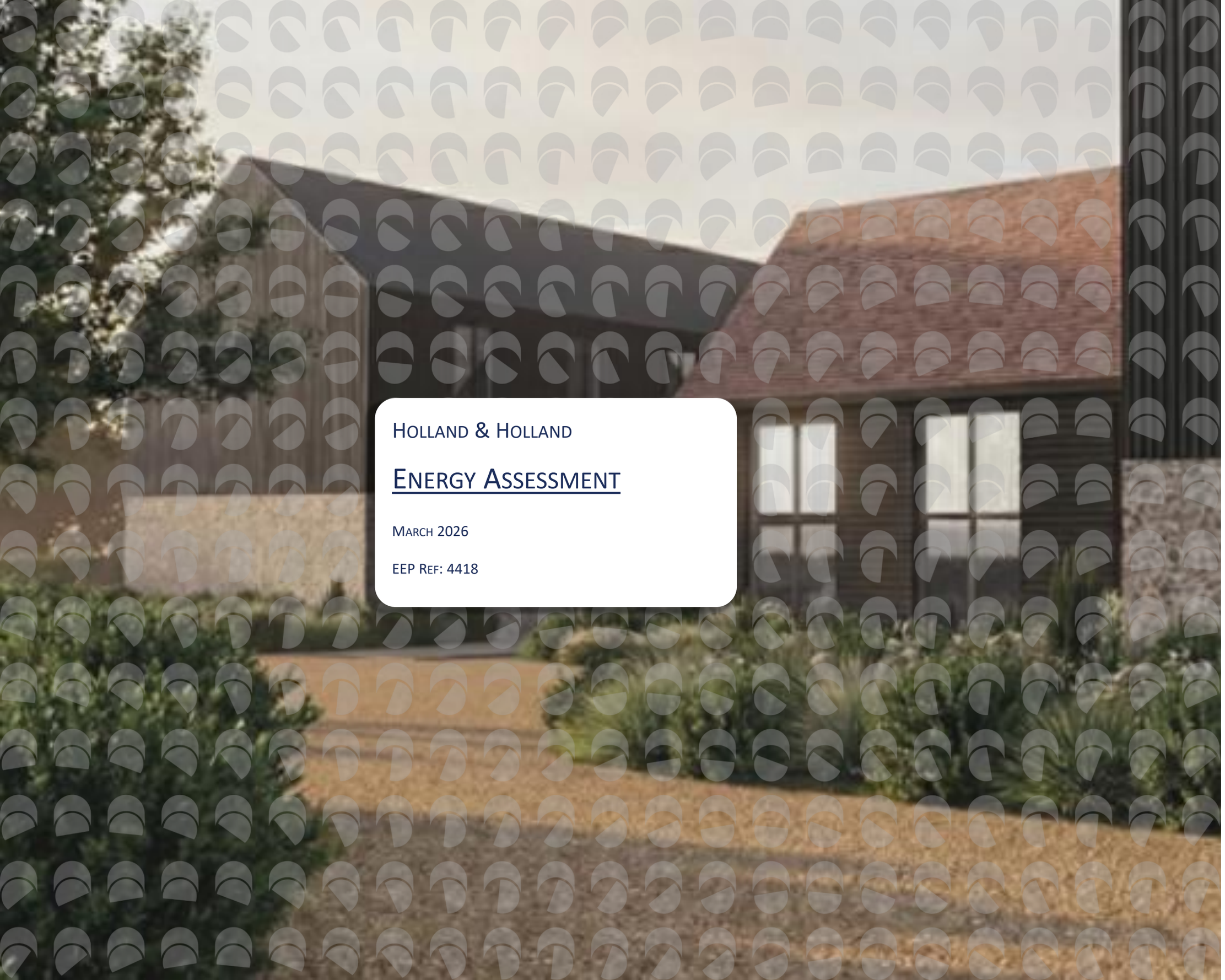

HOLLAND & HOLLAND

ENERGY ASSESSMENT

MARCH 2026

EEP REF: 4418

ENVIRONMENTAL ENGINEERING PARTNERSHIP

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Executive Summary

This Energy Statement has been prepared to support the planning application for the proposed removal of existing farm structures and the construction of a new workshop within the London Borough of Hillingdon.

The report aims to assess the energy demand and regulated CO2 emissions associated with the proposed development. As the proposal constitutes a major non-residential development, the assessment has been undertaken in accordance with Building Regulations Approved Document Part L (2021), the London Plan (2021), the National Planning Policy Framework and relevant local planning policies.

The assessment relies on dynamic thermal modelling undertaken using IES VE 2024 software to evaluate the performance of the proposed building fabric and building services systems. The modelling outputs form the basis of the energy hierarchy assessment and demonstrate how the development meets the required policy targets.

In addressing operational carbon emissions, the London Plan requires developments to follow the energy hierarchy, comprising:

- Be Lean – reducing energy demand through passive design and fabric efficiency.
- Be Clean – supplying energy efficiently.
- Be Green – using renewable energy.
- Be Seen – energy monitoring.

The proposed development has been assessed against each stage of the energy hierarchy, with the aim of achieving compliance with all relevant policy targets while ensuring that the design remains appropriate for the operational requirements of a workshop.

Through a combination of improved building fabric performance, high-efficiency building services and on-site renewable energy generation, the proposed development achieves a total regulated carbon dioxide emissions reduction of:

- Be Lean – **16.2%**
- Be Clean – **24.7%**
- Be Green – **37.3%**

This exceeds the London Plan requirement for a minimum 35% on-site reduction in regulated carbon emissions for major non-residential developments.

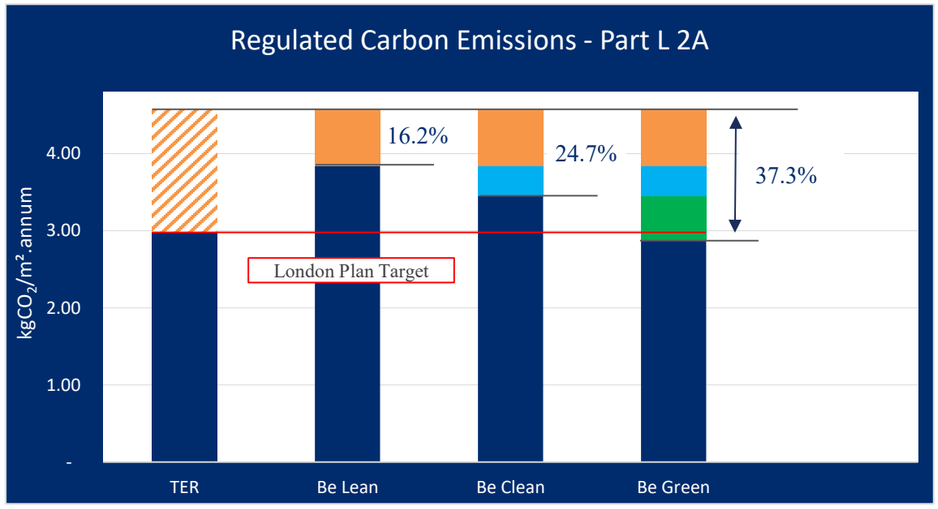
The development commits to energy monitoring and reporting, including sub-metering and submission of post-occupancy performance data to the GLA.

The remaining regulated carbon emissions equate to a one-off payment offset contribution of **£11,381** which is calculated over a 30-year period and is in line with the GLA's carbon price of £95/tCO_2.

Dynamic **TM52 overheating analysis** confirms that, due to significant internal gains from workshop machinery, mechanical cooling is required. All spaces comply with the 3 criteria under the proposed cooling strategy.

A **TM54 assessment** has also been undertaken to account for unregulated energy, resulting in a total predicted operational carbon emission of **87.98 tCO_2/year** (46.87 regulated + 41.11 unregulated).

In summary, the proposed workshop development has been designed to deliver high standards of energy performance and carbon reduction through a fabric-first approach, efficient building services and on-site renewable energy. The strategy fully complies with the London Plan, Building Regulations Part L (2021), and Hillingdon's local energy policies. It also provides a robust assessment of operational energy using TM54 and includes a clear commitment to post-occupancy energy monitoring.



Contents

Revision	Description	Date	Author	Checked By
A	Draft Issue to Architects	03/02/2026	SV	TD
B	Issue for Planning	05/03/2026	SV	TD

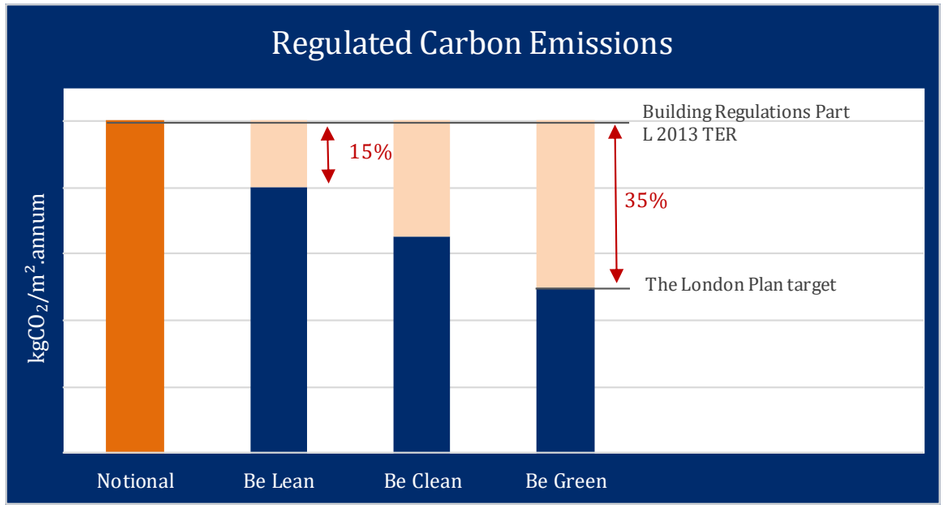
INTRODUCTION

This Energy Statement has been prepared in support of the planning application for the proposed demolition of existing farm structures and construction of a new workshop facility within the London Borough of Hillingdon. This report will demonstrate how the proposed development has been designed to minimise operational energy demand and carbon dioxide emissions, in accordance with the National Planning Policy Framework (2024), the London Plan (2021) and the London Borough of Hillingdon Local Plan.

It sets out the approach taken to reduce energy consumption, supply energy efficiently and incorporate low and zero carbon technologies, following the energy hierarchy established by the London Plan. The assessment also addresses the Be Seen requirements, ensuring that energy performance will be monitored and reported following occupation of the building.

The proposed development comprises a purpose-built facility to accommodate a new workshop, office and staff spaces. The operational nature of the building has informed the energy strategy, particularly in relation to internal heat gains, ventilation requirements and thermal comfort. As such, the energy strategy has been developed to balance energy efficiency, occupant comfort and operational functionality.

The assessment has been carried out using IES VE 2024 software. The proposed building's energy performance has been assessed against a Building Regulations Approved Document Part L (2021) notional building of equivalent size, form and use. The modelling outputs are used to quantify regulated energy consumption and associated carbon dioxide emissions and to demonstrate compliance with relevant policy targets.



Policy and Context

This Energy Statement has been prepared in accordance with the relevant national, regional and local planning policy framework, which collectively seeks to address climate change, reduce carbon emissions and support the transition to a low-carbon economy. Full regard has been given to the applicable requirements of the London Plan (2021), alongside national and local policy objectives.

National Planning Policy Framework (NPPF, 2024)

The National Planning Policy Framework (NPPF) sets out the Government's overarching planning policies for England and establishes a strong presumption in favour of sustainable development.

Paragraph 8 of the NPPF identifies three overarching objectives of sustainable development — economic, social and environmental — which are to be pursued in a mutually supportive manner. Of particular relevance to this Energy Statement is the environmental objective, which seeks to:

"protect and enhance our natural, built and historic environment… mitigate and adapt to climate change, including moving to a low carbon economy."

The NPPF places a clear emphasis on addressing climate change through the planning system. Paragraph 161 states that the planning system should:

"support the transition to net zero by 2050, taking full account of all climate impacts and supporting renewable and low carbon energy and associated infrastructure."

Paragraph 164 requires that new development should be planned in ways that:

- Reduce greenhouse gas emissions, including through location, orientation and design.
- Avoid increased vulnerability to climate change, incorporating suitable adaptation measures where necessary.

Paragraphs 165 and 166 further require local planning authorities to support renewable and low carbon energy and to expect new development to:

- Comply with development plan policies on decentralised energy supply, unless it can be demonstrated that this is not feasible or viable.
- Take account of layout, building orientation, massing and landscaping to minimise energy consumption.

Ministry of Housing, Communities & Local Government

National Planning Policy Framework

December 2024

Policy and Context

The London Plan (2021)

The Mayor's London Plan sets out targets and guidance for the 32 London boroughs, the City of London Corporation, and the Mayoral Development Corporations, shaping London's spatial development up to 2041.

The latest edition, published in March 2021, is the most ambitious to date, placing stronger emphasis on sustainable and inclusive growth. At its core is the principle of Good Growth—development that is socially and economically inclusive while environmentally responsible.

Average on-site carbon emission reductions of at least 35% compared to Building Regulations 2013 for approved referable development applications.

This vision aligns with the updated Building Regulations, incorporating revised energy performance standards to ensure London's future growth is both resilient and sustainable. Although the proposed scheme is not classified as a major development, the relevant energy policies have been considered as best practice guidance in the preparation of this Energy Statement.

Policy SI 2 – Minimising Greenhouse Gas Emissions

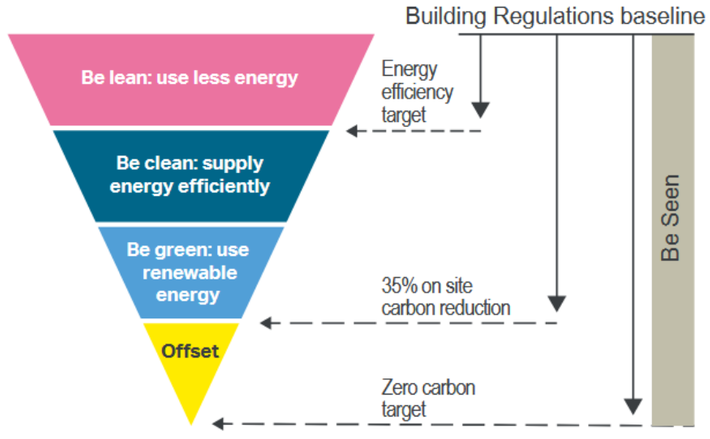
Policy SI 2 seeks to minimise greenhouse gas emissions from new development and promotes the application of the Mayor's Energy Hierarchy:

- Be Lean – Use less energy
- Be Clean – Supply energy efficiently
- Be Green – Use renewable energy
- Be Seen – Monitor energy performance

Major non-residential developments are required to achieve a minimum 35% reduction in regulated CO_2 emissions on site beyond the Building Regulations baseline. Of this reduction, a minimum of 15% must be achieved through energy efficiency measures alone.

Where it is not feasible to eliminate all regulated carbon emissions on site, Policy SI 2 requires that any residual emissions are addressed through a carbon offset payment, calculated in accordance with Greater London Authority guidance, to ensure that developments achieve net zero operational carbon.

The proposed development has been designed to comply fully with Policy SI 2 and explicitly commits to a carbon offset contribution to address any residual regulated emissions.



Policy and Context

Major developments must demonstrate a commitment to post-construction energy monitoring under the Be Seen approach. The proposed development will commit to:

- The provision of energy performance data following completion and occupation.
- Ongoing monitoring and reporting in line with Greater London Authority requirements.

This commitment will ensure transparency of operational energy performance and support continuous improvement over the life of the building.

Policy SI 3 – Energy Infrastructure

Policy SI 3 promotes the delivery of efficient, low-carbon energy infrastructure and sets out a heating hierarchy that prioritises:

- Connection to existing heat networks.
- Provision of site-wide heat networks supplied by low-carbon heat sources.
- Individual low-carbon heat solutions.

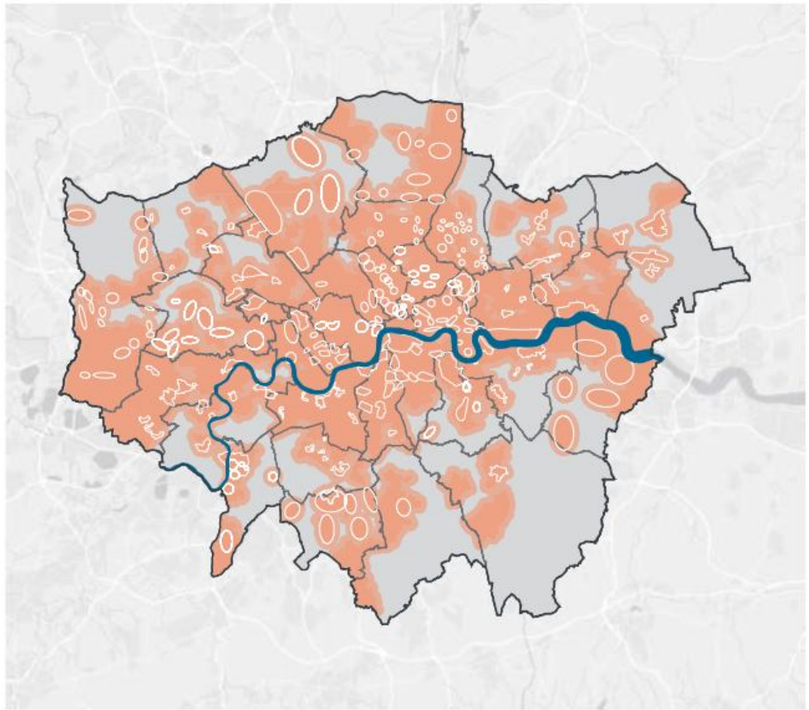
The policy requires major developments to demonstrate that opportunities for connection to district energy networks have been fully explored and to justify alternative approaches where such connections are not feasible.

The applicability of district energy networks to the proposed development has been assessed and is discussed in Section 4 of this Energy Statement. Where connection is not feasible, the London Plan supports the use of zero-emission heat technologies to minimise operational carbon emissions.

Policy SI 4 – Managing Heat Risk

The risk of overheating is to be minimised and to be designed in accordance with the following cooling hierarchy:

1. Minimise internal heat generation through efficient equipment, lighting and building services.
2. Reduce heat gains through passive design, including orientation, shading, high-performance glazing and fabric design.
3. Manage the heat within the building through exposed internal thermal mass and high ceilings.
4. Use natural ventilation.
5. Use mechanical ventilation.
6. Adopt efficient mechanical cooling systems including the use of low-GWP refrigerants and high-efficiency plant.



Heat Network Priority Areas

Heat Network Priority Areas
Local Authority Heat Network Studies

Source: GLA Environment

Policy and Context

London Borough of Hillingdon - Local Plan Part 1 (2012)

The Hillingdon Local Plan provides the local policy framework for development within the borough and seeks to ensure that new development contributes to climate change mitigation and environmental sustainability.

Policy EM1 – Climate Change Adaptation and Mitigation

Policy EM1 supports developments that:

- Reduce carbon dioxide emissions.
- Promote energy efficiency.
- Encourages the use of renewable and decentralised energy technologies where feasible.

The policy also requires development to minimise energy demand and support borough-wide objectives for reducing environmental impact.

The proposed development aligns with Policy EM1 through an integrated approach to energy efficiency, reduced operational carbon emissions and the incorporation of low-carbon technologies, with residual emissions addressed through carbon offsetting in accordance with London Plan policy.

Policy BE1 – Built Environment

Developments must achieve high-quality design that supports sustainability and reduces environmental impact. The policy seeks to ensure that:

- Carbon emissions are reduced in line with London Plan objectives.
- Sustainability measures are embedded within the design of buildings.

The energy strategy for the proposed development has been developed in parallel with the architectural design, ensuring that energy efficiency and carbon reduction are integral to the scheme rather than applied as add-on measures.

Policy EM1: Climate Change Adaptation and Mitigation

The Council will ensure that climate change mitigation is addressed at every stage of the development process by:

1. Prioritising higher density development in urban and town centres that are well served by sustainable forms of transport.
2. Promoting a modal shift away from private car use and requiring new development to include innovative initiatives to reduce car dependency.
3. Ensuring development meets the highest possible design standards whilst still retaining competitiveness within the market.
4. Working with developers of major schemes to identify the opportunities to help provide efficiency initiatives that can benefit the existing building stock.
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.
7. Encouraging sustainable techniques to land remediation to reduce the need to transport waste to landfill. In particular developers should consider bioremediation(39) as part of their proposals.
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, hydroelectricty and a greater use of waste as a resource.
9. Promoting new development to contribute to the upgrading of existing housing stock where appropriate.

The Borough will ensure that climate change adaptation is addressed at every stage of the development process by:

10. Locating and designing development to minimise the probability and impacts of flooding.
11. Requiring major development proposals to consider the whole water cycle impact which includes flood risk management, foul and surface water drainage and water consumption.
12. Giving preference to development of previously developed land to avoid the loss of further green areas.
13. Promoting the use of living walls and roofs, alongside sustainable forms of drainage to manage surface water run-off and increase the amount of carbon sinks(40).
14. Promoting the inclusion of passive design(41) measures to reduce the impacts of urban heat effects.

Policy and Context

London Borough of Hillingdon - Local Plan Part 2 (2020)

Part 2 of the Hillingdon Local Plan provides the detailed policy framework against which planning applications are assessed. The following policies are of direct relevance to the energy and carbon strategy for the proposed development.

Policy DMEI 2 – Energy Efficiency

Developments are to be designed to minimise energy demand through the incorporation of energy-efficient measures at the earliest stage of the design process. The policy places emphasis on reducing energy consumption through:

- Appropriate building orientation and layout.
- Efficient building form and massing.
- High standards of fabric performance.
- The use of efficient building services and controls.

Under this policy energy efficiency is to be embedded within the design of new development, rather than relying solely on renewable or low-carbon technologies to offset poor baseline performance.

Policy DMEI 3 – Decentralised Energy

DMEI 3 promotes the use of decentralised energy systems, including district heat networks, and requires major developments to demonstrate that opportunities for connection to such networks have been fully considered. The policy states that development proposals should:

- Connect to an existing decentralised energy network where one is available and has sufficient capacity.
- Demonstrate, through a feasibility assessment, why connection is not viable or feasible.

In accordance with Policy DMEI 3, the potential for connection to a district energy network has been assessed as part of the proposed energy strategy.

Policy DMEI 2: Reducing Carbon Emissions

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[7] 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.

POLICY DMEI 3: Decentralised Energy

A) All major developments are required to be designed to be able to connect to a Decentralised Energy Network (DEN).

B) Major developments located within 500 metres of an existing DEN, and minor new-build developments located within 100 metres, will be required to connect to that network, including provision of the means to connect to that network and a reasonable financial contribution to the connection charge, unless a feasibility assessment demonstrates that connection is not reasonably possible.

C) Major developments located within 500 metres of a planned future DEN, which is considered by the Council likely to be operational within 3 years of a grant of planning permission, will be required to provide a means to connect to that network and developers shall provide a reasonable financial contribution for the future cost of connection and a commitment to connect via a legal agreement or contract, unless a feasibility assessment demonstrates that connection is not reasonably possible.

D) The Council will support the development of DENs and energy centres in principle, subject to meeting the wider policy requirements of this plan and in particular on design and air quality.

Policy and Context

Building Regulations – Approved Document Part L2 (2021)

The energy performance of the proposed non-residential development is governed by Approved Document Part L2 (2021), which sets the statutory minimum requirements for the conservation of fuel and power and forms the baseline against which additional carbon reductions required by planning policy are assessed.

Part L2 (2021) requires new non-domestic buildings to demonstrate that:

- The Building Emission Rate (BER) does not exceed the Target Emission Rate (TER).
- The Building Primary Energy Rate (BPER) does not exceed the Target Primary Energy Rate (TPER).

These targets are derived from a notional building that reflects minimum standards for fabric performance, airtightness and building services efficiency. In addition, Part L2 (2021) sets limiting standards for building fabric and minimum efficiencies for heating, cooling, ventilation, hot water and lighting systems.

Full compliance with Part L2 (2021) is demonstrated through detailed energy modelling in later sections.

HM Government

The Building Regulations 2010

Conservation of fuel and power

APPROVED DOCUMENT

L

Volume 2: Buildings other than dwellings

Requirement L1: Conservation of fuel and power

Requirement L2: On-site generation of electricity

Regulations: 6, 22, 23, 24, 25, 25A, 25B, 26, 26C, 27, 27C, 28, 40, 40A, 43, 44 and 44ZA

2021 edition incorporating 2023 amendments – for use in England

District Energy Network Feasibility Study

The London Heat Map

An assessment has been undertaken to identify whether any existing or planned district heat networks are available within the vicinity of the site that could reasonably serve the proposed development.

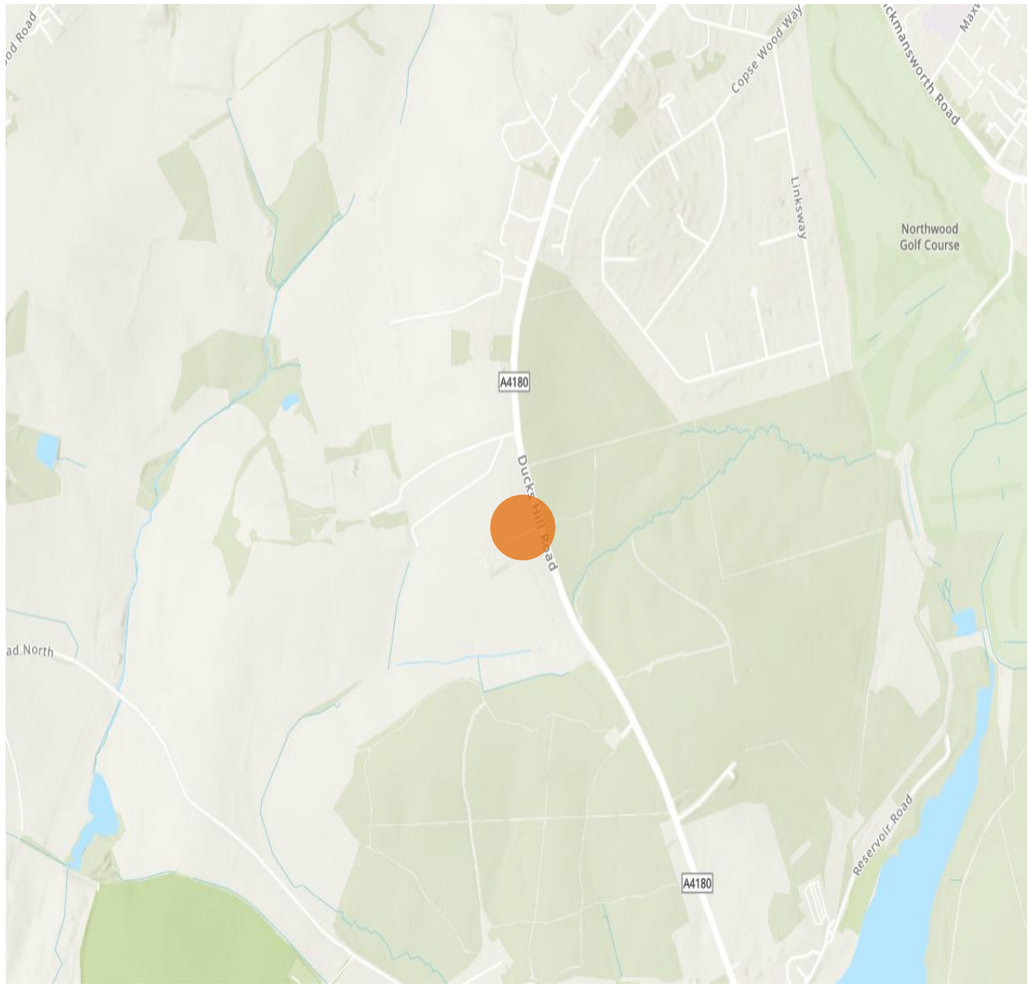
This assessment has confirmed that:

- There are no existing district heat networks located within a practical distance of the site.
- There are no planned, consented or safeguarded heat networks identified that could serve the development within the foreseeable future.

The site is located in a relatively low-density, semi-rural area, with limited surrounding heat demand. This significantly reduces the technical and commercial viability of extending district energy infrastructure to serve the proposed development.

Given the absence of existing or planned networks and the low surrounding heat demand density, connection to a district energy network is not considered to be:

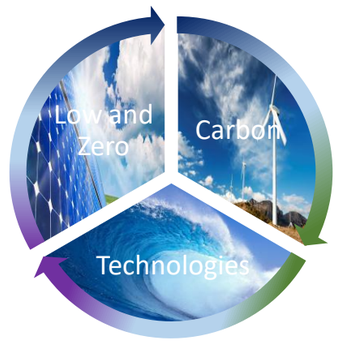
- Technically feasible, due to the lack of nearby infrastructure.
- Economically viable, due to the scale of the development and the cost of extending heat mains.
- Environmentally beneficial, as the carbon savings associated with network connection would be outweighed by distribution losses and infrastructure impacts.



Site location

Low and Zero Carbon (LZC) Feasibility Study

As part of the proposed energy strategy, a range of low and zero carbon technologies have been considered. There are several factors influencing the decision to pursue any LZC installation and these include; location, local environment, political drivers, feasibility (financial and technical), and marketability. In the following sections various available LZC technologies will be reviewed before presenting a decision matrix that will define which technologies will be pursued and tested.



Solar Thermal Collectors

Solar thermal systems generate useful heat by converting incident solar radiation into thermal energy, typically for domestic hot water or low-temperature process applications. The two most common collector types are flat plate collectors and evacuated tube collectors. Flat plate collectors generally achieve annual thermal outputs in the order of 400–500 kWh per square meter of collector area, while evacuated tube collectors can achieve higher outputs, typically in the range of 500–650 kWh per square meter per year, due to reduced convective and radiative heat losses. Net system efficiencies for solar thermal installations are typically in the region of 45–60%, significantly higher than photovoltaic systems when assessed on a pure energy conversion basis. Evacuated tube collectors are capable of producing hot water temperatures in excess of 90–100°C, and in some cases up to approximately 120–150°C, depending on system design. System performance is influenced by collector orientation, inclination, shading, storage capacity and hot water demand profile, and solar thermal systems generally require integration with thermal storage and auxiliary heating systems.

Photovoltaics

Photovoltaic panels convert solar radiation directly into electricity using semiconductor materials. Modern crystalline silicon PV modules typically achieve electrical conversion efficiencies in the range of 20–23%, with continued incremental improvements in performance and durability. In the London area, annual global horizontal solar irradiation is typically around 950–1,050 kWh per square meter. For a well-designed PV system with favourable orientation and limited shading, annual electricity generation of approximately 850–1,000 kWh per installed kilowatt peak (kWp) can be achieved. PV system performance is influenced by module efficiency, inverter performance, temperature effects and shading, with partial shading having a disproportionate impact on output, although modern inverter technologies have reduced this effect compared to earlier systems. PV systems have no moving parts, minimal maintenance requirements and operational lifespans typically in excess of 25 years.

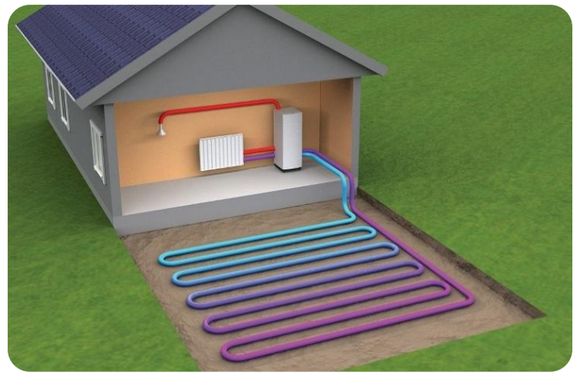
Low and Zero Carbon (LZC) Feasibility Study

Wind Turbines

Wind turbines generate electricity by converting the kinetic energy of moving air into mechanical energy, which is then converted into electrical power via a generator. The power available in the wind is proportional to the cube of wind speed and the square of the turbine rotor diameter, making both wind resource and turbine size critical determinants of performance. Small-scale wind turbines typically operate effectively at wind speeds above approximately 5–6 meters per second, with rated power output achieved at higher wind speeds. In areas with lower or more turbulent wind conditions, annual capacity factors can be significantly reduced, resulting in limited energy generation. In addition to energy yield, wind turbines introduce considerations relating to aerodynamic and mechanical noise, visual impact, structural loading and operational vibration, all of which must be carefully managed through design and siting.

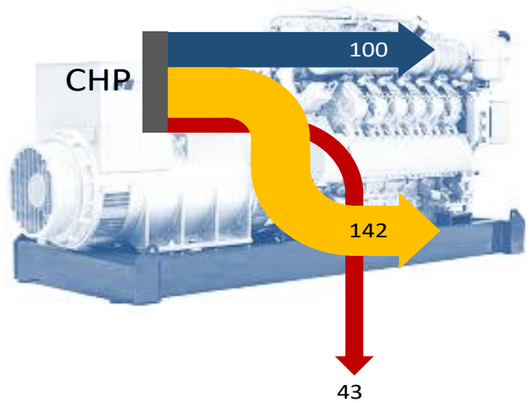
Heat Pumps

Heat pumps provide low-carbon heating and cooling by extracting low-grade heat from the environment and upgrading it to a usable temperature using electrically driven compressors. Air source heat pumps extract heat from ambient air, while ground source heat pumps utilise heat stored in the ground via horizontal loops or vertical boreholes. Modern heat pumps typically achieve Seasonal Coefficients of Performance (SCOP) in the range of approximately 2.8–4.5, meaning that for each unit of electrical energy consumed, between 2.8 and 4.5 units of useful heat are delivered over the course of a year. System efficiency is influenced by source temperature, heat distribution temperature, system design and operating regime. Heat pumps are capable of providing both space heating and cooling where appropriate and are most efficient when paired with low-temperature heat distribution systems such as underfloor heating or oversized radiators.



CHP

Combined Heat and Power systems generate electricity and useful heat simultaneously from a single fuel source. Typical CHP prime movers include gas engines, gas turbines and fuel cells. Electrical efficiencies for conventional gas engine CHP systems are typically in the range of 30–40%, with overall system efficiencies of up to 80–85% when both electrical and thermal outputs are fully utilised. Fuel cell CHP systems offer higher electrical efficiencies, often in the region of 45–60%, with lower noise levels and reduced local emissions compared to combustion-based systems. Effective CHP operation relies on a consistent and significant heat demand, with best practice requiring operating hours of approximately 5,000 hours per annum or more to ensure efficient utilisation of generated heat. CHP systems are generally designed to meet base heat loads, with supplementary plant provided for peak demand conditions.



Low and Zero Carbon (LZC) Feasibility Study

Results from the LZC decision matrix are shown below. The combination of PV solar panels for on site electricity generation and ASHP for heating, cooling and DHW has been selected to proceed at the design stage as the LZC technologies to meet annual CO_2 savings achieve London Plan's 35% reduction target.

The final solutions presented as part of the "Be Lean", "Be Clean" and "Be Green" methodology have been chosen because:

- Overall, with the passive savings, the LZCs will achieve the 35% target.
- Their installation won't detract from the architect's aesthetic design.
- They conform to the prescribed energy hierarchy.

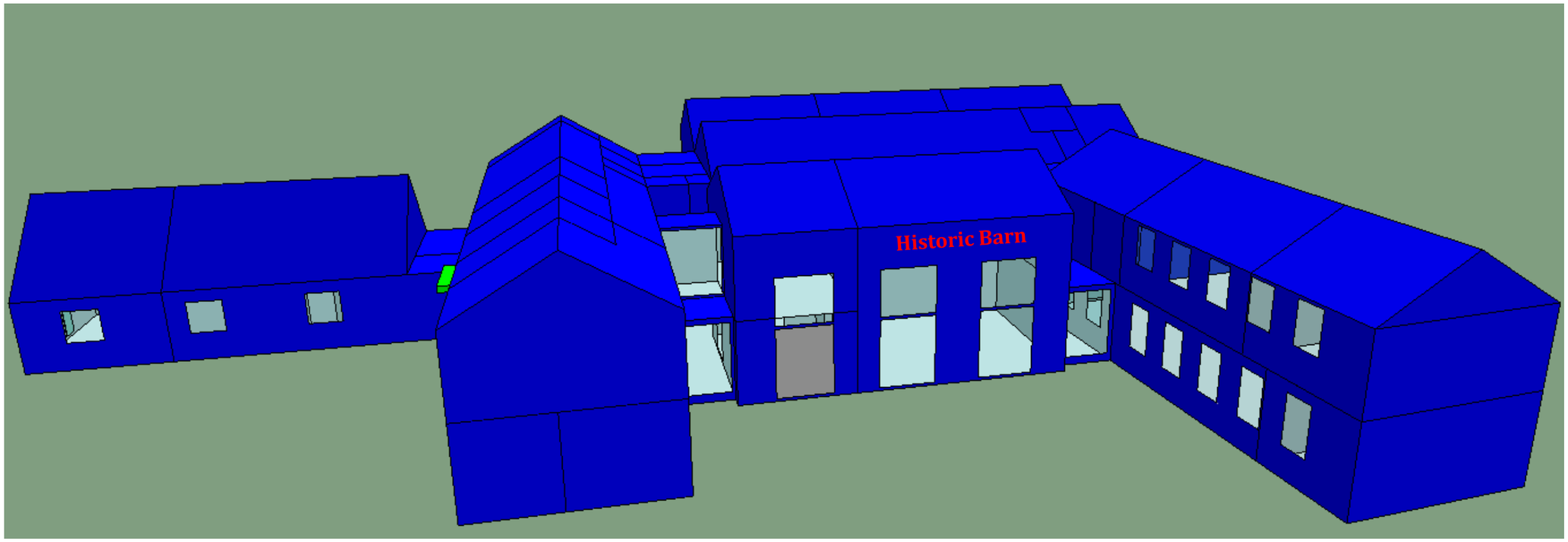
	Technology	Lifecycle Carbon Saving Potential	Grants	Lifecycle Costs	Space Requirements	Planning Restrictions	Noise	Appropriate for the site	Reason for exclusion
Solar Energy	**Solar Hot Water**	Low	N/A	Medium	Low	Suitable	Suitable	Suitable	Excluded due to seasonal efficiency and function limitations (only DHW) compared to ASHP.
	Photovoltaics	Low-Medium	Smart Export Guarantee (SEG)	High	Low	Suitable	Suitable	Suitable	Tested and shown to provide substantial CO2 savings.
Wind Energy	**Wind Turbines**	Low-Medium	Smart Export Guarantee (SEG)	Medium	Medium-High	Not suitable	Noise from blades, gears and generator	Suitable	Noisy, costly and not suitable due to space area limitations.
Heat Pumps	**Ground Source Heat Pumps**	Medium	N/A	Medium-High	Low	Suitable	Suitable	Suitable	Initially conidered but exluded due to space area limitaions.
	Air Source Heat Pumps	Low-Medium	N/A	Low	Low	Suitable	Fan and compressor noise to be considered	Suitable	ASHP tested and found to provide substantial savings during heating, cooling and DHW.
Co-generation and alternative fuels	**Biomass Boilers**	Medium	N/A	Medium-Low	Medium	PM10 particulate	Consideration for vehicle noise during regular fuel deliveries to be considered	Suitable	Not considered due to concerns over emissions, air quality, cost and carbon footprint from deliveries and concerns over fuel supplies.
	Biomass CHP	High	N/A	Medium	Medium	PM10 particulate		Suitable	
	Gas-fired CHP	Medium	N/A	Medium-Low	Low	Suitable	Located in acoustically treated plnatrooms	Suitable	CHP scenario considered but savings not greater than ASHP.
	Gas-fired CCHP	Medium	N/A	Medium-High	Low	Suitable		Suitable	CCHP scenario considered but savings not greater than ASHP.
	Fuel Cell CHP/CCHP	Medium	N/A	High	Low	Suitable	Suitable	Suitable	Offers similar savings to gas-fired CHP, hence not selected over ASHP.
	District Heating/cooling	Medium-High	N/A	Medium	Low	Suitable	Suitable	Suitable	No current nor future networks planned for the area.
Hydro Power	**Small Scale Hydro Power**	Low	N/A	Low	N/A	N/A	N/A	N/A	Not applicable due to geographical restrictions.
	Tidal Power	Low	N/A	Low	N/A	N/A	N/A	N/A	
	Wave Power	Low	N/A	Low	N/A	N/A	N/A	N/A	

Technology to be considered
Technology unfeasible or non-applicable

Energy Model Development

A 3D representation of the proposed development has been created using IES VE 2024 software. Dynamic thermal simulations have been performed for each stage of the London Plan energy hierarchy to assess the building's annual energy consumption and associated carbon emissions.

The following sections outline the results of the dynamic simulations and demonstrate how the proposed development complies with Building Regulations Approved Document Part L (2021), the London Plan and relevant local plans.



IES INTEGRATED ENVIRONMENTAL SOLUTIONS

‘Be Lean’ – Reducing Energy Demand

	Value	Unit	Notes
External Wall - U-value	0.15	W/m².K	
Ground Floor - U-value	0.12	W/m².K	
Roof - U-value	0.14	W/m².K	
Window - U-value	1.36	W/m².K	
Window - g-value	0.40		
Air permeability	3.80	m³/hr/m²	
Electricity power factor	<0.9		
Lighting efficacies	100 - 150	lm/W	High Performance LED
Lighting occupancy controls	Yes		PIR controls
Lighting daylight controls	Yes		Daylight dimming
Ventilation SFPs	1.80	W/l/s	Mechanical ventilation with heat recovery
Heat Recovery Efficiency	82%		Heat exchanger
Variable speed pumping	Yes		
Cooling efficiency	3.20	SEER	VRF Heat Pump
Heating efficiency	2.90	SCOP	VRF Heat Pump
DHW efficiency	2.90	SCOP	VRF Heat Pump

The Be Lean stage of the Energy Hierarchy focuses on reducing operational energy demand through good passive design, high levels of fabric performance and efficient building services.

Passive design measures

The building layout, orientation and massing have been developed to support energy-efficient operation and to minimise unnecessary energy demand.

Passive design measures include:

- A compact building form that reduces exposed envelope area and associated heat losses.
- The careful arrangement of internal spaces to align with building use and occupancy.
- Optimised glazing proportions to balance daylight provision with thermal performance.
- The incorporation of shading and façade design measures to manage solar gains and reduce overheating risk.

Fabric insulation and glazing specification

Key fabric measures include:

- Enhanced thermal performance of external walls, roofs and floors.
- High-performance double glazing with low U-values and appropriate solar control.
- Low air permeability to enhance building tightness.
- Robust detailing at junctions to minimise thermal bridging.

Improving the thermal efficiency of the building envelope reduces space heating and cooling demand, directly contributing to regulated carbon savings.

Efficient building services design strategy

Energy demand will be further minimised through the selection of efficient building services systems and controls, appropriate to the function of a workshop facility. Measures will include:

- High-efficiency heating and hot water systems (ASHP).
- Energy-efficient mechanical ventilation systems with heat recovery.
- Low-energy lighting with high efficacy luminaires (LED).
- Smart lighting controls, including occupancy sensors (PIR) and daylight dimming in appropriate areas.

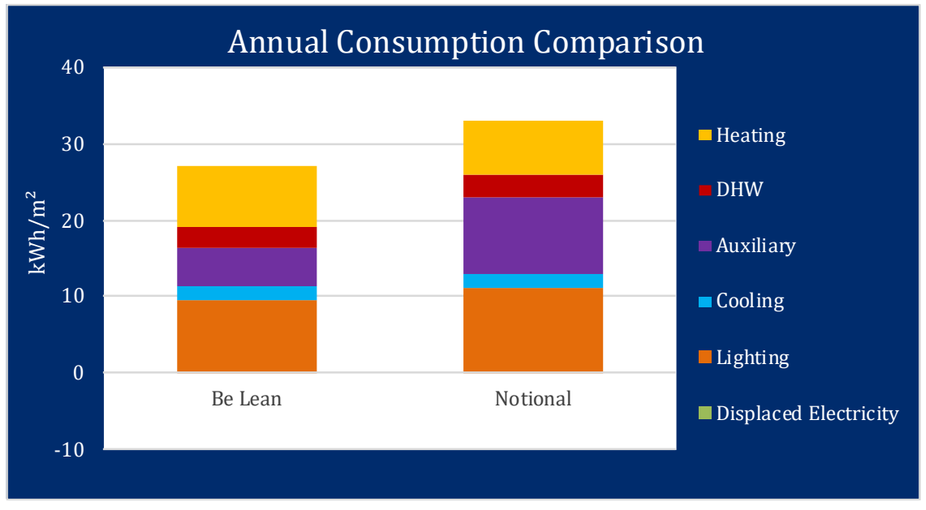
‘Be Lean’ - Annual CO_2 Emission Calculation

The building has been designed to optimise passive performance through appropriate orientation, careful control of glazing ratios, improved airtightness, and enhanced thermal insulation to walls, roof and floors. Thermal mass is introduced as an area of concrete slab over the workshop providing a more stable and comfortable indoor environment with reduced heating and cooling demands. High-performance glazing has been specified to balance solar gains with heat loss, contributing to reduced space heating demand while limiting the risk of overheating. These passive measures are supported by efficient building services, further reducing regulated energy demand.

The results of the dynamic simulation modelling demonstrate a clear improvement in energy efficiency when compared to the notional building. The building achieves a reduction in annual space heating demand, lighting, domestic hot water and auxiliary over the notional building. Although cooling energy demand is higher than the notional building, this reflects the modelling of realistic operational conditions and improved internal environmental control.

Overall, the total regulated energy consumption of the proposed development is reduced from 33.05 kWh/m² to 27.05 kWh/m². As illustrated in the accompanying comparison graph, these improvements result in a **16.2%** reduction in regulated CO_2 emissions relative to the Part L notional building, thereby meeting the London Plan requirement for a minimum 15% reduction at the Be Lean stage.

Annual Energy Consumption kWh/m²	Be Lean	Notional
Heating	7.99	7.05
Cooling	1.73	1.97
Auxiliary	4.98	10.06
Lighting	9.59	11.04
DHW	2.76	2.93
Displaced Electricity	0.00	0.00
	27.05	33.05
Model Area (m²)	1391	1391



‘Be Clean’ – Supply Energy Efficiently

	Value	Unit	Notes
External Wall - U-value	0.15	W/m².K	
Ground Floor - U-value	0.12	W/m².K	
Roof - U-value	0.14	W/m².K	
Window - U-value	1.36	W/m².K	
Window - g-value	0.40		
Air permeability	3.80	m³/hr/m²	
Electricity power factor	<0.9		
Lighting efficacies	100 - 150	lm/W	High Performance LED
Lighting occupancy controls	Yes		PIR controls
Lighting daylight controls	Yes		Daylight dimming
Ventilation SFPs	1.80	W/l/s	Mechanical ventilation with heat recovery
Heat Recovery Efficiency	82%		Heat exchanger
Variable speed pumping	Yes		
Cooling efficiency	6.00	SEER	VRF Heat Pump
Heating efficiency	4.00	SCOP	VRF Heat Pump
DHW efficiency	4.00	SCOP	VRF Heat Pump
District heating	No		Not feasible as no current nor future plans for networks in the area.

The second stage of the London Plan energy hierarchy seeks to further reduce regulated carbon emissions through the use of efficient energy supply systems. At the Be Clean stage, the building fabric and passive design measures established under the Be Lean scenario are retained, with the only change being an improvement in the performance of the proposed building services plant. This approach ensures that the reduction in carbon emissions is achieved through enhanced system efficiency rather than changes to building form or demand assumptions.

For the Be Clean scenario, heating, cooling and domestic hot water continue to be provided by an air source heat pump system; however, improved seasonal efficiencies have been modelled to reflect a more efficient system design. The heat pump has been modelled with a SCOP of 4.0 for space heating and domestic hot water, and a SEER of 6.0 for cooling. These values are representative of a high-efficiency, well-designed system based on the Daikin VRV 5 Heat Recovery REYA-A product range.

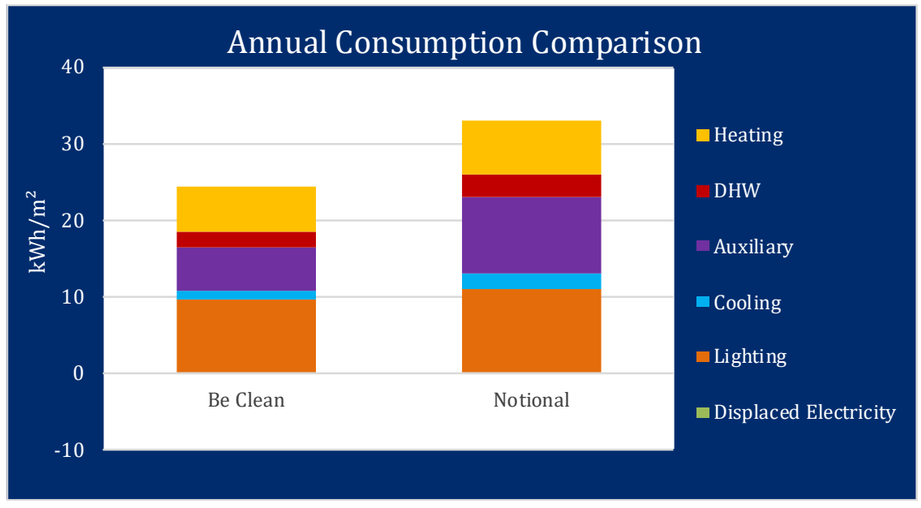
‘Be Clean’ - Annual CO_2 Emission Calculation

The dynamic thermal modelling undertaken demonstrates that the improved system efficiencies lead to a further reduction in regulated energy consumption across all of the building services, except for energy usage by auxiliary and lighting.

Overall, the total regulated energy consumption of the proposed development is reduced to 24.37 kWh/m², as illustrated in the accompanying comparison graph. The improved efficiency of the air source heat pumps have delivered a reduction in energy demand.

The introduction of energy efficient air source heat pumps to the Be Lean measures has resulted in a **24.7%** reduction in regulated CO_2 emissions relative to the Part L (2021) notional building. The Be Clean scenario therefore provides a strong platform upon which further carbon savings can be achieved at the Be Green stage through the incorporation of low and zero carbon technologies.

Annual Energy Consumption kWh/m²	Be Clean	Notional
Heating	5.79	7.05
Cooling	1.10	1.97
Auxiliary	5.78	10.06
Lighting	9.59	11.04
DHW	2.11	2.93
Displaced Electricity	0.00	0.00
	24.37	33.05
Model Area (m²)	1391	1391

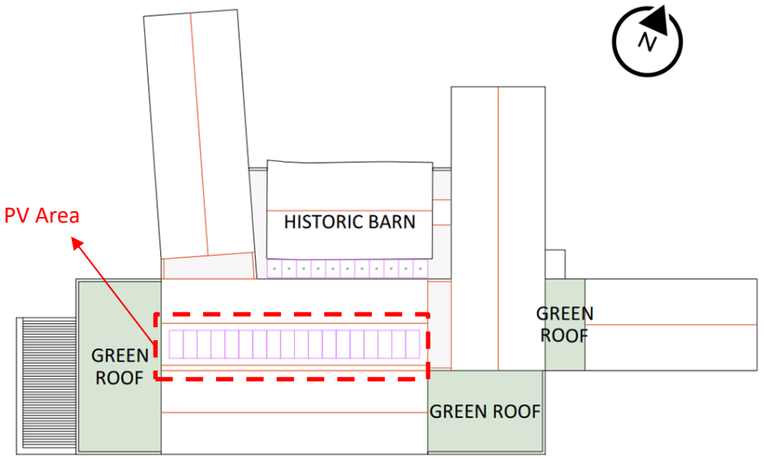


‘Be Green’ – Use Renewable Energy

	Value	Unit	Notes
External Wall - U-value	0.15	W/m².K	
Ground Floor - U-value	0.12	W/m².K	
Roof - U-value	0.14	W/m².K	
Window - U-value	1.36	W/m².K	
Window - g-value	0.40		
Air permeability	3.80	m³/hr/m²	
Electricity power factor	<0.9		
Lighting efficacies	100 - 150	lm/W	High Performance LED
Lighting occupancy controls	Yes		PIR controls
Lighting daylight controls	Yes		Daylight dimming
Ventilation SFPs	1.80	W/l/s	Mechanical ventilation with heat recovery
Heat Recovery Efficiency	82%		Heat exchanger
Variable speed pumping	Yes		
Cooling efficiency	6.00	SEER	VRF Heat Pump
Heating efficiency	4.00	SCOP	VRF Heat Pump
DHW efficiency	4.00	SCOP	VRF Heat Pump
District heating	No		Not feasible as no current nor future plans for networks in the area.
PV efficiency	22.0%		

The Be Green stage of the energy hierarchy focuses on further reducing regulated carbon emissions through the incorporation of on-site renewable energy technologies. Building on the demand reduction measures established at the Be Lean stage and the efficient energy supply systems introduced at the Be Clean stage.

Roof-mounted solar PV panels are to be installed to provide on-site generation of renewable electricity. For modelling purposes, the PV installation has been based on LG NeON R modules with a module efficiency of 22.0%. The PV panels have been modelled covering an area of approximately 30 m² on one of the building’s pitched roof slopes.



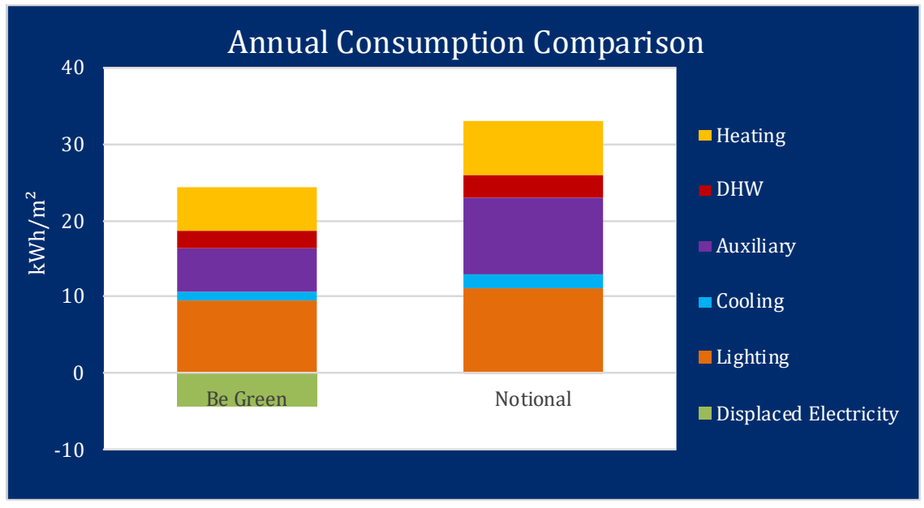
‘Be Green’ - Annual CO_2 Emission Calculation

The modelling undertaken demonstrates that the introduction of PV panels provides an offset to the building's energy consumption. The impact of on-site renewable generation reduces the total regulated energy consumption to 19.91 kWh/m² at the Be Green stage.

As illustrated in the comparison graph, the integration of PV panels provides a clear and measurable benefit, significantly reducing the building’s reliance on grid electricity and improving its CO_2 savings. The combined effect of demand reduction, efficient energy supply and on-site renewable generation results in a **37.3%** reduction in regulated CO_2 emissions relative to the Part L (2021) notional building.

This level of performance exceeds the London Plan target of a minimum 35% on-site reduction in regulated carbon emissions for major non-residential developments.

Annual Energy Consumption kWh/m²	Be Green	Notional
Heating	5.79	7.05
Cooling	1.10	1.97
Auxiliary	5.78	10.06
Lighting	9.59	11.04
DHW	2.11	2.93
Displaced Electricity	-4.46	0.00
	19.91	33.05
Model Area (m²)	1391	1391



‘Be Seen’ – Energy Monitoring

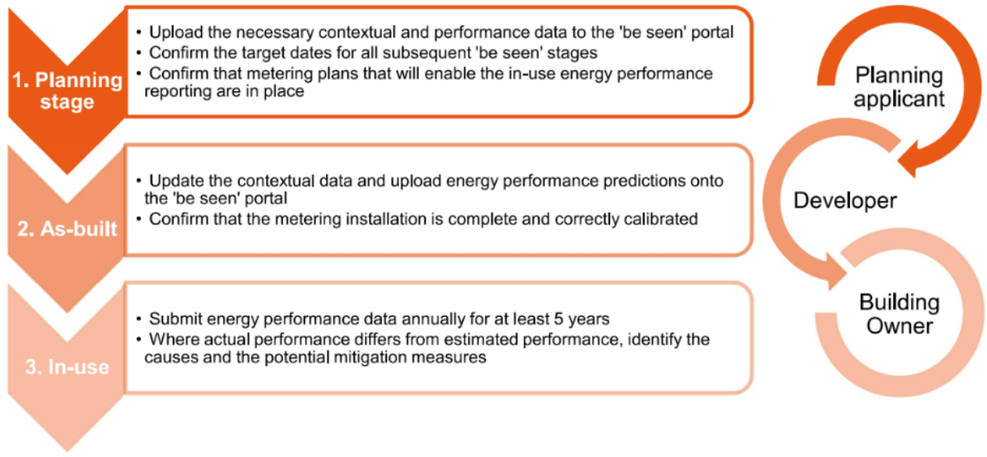
In accordance with London Plan Policy SI 2, the proposed development is committed to implementing appropriate measures to ensure transparency of energy performance and to support the long-term reduction of operational energy use and carbon emissions.

The proposed development will be designed to facilitate the monitoring of regulated energy consumption associated with space heating, cooling, domestic hot water, lighting and auxiliary systems. Sub-metering will be provided in accordance with Building Regulations Approved Document Part L (2021) to allow energy consumption to be measured at an appropriate level of granularity. This will enable comparison between predicted and actual energy use and support ongoing optimisation of building performance.

As part of the Be Seen commitment, an as-built energy model will be carried out. The as-built model will reflect the final construction details and installed services.

In-use energy performance data will be collected and reported in accordance with the GLA’s Be Seen reporting framework for major developments. This data will be submitted following the initial period of occupation, enabling the operational energy performance of the building to be reviewed against the design-stage predictions. Where necessary, this process will support the identification of any performance gap and inform opportunities for further optimisation through operational adjustments, controls tuning or user engagement.

The following performance indicators identify the key energy and carbon metrics that will be monitored and reported for the proposed development. These indicators provide a structured framework for tracking building energy use, on-site renewable energy generation, plant performance and operational carbon emissions.



‘Be Seen’ – Energy Monitoring

Performance Indicator Group	Description
Building Energy Use	The proposed development will import energy primarily in the form of electricity from the national electricity grid. Electricity will be used to serve space heating, cooling, domestic hot water, lighting, auxiliary systems and other regulated building services. No district heating or cooling connection is proposed due to the absence of existing or planned networks in the vicinity of the site. Regulated energy consumption has been modelled using IES VE 2024 and reported by end use, enabling future monitoring and reporting of energy consumption for distinct building uses in accordance with the GLA Be Seen framework.
Renewable Energy	On-site renewable energy generation is provided through roof-mounted photovoltaic panels.The PV panles have been modelled to cover a pitched roof area of 30 m² with a module efficiency of 22%. The system is predicted to generate renewable electricity sufficient to displace 4.46 kWh/m² per annum of grid-supplied electricity. Renewable electricity generated on-site will be used to offset the building’s electrical demand, with surplus generation exported to the grid where applicable.
Energy Storage Equipemnt	No electrical or thermal energy storage systems are currently proposed as part of the development. The energy strategy has, however, been designed to allow for the potential future integration of energy storage technologies, subject to operational requirements and technological developments. Energy storage provision will be reviewed further at detailed design stage should it be considered beneficial to support operational efficiency or on-site renewable energy utilisation.

Performance Indicator Group	Description
Plant Parameters	Space heating, cooling and domestic hot water are provided by a high-efficiency air source heat pump system. Plant parameters to be monitored include electrical energy input and thermal energy output from the heat pump system. No district or communal energy network is proposed; therefore, network efficiency losses associated with distribution systems are not applicable to the development.
Carbon Emissions	The development’s regulated operational carbon emissions have been calculated at planning stage in accordance with the GLA’s Energy Assessment Guidance and Building Regulations Approved Document Part L (2021), using the appropriate carbon emission factors. At the Be Green stage, the proposed development achieves a 37.3% reduction in regulated CO_2 emissions relative to the Part L notional building, exceeding the London Plan requirement for a minimum 35% on-site reduction. Any remaining residual carbon emissions will be addressed through financial contribution to Hillingdon’s carbon offset fund, in line with local policy requirements and the London Plan net zero carbon target.

The building’s energy strategy has been developed to support this monitoring approach, with high-efficiency building services systems, on-site renewable energy generation and clear zoning of energy uses. The inclusion of roof-mounted photovoltaic panels allows on-site renewable electricity generation to be monitored separately from imported grid electricity, providing visibility of renewable energy contribution and supporting future performance reporting.

The commitment to Be Seen also aligns with the wider sustainability objectives of the London Borough of Hillingdon and the London Plan, supporting transparency, accountability and continuous improvement in building energy performance. The monitoring framework will enable building operators and occupants to understand how energy is being used within the building and to take informed action to reduce consumption over time.

In summary, the proposed development fully incorporates the Be Seen stage of the London Plan energy hierarchy through the provision of appropriate sub-metering, post-construction modelling and in-use performance reporting. This approach ensures that the energy and carbon savings predicted at planning stage are monitored and verified in operation, reinforcing the development’s contribution to long-term carbon reduction targets and sustainable development objectives.

Carbon Offset Payment

In accordance with London Plan Policy SI 2 and the London Borough of Hillingdon's carbon offset requirements, any residual regulated carbon emissions remaining after the energy hierarchy stages ("Be Lean", "Be Clean" and "Be Green") must be addressed through a cash-in-lieu contribution. The Target Emission Rate (TER) for the development is 4.58 $kgCO_2/m^2$, while the Building Emission Rate (BER) achieved under the "Be Green" scenario is 2.87 $kgCO_2/m^2$, demonstrating compliance and an improvement beyond Part L requirements. However, despite maximising on-site carbon reduction measures, a residual 4 tonnes of regulated CO_2 per annum remains. In line with the Council's offset price of £95 per tonne of CO_2 per year, this shortfall is calculated over a 30-year period, resulting in a one-off carbon offset contribution of **£11,381**.

This payment will be used by the Local Planning Authority to fund local carbon reduction initiatives, thereby achieving net zero regulated operational emissions.

Carbon Offesting		
Hillingdon carbon offset price	£95.00	per tonnes CO_2
Residual regulated carbon emissions requiring offset to achieve net zero (per year)	3.99	tonnes CO_2
Carbon offset payment (over 30-year period)	**£**	**11,381**

Cooling Hierarchy

In line with the cooling hierarchy set out in the London Plan, a sequential approach has been adopted to minimise the risk of overheating. The strategy prioritises passive design measures to reduce heat gains, followed by natural ventilation where feasible, and finally the use of mechanical cooling to maintain internal comfort conditions. The following section outlines how each stage has been considered and implemented within the proposed development.

1. Minimising Internal Heat Generation

When it comes to building services, internal heat gains are minimised through high-efficiency LED lighting, low-energy auxiliary systems and accurate equipment load assumptions appropriate to the workshop. These measures reduce both electrical demand and incidental heat gains, contributing to lower peak internal temperatures and reduced reliance on active cooling.
However, the proposed workshop facility contains a substantial inventory of industrial machining equipment, each contributing sensible heat to the internal environment. In industrial premises, internal gains from machinery are typically in the range of 40–100 W/m² of floor area for manufacturing and metal machining processes. With multiple machines operating concurrently, the cumulative sensible heat gain becomes a key component of the cooling load and significantly exceeds gains associated with lighting or office equipment alone. Recognising these substantial process heat gains is central to the London Plan cooling hierarchy, as they cannot be eliminated through passive design alone.

2. Reducing Heat Gains Through Passive Design

The building has been designed with optimised glazing ratios, high-performance glazing and enhanced fabric insulation to limit solar and conductive heat gains. Orientation and façade design have been carefully considered to manage solar exposure, significantly reducing cooling demand. This is further explored in the Passive Design Analysis section of this report.

3. Managing Heat Through Thermal Mass and Building Form

Internal heat gains are moderated through the use of exposed internal thermal mass and generous floor-to-ceiling heights within the workshop spaces. This allows heat to be absorbed, stored and released more gradually, reducing peak internal temperatures and supporting passive temperature stability during periods of high equipment use.

4. Use of Natural Ventilation

Natural ventilation has been incorporated within the historic barn and ground and first floor administrative wing. In the workshop and circulation areas, operational requirements, internal layouts, air quality, acoustic considerations and security constraints limit the use of natural ventilation.

5. Use of Mechanical Ventilation

The provision of mechanical ventilation is considered necessary and appropriate due to the building's use as a workshop. The nature of the activities undertaken within the workshops involves the operation of machinery and multiple occupants for prolonged periods, all of which result in elevated internal heat gains and variable air quality requirements compared to typical commercial or educational spaces.

To maintain acceptable internal environmental conditions, a higher and more consistent rate of air changes is required to manage heat build-up, remove airborne particulates and fumes associated with workshop activities, and ensure adequate oxygen levels for occupant comfort and safety. Reliance on natural ventilation alone would not provide the level of control, reliability or performance required across all operational scenarios, particularly during periods of high occupancy or low external wind conditions.

6. Efficient Mechanical Cooling Systems

Following a thorough assessment of the London Plan cooling hierarchy, it is concluded that the inclusion of mechanical cooling is necessary to ensure that the proposed workshop facility operates safely, efficiently and comfortably. The design has prioritised the reduction of internal heat gains through efficient equipment selection where practicable, high-performance building fabric, solar control glazing and careful orientation. Opportunities for passive cooling and natural ventilation have been explored and incorporated where feasible; however, these measures alone are insufficient to address the significant and highly variable internal heat gains generated by specialist workshop machinery, teaching activities and periods of high occupancy.

Cooling Hierarchy

CIBSE TM52 - Overheating Analysis

The risk of overheating has been assessed in accordance with CIBSE TM52: The Limits of Thermal Comfort – Avoiding Overheating in European Buildings, which provides a dynamic methodology for evaluating summertime performance in naturally ventilated and mixed-mode buildings. TM52 defines overheating based on adaptive thermal comfort theory and requires assessment against three criteria:

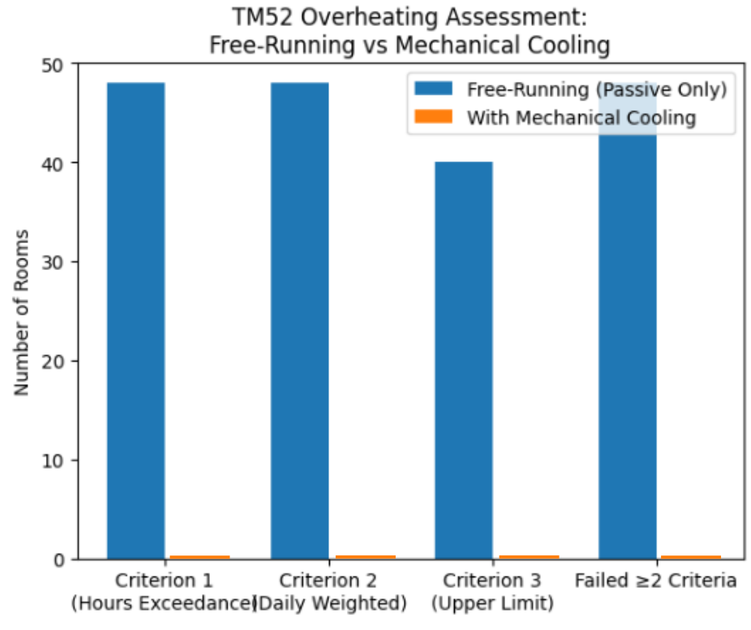
- Criterion 1 – Hours of Exceedance (He): The number of occupied hours during which the operative temperature exceeds the adaptive comfort temperature (Tmax) by 1K or more must not exceed 3% of total occupied hours.
- Criterion 2 – Daily Weighted Exceedance (We): This assesses the severity of overheating by applying a weighting factor to the temperature exceedance above Tmax. The cumulative weighted exceedance must not exceed 6 degree-hours on any single day.
- Criterion 3 – Upper Limit Temperature: The operative temperature must not exceed Tmax + 4K at any time.

A space is considered to fail if two of the three criteria are exceeded.

Dynamic thermal modelling has been undertaken in accordance with CIBSE TM52 using the DSY1 2020 High50 design weather file for London Heathrow (closest to the proposed development) to assess the risk of overheating within the building. An initial assessment was carried out under free-running conditions, incorporating all passive design measures, natural ventilation allowances and the proposed high-performance building fabric.

The results demonstrated that all 48 occupied spaces failed at least two of the three TM52 overheating criteria. This reflects the operational nature of the building, where significant internal heat gains arise from specialist workshop activities. Despite optimised glazing performance, controlled solar gains and natural ventilation in selected areas, passive measures alone were insufficient to maintain acceptable internal comfort conditions during summer periods.

A second modelling scenario was therefore undertaken incorporating the proposed mechanical cooling strategy via a fan coil VRF heat pump system. Under this scenario, all occupied spaces were demonstrated to comply with TM52 overheating criteria, maintaining internal operative temperatures within acceptable comfort limits.



Additional overheating simulations have been undertaken using the 2020 DSY2 and DSY3 weather files to further stress-test the building under more extreme summer scenarios. The results confirm that, with the proposed mechanical cooling strategy in place, all occupied spaces comply with the three CIBSE TM52 overheating criteria. Detailed simulation outputs for DSY1, DSY2 and DSY3 scenarios are provided within the Appendix for completeness and transparency.

This comparative analysis confirms that mechanical cooling is required to ensure thermal comfort, safeguard occupant wellbeing and maintain functional operational conditions within the workshop and training environment. The cooling strategy has been designed to operate efficiently and only where necessary, in line with the London Plan Cooling Hierarchy, following the maximisation of passive design measures.

Passive Design Analysis

Passive design focuses on reducing a building's energy demand by making full use of the site, climate, and building fabric before resorting to mechanical systems. By optimising the form, orientation, envelope, and natural environmental interactions, passive measures deliver long-term performance benefits with minimal operational energy input. This analysis reviews the core components of passive design and how they influence thermal comfort, energy efficiency, and operational carbon performance.

1. Site Location

The proposed development is located on Ducks Hill Road, a rural area in Northwood within the London Borough of Hillingdon.

2. Site Weather

The building has been assessed using the London Test Reference Year (TRY) weather file for Building Regulations compliance modelling within IES VE, and the London Design Summer Year (DSY1) file for TM52 overheating analysis. This approach ensures the design responds both to typical annual performance and to more extreme summer conditions representative of peak overheating risk in Greater London.

3. Microclimate

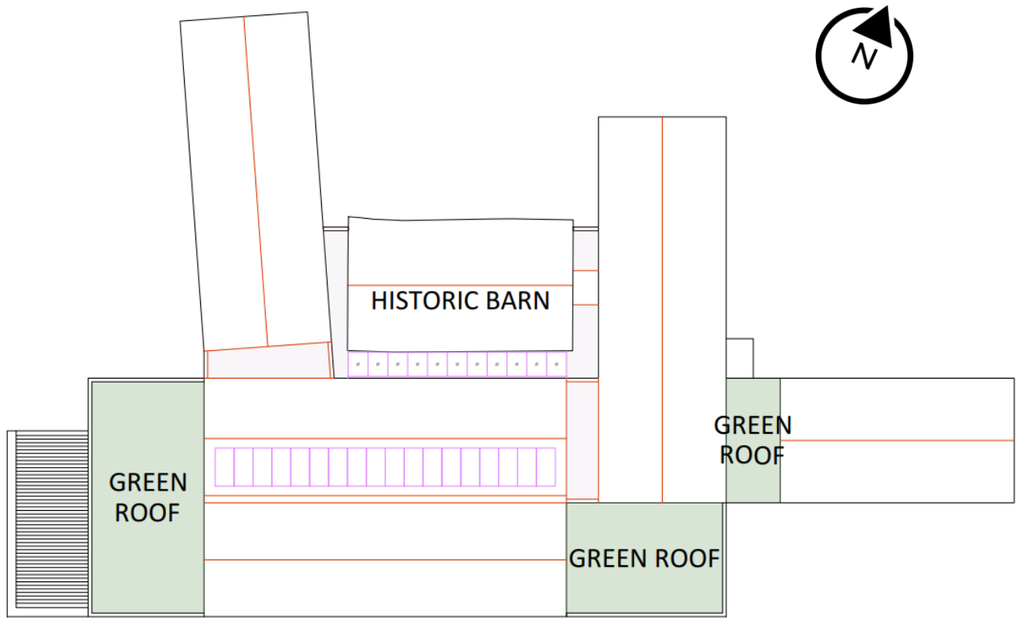
The immediate site context includes areas of soft landscaping, surrounding trees and small water ponds. There is no extensive hard landscaping, thereby limiting localised heat island effects. Minor shading from surrounding trees provides some mitigation of direct solar gains at certain times of the day. With no adjacent buildings, the development benefits from unobstructed solar access and wind exposure, both of which informed the passive design strategy.

4. Building Layout

The proposed development comprises a two-storey standalone new-build workshop facility with a total floor area of 1,416m². Both ground and first floors contain large open-plan workshop areas, alongside smaller cellular spaces including offices, meeting rooms, welfare facilities and circulation areas. The existing historic barn at the north façade is being retained for architectural aesthetic and presentation purposes.

5. Building Orientation

The below layout figure shows the building's orientation with the longest elevations facing north-west and south-east, which results in façades receiving varied solar exposure throughout the day, with increased morning solar gains on south-east facing elevations and increased afternoon gains on south-west facing elevations. Glazing is distributed across multiple façades to support balanced daylight provision, including a rooflight on the circulation area around the historic barn.



6. Building Form

The development adopts a relatively compact form with a combination of pitched , flat and green roofs, reducing exposed surface area relative to floor area and improving overall thermal efficiency. This building geometry supports airtightness continuity and minimises thermal bridging risk, contributing to reduced heating demand.

Passive Design Analysis

7. Building Fabric

To demonstrate the impact of passive design measures, a comparative analysis was undertaken using two DSM models in IES VE. Both models are identical in geometry, services strategy, occupancy profiles and operational assumptions. The only variation between the models relates to the building fabric parameters. The 'Standard' model was constructed using Building Regulations Part L limiting values, while the 'Proposed' model incorporates the enhanced passive design measures outlined below.

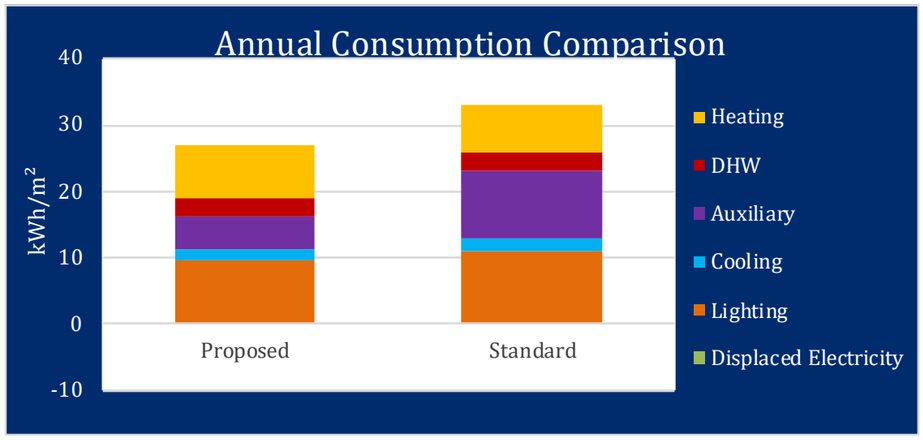
	Standard (Part L)	Proposed (Passive Design)	Unit
External Wall - U-value	0.26	0.15	$W/m^2.K$
Ground Floor - U-value	0.18	0.12	$W/m^2.K$
Roof - U-value	0.18	0.14	$W/m^2.K$
Window - U-value	1.60	1.36	$W/m^2.K$
Rooflight - U-value	2.20	1.35	$W/m^2.K$
Air permeability	8.00	3.80	$m^3/hr/m^2$
Door - U-value	1.60	1.41	$W/m^2.K$

As a result, annual regulated energy consumption is reduced from 31.80 kWh/m² to 27.05 kWh/m². The most significant improvement is observed in heating demand, which decreases from 12.62 kWh/m² to 7.99 kWh/m² demonstrating the effectiveness of the enhanced fabric and airtightness strategy.

This improvement in energy performance translates directly into a reduction in the 'proposed' building's emission rate, which improves from 4.56 to 3.84 $kgCO_2/m^2$/year, representing a 15.8% improvement relative to the 'standard' building.

As all other modelling inputs remain constant, the reduction in BER can be directly attributed to the passive design measures incorporated within the proposed building envelope.

Annual Energy Consumption kWh/m²	Proposed	Standard
Heating	7.99	12.62
Cooling	1.73	1.89
Auxiliary	4.98	4.98
Lighting	9.59	9.55
DHW	2.76	2.76
Displaced Electricity	0.00	0.00
	27.05	31.80
Model Area (m²)	1391	1391



Passive Design Analysis

8. Thermal Mass

The building has been designed with a highly insulated envelope to minimise unwanted heat transfer and stabilise internal temperatures throughout the year. Low U-values across the external walls, roof and ground floor significantly reduce conductive heat losses in winter while also limiting heat gains during summer periods. In addition, the use of solid concrete slabs at ground and first floor level provides inherent thermal mass within the structure.

9. Building Occupancy Type

The building will operate primarily as a workshop with an assumed weekday occupancy profile between 08:00 and 18:00 and no regular evening or weekend use. Occupancy densities have been modelled according to the government's NCM profiles to reflect the functional use of each space. Ancillary areas such as circulation spaces, storage rooms, welfare facilities and plant areas are assumed to have low and intermittent occupancy.

10. Daylighting Strategy

Daylighting is achieved through perimeter glazing and a rooflight element, ensuring good distribution of natural light to workshop and office areas. The glazing strategy balances daylight provision with solar control through a moderated g-value of 0.40, reducing reliance on artificial lighting while limiting excessive summer gains.

11. Ventilation Strategy

A naturally ventilated strategy utilising openable windows was initially considered across all occupied spaces during the early design stage. However, due to operational and security requirements associated with the workshop use of the building, full natural ventilation through openable windows was not considered appropriate for all areas. Natural ventilation has therefore been limited to spaces within the historic barn (including the presentation room, customer reception and mezzanine meeting room) and the ground and first floor administrative wing spaces with openable windows.

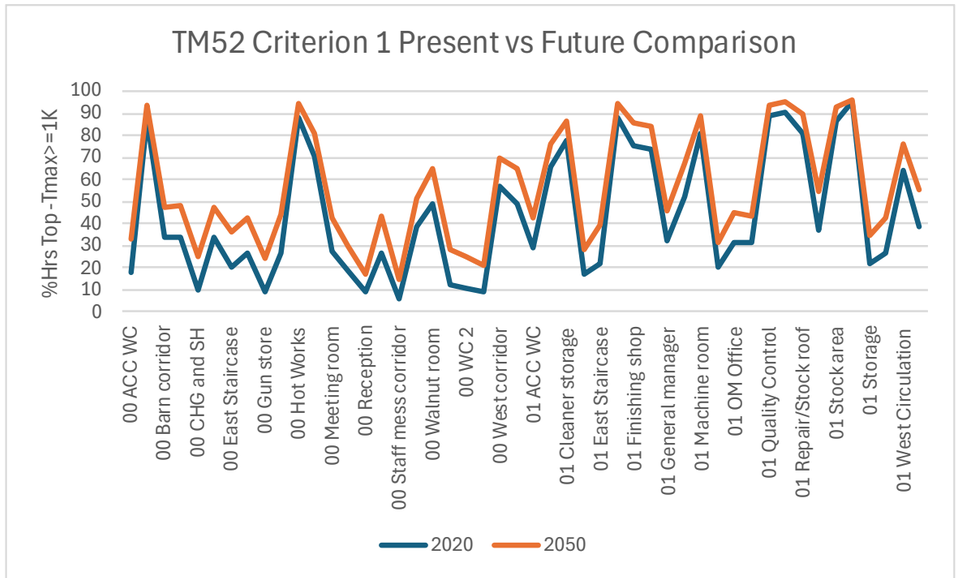
All remaining spaces are served by a high-efficiency mechanical ventilation system with a heat recovery efficiency of 82.4%. This approach ensures controlled ventilation rates, improved indoor air quality and reduced heat losses during winter operation, while maintaining appropriate environmental conditions for workshop and support spaces.

12. Adaptation to Climate Change

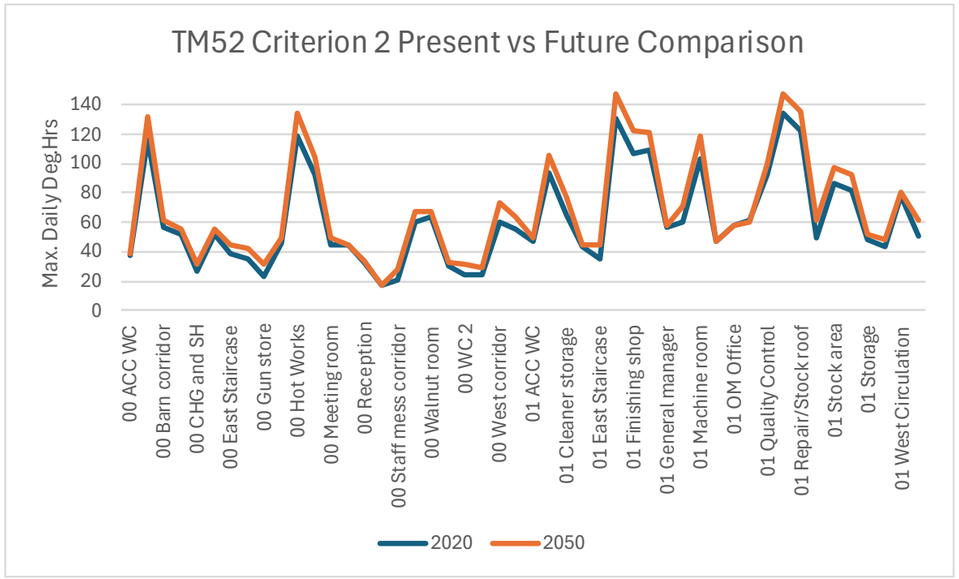
To assess the building's resilience to projected future climate conditions, dynamic thermal modelling has been undertaken using the CIBSE DSY1 London Heathrow 2050 Medium (50th percentile) future weather file. This scenario reflects anticipated increases in summer dry-bulb temperatures and solar gains associated with mid-century climate projections.

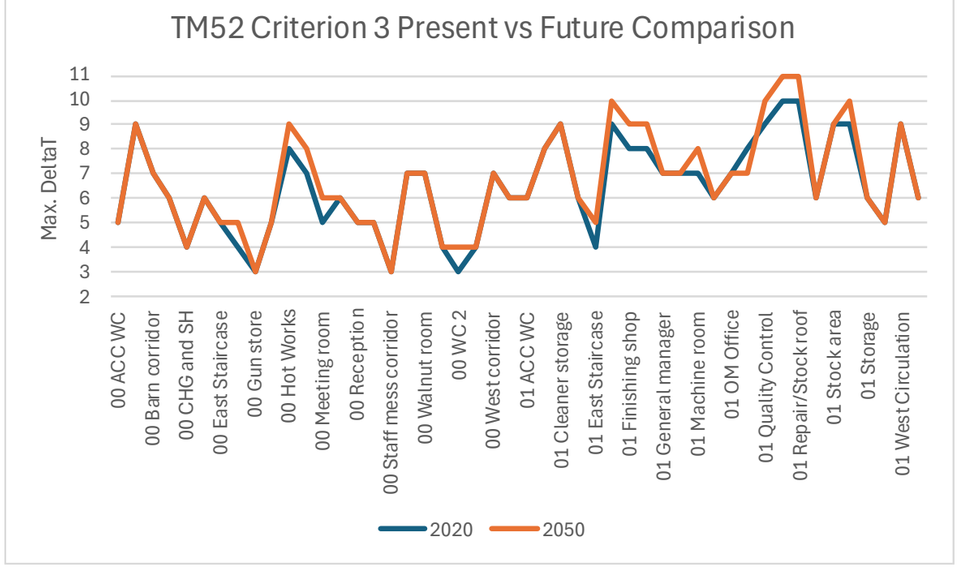
Under free-running conditions, the building continues to exceed TM52 overheating limits, consistent with the present-day assessment. The magnitude and frequency of exceedance increase under the 2050 scenario, reflecting the anticipated intensification of summer overheating risk. This confirms that passive design measures and natural ventilation alone are insufficient to maintain acceptable comfort conditions within the workshop environment, particularly given the significant internal heat gains from specialist equipment.

The results are presented below, illustrating the variation in performance against each of the three CIBSE TM52 overheating criteria. These graphs demonstrate how projected increases in summer temperatures influence both the frequency and severity of overheating within the building.



Passive Design Analysis





The TM52 Overheating Analysis suggests that when the building is modelled with the proposed high-efficiency mechanical cooling system, all occupied spaces achieve compliance with TM52 criteria under the 2050 climate scenario. This demonstrates that the proposed building design is resilient to future climate change and capable of maintaining thermal comfort for occupants over the building's lifetime.

Passive design principles have been maximised at the design stage, including enhanced fabric performance, solar control glazing and controlled natural ventilation where feasible. Mechanical cooling is therefore incorporated as a necessary and proportionate measure to ensure long-term climate resilience.

CIBSE TM54 - Unregulated Energy

To provide a more complete understanding of the building's overall energy consumption, it is necessary to assess the energy uses not captured within the thermal model outputs. The thermal model primarily represents regulated energy consumption, whereas CIBSE TM54 offers a methodology to evaluate and more accurately predict total operational energy use at design stage by accounting for both regulated and unregulated demands.

- Regulated energy (heating, cooling, ventilation and fixed building services)
- Unregulated energy (small power, lifts and specialist workshop equipment etc.)

As part of the Part L Dynamic Simulation Modelling (DSM) in IES VE, regulated emissions have been minimised through a fabric-first approach and the specification of high-efficiency building services. However, due to the operational profile of the building, a significant proportion of total emissions arises from unregulated energy uses, particularly those associated with workshop equipment.

Unregulated loads assessed include:

- Small power (workstations, printers, small catering equipment).
- Passenger lifts.
- Specialist workshop machinery and equipment.

Energy consumption for these unregulated loads has been estimated using the CIBSE TM54 methodology and CIBSE Guide F benchmarks, supplemented by installed load data and appropriate diversity assumptions.

One refrigerator per floor is assumed. Small catering equipment is assumed to comprise one kettle, one microwave and one toaster per floor, with a combined estimated energy consumption of approximately 3 kWh per day based on a 10-hour weekday operational profile.

Each workstation is assumed to comprise one desktop computer, one or two monitors and one printer, with the associated electrical loads detailed in the table below.

A diversity factor of 0.3 has been applied to the workshop machinery loads to reflect the operational characteristics of the existing facility. This assumption is based on on-site observations, which confirmed that approximately 30% of the installed equipment is typically in use at any one time due to the nature of the workflow and occupancy patterns.

Annual Unregulated Energy Consumption

- Small power: 10,324 kWh/year
- Lifts: 2,009 kWh/year
- Workshop equipment: 219,937 kWh/year

The total unregulated energy is 223,389 kWh/year. Using the 2025 UK Government GHG Conversion Factor of 0.177 kgCO_2/kWh for UK grid electricity, the total unregulated carbon emissions are **41.11 tonnes CO_2 per annum**.

Small Power		
Work Station Density	10	Desks
Average load per desk (Guide F)	140	W
Occupied hours (per day)	10	Hrs
Multifunction printer (Guide F)	1350	W
Multifunction printer (sleep mode) (Guide F)	400	W
Refrigerators (2)	40	W
Small catering equipment (per day)	3	kW.h
Average small power load (CIBSE Guide F)	13.9	W/m²

	Workstation Area (m²)	Annual Energy consumption (small power) (kW.h) By average	By workstation
Totals	**116**	**10,097**	**10,324**

Lifts		
Storeys	2	
Hoist height	6.5	m
Travel cycles	15,000	annual
Motor rating	9.7	kW
Standby power	200	W
Speed (ave.)	1	m/s
Time per cycle	7	sec
Annual energy consumption (1 lift)	**2,009**	**kW.h**

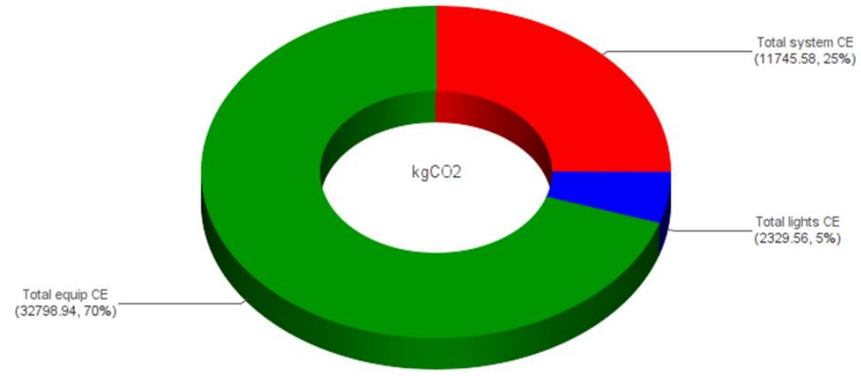
Workshop Equipment		
Total connected load	281971	W
Occupied hours (per day)	10	Hrs
Workshop Equipment area	791.945	m²
Diversity factor	0.3	
Annual energy consumption	**219,937**	**kW.h**

CIBSE TM54 - Regulated Energy

A detailed dynamic simulation has been undertaken in Apache (IES VE) to establish a more realistic operational carbon position reflecting the actual use of the building as a workshop and training facility. Unlike the compliance model, this assessment incorporates the internal heat gains associated with specialist workshop machinery.

A machinery heat gain of 106.815 W/m² has been applied to the workshop areas, which account for 791.945 m² of the total 1,416 m² gross internal floor area. This represents a significant internal sensible load and reflects the intensity of equipment expected within the operational spaces. An occupancy and operational profile of 10 hours per weekday (with no weekend operation) has been applied, consistent with the anticipated building use. All other modelling parameters remain consistent with the VE compliance model, including the Apache HVAC systems, lighting efficiencies, auxiliary energy assumptions and photovoltaic generation.

The introduction of these additional internal gains results in increased cooling demand during occupied periods, as the mechanical systems are required to offset the sensible heat generated by the machinery in order to maintain internal comfort conditions. Consequently, the total regulated carbon emissions calculated through the Apache dynamic simulation amount to **46.87 tCO_2 per annum**, using the 2025 UK Government GHG Conversion Factor of 0.177 $kgCO_2$/kWh for UK grid electricity.



Total Regulated and Unregulated Operational Emissions

The total unregulated energy consumption has been calculated based on small power, lift usage and workshop equipment loads. Small power demand is estimated at 10,324 kWh/annum, lift energy at 2,009 kWh/annum, and specialist workshop equipment at 219,937 kWh/annum, giving a combined unregulated electricity consumption of 232,270 kWh per annum. Applying the current UK grid electricity carbon factor of 0.177 $kgCO_2$/kWh results in total unregulated emissions of 41.11 tCO_2 per annum.

When combined with the dynamically simulated regulated emissions of 46.87 tCO_2 per annum, the total predicted operational carbon emissions for the development amount to **87.98 tCO_2 per annum**. This total reflects both building-related energy uses (heating, cooling, ventilation, lighting and auxiliary systems) and process-driven energy demands associated with the workshop function.

Emissions associated with the new proposed development				
Small power (kWh)	Lifts (kWh)	Equipment (kWh)	Regulated (tCO_2/annum)	**Total (tCO_2/annum)**
10,324	2,009	219,937	46.87	87.98

CONCLUSIONS

The proposed workshop development has been designed to deliver a robust, policy-compliant and operationally realistic energy strategy aligned with the London Plan Energy Hierarchy and Building Regulations Part L (2021).

At the Be Lean stage, energy demand has been reduced through the application of good passive design principles, enhanced fabric insulation, high-performance glazing and efficient lighting and auxiliary systems. These measures result in a 16.2% reduction in regulated carbon dioxide emissions compared to the Part L notional building, satisfying the London Plan requirement for a minimum 15% reduction through energy efficiency measures alone.

Further reductions are achieved at the Be Clean stage through the use of efficient building services systems. Space heating, cooling and domestic hot water are provided by a high-efficiency air source heat pump system, delivering improved system performance and reduced operational energy consumption. The Be Clean scenario results in a cumulative 24.7% reduction in regulated carbon emissions relative to the notional building.

At the Be Green stage, on-site renewable energy generation has been incorporated through roof-mounted photovoltaic panels. The introduction of on-site renewable electricity generation further reduces reliance on grid electricity and results in a total regulated carbon dioxide emissions reduction of 37.3% compared to the Part L notional building. This exceeds the London Plan target of a minimum 35% on-site reduction for major non-residential developments.

In accordance with London Plan Policy SI 2, the development commits to the Be Seen stage of the energy hierarchy, with appropriate sub-metering, post-construction energy modelling and in-use performance reporting. The residual emissions will be offset in accordance with Hillingdon's carbon offset policy of £95/tCO_2, resulting in a one-off payment offset contribution of £11,381 calculated over a 30-year period.

The energy strategy also addresses the London Plan cooling hierarchy, demonstrating that internal heat gains have been minimised, passive design measures have been maximised, and efficient mechanical cooling has been introduced only where necessary to maintain suitable internal conditions for the areas of the workshop. Mechanical ventilation is provided via high-efficiency air handling units with heat recovery to safeguard occupant comfort under both current and future (2050) climate scenarios.

A CIBSE TM54 assessment has been undertaken to provide a transparent and realistic estimate of total operational energy use, recognising the substantial contribution of unregulated workshop equipment loads. The total predicted operational emissions are 87.98 tCO_2 per annum.

In accordance with London Plan Policy SI 2, the development commits to the Be Seen stage of the energy hierarchy, with appropriate sub-metering, post-construction energy modelling and in-use performance reporting.

ENVIRONMENTAL
ENGINEERING
PARTNERSHIP

CONSULTING ENGINEERS

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Holland and Holland Be Lean — As designed

Date: Tue Feb 24 16:18:48 2026

Administrative information

Building Details

Address: Ducks Hill Road, London, HA6 2SS

Certifier details

Name: Environmental Engineering Partnership

Telephone number: 0149446544

Address: The Chapel House, High Street, West Wycombe, HP14 3AG

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.28

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.28

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

Foundation area [m^2]: 480.29

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

Target CO_2 emission rate (TER), $kgCO_2/m^2annum$	4.58	
Building CO_2 emission rate (BER), $kgCO_2/m^2annum$	3.84	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	49.17	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	41.25	
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	$U_{i\text{-Limit}}$	$U_{i\text{-Calc}}$	$U_{i\text{-Calc}}$	First surface with maximum value
Walls*	0.26	0.15	0.15	WS000013:Surf[2]
Floors	0.18	0.12	0.12	WS000013:Surf[0]
Pitched roofs	0.16	0.14	0.14	00000000:Surf[7]
Flat roofs	0.18	0.14	0.14	WS000013:Surf[1]
Windows** and roof windows	1.6	1.36	1.36	TS000006:Surf[1]
Rooflights***	2.2	1.35	1.35	WS00001C:Surf[5]
Personnel doors^	1.6	1.41	1.41	00000012:Surf[0]
Vehicle access & similar large doors	1.3	1.3	1.3	WS000008:Surf[4]
High usage entrance doors	3	-	-	No high usage entrance doors in building

$U_{i\text{-Limit}}$ = Limiting area-weighted average U-values [$W/(m^2K)$] $U_{i\text{-Calc}}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

$U_{i\text{-Calc}}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

* 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/m^2K

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
$m^3/(h.m^2)$ at 50 Pa	8	3.8

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	<0.9

1- Main system

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.9	3.2	0	1.8	0.82
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- Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.9	3.2	0	0	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

1- Main system

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	2.9	0.003
Standard value	2*	N/A

* Standard shown is for all types except absorption and gas engine heat pumps.

2- Nat Vent

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	2.9	0.003
Standard value	2*	N/A

* Standard shown is for all types except absorption and gas engine heat pumps.

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

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m^2]
Standard value	95	80	0.3
00 ACC WC	110	-	-
00 Action & Barrel Shop	144	-	-
00 Barn corridor	110	-	-
00 CAD CAM office	110	-	-
00 CHG and SH	110	-	-
00 Client WC	110	-	-
00 East Staircase	110	-	-
00 First aid	110	-	-
00 Gun store	110	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
00 Hot desk	110	-	-
00 Hot Works	144	-	-
00 Machine room	144	-	-
00 Meeting room	110	-	-
00 Presentation room	110	-	-
00 Reception	110	-	-
00 Staff mess	110	-	-
00 Staff mess corridor	110	-	-
00 Tea point	110	-	-
00 Walnut room	110	-	-
00 WC 1	110	-	-
00 WC 2	110	-	-
00 WC lobby	110	-	-
00 West corridor	110	-	-
00 West Staircase	110	-	-
01 ACC WC	110	-	-
01 Blackening room	144	-	-
01 Cleaner storage	110	-	-
01 East corridor	110	-	-
01 East Staircase	110	-	-
01 Engraving Room	144	-	-
01 Finishing shop	144	-	-
01 Forge	144	-	-
01 General manager	110	-	-
01 Gun store	110	-	-
01 Machine room	144	-	-
01 Meeting room	110	-	-
01 OM Office	110	-	-
01 Production manager	110	-	-
01 Quality Control	110	-	-
01 Repair/Stock	144	-	-
01 Repair/Stock roof	144	-	-
01 Smoke lobby	110	-	-
01 Stock area	110	-	-
01 Storage	110	-	-
01 WC	110	-	-
01 West Circulation	110	-	-
01 West stairs	110	-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00 ACC WC	N/A	N/A
00 Action & Barrel Shop	NO (-52.5%)	YES

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00 Barn corridor	NO (-3.5%)	YES
00 CAD CAM office	NO (-86.4%)	YES
00 CHG and SH	N/A	N/A
00 Client WC	N/A	N/A
00 East Staircase	N/A	N/A
00 First aid	N/A	N/A
00 Gun store	N/A	N/A
00 Hot desk	NO (-93.8%)	YES
00 Hot Works	NO (-62.1%)	YES
00 Machine room	N/A	N/A
00 Meeting room	NO (-94.1%)	YES
00 Presentation room	NO (-84.2%)	YES
00 Reception	NO (-95.3%)	YES
00 Staff mess	NO (-91.6%)	YES
00 Staff mess corridor	NO (-94.5%)	YES
00 Tea point	NO (-85.6%)	YES
00 Walnut room	N/A	N/A
00 WC 1	N/A	N/A
00 WC 2	N/A	N/A
00 WC lobby	N/A	N/A
00 West corridor	N/A	N/A
00 West Staircase	N/A	N/A
01 ACC WC	N/A	N/A
01 Blackening room	N/A	N/A
01 Cleaner storage	N/A	N/A
01 East corridor	NO (-86.7%)	YES
01 East Staircase	N/A	N/A
01 Engraving Room	NO (-51.3%)	YES
01 Finishing shop	NO (-84.7%)	YES
01 Forge	NO (-11.1%)	YES
01 General manager	NO (-74.9%)	YES
01 Gun store	N/A	N/A
01 Machine room	NO (-68.3%)	YES
01 Meeting room	NO (-92.3%)	YES
01 OM Office	NO (-84.3%)	YES
01 Production manager	NO (-75.1%)	YES
01 Quality Control	N/A	N/A
01 Repair/Stock	NO (-38.1%)	YES
01 Repair/Stock roof	NO (-96.3%)	NO
01 Smoke lobby	N/A	N/A
01 Stock area	N/A	N/A
01 Storage	NO (-57.4%)	YES
01 WC	N/A	N/A
01 West Circulation	NO (-64.6%)	YES
01 West stairs	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]	1391.4	1391.4
External area [m²]	2994.5	2994.5
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	4	4
Average conductance [W/K]	630.49	940.25
Average U-value [W/m²K]	0.21	0.31
Alpha value* [%]	25.96	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
40	**Offices and Workshop Businesses**
60	**General Industrial and Special Industrial Groups**
	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
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	7.99	7.05
Cooling	1.73	1.97
Auxiliary	4.98	10.06
Lighting	9.59	11.04
Hot water	2.76	2.93
Equipment*	28	28
TOTAL**	**27.04**	**33.05**

* 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]	97.66	103.29
Primary energy [kWh_{PE}/m²]	41.25	49.17
Total emissions [kg/m²]	3.84	4.58

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	30.6	14.4	2.9	1.7	6.1	2.9	2.3	2.9	3.2
	Notional	45.4	27.4	4.5	1.6	9.5	2.78	4.63	----	----
[ST] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	328.6	13.7	31.5	1.7	0	2.9	2.3	2.9	3.2
	Notional	187.2	57.5	18.7	3.5	9.6	2.78	4.63	----	----

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

APPENDIX – BRUKL DOCUMENTS – BE CLEAN

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Holland and Holland Be Clean — As designed

Date: Tue Feb 24 16:03:30 2026

Administrative information

Building Details

Address: Ducks Hill Road, London, HA6 2SS

Certifier details

Name: Environmental Engineering Partnership

Telephone number: 0149446544

Address: The Chapel House, High Street, West Wycombe, HP14 3AG

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.28

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.28

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

Foundation area [m²]: 480.29

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

Target CO_2 emission rate (TER), $kgCO_2/m^2annum$	4.58
Building CO_2 emission rate (BER), $kgCO_2/m^2annum$	3.45
Target primary energy rate (TPER), kWh_{PE}/m^2annum	49.17
Building primary energy rate (BPER), kWh_{PE}/m^2annum	37.14
Do the building's emission and primary energy rates exceed the targets?	BER =< TER | BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.15	0.15	WS000013:Surf[2]
Floors	0.18	0.12	0.12	WS000013:Surf[0]
Pitched roofs	0.16	0.14	0.14	00000000:Surf[7]
Flat roofs	0.18	0.14	0.14	WS000013:Surf[1]
Windows** and roof windows	1.6	1.36	1.36	TS000006:Surf[1]
Rooflights***	2.2	1.35	1.35	WS00001C:Surf[5]
Personnel doors^	1.6	1.41	1.41	00000012:Surf[0]
Vehicle access & similar large doors	1.3	1.3	1.3	WS000008:Surf[4]
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position.
^ For fire doors, limiting U-value is 1.8 W/m²K
NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	3.8

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	<0.9

1- Main system

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	6	0	1.8	0.82
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- Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	6	0	0	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

1- Main system

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	4	0.003
Standard value	2*	N/A

* Standard shown is for all types except absorption and gas engine heat pumps.

2- Nat Vent

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	4	0.003
Standard value	2*	N/A

* Standard shown is for all types except absorption and gas engine heat pumps.

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

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
00 ACC WC	110	-	-
00 Action & Barrel Shop	144	-	-
00 Barn corridor	110	-	-
00 CAD CAM office	110	-	-
00 CHG and SH	110	-	-
00 Client WC	110	-	-
00 East Staircase	110	-	-
00 First aid	110	-	-
00 Gun store	110	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
00 Hot desk	110	-	-
00 Hot Works	144	-	-
00 Machine room	144	-	-
00 Meeting room	110	-	-
00 Presentation room	110	-	-
00 Reception	110	-	-
00 Staff mess	110	-	-
00 Staff mess corridor	110	-	-
00 Tea point	110	-	-
00 Walnut room	110	-	-
00 WC 1	110	-	-
00 WC 2	110	-	-
00 WC lobby	110	-	-
00 West corridor	110	-	-
00 West Staircase	110	-	-
01 ACC WC	110	-	-
01 Blackening room	144	-	-
01 Cleaner storage	110	-	-
01 East corridor	110	-	-
01 East Staircase	110	-	-
01 Engraving Room	144	-	-
01 Finishing shop	144	-	-
01 Forge	144	-	-
01 General manager	110	-	-
01 Gun store	110	-	-
01 Machine room	144	-	-
01 Meeting room	110	-	-
01 OM Office	110	-	-
01 Production manager	110	-	-
01 Quality Control	110	-	-
01 Repair/Stock	144	-	-
01 Repair/Stock roof	144	-	-
01 Smoke lobby	110	-	-
01 Stock area	110	-	-
01 Storage	110	-	-
01 WC	110	-	-
01 West Circulation	110	-	-
01 West stairs	110	-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00 ACC WC	N/A	N/A
00 Action & Barrel Shop	NO (-52.5%)	YES

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00 Barn corridor	NO (-3.5%)	YES
00 CAD CAM office	NO (-86.4%)	YES
00 CHG and SH	N/A	N/A
00 Client WC	N/A	N/A
00 East Staircase	N/A	N/A
00 First aid	N/A	N/A
00 Gun store	N/A	N/A
00 Hot desk	NO (-93.8%)	YES
00 Hot Works	NO (-62.1%)	YES
00 Machine room	N/A	N/A
00 Meeting room	NO (-94.1%)	YES
00 Presentation room	NO (-84.2%)	YES
00 Reception	NO (-95.3%)	YES
00 Staff mess	NO (-91.6%)	YES
00 Staff mess corridor	NO (-94.5%)	YES
00 Tea point	NO (-85.6%)	YES
00 Walnut room	N/A	N/A
00 WC 1	N/A	N/A
00 WC 2	N/A	N/A
00 WC lobby	N/A	N/A
00 West corridor	N/A	N/A
00 West Staircase	N/A	N/A
01 ACC WC	N/A	N/A
01 Blackening room	N/A	N/A
01 Cleaner storage	N/A	N/A
01 East corridor	NO (-86.7%)	YES
01 East Staircase	N/A	N/A
01 Engraving Room	NO (-51.3%)	YES
01 Finishing shop	NO (-84.7%)	YES
01 Forge	NO (-11.1%)	YES
01 General manager	NO (-74.9%)	YES
01 Gun store	N/A	N/A
01 Machine room	NO (-68.3%)	YES
01 Meeting room	NO (-92.3%)	YES
01 OM Office	NO (-84.3%)	YES
01 Production manager	NO (-75.1%)	YES
01 Quality Control	N/A	N/A
01 Repair/Stock	NO (-38.1%)	YES
01 Repair/Stock roof	NO (-96.3%)	NO
01 Smoke lobby	N/A	N/A
01 Stock area	N/A	N/A
01 Storage	NO (-57.4%)	YES
01 WC	N/A	N/A
01 West Circulation	NO (-64.6%)	YES
01 West stairs	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]	1391.4	1391.4
External area [m²]	2994.5	2994.5
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	4	4
Average conductance [W/K]	630.49	940.25
Average U-value [W/m²K]	0.21	0.31
Alpha value* [%]	25.96	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
40	**Offices and Workshop Businesses**
60	**General Industrial and Special Industrial Groups**
	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
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	5.79	7.05
Cooling	1.1	1.97
Auxiliary	5.78	10.06
Lighting	9.59	11.04
Hot water	2.11	2.93
Equipment*	28	28
TOTAL**	**24.37**	**33.05**

* 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]	97.66	103.29
Primary energy [kWh_{PE}/m²]	37.14	49.17
Total emissions [kg/m²]	3.45	4.58

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	30.6	14.4	2.1	1.1	6.1	4	3.6	4	6
	Notional	45.4	27.4	4.5	1.6	9.5	2.78	4.63	----	----
[ST] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	328.6	13.7	22.8	1.1	0	4	3.6	4	6
	Notional	187.2	57.5	18.7	3.5	9.6	2.78	4.63	----	----

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

Holland and Holland Be Green

As designed

Date: Tue Feb 24 15:58:50 2026

Administrative information

Building Details

Address: Ducks Hill Road, London, HA6 2SS

Certifier details

Name: Environmental Engineering Partnership

Telephone number: 0149446544

Address: The Chapel House, High Street, West Wycombe, HP14 3AG

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.28

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.28

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

Foundation area [m²]: 480.29

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	4.58	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	2.87	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	49.17	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	30.54	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.15	0.15	WS000013:Surf[2]
Floors	0.18	0.12	0.12	WS000013:Surf[0]
Pitched roofs	0.16	0.14	0.14	00000000:Surf[7]
Flat roofs	0.18	0.14	0.14	WS000013:Surf[1]
Windows** and roof windows	1.6	1.36	1.36	TS000006:Surf[1]
Rooflights***	2.2	1.35	1.35	WS00001C:Surf[5]
Personnel doors^	1.6	1.41	1.41	00000012:Surf[0]
Vehicle access & similar large doors	1.3	1.3	1.3	WS000008:Surf[4]
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position.

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

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

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	3.8

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	<0.9

1- Main system

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	6	0	1.8	0.82
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- Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	6	0	0	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

1- Main system

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	4	0.003
Standard value	2*	N/A

* Standard shown is for all types except absorption and gas engine heat pumps.

2- Nat Vent

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	4	0.003
Standard value	2*	N/A

* Standard shown is for all types except absorption and gas engine heat pumps.

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

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
00 ACC WC	110	-	-
00 Action & Barrel Shop	144	-	-
00 Barn corridor	110	-	-
00 CAD CAM office	110	-	-
00 CHG and SH	110	-	-
00 Client WC	110	-	-
00 East Staircase	110	-	-
00 First aid	110	-	-
00 Gun store	110	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
00 Hot desk	110	-	-
00 Hot Works	144	-	-
00 Machine room	144	-	-
00 Meeting room	110	-	-
00 Presentation room	110	-	-
00 Reception	110	-	-
00 Staff mess	110	-	-
00 Staff mess corridor	110	-	-
00 Tea point	110	-	-
00 Walnut room	110	-	-
00 WC 1	110	-	-
00 WC 2	110	-	-
00 WC lobby	110	-	-
00 West corridor	110	-	-
00 West Staircase	110	-	-
01 ACC WC	110	-	-
01 Blackening room	144	-	-
01 Cleaner storage	110	-	-
01 East corridor	110	-	-
01 East Staircase	110	-	-
01 Engraving Room	144	-	-
01 Finishing shop	144	-	-
01 Forge	144	-	-
01 General manager	110	-	-
01 Gun store	110	-	-
01 Machine room	144	-	-
01 Meeting room	110	-	-
01 OM Office	110	-	-
01 Production manager	110	-	-
01 Quality Control	110	-	-
01 Repair/Stock	144	-	-
01 Repair/Stock roof	144	-	-
01 Smoke lobby	110	-	-
01 Stock area	110	-	-
01 Storage	110	-	-
01 WC	110	-	-
01 West Circulation	110	-	-
01 West stairs	110	-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00 ACC WC	N/A	N/A
00 Action & Barrel Shop	NO (-52.5%)	YES

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00 Barn corridor	NO (-3.5%)	YES
00 CAD CAM office	NO (-86.4%)	YES
00 CHG and SH	N/A	N/A
00 Client WC	N/A	N/A
00 East Staircase	N/A	N/A
00 First aid	N/A	N/A
00 Gun store	N/A	N/A
00 Hot desk	NO (-93.8%)	YES
00 Hot Works	NO (-62.1%)	YES
00 Machine room	N/A	N/A
00 Meeting room	NO (-94.1%)	YES
00 Presentation room	NO (-84.2%)	YES
00 Reception	NO (-95.3%)	YES
00 Staff mess	NO (-91.6%)	YES
00 Staff mess corridor	NO (-94.5%)	YES
00 Tea point	NO (-85.6%)	YES
00 Walnut room	N/A	N/A
00 WC 1	N/A	N/A
00 WC 2	N/A	N/A
00 WC lobby	N/A	N/A
00 West corridor	N/A	N/A
00 West Staircase	N/A	N/A
01 ACC WC	N/A	N/A
01 Blackening room	N/A	N/A
01 Cleaner storage	N/A	N/A
01 East corridor	NO (-86.7%)	YES
01 East Staircase	N/A	N/A
01 Engraving Room	NO (-51.3%)	YES
01 Finishing shop	NO (-84.7%)	YES
01 Forge	NO (-11.1%)	YES
01 General manager	NO (-74.9%)	YES
01 Gun store	N/A	N/A
01 Machine room	NO (-68.3%)	YES
01 Meeting room	NO (-92.3%)	YES
01 OM Office	NO (-84.3%)	YES
01 Production manager	NO (-75.1%)	YES
01 Quality Control	N/A	N/A
01 Repair/Stock	NO (-38.1%)	YES
01 Repair/Stock roof	NO (-96.3%)	NO
01 Smoke lobby	N/A	N/A
01 Stock area	N/A	N/A
01 Storage	NO (-57.4%)	YES
01 WC	N/A	N/A
01 West Circulation	NO (-64.6%)	YES
01 West stairs	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]	1391.4	1391.4
External area [m²]	2994.5	2994.5
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	4	4
Average conductance [W/K]	630.49	940.25
Average U-value [W/m²K]	0.21	0.31
Alpha value* [%]	25.96	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
40	**Offices and Workshop Businesses**
60	**General Industrial and Special Industrial Groups**
	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
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	5.79	7.05
Cooling	1.1	1.97
Auxiliary	5.78	10.06
Lighting	9.59	11.04
Hot water	2.11	2.93
Equipment*	28	28
TOTAL**	**24.37**	**33.05**

* 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	4.46	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*4.46*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	97.66	103.29
Primary energy [kWh_{PE}/m^2]	30.54	49.17
Total emissions [kg/m²]	2.87	4.58

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	30.6	14.4	2.1	1.1	6.1	4	3.6	4	6
	Notional	45.4	27.4	4.5	1.6	9.5	2.78	4.63	----	----
[ST] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	328.6	13.7	22.8	1.1	0	4	3.6	4	6
	Notional	187.2	57.5	18.7	3.5	9.6	2.78	4.63	----	----

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

Appendix – BRUKL Documents – 'Standard' Building Limiting Values

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Holland and Holland Limiting Values As designed

Date: Tue Feb 24 16:58:42 2026

Administrative information

Building Details

Address: Ducks Hill Road, London, HA6 2SS

Certifier details

Name: Environmental Engineering Partnership

Telephone number: 0149446544

Address: The Chapel House, High Street, West Wycombe, HP14 3AG

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.28

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.28

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

Foundation area [m²]: 480.29

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	4.58	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	4.56	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	49.17	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	48.66	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.26	0.26	WS000013:Surf[2]
Floors	0.18	0.12	0.12	WS000013:Surf[0]
Pitched roofs	0.16	0.16	0.16	00000000:Surf[7]
Flat roofs	0.18	0.18	0.18	WS000013:Surf[1]
Windows** and roof windows	1.6	1.6	1.6	TS000006:Surf[1]
Rooflights***	2.2	2.17	2.17	WS00001C:Surf[5]
Personnel doors^	1.6	1.52	1.52	00000012:Surf[0]
Vehicle access & similar large doors	1.3	1.3	1.3	WS000008:Surf[4]
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position.

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

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

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	8

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	<0.9

1- Main system

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.9	3.2	0	1.8	0.82
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- Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.9	3.2	0	0	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

1- Main system

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	2.9	0.003
Standard value	2*	N/A

* Standard shown is for all types except absorption and gas engine heat pumps.

2- Nat Vent

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	2.9	0.003
Standard value	2*	N/A

* Standard shown is for all types except absorption and gas engine heat pumps.

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

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
00 ACC WC	110	-	-
00 Action & Barrel Shop	144	-	-
00 Barn corridor	110	-	-
00 CAD CAM office	110	-	-
00 CHG and SH	110	-	-
00 Client WC	110	-	-
00 East Staircase	110	-	-
00 First aid	110	-	-
00 Gun store	110	-	-

Appendix – BRUKL Documents – 'Standard' Building Limiting Values

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
00 Hot desk	110	-	-
00 Hot Works	144	-	-
00 Machine room	144	-	-
00 Meeting room	110	-	-
00 Presentation room	110	-	-
00 Reception	110	-	-
00 Staff mess	110	-	-
00 Staff mess corridor	110	-	-
00 Tea point	110	-	-
00 Walnut room	110	-	-
00 WC 1	110	-	-
00 WC 2	110	-	-
00 WC lobby	110	-	-
00 West corridor	110	-	-
00 West Staircase	110	-	-
01 ACC WC	110	-	-
01 Blackening room	144	-	-
01 Cleaner storage	110	-	-
01 East corridor	110	-	-
01 East Staircase	110	-	-
01 Engraving Room	144	-	-
01 Finishing shop	144	-	-
01 Forge	144	-	-
01 General manager	110	-	-
01 Gun store	110	-	-
01 Machine room	144	-	-
01 Meeting room	110	-	-
01 OM Office	110	-	-
01 Production manager	110	-	-
01 Quality Control	110	-	-
01 Repair/Stock	144	-	-
01 Repair/Stock roof	144	-	-
01 Smoke lobby	110	-	-
01 Stock area	110	-	-
01 Storage	110	-	-
01 WC	110	-	-
01 West Circulation	110	-	-
01 West stairs	110	-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00 ACC WC	N/A	N/A
00 Action & Barrel Shop	NO (-0.5%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00 Barn corridor	YES (+225.2%)	NO
00 CAD CAM office	NO (-71.4%)	NO
00 CHG and SH	N/A	N/A
00 Client WC	N/A	N/A
00 East Staircase	N/A	N/A
00 First aid	N/A	N/A
00 Gun store	N/A	N/A
00 Hot desk	NO (-86.9%)	NO
00 Hot Works	NO (-20.6%)	NO
00 Machine room	N/A	N/A
00 Meeting room	NO (-87.5%)	NO
00 Presentation room	NO (-67.1%)	NO
00 Reception	NO (-79%)	NO
00 Staff mess	NO (-82.4%)	NO
00 Staff mess corridor	NO (-88.5%)	NO
00 Tea point	NO (-69.8%)	NO
00 Walnut room	N/A	N/A
00 WC 1	N/A	N/A
00 WC 2	N/A	N/A
00 WC lobby	N/A	N/A
00 West corridor	N/A	N/A
00 West Staircase	N/A	N/A
01 ACC WC	N/A	N/A
01 Blackening room	N/A	N/A
01 Cleaner storage	N/A	N/A
01 East corridor	NO (-72.1%)	NO
01 East Staircase	N/A	N/A
01 Engraving Room	YES (+1.7%)	NO
01 Finishing shop	NO (-68%)	NO
01 Forge	YES (+86%)	NO
01 General manager	NO (-47.2%)	NO
01 Gun store	N/A	N/A
01 Machine room	NO (-33.2%)	NO
01 Meeting room	NO (-83.8%)	NO
01 OM Office	NO (-67.1%)	NO
01 Production manager	NO (-47.6%)	NO
01 Quality Control	N/A	N/A
01 Repair/Stock	YES (+19.5%)	NO
01 Repair/Stock roof	NO (-83.9%)	NO
01 Smoke lobby	N/A	N/A
01 Stock area	N/A	N/A
01 Storage	NO (-10.3%)	NO
01 WC	N/A	N/A
01 West Circulation	NO (-25.8%)	NO
01 West stairs	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

Appendix – BRUKL Documents – 'Standard' Building Limiting Values

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m²]	1391.4	1391.4
External area [m²]	2994.5	2994.5
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	8	4
Average conductance [W/K]	805.78	940.25
Average U-value [W/m²K]	0.27	0.31
Alpha value* [%]	25.97	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
40	**Offices and Workshop Businesses**
60	**General Industrial and Special Industrial Groups**
	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
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	12.62	7.05
Cooling	1.89	1.97
Auxiliary	4.98	10.06
Lighting	9.53	11.04
Hot water	2.76	2.93
Equipment*	28	28
TOTAL**	**31.78**	**33.05**

* 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]	147.37	103.29
Primary energy [kWh_{PE}/m²]	48.66	49.17
Total emissions [kg/m²]	4.56	4.58

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	67.1	14.6	6.4	1.8	6.1	2.9	2.3	2.9	3.2
	Notional	45.4	27.4	4.5	1.6	9.5	2.78	4.63	----	----
[ST] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	432.1	20.8	41.4	2.5	0	2.9	2.3	2.9	3.2
	Notional	187.2	57.5	18.7	3.5	9.6	2.78	4.63	----	----

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

Appendix - Overheating TM52 Thermal Comfort Analysis Under Free-Running Conditions (DSY1 2020)

Overall
Passed: 0 rooms:
Failed: 48 rooms:
Unoccupied: 8 rooms:

Data:
Building category: Category II (new builds.)
Weather file: London_LHR_DSY1_2020High50.epw
Days data= 365 01-Jan 31-Dec
Days (summer)= 153 01-May 30-Sep
Data OK? OK Full summer

Occupancy:
Note: This report assesses occupied periods only. Please be aware that TM52 should be conducted for occupied and/or "available hours".
Use of educational NCM profiles may be seen as inappropriate due to prolonged unoccupied periods during summer months.
See Section 6.1.2 (a) of TM52 for further information.

Passed: 0 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing

Failed: 48 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
00 ACC WC	WS000013	71.9	18	37	5	1 & 2 & 3
00 Action & Barrel Shop	TS000006	100	87.3	117	9	1 & 2 & 3
00 Barn corridor	WS00001C	71.9	34.2	57	7	1 & 2 & 3
00 CAD CAM office	WS000010	71.9	33.9	52	6	1 & 2 & 3
00 CHG and SH	WS000015	71.9	10.2	27	4	1 & 2
00 Client WC	WS00000E	71.9	33.6	52	6	1 & 2 & 3
00 East Staircase	12	71.9	20.5	39	5	1 & 2 & 3
00 First aid	WS000019	71.9	26.4	35	4	1 & 2
00 Gun store	WS000016	71.9	9	23	3	1 & 2
00 Hot desk	WS000009	71.9	26.9	46	5	1 & 2 & 3
00 Hot Works	TS000005	100	87.9	119	8	1 & 2 & 3
00 Machine room	WS000008	100	70.1	93	7	1 & 2 & 3
00 Meeting room	WS00000D	71.9	27.7	45	5	1 & 2 & 3
00 Presentation room	0	71.9	18.6	45	6	1 & 2 & 3
00 Reception	WS000012	71.9	9.5	33	5	1 & 2 & 3
00 Staff mess	0000000B	71.9	26.4	17	5	1 & 2 & 3
00 Staff mess corridor	14	71.9	6.1	21	3	1 & 2
00 Tea point	WS00000F	100	38.5	60	7	1 & 2 & 3
00 Walnut room	WS00000C	71.9	48.9	64	7	1 & 2 & 3
00 WC 1	WS000017	71.9	12.2	30	4	1 & 2
00 WC 2	WS000018	71.9	10.5	24	3	1 & 2
00 WC lobby	WS00001A	71.9	8.8	24	4	1 & 2
00 West corridor	WS00001B	71.9	56.6	60	7	1 & 2 & 3
00 West Staircase	WS000002	71.9	48.6	55	6	1 & 2 & 3
01 ACC WC	10	71.9	29.3	47	6	1 & 2 & 3

Appendix - Overheating TM52 Thermal Comfort Analysis Under Free-Running Conditions (DSY1 2020)

01 Blackening room	0000000E	100	65.9	94	8	1&2&3
01 Cleaner storage	1000003	71.9	77.7	65	9	1&2&3
01 East corridor	4	71.9	17.2	44	6	1&2&3
01 East Staircase	1000005	71.9	22.2	35	4	1&2
01 Engraving Room	1000000	100	88.4	131	9	1&2&3
01 Finishing shop	1000001	100	74.9	107	8	1&2&3
01 Forge	0000000C	100	73.8	109	8	1&2&3
01 General manager	8	71.9	32.5	57	7	1&2&3
01 Gun store	1000002	71.9	52.4	60	7	1&2&3
01 Machine room	0000000F	100	80.8	103	7	1&2&3
01 Meeting room	9	71.9	20	47	6	1&2&3
01 OM Office	6	71.9	31.8	58	7	1&2&3
01 Production manager	5	71.9	31.5	62	8	1&2&3
01 Quality Control	TS000002	71.9	89.1	92	9	1&2&3
01 Repair/Stock	TS000001	100	90.4	134	10	1&2&3
01 Repair/Stock roof	RF000003	100	81.2	123	10	1&2&3
01 Smoke lobby	7	71.9	37.2	50	6	1&2&3
01 Stock area	TS000004	71.9	86.3	86	9	1&2&3
01 Stock Storage	TS000000	71.9	95.5	82	9	1&2&3
01 Storage	2	71.9	21.7	48	6	1&2&3
01 WC	3	71.9	26.7	43	5	1&2&3
01 West Circulation	TS000003	71.9	63.9	78	9	1&2&3
01 West stairs	0100000B	71.9	38.6	51	6	1&2&3

Unoccupied:	8 rooms:					
Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
00 Riser east	13	0	0	0	0	-
00 Riser west	1000004	0	0	0	0	-
00 WC R	RF000000	0	0	0	0	-
01 East Staircase R	0100000A	0	0	0	0	-
01 Machine room R	1	0	0	0	0	-
01 Plant room	11	0	0	0	0	-
QC Ceiling void	RF000001	0	0	0	0	-
n/a		0	0	0	0	1&2&3

Note: A TM 52 2013 analysis provides an assessment of comfort compliance based on bulk air modelling i.e. each space is considered idealised and the air in the space perfectly mixed. The assessment does not assess placement of space features e.g. windows & openings, airflow patterns or discomfort issues. The user should assess these design aspects outside of the TM52 analysis.

Appendix - Overheating TM52 Thermal Comfort Analysis With Mechanical Cooling (DSY1 2020)

Overall
Passed: 48 rooms:
Failed: 0 rooms:
Unoccupied: 8 rooms:

Data:
Building category: Category II (new builds.)
Weather file: London_LHR_DSY1_2020High50.epw
Days data= 365 01-Jan 31-Dec
Days (summer)= 153 01-May 30-Sep
Data OK? OK Full summer

Occupancy:
Note: This report assesses occupied periods only. Please be aware that TM52 should be conducted for occupied and/or "available hours".
Use of educational NCM profiles may be seen as inappropriate due to prolonged unoccupied periods during summer months.
See Section 6.1.2 (a) of TM52 for further information.

Passed: 48 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
00 ACC WC	WS000013	71.9	0	0	0	-
00 Action & Barrel Shop	TS000006	100	0	0	0	-
00 Barn corridor	WS00001C	71.9	0	0	0	-
00 CAD CAM office	WS000010	71.9	0	0	0	-
00 CHG and SH	WS000015	71.9	0	0	0	-
00 Client WC	WS00000E	71.9	0	0	0	-
00 East Staircase	12	71.9	0	0	0	-
00 First aid	WS000019	71.9	0	0	0	-
00 Gun store	WS000016	71.9	0	0	0	-
00 Hot desk	WS000009	71.9	0	0	0	-
00 Hot Works	TS000005	100	0	0	0	-
00 Machine room	WS000008	100	0	0	0	-
00 Meeting room	WS00000D	71.9	0	0	0	-
00 Presentation room	0	71.9	0	0	0	-
00 Reception	WS000012	71.9	0	0	0	-
00 Staff mess	0000000B	71.9	0	0	0	-
00 Staff mess corridor	14	71.9	0	0	0	-
00 Tea point	WS00000F	100	0	0	0	-
00 Walnut room	WS00000C	71.9	0	0	0	-
00 WC 1	WS000017	71.9	0	0	0	-
00 WC 2	WS000018	71.9	0	0	0	-
00 WC lobby	WS00001A	71.9	0	0	0	-
00 West corridor	WS00001B	71.9	0	0	0	-
00 West Staircase	WS000002	71.9	0	0	0	-
01 ACC WC	10	71.9	0	0	0	-
01 Blackening room	0000000E	100	0	0	0	-
01 Cleaner storage	1000003	71.9	0	0	0	-
01 East corridor	4	71.9	0	0	0	-

Appendix - Overheating TM52 Thermal Comfort Analysis With Mechanical Cooling (DSY1 2020)

01 East Staircase	1000005	71.9	0	0	0	-
01 Engraving Room	1000000	100	0	0	0	-
01 Finishing shop	1000001	100	0	0	0	-
01 Forge	0000000C	100	0	0	0	-
01 General manager	8	71.9	0	0	0	-
01 Gun store	1000002	71.9	0	0	0	-
01 Machine room	0000000F	100	0	0	0	-
01 Meeting room	9	71.9	0	0	0	-
01 OM Office	6	71.9	0	0	0	-
01 Production manager	5	71.9	0	0	0	-
01 Quality Control	TS000002	71.9	0	0	0	-
01 Repair/Stock	TS000001	100	0	0	0	-
01 Repair/Stock roof	RF000003	100	0	0	0	-
01 Smoke lobby	7	71.9	0	0	0	-
01 Stock area	TS000004	71.9	0	0	0	-
01 Stock Storage	TS000000	71.9	0.1	1	1	-
01 Storage	2	71.9	0	0	0	-
01 WC	3	71.9	0	0	0	-
01 West Circulation	TS000003	71.9	0	0	0	-
01 West stairs	0100000B	71.9	0	0	0	-

Failed:	0 rooms:					
Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing

Unoccupied:	8 rooms:					
Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
00 Riser east	13	0	0	0	0	-
00 Riser west	1000004	0	0	0	0	-
00 WC R	RF000000	0	0	0	0	-
01 East Staircase R	0100000A	0	0	0	0	-
01 Machine room R	1	0	0	0	0	-
01 Plant room	11	0	0	0	0	-
QC Ceiling void	RF000001	0	0	0	0	-
n/a		0	0	0	0	1&2&3

Note: A TM 52 2013 analysis provides an assessment of comfort compliance based on bulk air modelling i.e. each space is considered idealised and the air in the space perfectly mixed. The assessment does not assess placement of space features e.g. windows & openings, airflow patterns or discomfort issues. The user should assess these design aspects outside of the TM52 analysis.

Appendix - Overheating TM52 Thermal Comfort Analysis Under Free-Running Conditions (DSY1 2050)

Overall
Passed: 0 rooms:
Failed: 48 rooms:
Unoccupied: 8 rooms:

Data:
Building category: Category II (new builds.)
Weather file: London_LHR_DSY1_2050Med50.epw
Days data= 365 01-Jan 31-Dec
Days (summer)= 153 01-May 30-Sep
Data OK? OK Full summer

Occupancy:
Note: This report assesses occupied periods only. Please be aware that TM52 should be conducted for occupied and/or "available hours".
Use of educational NCM profiles may be seen as inappropriate due to prolonged unoccupied periods during summer months.
See Section 6.1.2 (a) of TM52 for further information.

Passed: 0 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing

Failed: 48 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
00 ACC WC	WS000013	71.9	32.9	39	5	1 & 2 & 3
00 Action & Barrel Shop	TS000006	100	93.4	132	9	1 & 2 & 3
00 Barn corridor	WS00001C	71.9	47.5	61	7	1 & 2 & 3
00 CAD CAM office	WS000010	71.9	47.8	55	6	1 & 2 & 3
00 CHG and SH	WS000015	71.9	24.7	32	4	1 & 2
00 Client WC	WS00000E	71.9	47.2	56	6	1 & 2 & 3
00 East Staircase	12	71.9	36.5	45	5	1 & 2 & 3
00 First aid	WS000019	71.9	42.2	42	5	1 & 2 & 3
00 Gun store	WS000016	71.9	24.1	32	3	1 & 2
00 Hot desk	WS000009	71.9	43.8	50	5	1 & 2 & 3
00 Hot Works	TS000005	100	94.5	134	9	1 & 2 & 3
00 Machine room	WS000008	100	81	105	8	1 & 2 & 3
00 Meeting room	WS00000D	71.9	42.5	49	6	1 & 2 & 3
00 Presentation room	0	71.9	29.5	45	6	1 & 2 & 3
00 Reception	WS000012	71.9	16.8	34	5	1 & 2 & 3
00 Staff mess	0000000B	71.9	43.6	17	5	1 & 2 & 3
00 Staff mess corridor	14	71.9	14.7	28	3	1 & 2
00 Tea point	WS00000F	100	51.5	67	7	1 & 2 & 3
00 Walnut room	WS00000C	71.9	65	67	7	1 & 2 & 3
00 WC 1	WS000017	71.9	28.3	33	4	1 & 2
00 WC 2	WS000018	71.9	25.4	32	4	1 & 2
00 WC lobby	WS00001A	71.9	21.1	29	4	1 & 2
00 West corridor	WS00001B	71.9	69.5	73	7	1 & 2 & 3
00 West Staircase	WS000002	71.9	64.8	64	6	1 & 2 & 3
01 ACC WC	10	71.9	42.2	50	6	1 & 2 & 3

Appendix - Overheating TM52 Thermal Comfort Analysis Under Free-Running Conditions (DSY1 2050)

01 Blackening room	0000000E	100	76.2	106	8	1 & 2 & 3
01 Cleaner storage	1000003	71.9	86.8	77	9	1 & 2 & 3
01 East corridor	4	71.9	28.1	45	6	1 & 2 & 3
01 East Staircase	1000005	71.9	39.8	45	5	1 & 2 & 3
01 Engraving Room	1000000	100	94.5	147	10	1 & 2 & 3
01 Finishing shop	1000001	100	85.3	123	9	1 & 2 & 3
01 Forge	0000000C	100	83.7	121	9	1 & 2 & 3
01 General manager	8	71.9	45.5	58	7	1 & 2 & 3
01 Gun store	1000002	71.9	67.3	71	7	1 & 2 & 3
01 Machine room	0000000F	100	88.5	119	8	1 & 2 & 3
01 Meeting room	9	71.9	31.4	47	6	1 & 2 & 3
01 OM Office	6	71.9	44.6	58	7	1 & 2 & 3
01 Production manager	5	71.9	43.6	60	7	1 & 2 & 3
01 Quality Control	TS000002	71.9	93.9	100	10	1 & 2 & 3
01 Repair/Stock	TS000001	100	95.4	147	11	1 & 2 & 3
01 Repair/Stock roof	RF000003	100	89.7	136	11	1 & 2 & 3
01 Smoke lobby	7	71.9	54.4	61	6	1 & 2 & 3
01 Stock area	TS000004	71.9	92.9	97	9	1 & 2 & 3
01 Stock Storage	TS000000	71.9	96.1	92	10	1 & 2 & 3
01 Storage	2	71.9	34.8	52	6	1 & 2 & 3
01 WC	3	71.9	42.7	48	5	1 & 2 & 3
01 West Circulation	TS000003	71.9	76.1	81	9	1 & 2 & 3
01 West stairs	0100000B	71.9	55.2	61	6	1 & 2 & 3

Unoccupied: 8 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
00 Riser east	13	0	0	0	0	-
00 Riser west	1000004	0	0	0	0	-
00 WC R	RF000000	0	0	0	0	-
01 East Staircase R	0100000A	0	0	0	0	-
01 Machine room R	1	0	0	0	0	-
01 Plant room	11	0	0	0	0	-
QC Ceiling void	RF000001	0	0	0	0	-
n/a		0	0	0	0	1 & 2 & 3

Note: A TM 52 2013 analysis provides an assessment of comfort compliance based on bulk air modelling i.e. each space is considered idealised and the air in the space perfectly mixed. The assessment does not assess placement of space features e.g. windows & openings, airflow patterns or discomfort issues. The user should assess these design aspects outside of the TM52 analysis.

APPENDIX - OVERHEATING TM52 THERMAL COMFORT ANALYSIS WITH MECHANICAL COOLING (DSY2 2020)

Overall
Passed: 48 rooms:
Failed: 0 rooms:
Unoccupied: 8 rooms:

Data:
Building category: Category II (new builds.)
Weather file: London_LHR_DSY2_2020High50.epw
Days data= 365 01-Jan 31-Dec
Days (summer)= 153 01-May 30-Sep
Data OK? OK Full summer

Occupancy:
Note: This report assesses occupied periods only. Please be aware that TM52 should be conducted for occupied and/or "available hours".
Use of educational NCM profiles may be seen as inappropriate due to prolonged unoccupied periods during summer months.
See Section 6.1.2 (a) of TM52 for further information.

Passed: 48 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
00 ACC WC	WS000013	71.9	0	0	0	-
00 Action & Barrel Shop	TS000006	100	0	0	0	-
00 Barn corridor	WS00001C	71.9	0	0	0	-
00 CAD CAM office	WS000010	71.9	0	0	0	-
00 CHG and SH	WS000015	71.9	0	0	0	-
00 Client WC	WS00000E	71.9	0	0	0	-
00 East Staircase	12	71.9	0	0	0	-
00 First aid	WS000019	71.9	0	0	0	-
00 Gun store	WS000016	71.9	0	0	0	-
00 Hot desk	WS000009	71.9	0	0	0	-
00 Hot Works	TS000005	100	0	0	0	-
00 Machine room	WS000008	100	0	0	0	-
00 Meeting room	WS00000D	71.9	0	0	0	-
00 Presentation room	0	71.9	0	0	0	-
00 Reception	WS000012	71.9	0	0	0	-
00 Staff mess	0000000B	71.9	0	0	0	-
00 Staff mess corridor	14	71.9	0	0	0	-
00 Tea point	WS00000F	100	0	0	0	-
00 Walnut room	WS00000C	71.9	0	0	0	-
00 WC 1	WS000017	71.9	0	0	0	-
00 WC 2	WS000018	71.9	0	0	0	-
00 WC lobby	WS00001A	71.9	0	0	0	-
00 West corridor	WS00001B	71.9	0	0	0	-
00 West Staircase	WS000002	71.9	0	0	0	-
01 ACC WC	10	71.9	0	0	0	-
01 Blackening room	0000000E	100	0	0	0	-
01 Cleaner storage	1000003	71.9	0	0	0	-
01 East corridor	4	71.9	0	0	0	-

APPENDIX - OVERHEATING TM52 THERMAL COMFORT ANALYSIS WITH MECHANICAL COOLING (DSY2 2020)

01 East Staircase	1000005	71.9	0	0	0	-
01 Engraving Room	1000000	100	0	0	0	-
01 Finishing shop	1000001	100	0	0	0	-
01 Forge	0000000C	100	0	0	0	-
01 General manager	8	71.9	0	0	0	-
01 Gun store	1000002	71.9	0	0	0	-
01 Machine room	0000000F	100	0	0	0	-
01 Meeting room	9	71.9	0	0	0	-
01 OM Office	6	71.9	0	0	0	-
01 Production manager	5	71.9	0	0	0	-
01 Quality Control	TS000002	71.9	0	0	0	-
01 Repair/Stock	TS000001	100	0	0	0	-
01 Repair/Stock roof	RF000003	100	0	0	0	-
01 Smoke lobby	7	71.9	0	0	0	-
01 Stock area	TS000004	71.9	0	0	0	-
01 Stock Storage	TS000000	71.9	0	0	0	-
01 Storage	2	71.9	0	0	0	-
01 WC	3	71.9	0	0	0	-
01 West Circulation	TS000003	71.9	0	0	0	-
01 West stairs	0100000B	71.9	0	0	0	-

Failed: 0 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing

Unoccupied: 8 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
00 Riser east	13	0	0	0	0	-
00 Riser west	1000004	0	0	0	0	-
00 WC R	RF000000	0	0	0	0	-
01 East Staircase R	0100000A	0	0	0	0	-
01 Machine room R	1	0	0	0	0	-
01 Plant room	11	0	0	0	0	-
QC Ceiling void	RF000001	0	0	0	0	-
n/a		0	0	0	0	1&2&3

Note: A TM 52 2013 analysis provides an assessment of comfort compliance based on bulk air modelling i.e. each space is considered idealised and the air in the space perfectly mixed. The assessment does not assess placement of space features e.g. windows & openings, airflow patterns or discomfort issues. The user should assess these design aspects outside of the TM52 analysis.

Appendix - Overheating TM52 Thermal Comfort Analysis With Mechanical Cooling (DSY3 2020)

Overall
Passed: 48 rooms:
Failed: 0 rooms:
Unoccupied: 8 rooms:

Data:
Building category: Category II (new builds.)
Weather file: London_LHR_DSY3_2020High50.epw
Days data= 365 01-Jan 31-Dec
Days (summer)= 153 01-May 30-Sep
Data OK? OK Full summer

Occupancy:
Note: This report assesses occupied periods only. Please be aware that TM52 should be conducted for occupied and/or "available hours".
Use of educational NCM profiles may be seen as inappropriate due to prolonged unoccupied periods during summer months.
See Section 6.1.2 (a) of TM52 for further information.

Passed: 48 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
00 ACC WC	WS000013	71.2	0	0	0	-
00 Action & Barrel Shop	TS000006	100	0	0	0	-
00 Barn corridor	WS00001C	71.2	0	0	0	-
00 CAD CAM office	WS000010	71.2	0	0	0	-
00 CHG and SH	WS000015	71.2	0	0	0	-
00 Client WC	WS00000E	71.2	0	0	0	-
00 East Staircase	12	71.2	0	0	0	-
00 First aid	WS000019	71.2	0	0	0	-
00 Gun store	WS000016	71.2	0	0	0	-
00 Hot desk	WS000009	71.2	0	0	0	-
00 Hot Works	TS000005	100	0	0	0	-
00 Machine room	WS000008	100	0	0	0	-
00 Meeting room	WS00000D	71.2	0	0	0	-
00 Presentation room	0	71.2	0	0	0	-
00 Reception	WS000012	71.2	0	0	0	-
00 Staff mess	0000000B	71.2	0	0	0	-
00 Staff mess corridor	14	71.2	0	0	0	-
00 Tea point	WS00000F	100	0	0	0	-
00 Walnut room	WS00000C	71.2	0	0	0	-
00 WC 1	WS000017	71.2	0	0	0	-
00 WC 2	WS000018	71.2	0	0	0	-
00 WC lobby	WS00001A	71.2	0	0	0	-
00 West corridor	WS00001B	71.2	0	0	0	-
00 West Staircase	WS000002	71.2	0	0	0	-
01 ACC WC	10	71.2	0	0	0	-
01 Blackening room	0000000E	100	0	0	0	-
01 Cleaner storage	1000003	71.2	0	0	0	-
01 East corridor	4	71.2	0	0	0	-

Appendix - Overheating TM52 Thermal Comfort Analysis With Mechanical Cooling (DSY3 2020)

01 East Staircase	1000005	71.2	0	0	0	-
01 Engraving Room	1000000	100	0	0	0	-
01 Finishing shop	1000001	100	0	0	0	-
01 Forge	0000000C	100	0	0	0	-
01 General manager	8	71.2	0	0	0	-
01 Gun store	1000002	71.2	0	0	0	-
01 Machine room	0000000F	100	0	0	0	-
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01 OM Office	6	71.2	0	0	0	-
01 Production manager	5	71.2	0	0	0	-
01 Quality Control	TS000002	71.2	0	0	0	-
01 Repair/Stock	TS000001	100	0	0	0	-
01 Repair/Stock roof	RF000003	100	0	0	0	-
01 Smoke lobby	7	71.2	0	0	0	-
01 Stock area	TS000004	71.2	0	0	0	-
01 Stock Storage	TS000000	71.2	0	0	0	-
01 Storage	2	71.2	0	0	0	-
01 WC	3	71.2	0	0	0	-
01 West Circulation	TS000003	71.2	0	0	0	-
01 West stairs	0100000B	71.2	0	0	0	-

Failed: 0 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing

Unoccupied: 8 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
00 Riser east	13	0	0	0	0	-
00 Riser west	1000004	0	0	0	0	-
00 WC R	RF000000	0	0	0	0	-
01 East Staircase R	0100000A	0	0	0	0	-
01 Machine room R	1	0	0	0	0	-
01 Plant room	11	0	0	0	0	-
QC Ceiling void	RF000001	0	0	0	0	-
n/a		0	0	0	0	1&2&3

Note: A TM 52 2013 analysis provides an assessment of comfort compliance based on bulk air modelling i.e. each space is considered idealised and the air in the space perfectly mixed. The assessment does not assess placement of space features e.g. windows & openings, airflow patterns or discomfort issues. The user should assess these design aspects outside of the TM52 analysis.

Appendix – GLA Spreadsheet Development Information Tab

TABLE 1. APPLICATION COMPLETENESS CHECK	
Development information tab (Tables 1-4) completed and included in appendix of energy strategy?	yes
Part L outputs tab completed	yes
EUI & space heating demand completed	yes
Confirmation that the planning stage webform will be completed at planning application submission and that the Be Seen process and reporting responsibilities are fully understood, including the requirement for as-built and in-use stage reporting to be undertaken (or where the legal owner changes from one reporting stage to another that the responsible party will be notified).	yes

TABLE 2. DEVELOPMENT DETAILS		Further notes	Response	Supporting comments (or signpost sections in the energy assessment)
Application details	Date of Application	Please provide the date the application was submitted to the Local Planning Authority.		*Issued to architects for planning submissions on 05/03/2026.*
	Local Planning Authority	Please indicate the Local Planning Authority determining the application.	*Hillingdon Council*	
	Confirmed carbon offset price (£/tonne of carbon dioxide)	Please confirm the agreed carbon offset price for the Local Planning Authority. If no value is entered then the GLA's recommend price of £95 per tonne of carbon dioxide will be used.	*95.00*	
	Evidence of communication on the carbon offset price included in the energy assessment (Y/N).		*Y*	*Page 29 of the Energy Assessment.*
	Residential units number (Part L1)		*N/A*	
	Non-residential floor area in m^2 (Part L2)		*1416.00*	
Heat risk	CIBSE TM59 undertaken for residential development (Y/N)		*N*	
	CIBSE TM52 undertaken for non-residential development (Y/N)		*Y*	*Page 22 of the Energy Assessment.*
	All sample units meet CIBSE criteria with DSY1 weather file (Y/N)		*Y*	*Page 22 of the Energy Assessment.*
	DSY2 and DSY3 included in overheating assessments (Y/N)		*Y*	*Page 22 of the Energy Assessment.*
	Residential g-value		*N/A*	
	% Glazing Ratio over façade		*13.40*	
	External shading proposed (Y/N)		*N*	
Energy efficiency measures	Target Fabric Energy Efficiency met (Y/N)		*N*	*Not applicable to non-dwellings.*
	Mechanical Ventilation with Heat Recovery included (Y/N)		*Y*	
	Waste Water Heat Recovery (Y/N)		*N*	
	Low energy lighting (Y/N)		*Y*	

Appendix – GLA Spreadsheet Development Information Tab

District heating connection	Development in a Heat Network Priority Area (HNPA) (Y/N)		*N*	*Not feasible, due to the lack of nearby present or infrastructure.*
	District Heating Network connection (Y/N)		*N*	*Not feasible.*
	Name of District Heating Network		*N/A*	*N/A*
	Carbon factor ($kgCO_2$/ kWh)		*N/A*	*N/A*
	Borough energy officer and Heat Network Operator contacted and evidence of correspondence included in the energy strategy (Y/N)	Applicable to all applications.	*N*	*N/A*
Site heating distribution configuration	Development future proofed for DHN connection (Y/N)	Note that individual heating systems would not be appropriate for developments in HNPAs.	*N*	
	Drawings of communal system provided (Y/N)	Applicants should provide a drawings of the energy centre, on-site communal network with all building uses connected and future proofing arrangements detailed, including single point of connection.	*N*	
	Distribution type		*Individual systems*	
	Flow temperature (°C)		*N/A*	*VRF system with R-32 refrigerant.*
	Return temperature (°C)		*N/A*	*VRF system with R-32 refrigerant.*
	Distribution losses modelled (%)	See table 4 below for details.		
Heating system performance	Heat Pump (Y/N)		*Y*	
	Heat Pump source		*Air*	
	Centralised Heat Pump capacity (kWth)		*247.90*	*System comprises 6 heat pump units.*
	Heat Pump Seasonal Heating Efficiency (SCoP)		*4.00*	
	Heat Pump SCoP calculation includes heat source and heat distribution temperature and seasonal performance factor (Y/N)	See table 5 below for details.	*Y*	
	Fraction of heat supplied by heat pump (only for hybrid systems with boilers) (%)		*N/A*	
	Low-emission on-site CHP enabling an area-wide heat network (Y/N)	Only low-emission CHP is suitable and only where it is facilitating an area-wide heat network. Therefore, new gas engine CHP is not suitable for any other purpose for new developments.	*N*	
	CHP (kWe)		*N/A*	
	Estimated end user cost (pence/kWh)		*N/A*	
	Energy assessment includes consideration of occupant running costs (Y/N)	Applicants should consider the estimated costs to occupants of the energy assessment and outline how they are committed to protecting the consumer from high prices.	*N*	
Solar technologies	Solar PV included (Y/N)		*Y*	*Page 11,17 of the Energy Assessment.*
	Roof layout demonstrating solar PV technologies have been maximised included in energy strategy (Y/N)		*Y*	*Page 17 of the Energy Assessment.*
	kWh generated		*6203.86*	*Calculated from BRUKL (Appendix).*
	kWp		*0.48*	
	Total PV panel area (m^2) installed		*30.00*	*Page 17 of the Energy Assessment.*
	Solar Thermal included (Y/N)		*N*	
	Solar Thermal panel area (m^2) installed		*N/A*	

APPENDIX – GLA SPREADSHEET DEVELOPMENT INFORMATION TAB

Flexibility and peak energy demand	Site-wide peak demand, capacity and flexibility potential included in energy assessment (Y/N)	Table 9 in the energy assessment guidance to be completed.	*N*	*Cannot be reliably defined due to variable workshop equipment use.*
	Interventions for achieving flexibility included in energy assessment (Y/N)	Table 10 in the energy assessment guidance to be completed.	*N*	
	Estimated peak demand (MW)		*N/A*	*Cannot be reliably defined due to variable workshop equipment use.*
	Electrical energy storage (kWh) capacity		*N/A*	*PV panels act as indirect energy storage by offsetting grid demand during generation. The design allows for potential future energy storage integration.*
	Heat energy storage (kWh) capacity		*N/A*	*Hot water storage through hot water cylinder.*
Other technologies	System type (e.g. wind turbine)		*N*	
	Capacity (kW)		*N/A*	
Cooling	Cooling proposed - Residential (Y/N)	It is not expected that 'active cooling' will be proposed for any residential developments. It will be expected that applicants can fully demonstrate that all passive design measures have been thoroughly investigated before considering 'active cooling'.	*N*	
	Cooling proposed - Non-residential (Y/N)		*Y*	*Justified by the Cooling Hierarchy. (pages 21-22)*
	Residential Cooling consumption (kWh p.a.)	See note in cell C60.	*N/A*	
	Commercial Cooling consumption (MJ p.a.)		*5509.94*	*Calculated from BRUKL (Appendix).*

TABLE 3. BESPOKE DH CARBON FACTOR CALCULATION METHODOLOGY
N/A

TABLE 4. DISTRIBUTION LOSSES				COMMENTS
Primary network (buried pipe)	Total pipe length (m)		N/A	The units SCOP accounts for distribution loses.
	Average heat loss rate (W/m)		N/A	The units SCOP accounts for distribution loses.
Secondary network (buried pipe)	Total pipe length (m)		N/A	The units SCOP accounts for distribution loses.
	Average heat loss rate (W/m)		N/A	The units SCOP accounts for distribution loses.
Total losses (MWh/year)			N/A	The units SCOP accounts for distribution loses.
Total heat supplied (MWh/year)			N/A	The units SCOP accounts for distribution loses.
Distribution Loss Factor (DLF)			N/A	The units SCOP accounts for distribution loses.
Calculation included in energy statement (yes/no)			N/A	The units SCOP accounts for distribution loses.