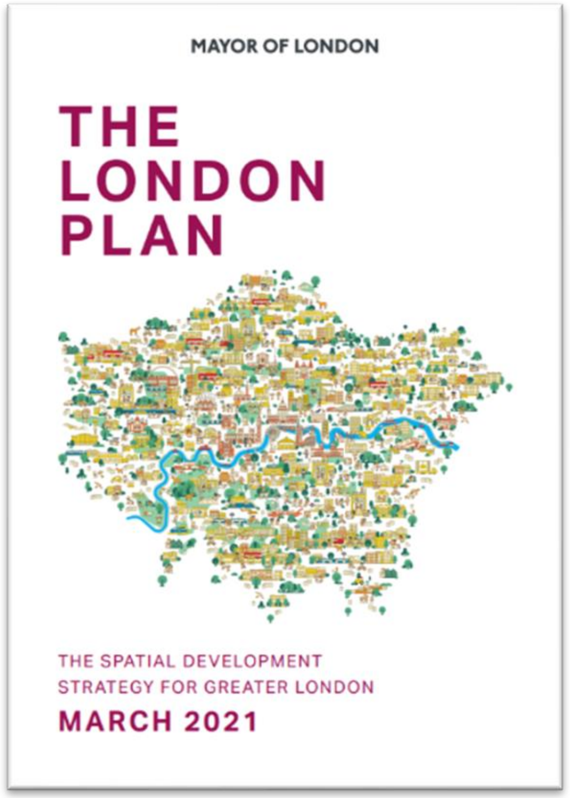
Section 9: Providing information
This section outlines how O+M operations and maintenance instructions log book (compliance with CIBSE TM31 guidance) should be provided to building users/operators.

Section 10: New elements in existing buildings, including extensions
This guidance covers new or replacement thermal elements (opaque envelope, windows, doors, rooflights, etc.), for extending an existing building (i.e., adding a conservatory, extension, porch, etc.).

Section 11: Work to fabric elements in existing buildings
This is a guidance for renovations of existing elements, making a change of use or any other change that constitutes a change to energy status in existing buildings.

Section 12: Consequential improvements
This section refers to existing buildings with a total useful area of over 1000 sqm, and it concerns overall energy efficiency improvement if the proposed work consists of an extension, a provision of fixed building services for the first time, or an increase in their capacity. Consequential improvements are to ensure that the entire building complies with part L of Building Regulations.

2.2 The London Plan (2021)



The London Plan 2021 is the Spatial Development Strategy for Greater London. It sets out a framework for how London will develop over the next 20-25 years and the Mayor's vision for Good Growth.

The Plan is part of the statutory development plan for London, meaning that the policies in the Plan should inform decisions on planning applications across the capital. The following provides a high-level summary of the policies affecting this Energy Statement.

Policy GG6 – Increasing efficiency and resilience

To help London become a more efficient and resilient city:

- Improve energy efficiency, move towards a low carbon, circular economy and target a zero-carbon city by 2050; and
- Ensure buildings and infrastructure are designed to adapt to a changing climate, making efficient use of water, reducing the impact from natural hazards such as flooding and heatwaves, while mitigating against the urban heat island effect.

Policy SI2 – Minimising greenhouse gas emissions

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:

- Be Lean: use less energy and manage demand during operation.
- Be Clean: exploit local energy resources and supply energy efficiently and cleanly.
- Be Green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site.
- Be Seen: monitor, verify and report on energy performance.

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.

- Policy SI2 is summarised in Figure 2-1 below:

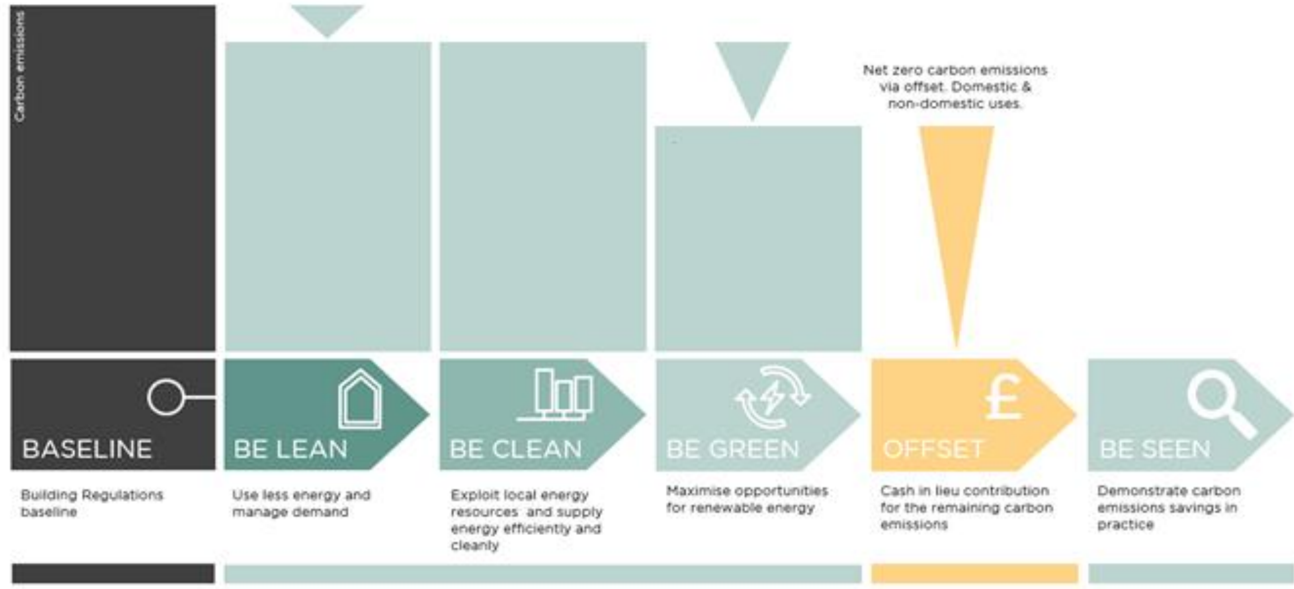


Figure 2-1: The Energy Hierarchy with associated London Plan 2021 regulated carbon emissions targets.

Policy SI3 – Energy infrastructure

Boroughs and developers should engage at an early stage with relevant energy companies and bodies to establish the future energy and infrastructure requirements arising from large-scale development proposals such as Opportunity Areas, Town Centre's, other growth areas or clusters of significant new development.
Major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system:

- The heat source for the communal heating system should be selected in accordance with the following heating hierarchy:
- Connect to local existing or planned heat networks.
- Use zero-emission or local secondary heat sources (in conjunction with heat pump, if required).
- 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.
- Use ultra-low NOx gas boilers.
- CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements of policy SI1 – Improving air quality; and
- 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.

Policy SI4 – Managing heat risk

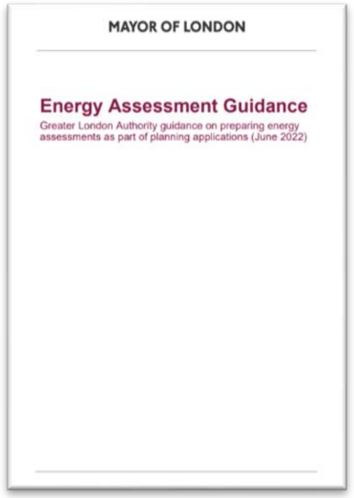
Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials, and the incorporation of green infrastructure.

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:

- Reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation, and the provision of green infrastructure.
- Minimise internal heat generation through energy-efficient design.

- Manage the heat within the building through exposed internal thermal mass and high ceilings.
- Provide passive ventilation.
- Provide mechanical ventilation.
- Provide active cooling systems in a way that utilises rejected heat locally.

2.2.1 GLA Energy assessment guidance 2022



In June 2022, the GLA published an updated version of the Energy Assessment Guidance, and a cover note to address the update in Building Regulations. This GLA guidance note provides further details on how to prepare an energy assessment to accompany strategic planning applications as set out in London Plan Policy SI 2.

Within this guidance, it acknowledges that under Part L 2021, it is more challenging for non-residential developments might to achieve the carbon saving requirements outlined in the London Plan 2021.

The cover notes states that:

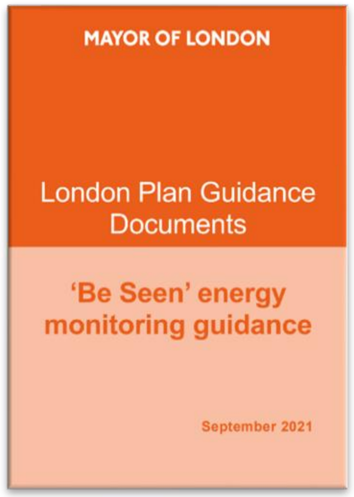
"Initially, non-residential developments may find it more challenging to achieve significant on-site carbon reductions beyond Part L 2021 to meet both the energy efficiency target and the minimum 35 per cent improvement. This is because the new Part L baseline now includes low carbon heating for non-residential developments but not for residential developments. However, planning applicants will still be expected to follow the energy hierarchy to maximise carbon savings before offsetting is considered."

It continues to advise that:

"Over time it is expected that performance against Part L 2021 will improve to enable these developments to achieve closer alignment with the energy efficiency targets and the minimum 35 per cent on-site improvement due to technological improvements and as costs come down. We will monitor this progress and may update the benchmarks to reflect these improvements as appropriate. In the intervening period applicants should continue to aim to maximise on-site carbon reductions as far as possible."

The energy assessment carried out for the Proposed Development follows the principles of the GLA Energy Assessment Guidance and the associated cover note.

2.2.2 GLA 'Be Seen' Energy Monitoring Guidance 2021

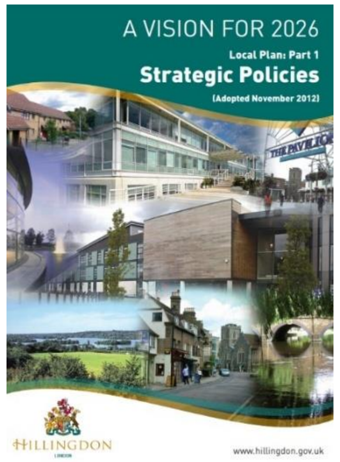


The 'Be Seen' energy monitoring guidance explains how developers and owners of new major developments should monitor and report actual operational energy performance to comply with London Plan Policy SI 2, i.e. the 'be seen' element of the energy hierarchy.

It sets out what each responsible party needs to do to comply with the policy from the inception stage of a development to full occupancy. It provides information on the reporting templates applicants will need to use to report and explains how and when to report to the GLA.

2.3 Local Planning Policy

2.3.1 Part 1 – Strategic Policies (Adopted November 2012)



The Hillingdon Council adopted the Hillingdon Local Plan: Part 1 – Strategic Policies in November 2012, which contains the planning vision and strategy for the Borough. With the ambition to be an attractive and sustainable borough, the Council addressed climate change mitigation at every stage of the development process.

In particular to energy, under Policy EM1: Climate Change Adaptation and Mitigation, the Council ensures that the following are addressed at each development stage:

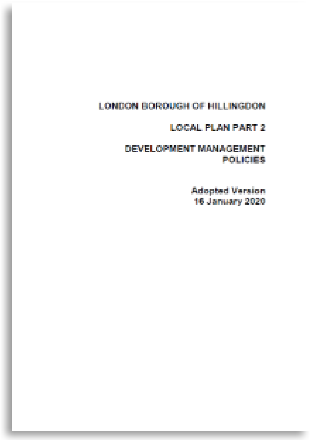
5. Promoting the use of decentralised energy within large scale development whilst improving local air quality levels.

6. Targeting areas with high carbon emissions for additional reductions through low carbon strategies. These strategies will also have an objective to minimise other pollutants that impact on local air quality. Targeting areas of poor air quality for additional emissions reductions.

8. Encouraging the installation of renewable energy for all new development in meeting the carbon reduction targets savings set out in the London Plan. Identify opportunities for new sources of electricity generation including anaerobic digestion, hydroelectricity and a greater use of waste as a resource.

14. Promoting the inclusion of passive design measures to reduce the impacts of urban heat effects.

2.3.2 Part 2 – Development management policies (January 2020)



The Development Management Policies document forms part of Hillingdon's Local Plan Part 2. Its purpose is to provide detailed policies that will form the basis of the Council's decisions on individual planning applications. The Environmental Protection and Enhancement includes the following: The London Plan 2016 Policy 5.2: Minimising carbon dioxide emissions sets out targets for carbon emissions reduction to be met by major development proposals. These targets are expressed as minimum improvements over the 'Target Emission Rate' outlined in the national 2013 Building Regulations and are as follows:

<u>Non-residential Development</u>

- 2013 – 2016: 35 per cent
- 2016 – 2019: As per building regulations requirements
- 2019 onwards: Zero carbon

3 Establishing baseline CO_2 emissions

The following section presents the baseline CO_2 emissions or Target Emissions Rate (TER). This establishes the Building Regulations baseline from which performance against the London Plan 2021 targets can be measured.

3.1 Software and modelling information

To establish this baseline, energy modelling has been completed using the approved software IES-VE 2023.

The Proposed Development has been modelled in full, with all proposed uses appropriately zoned with internal conditions in line with the National Calculation Methodology (NCM), providing an accurate representation of the proposal.

3.2 Methodology

The baseline for the Proposed Development is the 'notional building' according to Part L 2021 of the Building Regulations. For data halls, Part L states that data centres should be allocated an activity class of 'Others-miscellaneous 24hr activities' to account for high internal gains from equipment and transient occupancy over twenty-four hours.

3.3 Baseline fabric performance

The table below summarises the fabric parameters used by the baseline, by Part L2 2021.

Building element	Thermal performance
External walls W/(m^2.K)	0.18
Roof W/(m^2.K)	0.15
Floor W/(m^2.K)	0.15
Window W/(m^2.K)	1.40
Glazing g-value	0.29
Air permeability	5 m^3/(m^2.hr) @ 50 Pa

Table 3-1: Fabric performance for the notional building elements

3.4 Baseline building services systems

System types and efficiencies of the notional building are outlined in NCM Modelling Guide 2021, and can be found in the table below:

System	Notional Building
Space heating (%)	264
DHW (%)	100
Cooling (%)	440
Ventilation	
Central ventilation SFP (W/l/s)	2.8
Heat recovery (%)	76
Lighting efficacy lm/W	95

Table 3-2: Building services systems of the notional building

3.5 Baseline CO_2 emissions

In line with the latest GLA Energy Assessment Guidance, the calculations presented in this report are based on the SAP 10.2 carbon factors. Baseline carbon emissions for the Proposed Development are summarised below.

	Carbon Dioxide Emissions for the Proposed Development (Tonnes CO_2 per annum)		
	Regulated	Unregulated	Total
Part L 2021 compliant building	173.6	452.2	625.8
Be Lean	-	-	-
Be Clean	-	-	-
Be Green	-	-	-

Table 3-3: Baseline non-domestic CO_2 emissions of the energy hierarchy

The BRUKL document for the Proposed Development can be found in Appendix 12.2. The GLA Carbon Emissions Reporting Spreadsheet v2.0.0 has been submitted as a separate document to accompany this Energy Statement.

4 Demand reduction (Be Lean)

In line with the Energy Hierarchy, the design approach for the Proposed Development has prioritised passive design and energy efficiency measures to limit energy use, as not using energy in the first instance is the best way to reduce energy consumption.

Passive building design is focused on reducing both the duration and intensity of periods requiring active heating or cooling to provide year-round thermal comfort.

Where systems do require energy to operate, selecting energy-efficient plant and services reduces energy consumption as much as possible.

However, designing energy-efficient buildings can lead to overheating risks if not properly considered. To avoid this, dynamic modelling of overheating risk was carried out in parallel to provide a holistic design solution.
The following sections summarise the passive design and energy efficiency measures proposed to reduce operational carbon emissions and mitigate overheating risk.

4.1 Passive design measures

Key passive design measures incorporated in the project include:

- Solar control glass (G-value of 0.32) to limit solar gain, whilst also enabling good light transmittance (VLT 67%) which contributes to good internal daylight, reducing artificial lighting. This will apply mainly to the staff areas where the benefit is best realised. The data halls will be kept free from glazing.
- Efficient fabric performance, see the further information on the following table.
- Thermal bridging mitigated in design detailing wherever possible to limit heat loss.
- High levels of airtightness (target air permeability 3 m^3/m^2.h @50Pa for the admin spaces and 5 m^3/m^2.h @50Pa for the rest of building), reducing heat loss and mitigating drafts.
- Orientation ensures that the south-facing elements of the building are minimised.

  Building form has been kept simplified to reduce heat loss perimeters.

4.1.1 Building fabric

The target fabric performance for the Proposed Development is presented in the table below.

Parameters		Units	Non-domestic		
			Part L limit	Office/Admin spaces/Security Hut Proposed (thermal line envelope)	Rest of building/Technical space (thermal line)
External walls		$W/(m^2K)$	0.26	0.15	0.18
Exposed & ground floors		$W/(m^2K)$	0.18 (new or replacement)	0.15	0.15
Exposed roof		$W/(m^2K)$	0.18 (flat) 0.16 (pitched)	0.12	0.15
Windows (incl. glazing and frame)	U-Value	$W/(m^2K)$	1.60	1.3	N/A
	g-value	%	0.48	0.32	N/A
	Light transmittance	%	-	67%	N/A
Door (fully glazed)		$W/(m^2K)$	1.6	1.4	N/A
Air permeability rate		m^3/m^2.hr @50Pa	8	3	5

Table 4-1: Fabric performance parameters for the Proposed Development

In addition to the above fabric values, it is proposed that the internal wall separating the data hall from the office space should be a high-performing wall, i.e. with U-value of 0.20W/(m^2K).

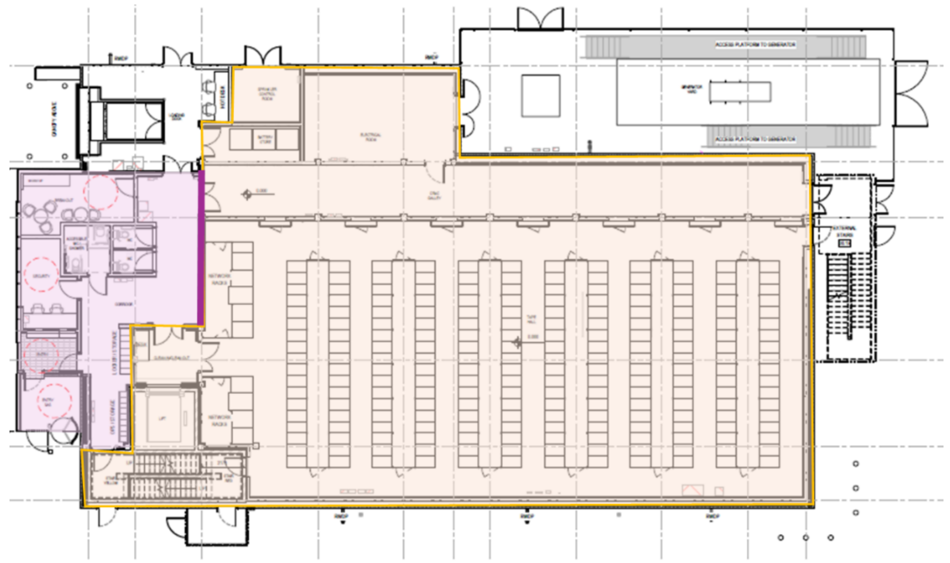


Figure 4-1. Ground floor Data centre – Office thermal line (proposed in purple, technical space in orange)

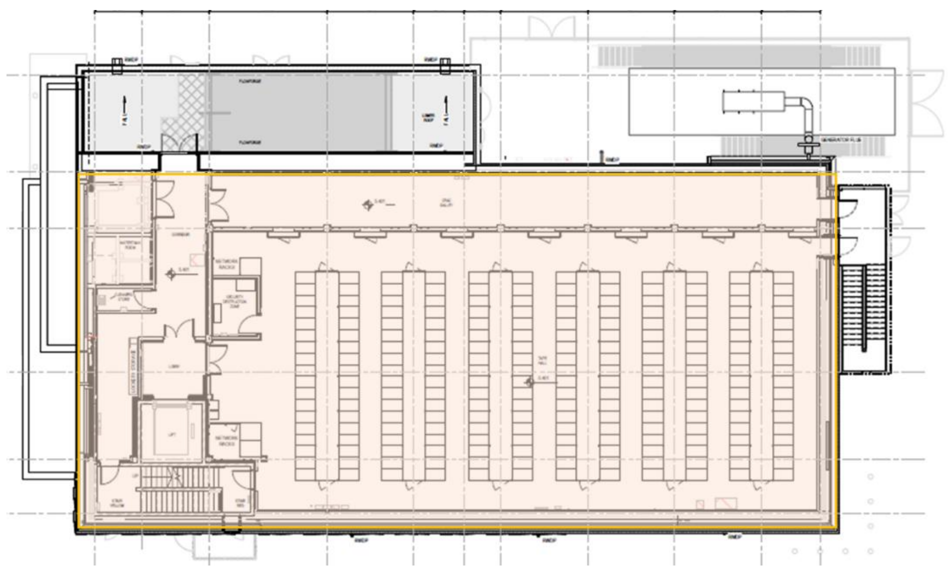


Figure 4-2. First floor Data centre – Technical space (in orange).

4.2 Active design measures

Active design measures seek to limit energy use through efficient selection of building services or utilise energy to reduce heat loss providing a net saving, e.g. heat recovery technology.

Mechanical ventilation with Variable Refrigerant flow (VRF) is proposed for the offices, and reception areas and mechanical exhaust only for the toilets.

Please refer to Appendix 12.3 for further information on the proposed systems for the Proposed Development. In line with paragraph 7.9 of the GLA Energy Assessment Guidance, savings achieved by the proposed low carbon technologies are accounted for in the 'Be Green' stage of the energy hierarchy, and the 'Be Lean' case should use the notional building system type and performance values specified in the Part L 2021 baseline as determined by the final proposed building specification. This has been outlined in Table 3-2 of this document.

4.3 'Be Lean' Summary

4.3.1 Estimated carbon emissions savings ('Be Lean')

Based on the Energy Assessment Guidance (2022) calculation procedure the passive design and energy efficiency measures described throughout Section 4 are currently estimated to exceed London Plan policy requirements and offer savings as outlined below.

	Carbon dioxide emissions for the Proposed Development (Tonnes CO_2 per annum)		
	Regulated	Unregulated	Total
Part L 2021 compliant building	173.6	452.2	625.8
Be Lean	168.1	452.2	620.3
Be Clean	-	-	-
Be Green	-	-	-

Table 4-2: CO_2 emission after the Be Lean stage of the energy hierarchy

	Regulated carbon dioxide savings for the Proposed Development	
	(Tonnes CO_2 per annum)	(%)
Be Lean: savings from energy demand reduction	5.5	3%

Table 4-3: CO_2 savings after the Be Lean stage of the energy hierarchy

5 Cooling and overheating

5.1 The Cooling hierarchy

As part of the drive to reduce demand for cooling highlighted by the Mayor's Cooling Hierarchy set out in the London Plan, the design has considered several passive and active measures that help reduce the cooling demand. The proposed approach is summarised in the table below.

London Plan Cooling Hierarchy	Measures at the Proposed Development
Minimise internal heat generation through energy-efficient design	• Low energy lighting specified throughout with the inclusion of presence detection, where feasible. • Pipework will be insulated to mitigate distribution losses.
Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls.	• Building fabric has high levels of insulation and good levels of airtightness limiting heat ingress. • Largely windowless design which limits solar gain to achieve the BCO best practice guidance of 40 W/m^2. • Light-coloured elements will be used to reflect heat.
Provide passive ventilation	• High thermal mass of the slab stabilises daytime internal temperature fluctuations.
Provide mechanical ventilation	• Adequate ventilation provided with heat recovery. • Utilise systems which prioritise mechanical ventilation without cooling, before rollback to cooling, for the office spaces.
Provide active cooling systems	• Highly efficient air source heat pump, specifically Variable Refrigerant Flow (VRF), across the office space to provide active cooling (and heating).

Table 5-1 – Measures from the London Plan cooling hierarchy implemented in the Proposed Development.

5.2 Overheating risk analysis

London Plan Policy SI4 requires *all major proposals to undertake dynamic overheating modelling in line with the relevant Chartered Institution of Building Services Engineers (CIBSE) guidance.* In line with this GLA requirement, a detailed overheating analysis has been undertaken for the Proposed Development to support the Energy Statement.

Methodology

According to the GLA Energy Assessment Guidance (2022), overheating analysis for non-domestic buildings should be demonstrated according to CIBSE TM52. This methodology intends to inform designers, developers, and others responsible for defining the indoor environment in buildings and should be considered when carrying out dynamic thermal modelling.

Software details

Overheating analysis has been carried out using dynamic simulation modelling software IES-VE 2023. This software tool is fully compliant with the CIBSE Applications Manual 11: Building Energy and Environment Modelling.

Weather files

In line with London Plan policy overheating risk analysis has considered future weather scenarios to ensure that the building is fit for the future. The following weather scenarios have been assessed and presented in this report:

- London LHR DSY1 - a moderately warm summer (considered a 1 in 3-year summer event).
- London LHR DSY2 - a single intense warm spell (1 in 7-year summer event).
- London LHR DSY3 - a relatively intense persistent warm spell (1 in 11-year summer event).

The weather files are based on a 2020s high emission 50% percentile scenario adjusted to represent a 2020 – 2040 weather scenario.

Modelling assumptions

The following assumptions have been accounted for in the detailed overheating analysis:

- Surrounding buildings have been modelled to take into account the overshadowing from the neighbouring buildings, implying a real-case scenario concerning solar exposure.
- The Proposed Development has been modelled in full and the model has been built in line with planning drawings issued by MCA.
- Occupancy patterns and internal gains are modelled as per the NCM guide.
- Thermal elements performance (U-values and glazing g-values), shading features and thermal mass details can be found in Section 4.1.1.

5.3 Overheating results

An overheating assessment has been carried out for the Proposed Development following the methodology outlined in CIBSE TM52: The limits of thermal comfort: avoiding overheating in European buildings.

To mitigate overheating risks, passive design measures were incorporated into the design before considering any mechanical or active measures.

A sensitivity study has been carried out to identify the potential overheating risk in office spaces without the provision of mechanical cooling (i.e. natural ventilation only).
Active cooling is proposed for the Proposed Development to mitigate overheating risks. The results of the assessment with full mechanical cooling show that all the assessed zones pass the criteria for DSY1.

	Pass	Fail
Office areas	100.0% (6 rooms)	0.0% (0 rooms)
Ancillary	100.0% (4 rooms)	0.0% (0 rooms)
Total	**100%**	**0%**

Table 5-2: Overheating results summary - active cooling mode

5.4 Active cooling

As demonstrated in Section 5.3, natural ventilation is not enough to guarantee the occupant's comfort in line with the criteria set out in CIBSE TM52. Therefore, active cooling has been proposed. The cooling requirement for the Proposed Development is identified in the table below.

Proposed New Building	Area weighted average non-domestic cooling demand (MJ/m^2)	Total area weighted non-domestic cooling demand (MJ/year)
Actual	175	257,932
Notional	431.3	635,693

Table 5-3: Cooling demand for the Proposed Development

All spaces within the Proposed Development comply with Criterion 3 of the Part L 2021. Results can be found in Appendix 12.2.

5.5 Further testing

Testing against CIBSE methodologies will continue through detailed design to maintain a successful strategy as the design develops.

6 Heating infrastructure (Be Clean)

The London Plan 2021 encourages all the major development to consider connecting to a decentralised energy network, if one is available within the proximity of the Site.

6.1 Local district heating networks

A desktop-based study was undertaken using the London Heat Map to identify if there are any district energy networks that the Proposed Development could connect to. The study indicated that the existing E.ON DGV high temperature network is approximately 3,400 meters away from the Proposed Development. The network currently serves Drayton Village Care Centre and other commercial and residential areas. Note that the proposed route near the site "Hillingdon-Haynes" is a legacy markup.

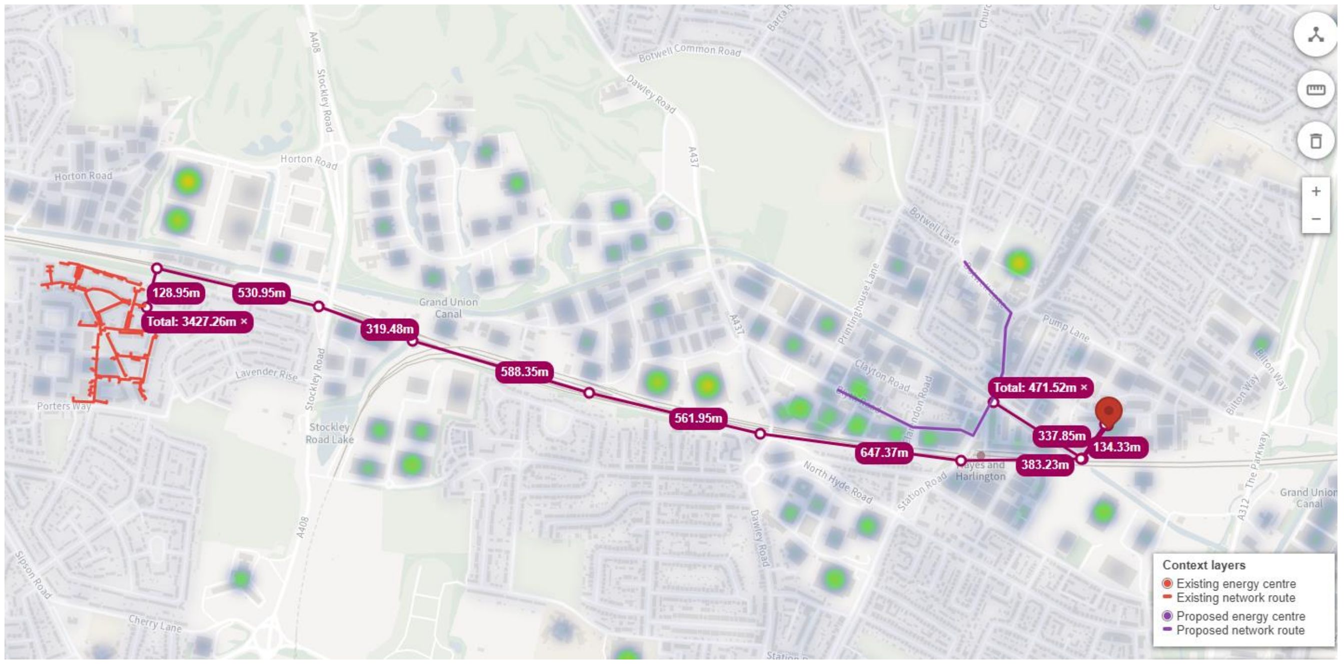


Figure 6-1: London Heat Map of the Site

As per the GLA's Energy Assessment Guidance 2020, new developments in the Heat Network Priority Area (HNPA) should consider connecting to the available district network before considering other zero-emission heat sources.

Due to the high temperature of the district heat network being incompatible with the building's energy requirements, as well as the distance of the Proposed Development from the network, it is not expected that a connection will be made.

6.2 Use zero-emission and/or local secondary heat source (in conjunction with heat pump, if required)

The second step of the heating hierarchy in the London Plan encourages exploration of local energy opportunities such as supplying low-carbon waste heat to a new or existing network to maximise the use of available energy sources whilst minimising primary energy demand and carbon emissions.

This waste heat, especially it is low-grade heat, can be reused to meet demand for low-quality energy such as space heating and hot water. Many secondary heat sources will be low-grade heat i.e. below 30°; it may need elevating using a heat pump either at sources before going into the network, or at the point of use.

We have reviewed the surrounded buildings to the Proposed Development and there has not been identified any compatible heat requirements to consider and a secondary heat source.

6.3 'Be Clean' results

The tables below show the expected carbon emissions and reductions after the introduction of the 'Be Clean' measures. As it is not possible to connect to a district network and CHP is no longer considered a viable low-carbon technology in the new GLA guidance, there are no opportunities for improvements at this stage.

	Carbon Dioxide Emissions for the Proposed Development (Tonnes CO_2 per annum)		
	Regulated	Unregulated	Total
Part L 2021 compliant building	173.6	452.2	625.8
Be Lean	168.1	452.2	620.3
Be Clean	168.1	452.2	620.3
Be Green	-	-	-

Table 6-1: CO_2 emissions after the Be Clean stage of the energy hierarchy

	Regulated carbon dioxide savings for the Proposed Development	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	5.5	3%
Be clean: savings from heat network	0.0	0%

Table 6-2: CO_2 savings after the Be Clean stage of the energy hierarchy

7 Renewable energy (Be Green)

The final step in the Energy Hierarchy, 'Be Green' promotes the generation of energy from low and zero-carbon technologies, to be examined in line with the London Plan Policy SI 2: 'Minimising Carbon Dioxide Emissions'.

At an early stage, a holistic review of low and zero-carbon technologies was undertaken factoring in a wide range of factors that influence their successful design and operation. A summary of the low and zero carbon matrix can be found in Appendix 12.4 which considers the following:

- Current and future planning policies/aspirations.
- Opportunities of the Site and energy demand/profile of the Proposed Development.
- Practical implementation considerations.
- Installation and maintenance issues.
- Implications for internal arrangement and space allocation, infrastructure and site layout.
- Public acceptability.
- Environmental and visual impact.
- Deliverability.
- Security and availability of fuel supply.
- Capital and life cycle costs, payback and grants.
- Carbon contribution and cost per CO_2 saving.
- Interactions of the technologies with one another.

The study concluded that air source heat pumps (ASHP) and photovoltaics are suitable technologies for the Proposed Development, and further in-depth analysis of those systems is summarised below.

Air Source Heat Pump (ASHP)

The National Grid is, over time, seeing an increase in contribution to renewable energy technology and as a result, a reduced contribution from fossil fuels. The net result is that the National Grid is becoming cleaner and the 'carbon intensity' is reducing. The reduction in carbon intensity is now so significant that in the latest Building Regulations, a unit of electricity now has a lower carbon intensity than a unit of gas.

The impact of this is that traditional technologies such as boilers or combined heat and power (CHP), which were preferable due to their ability to offset high carbon intensity mains electricity, see their benefit diminish to, in the majority of cases, zero. Alongside this, electrically run technologies such as heat pumps which previously resulted in high carbon emissions, are no longer as carbon-intensive and have become more preferable.

Given the impact of National Grid decarbonisation, the Proposed Development seeks to achieve compliance with Building Regulations and GLA carbon emissions targets via an Air Source Heat Pump system (ASHP).

The advantages of such a system are as follows:

- Combustion-free, no local emissions
- Provides a route to zero carbon as grid electricity de-carbonises further.
- Lower distribution losses & benefits from sharing heat recovery.
- Lowest lifetime operational carbon emissions.
- Lowest operational costs compared to alternative electric systems.

Based on the advantages above, the Variable Refrigerant Flow (VRF) system was chosen as the preferred system for the Proposed Development.

Photovoltaic

Photovoltaic (PV) panels directly convert sunlight into electrical current using semiconductors. The output of a cell is directly proportional to the intensity of the light received by the active surface of the cell.

It is expected that 8.55 kWp (39 m^2 of PV panels) of roof space will be provided for PV installation. Further details are to can be found in appendix 12.5. Figure 7-1 shows the proposed roof level GA.

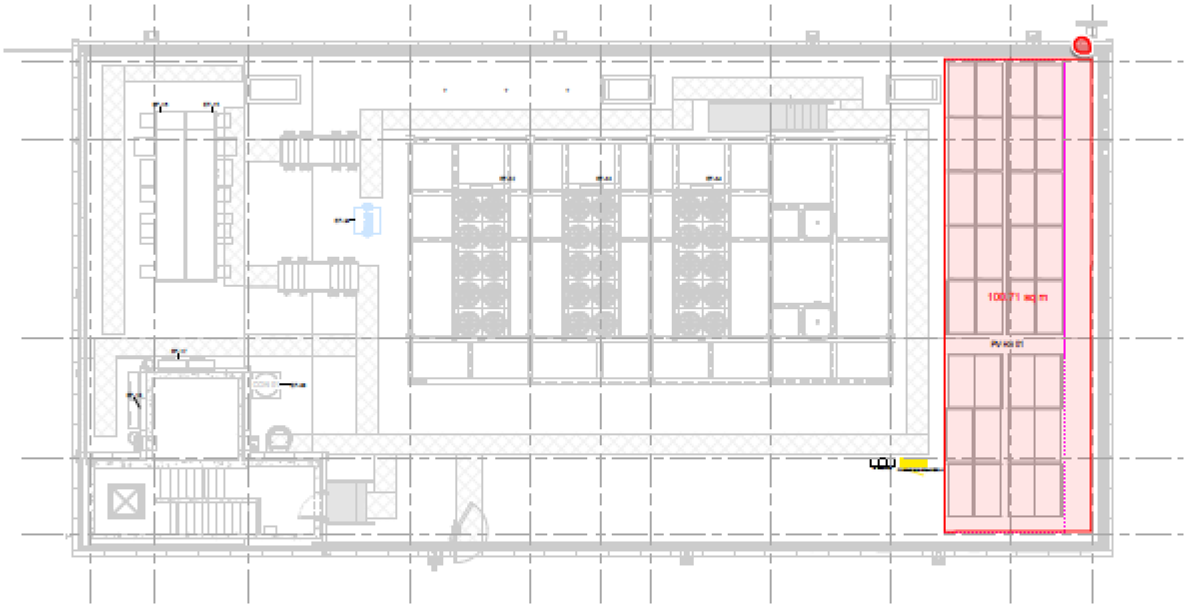


Figure 7-1: Proposed roof level GA showing maximum PV potential

The parameters and likely performance of the proposed PV array are summarised in the table below.

Parameter	Value
Orientation	Southeast 154°
Total capacity	8.55 kWp
Inclination	5°
Displaced electricity	-1,260 kWh/year
Carbon emissions savings	-813 kg/year

Table 7-1: Photovoltaic panel system details

7.1 'Be Green' results

The 'Be Green' stage carbon dioxide emissions and savings for the Proposed Development are presented in the table below.

	Carbon Dioxide Emissions for the Proposed Development (Tonnes CO_2 per annum)		
	Regulated	Unregulated	Total
Part L 2021 compliant building	173.6	452.2	625.8
Be Lean	168.1	452.2	620.3
Be Clean	168.1	452.2	620.3
Be Green	152.8	452.2	605.0

Table 7-2 – Non-domestic CO_2 emissions after the Be Green stage of the energy hierarchy

	Regulated carbon dioxide savings for the Proposed Development	
	(Tonnes CO_2 per annum)	(%)
Be Lean: savings from energy demand reduction	5.5	3%
Be Clean: savings from a heat network	0.0	0%
Be Green: savings from renewable energy	15.2	9%
Total Cumulative Savings	**20.7**	**12%**
Annual savings from off-set payment	152.8	-

Cumulative savings for off-set payment	4,585 tonnes CO
Cash in-lieu contribution (£)	435,604

Table 7-3: CO_2 savings after the Be Green stage of the energy hierarchy

The GLA has indicated that, given the stringent requirements of the new Part L 2021 for emission reductions, it will currently accept lower emission savings than the policy targets, as outlined in the GLA's published note below:

"Over time it is expected that performance against Part L 2021 will improve to enable these developments to achieve closer alignment with the energy efficiency targets and the minimum 35 per cent on-site improvement due to technological improvements and as costs come down. We will monitor this progress and may update the benchmarks to reflect these improvements as appropriate. In the intervening period applicants should continue to aim to maximise on-site carbon reductions as far as possible."

The Proposed Development has incorporated several energy-efficient measures, ranging from passive design strategies to the use of highly efficient equipment and renewable technologies, to minimise on-site energy demand, However, during the next stage, the design team will explore further opportunities to enhance building performance where feasible.

7.2 Carbon offsetting

As part of the London Plan, developments are required to offset all remaining CO_2 emissions associated with the building through a financial contribution towards measures which reduce CO_2 emissions from the existing building stock.

London Plan Policy SI 2 sets out that where the required percentage improvements beyond Part L of the Building Regulations are not met on-site, any shortfall should be provided off-site or through a cash-in-lieu contribution to the relevant borough.

The CO_2 emissions offset cost is currently set at £95/tCO_2 over 30 years. The estimated carbon offset payment for the Proposed Development is £435,604.

8 Deliver the savings in practice (Be Seen)

The Mayor of London has declared a climate emergency and has set an ambition for London to be net zero-carbon. To truly achieve net zero-carbon buildings, a better understanding of their actual operational energy performance is required. Although Part L calculations indicate the theoretical performance of buildings, it is well established that there is a 'performance gap' between design theory and measured reality. The London Plan has introduced the 'Be Seen' framework as an attempt to bridge this gap.

To comply with the 'Be Seen' policy, development is split into a number of 'reportable units' (RUs) which applicants will need to report individually. These are illustrated in the figure below.

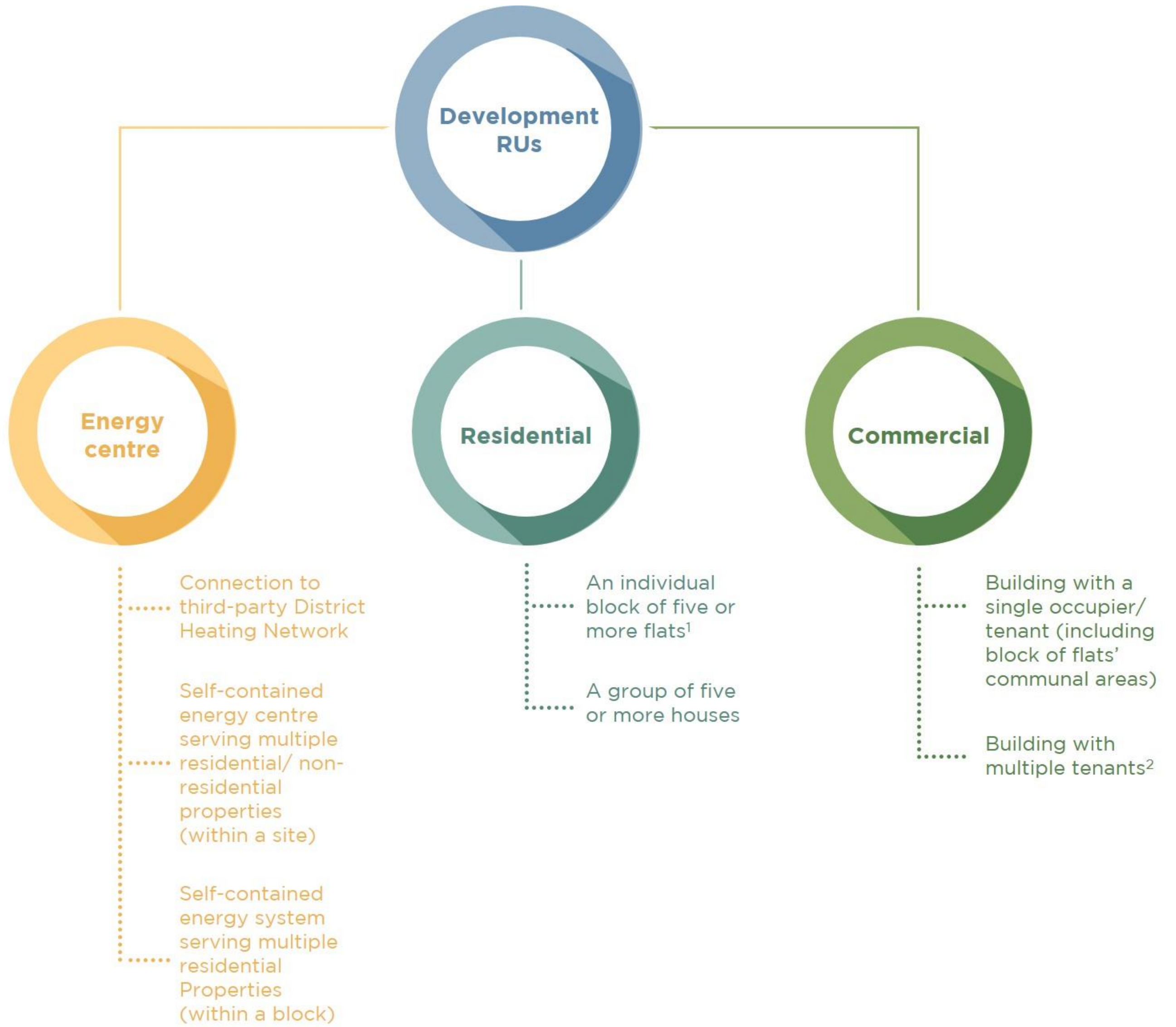


Figure 8-1 – Visual representation of a development's Reportable Units (RUs)

Note that a de minimis threshold applies, where the gross internal floor area of a RU is less than 250 m^2 and/or the expected emissions for the unit are less than 5% of the development's total emissions. De minimis buildings are only required to report energy generation from renewable energy technologies.

8.1 Planning stage

The evidence being requested at the planning stage should be generated via the analysis conducted as part of the energy assessment submission. For non-residential uses, energy consumption (kWh/m^2) and carbon emissions (tonnes CO_2/m^2) estimates should be informed and reported using two separate methodologies.

Once planning approval has been granted, the Applicant will endeavour to provide estimates of each of the performance indicators listed in the table below using the 'be seen' spreadsheet. It should be noted that at this stage of reporting, estimates should be provided for the development as a whole.

Performance indicator group	Description
Contextual data	• Location Unique Property Reference Number (UPRN) or Address (if no UPRN available) • Site plan • Typology / Planning Use Class (all included) • GIA (m^2) for each Typology / Use Class • Anticipated target dates for each 'Be Seen' reporting stage
Building energy use	• Grid electricity consumption (kWh) • Gas consumption (kWh) • Other fuels consumption (kWh) • Energy generation (kWh) • District heating/cooling consumption (kWh) (if applicable) • Confirm that metering plans that will enable the in-use energy performance reporting are in place
Carbon emissions	• Carbon emissions estimates (tonnes CO_2/m^2) for residential and non-residential uses separately as well as the whole development • Carbon shortfall for the entire development (tonnes CO_2) • Estimated carbon offset amount (£)

Table 8-1 – Planning stage performance indicators

8.2 Demand side response

Advancement and commercialisation of smart technologies present additional opportunities to manage and save energy. However, the rate of smart technology development means that specified equipment could be meaningfully improved by the time of procurement. Therefore, some scope flexibility is relevant at the design stage to take advantage of this.

In this context, the following features may be considered during detailed design:

- Power, data and media infrastructure to deliver buildings which are smart enabled for future connectivity by occupants.
- Smart metering will support the operational energy monitoring requirements.

9 Sustainability Energy Initiatives

The operator places a strong emphasis on energy efficiency and continuous innovation within its data centres, integrating advanced technologies to optimize performance while operating in an environmentally sustainable manner. By leveraging the economies of scale in cloud computing, the operator helps businesses and the public sector reduce their carbon footprint by up to 99% across various regions. Their data centres benefit from higher server utilization, advanced cooling designs, and energy-efficient hardware, while also prioritizing water conservation by selecting the most efficient cooling methods based on climate patterns for each region. Additionally, the operator invests in global solar and wind projects to achieve its goal of powering its entire infrastructure with 100% renewable energy, significantly reducing reliance on non-renewable sources.

10 Sustainability of design and construction

The Proposed Development will adhere to the highest standards of sustainable design and construction wherever feasible. Throughout the design and construction phases, the following sustainability factors will be addressed to ensure the overall development will meet these goals.

10.1 Ecology

A preliminary ecological appraisal from Trinity Trading Estate in Hayes found no statutory designated sites within 1 km of the site. However, it lies within the Impact Risk Zones of four Sites of Special Scientific Interest (SSSIs), located 7.2 to 10.4 km away, including Staines Moors, Syon Park, Wraysbury Reservoir, and Wraysbury & Hythe End Gravel Pits. Due to the site's distance and urban setting, no harmful effects on these areas are anticipated, and no further consultation with Natural England is needed. Three non-statutory Sites of Importance for Nature Conservation (SINCs) are nearby, with the London's Canals SINC (150 m away) potentially at risk from pollution and dust if not mitigated. The industrial redevelopment is not expected to increase visitor pressure on these sites.

It was found that the site has moderate bat potential due to possible access points for crevice-dwelling bats. Two nocturnal bat surveys are required between May and September, with at least one survey between May and August. If a bat roost is found, an additional survey will be needed, and a European Protected Species License will be required for roosting bats.

Mitigation measures include:

- Keeping adjacent habitats like the treelined railway and Grand Union Canal dark during and after construction.
- Conducting an updated badger walkover and following precautionary methods for badgers.
- Demolishing the building outside the bird breeding season (March to September). If demolition must occur during this period, a nesting bird check by an ecologist is required, with a stand-off distance for any active nests.

Since the site has no biodiversity value, a Biodiversity Net Gain report is not required under the 2024 regulations.

Figure 10-1: The building on site found to have moderate bat roosting potential

Please refer to the ecology report for further details

10.2 Arboricultural impact:

Trinity Trading Estate also did an arboricultural impact assessment, where the site survey identified five Category C (low value) trees on or near the site. No tree removal is required for the project. Key recommendations include:

- Discussing any necessary access pruning with the project arboriculturist.
- Installing protective fencing around retained trees before any materials or machinery are brought on-site.
- Planning site operations involving heavy equipment to avoid contact with trees, with supervision from a banksman.
- Keeping storage, cement mixing, and fuel areas outside the root protection areas (RPAs) of trees, ensuring no contamination risks.
- All tree work should be done by a qualified arborist, following BS 3998:2010 guidelines

Please refer to the arboricultural impact assessment for further details

10.3 Operational waste strategy

EHS Projects created the Operational Waste Management Plan which outlines strategies to manage waste during the Centre's operation, aiming to comply with legal requirements, promote environmental performance, and contribute to UK waste minimization, recycling, and re-use targets.

Key components of the waste management strategy include:

- Providing facilities for waste storage and recycling, with clear instructions for site personnel.
- Implementing environmental controls to minimize pollution from waste handling.
- Ensuring waste collection processes are efficient and compliant with regulations.

The design includes waste storage areas outside the building, accessible to collection vehicles and designed to prevent health hazards or nuisances. Waste will be stored in wheeled, lidded bins to prevent vermin and windblown waste. Internal waste management will sort waste into Dry Mixed Recycling (DMR) and non-recyclable waste, with special arrangements for hazardous materials like Waste Electronic and Electrical Equipment (WEEE).
Pollution prevention measures will ensure licensed waste carriers are used, and efforts will be made to avoid landfill disposal where possible.

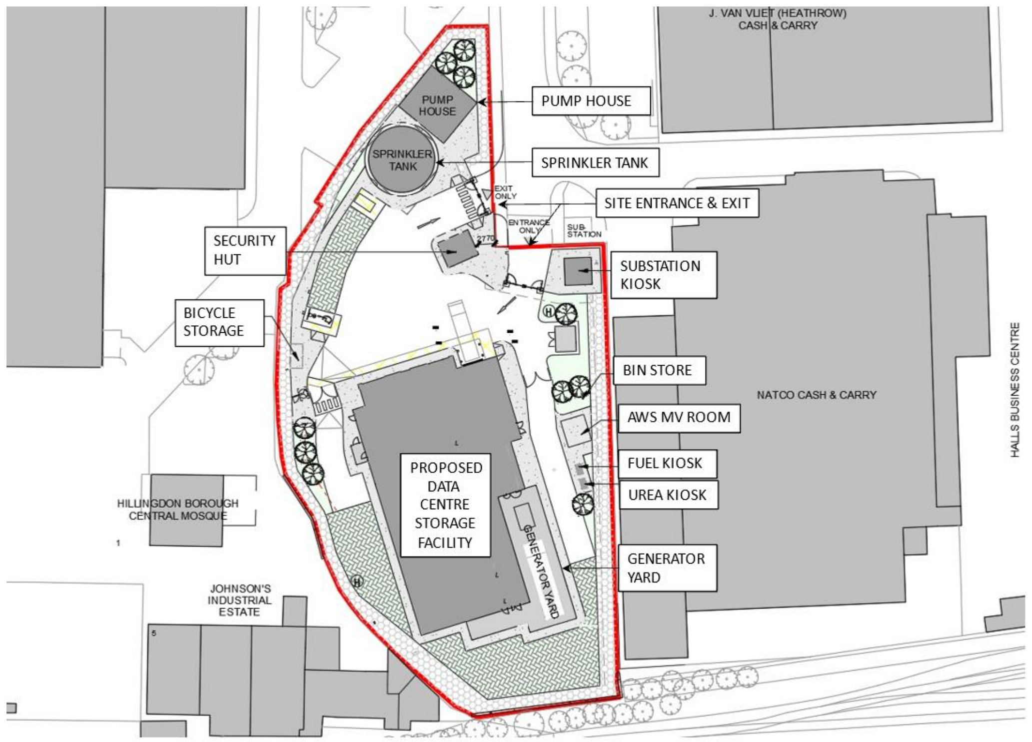


Figure 10-2: The Proposed Development overview

Please refer to the arboricultural impact assessment for further details

10.4 Air quality

The Air Quality Assessment was prepared by Redmore Environmental to evaluate the potential air quality impacts from construction and operation. The key concerns are:

- Fugitive dust during construction.
- Road vehicle exhaust emissions during construction and operation.
- Combustion emissions from the emergency generator during operation.

The assessment concluded that:

- Good practice control measures would mitigate dust emissions during construction.
- Vehicle exhaust emissions during both construction and operation are predicted to be insignificant due to low traffic volumes.
- Modelling of emissions from the emergency generator showed no significant impacts.

The development complies with the London Plan's air quality neutral requirements, as the heating system does not emit pollutants, and transport emissions are within acceptable levels. Overall, air quality is not considered a barrier to planning consent for the project.

10.5 Landscape strategy

To ensure that the project integrates harmoniously with its surroundings, enhances biodiversity, and mitigates environmental impacts. HED carried out a landscape strategy, which entailed:

- Planting within the site and security limits
    - Ensuring the planting does not create camera shadows
    - Trees no closer than 3m from internal security fence
    - Using appropriate planting heights depending on locations

- Providing low maintenance and drought tolerant shrubs and groundcovers
    - Incorporating perennial species for sustainable landscaping.
    - Choosing native plants that attract pollinators.
    - Planting smaller, low-maintenance trees that require no watering once established.

- Rain gardens as a means of sustainable urban drainage
    - Coordinating with the drainage strategy to integrate Sustainable Urban Drainage Systems (SUDS).
    - Using perennial plants that can tolerate waterlogging and drought along higher edges.
    - Ensuring no additional watering is needed once plants are established

Please refer to the landscape strategy report for further details

Figure 10-3: The varieties of plants selected for the landscaping strategies

11 Conclusion

In summary, the Proposed Development is supported by a robust energy strategy which demonstrates a firm commitment to the London Plan and Hillingdon Council planning policies. The Proposed Development seeks to deliver savings in line with the Energy Hierarchy, limiting energy use in the first instance, selecting energy-efficient plant and building services, before maximising the use of any renewable energy.

In addition, the Applicant is committed to the energy monitoring and reporting framework set out by the GLA and seeks to minimise the operational energy use of the Proposed Development.

Overall, the Proposed Development could be expected to achieve a 12% reduction in regulated carbon emissions over Part L 2021. This saving includes a 3% and 9% reduction in regulated carbon emissions for the 'Be Lean' and 'Be Green' stages respectively.

The regulated CO_2 savings (12%) of the proposed site are below the minimum target (35%) setting by GLA SI2 planning policy (Table 11-1). However, regulated CO_2 savings have been maximised as much as possible at this stage with the provision of efficient fabric, highly efficient MEP systems for heating and cooling, ventilation system with low specific fan power, and low energy lighting and photovoltaic panels.

Key design features of the Proposed Development include:

- High levels of envelope insulation to reduce energy demand.
- Airtight construction to prevent heat loss.
- High levels of airtightness, reducing heat loss and mitigating drafts.
- All electric schemes with highly efficient ASHP systems provide both heating and cooling.
- Mechanical ventilation systems with low specific fan power and heat recovery.
- Low energy lighting throughout with daylight and occupant detection, where possible.
- System controls and diagnostics systems to operate the building effectively.
- Metering and sub-metering to monitor energy use, enabling energy use and occupant behavioural learnings and subsequent adjustments to improve building energy consumption post-occupancy.
- Maximised photovoltaic system on the roof.

Part L2 2021 has been recognised as a challenging standard to be exceeded by GLA in its Note to accompany GLA Energy Assessment Guidance 2022', acknowledging that:

- "*Initially, non-residential developments may find it more challenging to achieve significant on-site carbon reductions beyond Part L 2021 to meet both the energy efficiency target and the minimum 35 per cent improvement. This is because the new Part L baseline now includes low carbon heating for non-residential developments but not for residential developments. However, planning applicants will still be expected to follow the energy hierarchy to maximise carbon savings before offsetting is considered*.
- *Over time it is expected that performance against Part L 2021 will improve to enable these developments to achieve closer alignment with the energy efficiency targets and the minimum 35 per cent on-site improvement due to technological improvements and as costs come down. We will monitor this progress and may update the benchmarks to reflect these improvements as appropriate. In the intervening period applicants should continue to aim to maximise on-site carbon reductions as far as possible*."

The breakdown in savings is shown in Table 11-1 below.

	Total regulated emissions (Tonnes CO_2 / year)	Regulated CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2021 baseline	173.6	-	-
Be Lean	168.1	5.5	3%
Be Clean	168.1	0.0	0%
Be Green	152.8	15.2	9%
Total Savings	-	20.7	12%

Cumulative savings for off-set payment	4,585 tonnes CO_2
Cash in-lieu contribution	£ 435,604

Table 11-1 – Total regulated CO_2 savings from each stage of the energy hierarchy for the Proposed Development

12 Appendices

12.1 GLA Carbon Emissions Reporting Spreadsheet

The GLA carbon emission reporting spreadsheet has been submitted separately as a standalone spreadsheet alongside the full application.

12.2 BRUKL documents

Be Lean

BRUKL Output Document HM Government

Compliance with England Building Regulations Part L 2021

Project name

Be Lean_Rev01 As designed

Date: Wed Sep 11 17:55:27 2024

Administrative information

Building Details

Address: Unit 4, Silverdale Industrial Estate, Hayes, UB3 3BL

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.25

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.25

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

Foundation area [m²]: 477.05

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	117.74	
Building CO_2 emission rate (BER), $kgCO_2/m^2$annum	116.19	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	1285.5	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	1268.82	
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	0.2	0.26	L0000029:Surf[0]
Floors	0.18	0.15	0.15	L0000000:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.14	0.15	L000000C:Surf[1]
Windows** and roof windows	1.6	1.27	1.27	L0000007:Surf[3]
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	1.36	1.36	L0000007:Surf[1]

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]
* 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	5

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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- Water Tank/Breakout/Security/Stairs

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.64	2.64	0	1.75	0.8
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- VRF- Elec Room/Battery Store/Sprinkler

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.64	2.64	0	1.75	0.8
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.

3- Data Hall -DX Coil-CRAC

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.09	5.79	0	1.85	-
Standard value	2.5*	1.6	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.

1- DHW inst.

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	1	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

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

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Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
L00_data_hall	-	-	-	-	-	-	-	0.3	-	-	N/A
L01_data_hall	-	-	-	-	-	-	-	0.3	-	-	N/A

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
L00_clean_in/out	156	-	-
L00-Entry	156	-	-
L00-Security	156	-	-
L00-WC	156	-	-
L00-Breakout	156	-	-
L00-WC-Shower	156	-	-
L00-Corridor	156	-	-
L00-Battery Store	156	-	-
L00-Sprinkler Room	151	-	-
L00-Security Storage	156	-	-
L00-Electircal Room	156	-	-
L00_stairs	156	-	-
L01_Lobby	156	-	-
L01_stairs	156	-	-
L01-Cleaners_Store	151	-	-
L01-Water_Tank	156	-	-
L02_stairs	156	-	-
L01-Corridor	156	-	-
L01_SecurityLobby	156	-	-
L00_data_hall	151	-	-
L01_data_hall	151	-	-

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?
L00_clean_in/out	N/A	N/A
L00-Entry	NO (-51.8%)	NO
L00-Security	NO (-76.5%)	NO
L00-Breakout	NO (-40.3%)	NO
L00-Corridor	N/A	N/A
L00-Battery Store	N/A	N/A
L00-Sprinkler Room	N/A	N/A
L00-Security Storage	N/A	N/A
L00-Electircal Room	N/A	N/A
L00_stairs	N/A	N/A
L01_Lobby	N/A	N/A
L01_stairs	N/A	N/A

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Zone	Solar gain limit exceeded? (%)	Internal blinds used?
L01-Cleaners_Store	N/A	N/A
L01-Water_Tank	N/A	N/A
L02_stairs	N/A	N/A
L01-Corridor	N/A	N/A
L01_SecurityLobby	N/A	N/A
L00_data_hall	N/A	N/A
L01_data_hall	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?	YES
Are any such measures included in the proposed design?	YES

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Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m²]	1473.9	1473.9
External area [m²]	2968.8	2968.8
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	5	4
Average conductance [W/K]	562.85	634.76
Average U-value [W/m²K]	0.19	0.21
Alpha value* [%]	25.99	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
24	**Storage or Distribution**
	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
76	**Others: Miscellaneous 24hr Activities**
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	0.39	0.33
Cooling	716.86	703.38
Auxiliary	111.11	116.92
Lighting	29.6	50.13
Hot water	2.85	1.27
Equipment*	3324.82	3324.82
TOTAL**	**860.82**	**872.04**

* 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/m²]

	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/m²]	11688.3	11731.4
Primary energy [kWh_{PE}/m^2]	1268.82	1285.5
Total emissions [kg/m²]	116.19	117.74

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	0	175	0	26.8	5.4	2.73	1.82	2.64	2.64
	Notional	0	431.3	0	25.9	12.7	2.78	4.63	---	---
[ST] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	21.9	133.3	2.2	20.4	6.9	2.73	1.82	2.64	2.64
	Notional	18.9	295.2	1.9	17.7	15.1	2.78	4.63	---	---
[ST] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	0	15400.5	0	941.2	143.7	2.89	4.55	3.09	5.79
	Notional	0	15408.2	0	924.1	147.4	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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Be Green_Rev01 — As designed

Date: Thu Sep 12 15:02:57 2024

Administrative information

Building Details

Address: Unit 4, Silverdale Industrial Estate, Hayes, UB3 3BL

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.25

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.25

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

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Foundation area [m²]: 477.05

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	117.74	
Building CO_2 emission rate (BER), $kgCO_2/m^2$annum	103.44	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	1285.5	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	1128.96	
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	0.2	0.26	L0000029:Surf[0]
Floors	0.18	0.15	0.15	L0000000:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.14	0.15	L000000C:Surf[1]
Windows** and roof windows	1.6	1.27	1.27	L0000007:Surf[3]
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	1.36	1.36	L0000007:Surf[1]

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]
* 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	5

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- Water Tank/Breakout/Security/Stairs

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.4	7.54	0	1.75	0.8
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- VRF- Elec Room/Battery Store/Sprinkler

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.17	7.08	0	1.75	0.8
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.

3- Data Hall -DX Coil-CRAC

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.54	6.58	0	1.85	-
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.

1- DHW inst.

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	1	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
L00_data_hall	-	-	-	-	-	-	-	0.3	-	-	N/A
L01_data_hall	-	-	-	-	-	-	-	0.3	-	-	N/A

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
L00_clean_in/out	156	-	-
L00-Entry	156	-	-
L00-Security	156	-	-
L00-WC	156	-	-
L00-Breakout	156	-	-
L00-WC-Shower	156	-	-
L00-Corridor	156	-	-
L00-Battery Store	156	-	-
L00-Sprinkler Room	151	-	-
L00-Security Storage	156	-	-
L00-Electircal Room	156	-	-
L00_stairs	156	-	-
L01_Lobby	156	-	-
L01_stairs	156	-	-
L01-Cleaners_Store	151	-	-
L01-Water_Tank	156	-	-
L02_stairs	156	-	-
L01-Corridor	156	-	-
L01_SecurityLobby	156	-	-
L00_data_hall	151	-	-
L01_data_hall	151	-	-

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?
L00_clean_in/out	N/A	N/A
L00-Entry	NO (-51.8%)	NO
L00-Security	NO (-76.5%)	NO
L00-Breakout	NO (-40.3%)	NO
L00-Corridor	N/A	N/A
L00-Battery Store	N/A	N/A
L00-Sprinkler Room	N/A	N/A
L00-Security Storage	N/A	N/A
L00-Electircal Room	N/A	N/A
L00_stairs	N/A	N/A
L01_Lobby	N/A	N/A
L01_stairs	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
L01-Cleaners_Store	N/A	N/A
L01-Water_Tank	N/A	N/A
L02_stairs	N/A	N/A
L01-Corridor	N/A	N/A
L01_SecurityLobby	N/A	N/A
L00_data_hall	N/A	N/A
L01_data_hall	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?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m²]	1473.9	1473.9
External area [m²]	2968.8	2968.8
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	5	4
Average conductance [W/K]	562.85	634.76
Average U-value [W/m²K]	0.19	0.21
Alpha value* [%]	25.99	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
24	**Storage or Distribution**
	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
76	**Others: Miscellaneous 24hr Activities**
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	0.24	0.33
Cooling	628.32	703.38
Auxiliary	111.11	116.92
Lighting	29.6	50.13
Hot water	2.85	1.27
Equipment*	3324.82	3324.82
TOTAL**	**772.13**	**872.04**

* 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/m²]

	Actual	Notional
Photovoltaic systems	6.29	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*6.29*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	11688.3	11731.4
Primary energy [kWh_{PE}/m²]	1128.96	1285.5
Total emissions [kg/m²]	103.44	117.74

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	0	175	0	10	5.4	4.31	4.87	4.17	7.08
	Notional	0	431.3	0	25.9	12.7	2.78	4.63	---	---
[ST] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	21.9	133.3	1.4	7.1	6.9	4.4	5.19	4.4	7.54
	Notional	18.9	295.2	1.9	17.7	15.1	2.78	4.63	---	---
[ST] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	0	15400.5	0	828.2	143.7	3.32	5.17	3.54	6.58
	Notional	0	15408.2	0	924.1	147.4	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

12.3 MEP Services Workbook

Parameters		Data hall	CRAH Corridor	Electrical Room	Admin Area	WC	Battery Storage	Circulation/Corridors/Stairs	Entrance Lobby	Security	Sprinkler Room	Security Destruction Room	Cleaners Store	Break-Out Room	Loading Dock
Lighting	Units														
Power density / 100 lux	W/m2 (100 lux)	6.35	2.18	2.18	6	4.8	6.3	2.18	6	5	6.3		6.3	5	6.3
Lamp Efiiciency	lm/W	151	156	156	156	156	151	156	156	156	151		151	156	151
Lux		600	200	200	500	200	250	250	500	400	250		250	400	250
Auto presence detection		Auto-On-OFF	Auto-On-OFF	Man-On-Auto-Off	Auto-On-OFF	Auto-On-OFF	Auto-On-OFF	Auto-On-OFF	Auto-On-OFF	Auto-On-Off	Man-On-Auto-Off		Man-On-Auto-Off	Auto-On-Off	Auto-On-OFF
Light output ratio		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0
Constant illuminance control		No	No	No	No	No	No	No	No	No	No		No	No	No
Total parasitic power	W/m2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1		0.1	0.1	0.1
Ventilation	Units														
System type		Supply and Extract Ventilation - AHU Recirculation Unit (2No. Units)	CRAH Units (Chilled Water System) 8No. Units	Energy Recovery Unit (Supply & Extract)	Energy Recovery Unit (Supply & Extract)	Extract only (fan remote from zone)	Extract only (fan remote from zone)	VRF	VRF	VRF		Extract only (fan remote from zone)	Extract only (fan remote from zone)	VRF	VRF
Demand control sensor*		N/A	N/A	N/A	N/A	-	-	N/A	0.8	N/A	N/A	-	-	N/A	N/A
Demand control method		N/A	N/A	N/A	N/A	-	-	N/A	0.8	N/A	N/A	-	-	N/A	N/A
SFP - Supply	W/l/s	N/A	-	N/A	N/A	-	-	1.8	-	0.8	0.8	-	-	0.8	1.8
SFP - Extract	W/l/s	N/A	-	N/A	N/A	0.367	0.319			0.8	0.8	0.319	0.278	0.8	
Air Supply		Mech Vent	Mech Vent	Mech Vent	AC / Mech Vent	Mech vent	Mech vent	Central A/C / Mech Vent	Central A/C / Mech Vent	Central A/C / Mech Vent	Mech vent	Mech vent	Mech vent	Central A/C / Mech Vent	Central A/C / Mech Vent
SFP - Terminal	W/l/s	1.38	2	0.63	2.67	Ext air	Ext air	-	-	-	-	Ext air	Ext air	-	Ext air
Heat recovery		N/A	N/A	Centrifugal	Yes	-	-	Thermal Wheel	Thermal Wheel	Thermal Wheel		-	-	Thermal Wheel	Thermal Wheel
Efficiency	%	65.8	57.4	80	77.5	-	-	0.8	0.8	0.8		-	-	0.8	0.8
Miscellaneous - space related	Units														
Out of value monitoring		Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pump configuration		Constant Speed	Constant Speed	Constant Speed	Constant Speed	Variable speed with multiple pressure sensor in the system	Constant Speed	Variable speed with multiple pressure sensor in the system	Variable speed with multiple pressure sensor in the system	Variable speed with multiple pressure sensor in the system	Variable speed with multiple pressure sensor in the system	Constant Speed	Constant Speed	Variable speed with multiple pressure sensor in the system	Variable speed with multiple pressure sensor in the system
Heating circuit	Units	DX Coil		N/A	DX Coil										
System type/Heat Source			No Heating	No Heating	Heat Pump (electric): air source	No Heating	No Heating	Heat Pump (electric): air source	Heat Pump (electric): air source	Heat Pump (electric): air source	No Heating	No Heating	No Heating	Heat Pump (electric): air source	No Heating
Heat Emitter		-	-	-	-	-	-	VRF	VRF	VRF	-	-	-	VRF	-
Efficiency	COP / %	-	N/A	N/A	-		-	500%	500%	500%	-			500%	
Seasonal Efficiency	SCOP / %	-	N/A	N/A	-		-	500%	500%	500%	-	-	-	500%	-
Distribution efficiency	%		N/A	N/A	-										

Fuel source		Electricty	Electricty	N/A	Electricty	-	-	Electricty	Electricty	Electricty	-	-	-	Electricty	Electricty
CHP present		No	No	N/A	No	No	No	No	No	No	No	No	No	No	No
Efficiency / H:P	%	N/A	N/A	N/A	-	-	-	-	-	-	-	-	-	-	-
Fuel source		N/A	N/A	N/A	-	-	-	-	-	-	-	-	-	-	-
Priority / size basis		N/A	N/A	N/A	-	-	-	-	-	-	-	-	-	-	-
Size fraction		N/A	N/A	N/A	-	-	-	-	-	-	-	-	-	-	-
Cooling circuit	Units	DX Coil			DX Coil										
System type			Water Cooled	No cooling	Remote Condensor	No cooling	No cooling	Heat Pump	Heat Pump	Heat Pump	No cooling	No cooling	No cooling	Heat Pump	No cooling
Efficiency	EER / %			N/A	-			500%	500%	500%				500%	
Seasonal Efficiency	SEER / %			N/A	-			5.00	5.00	5.00				5.00	
Distribution efficiency	%	95%		N/A	-			95%	95%	95%				95%	
Fuel source		Electricity	Electricity	Electricity	Electricty	-	-	Electricity	Electricity	Electricity	-	-	-	Electricity	
System Adjustments	Units														
Ductwork leakeage tested		Yes, Class B	Yes, Class B	Yes, Class B	Yes, Class B	Yes, Class B	Yes, Class B	Yes, Class B	Yes, Class B	Yes, Class B	Yes, Class B	Yes, Class B	Yes, Class B	Yes, Class B	Yes, Class B
AHU leakeage tested		Yes, Class L2	Yes, Class L2	Yes, Class L2	Yes, Class L2	Yes, Class L2	Yes, Class L2	Yes, Class L2	Yes, Class L2	Yes, Class L2	Yes, Class L2	Yes, Class L2	Yes, Class L2	Yes, Class L2	Yes, Class L2
Hot water circuit	Units	**N/A**	**N/A**	**N/A**	**N/A**										
System type						Inst hot water only							Inst hot water only	Inst hot water only	
Efficiency	%	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A			N/A
Distribution efficiency	%	N/A	N/A	N/A	N/A	100%	N/A	N/A	N/A	N/A	N/A	N/A	100%	100%	N/A
Fuel source		N/A	N/A	N/A	N/A	Elec	N/A	N/A	N/A	N/A	N/A	N/A	Elec	Elec	N/A
Cylinder Size	L	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A			N/A
Standing Loss	kWh/l/day	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A			N/A
Renewables	Units												**Whole scheme**		**Whole scheme**
Photovoltaics present															
Efficiency	%														
Inclination	°														
Sqm [m2]															
Miscellaneous	Units														
Power factor correction															
Out of rage warning															
Separate metering															

12.4 Low and Zero Carbon technologies

Source	Low Zero Carbon Technology	Lifespan (years)	Lifecycle Carbon Savings* (tCO2/yr)	Applicable Grants	Life Cycle Cost*	Space Use	Local Planning Criteria	Noise	Feasibility of Export	Technology Appropriate for the Proposed Development	Reasons for Inclusion/Exclusion
Solar	Photovoltaics	25	Low (325 $kgCO_2$/yr per 1 kWp El)	-	Medium	Suitable (roof spaces available)	Suitable	Suitable	Possible (export of power to the local grid)	Yes	Solar photovoltaic cells (PV) convert sunlight into usable electricity. Due to the relatively low efficiencies of this system, a large area is often required to provide a reasonable quantity of power. 39sqm of PV panels have been specified within the Proposed Development's design (refer to Section 7)
	Solar thermal	20	Low	Renewable Heat Incentive (RHI)	Low	Suitable (roof spaces available)	Suitable	Suitable	Possible export of heat to future district heat network	No	Solar water heating is traditionally one of the more simplistic and affordable renewable technologies. Solar energy is converted to heat via panels that absorb the high-frequency heat radiation emitted from the sun. Advanced technology utilising 'heat pipes' (tubes utilising refrigerant technology) maximises useful heat extraction even on cold, cloudy days. However, the carbon saving of solar hot water depends on the fuel being displaced. The development is not expected to require a large volume of domestic hot water, which makes solar thermal technically and economically unfeasible. The installation of photovoltaic panels is prioritised on available roof space, while inconsistent load profiles will require significant solar thermal storage and associated plant space. This technology is not considered appropriate for the development.
Wind power	Wind turbines	20	Low (0.5 t/kWe per yr)	-	High	Not suitable (suitable space for stand-alone a roof-mounted wind turbine cannot be found for the scheme)	Not Suitable due to height restriction, significant visual impact, and flicker.	Potentially not suitable due to noise from the turbine's generator.	Possible (export of power to the local grid)	No	Wind turbines produce electrical energy by absorbing wind energy. They are typically available on a vertical or horizontal axis. The quantity of energy generated is directly related to the 'swept area' of the blades and as such size is of immense importance. However, smaller systems are becoming increasingly more common as well as more accepted and have been used to power schools, sports centres and business parks. For wind turbines to operate effectively, the average wind speed for the Site needs to be above a threshold level of 6 m/s. Wind speeds in built-up urban areas are not reliable and therefore this technology is not considered suitable for the scheme.
Hydro, wave & tidal	Hydro power	-	-	-	-	-	-	-	-	-	No suitable water sources near the development.
	Tidal power	-	-	-	-	-	-	-	-	-	
	Wave power	-	-	-	-	-	-	-	-	-	
Biofuels	Biomass boilers	20	Medium	RHI	Low-Medium	Not suitable (large space required for fuel storage)	Not suitable due to potential air quality issues	Vehicle noise during regular fuel deliveries and removal of ash from combustion	Possible export of heat to future district heat network	No	Biomass is an organic matter of recent origin which can be replenished at the rate at which it is used. It does not include fossil fuels, which have formed over millions of years and thus of finite supply. The CO_2 released when energy is generated from biomass is balanced by that absorbed during the fuel's production. This is termed a carbon-neutral process, but only when the source of the fuels is renewable, as a sustainable rotation coppice woodland. Such fuels include logs, compressed sawdust pellets, vegetable oil and ethanol. On-site fuel storage requirements require additional space, along with regular access to the on-site fuel storage area. Biomass/Biofuel Boiler is not considered viable as high load requirements (peak heating load) would require big biofuel/biomass storage for this scheme. Biofuel CHP with a smaller capacity (consequently smaller biofuel/biomass tank) appears to be more suitable Due to the intensive nature of biofuel use on-site concerning deliveries, maintenance, dust and equipment responsiveness, Biofuels are not considered appropriate for this site and have been discounted in favour of more reliable fit-and-forget equipment.
	Biomass Co-generation (CHP)	20	Medium-High	ROCs & RHI	Medium	Not suitable (large space required for fuel storage)	Not suitable due to potential air quality issues	Vehicle noise during regular fuel deliveries and removal of ash from combustion	Possible export of heat to future district heat network	No	
District heating & cooling	District heating and cooling (based on gas-fired CHP/ CCHP)	25+	Medium-High	Renewable Heat Incentive (RHI) + possible Feed-In Tariff (FiT)	Medium	Suitable	Suitable	Suitable	n/a	No	The Proposed Development is not near a heat network to connect to.

Source	Low Zero Carbon Technology	Lifespan (years)	Lifecycle Carbon Savings* (tCO2/yr)	Applicable Grants	Life Cycle Cost*	Space Use	Local Planning Criteria	Noise	Feasibility of Export	Technology Appropriate for the Proposed Development	Reasons for Inclusion/Exclusion
Heat pumps	Ground source heat pumps (closed-loop system)	25 (50+ earth heat exchangers)	Medium (30-50% compared to a gas heating system)	Renewable Heat Incentive (RHI)	Medium-High	Not suitable (space not sufficient for a horizontal or vertical system)	Suitable	Suitable	Possible but unlikely	No	Ground source heat pumps are an established technology which operates like a refrigerator, consisting of a vapour compression cycle heat pump, linked to a heat exchanger buried in the ground. Heat pumps utilising low-grade heat from the ground as a thermal resource have been reviewed in the context of the Proposed Development. They are not considered viable for this scheme for the following key reasons: - There is insufficient space around the building for a horizontal system; and - It is not considered economically or practically feasible to integrate a pile/loop under the building (space not sufficient to allow for the required distance between bore holes). Ground source heat pumps are therefore not proposed for this scheme.
	Ground source heat pumps (open loop system)	25 (50+ boreholes)	Medium (40-60% compared to a gas heating system)	Renewable Heat Incentive (RHI)	Medium	Not suitable (space not sufficient to allow for required distance between boreholes)	Suitable	Suitable	Possible but unlikely	No	
	Air source heat pumps	20	Low-Medium (20-40% compared to a gas heating system)	N/A	Low	Suitable	Not suitable due to connection to district heating network	Suitable (Acoustically insulated engine)	Possible but unlikely	Yes	Air source heat pump systems can efficiently elevate low-grade environmental heat from the air to the level required for space heating and even domestic hot water systems (albeit at low efficiency). Heat pumps work much more efficiently at lower temperatures than standard boiler systems and are hence more suitable to "low-energy" underfloor heating systems or larger low-temperature radiator and fan-coil systems that are also considered low-response systems as they give out heat at lower temperatures over longer periods. Air source heat pumps are considered particularly suitable for the scheme for the following reasons: - They can provide space heating and cooling in a very efficient way. - Heat pumps are relatively quiet in operation and are typically contained within plant spaces without any significant impact on the local environment. - Lower corridor overheating risk due to near ambient temperature within the pipework; and - Heat pump systems are inherently a renewable source of energy
Co-Generation	Gas-fired Co-generation (CHP)	15	Medium (30% CO_2 reduction compared to condensing boilers)	N/A	Low-Medium	Suitable	Not suitable due to potential air quality issues	Suitable (acoustically insulated engine)	Possible export of heat to future district heat network	No	A CHP engine produces both heating and electrical power for a building. The benefit of generating electricity on-site is that the waste heat that is usually rejected at power stations can be used to serve the heating and power requirements of a building or wider community. Smaller single-site systems generally utilise fossil fuels such as gas to operate a spark-ignition engine or turbine to turn a generator. Biodiesels can be used which includes correctly processed waste vegetable oil. The main vital pre-requisite of a CHP system is that demand for both power and heat is required at the same time and a baseload exists for the CHP plant to operate efficiently and cost-effectively. CHP plant often has an impact on local air quality. The Proposed Development seeks to minimise the generation of air pollution by pursuing a heat pump-led heating system as such a system not only provides an efficient source of heat energy but does not contribute to local air pollution whilst in operation.
Heat recovery & energy storage	Waste heat recovery	15	Low-Medium	N/A	Low	Not suitable	Suitable	Suitable	N/A	No	Insufficient waste heat available.
	Energy storage	15 (50+ for seasonal storage)	Low-Medium (technology dependent)	N/A	Medium-High (dependent on technology)	Not suitable	Suitable	Suitable	Possible (integration within district network)	No	Large space required; energy use such that storage is required is not applicable.

Payback period

Low: 1-7 years
Medium: 7-15 years
High: 15+ years

* From industry standards and case studies (e.g. CIBSE, EST, Carbon Trust, etc.)

12.5 PV System

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Project Overview

Figure: Overview Image, 3D Design

PV System

3D, Grid-connected PV System	
Climate Data	London/Heathrow, GBR (2001 - 2020)
Values source	Meteonorm 8.2
PV Generator Output	8.55 kWp
PV Generator Surface	39.0 m²
Number of PV Modules	18
Number of Inverters	1

Resoulte Group

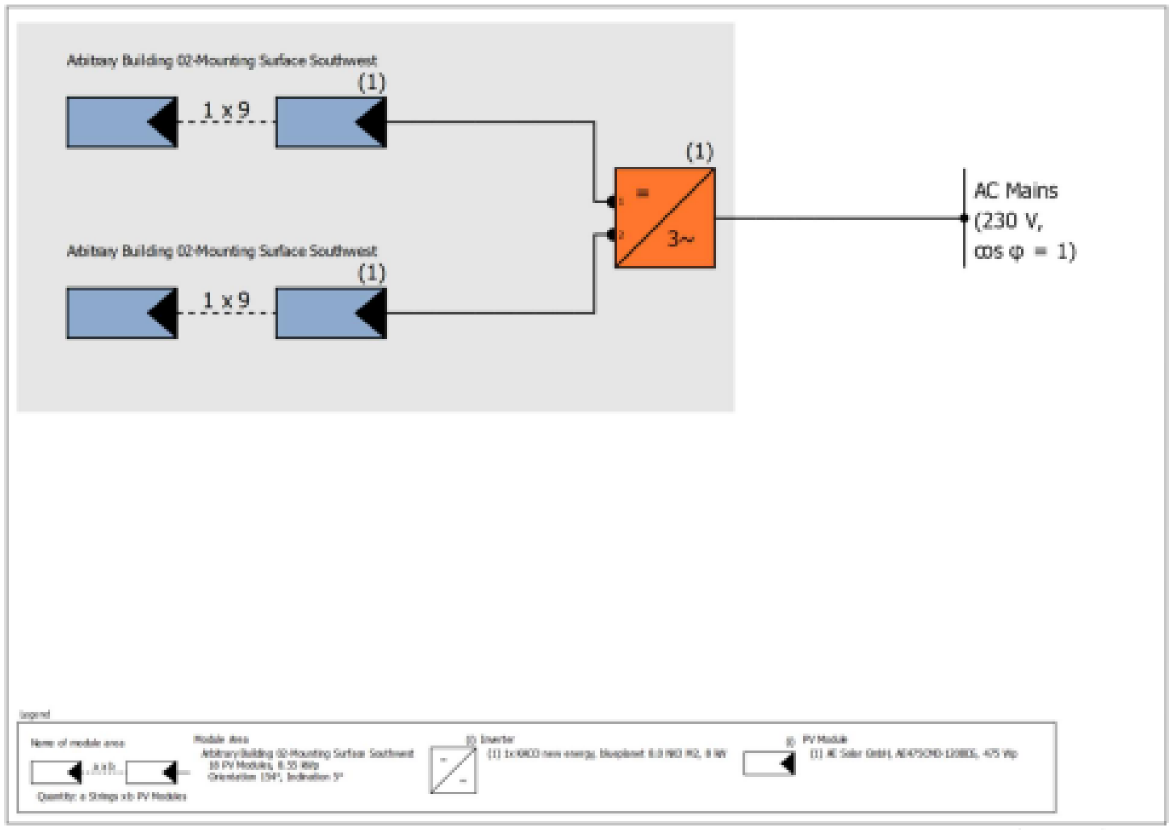

Figure: Schematic diagram

Production Forecast

Production Forecast	
PV Generator Output	8.55 kWp
Spec. Annual Yield	698.73 kWh/kWp
Performance Ratio (PR)	73.62 %
Yield Reduction due to Shading	20.6 %
Grid Export	5,978 kWh/Year
Grid Export in the first year (incl. module degradation)	5,764 kWh/Year
Standby Consumption (Inverter)	4 kWh/Year
CO_2 Emissions avoided	2,808 kg / year