University College School, Hampstead - Project 200

Energy Statement

Planning Issue

30th April 2024

MAX FORDHAM

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ISSUE HISTORY

Issue	Date	Description
P01	15/12/2023	Planning issue
P02	26/03/2024	Updated issue for planning
P03	30/04/2024	Updated issue for planning

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1.0 EXECUTIVE SUMMARY

1.1 Introduction

This Energy Statement has been produced in support of the application for full planning permission for the University College School (UCS) development in Hampstead, London, NW3 6XH.

The description of development is as follows and Planning Permission is sought for the following:

The project is the partial demolition of the existing Giles Slaughter wing, retaining some of the structural elements, and the erection of a new 2-storey building in its' place, a one-storey extension, re-provision of tennis courts on the roof, external plant equipment and enclosures, external landscaping works.

The report's structure is based on the "Greater London Authority guidance on preparing energy assessments as part of planning applications (June 2022)" and aims to:

- Demonstrate compliance with Building Regulations Part L2A, primarily comparing the building emission rate (BER) to the target emission rate (TER) using the Building Regulations Part L 2021.
- Demonstrate the development complies with the London Plan Energy Hierarchy – 'Be lean, be clean, be green'.
- Show the measures adopted to reduce the cooling demand, by following the Cooling Hierarchy, whilst also ensuring the risk from overheating is reduced, in line with TM52.

2.0 Design Philosophy

The proposed development responds to the Mayor's Energy Strategy as stated in The London Plan. The design team has approached the design in the following order:

1. Be Lean: use less energy (energy efficient fabric, high performance lighting and controls)
2. Be Clean: supply energy efficiently (i.e., connection to local district heat network, none present for this site)
3. Be Green: use renewable energy and low or zero carbon technologies (e.g ASHPs and PV panels)
4. Be Seen: monitor, verify and report on energy performance through the Mayor's post construction monitoring platform

Energy Hierarchy - Be Lean
Key passive ('Be Lean') design features include:

UCS (all building):

- High-performance building fabric, airtightness and thermal bridging to reduce winter heat loss and summertime heat gains.
- Mechanical ventilation with heat recovery (MVHR)
- Variable speed and demand-led controls
- High efficiency lighting and demand-led presence control

Energy Hierarchy - Be Clean
The first step in developing the 'Be Clean' strategy was to evaluate whether a connection to an area wide district heating network is possible. There are no existing or proposed area-wide district heat networks in the vicinity of the site available for connection, and so no reduction is available in this part of the hierarchy.

Energy Hierarchy - Be Green
An assessment of which renewable energy technologies are achievable and compatible with the above measures has been carried out. The study concludes that the following technologies are applied:

UCS (all building):

- ASHPs are proposed as the lead heat source for heating and space cooling
- Vertically mounted solar PV array provides 64.40m^2 of PV area at the top of the retaining wall to the East of the new building

Energy Hierarchy - Be Seen
The post-construction energy performance of the development will be monitored and reported to ensure the actual carbon performance is aligned with the net zero carbon target. At planning stage 1 the first stage of reporting is provided to the 'be seen'

2.1 Carbon Emission Reduction Targets

The London Plan calls for all major developments to achieve 'net zero' regulated carbon emissions, and a minimum 35% reduction as compared to a notional building with performance values from Part L 2021 of the Building Regulations. This 35% is expected to be achieved onsite through the application of the 'be lean, be clean, be green' principles of the Energy Hierarchy.

In addition to the above requirements, Camden's Design Standards require a 20% CO_2 reduction to be achieved by on-site renewable energy generation. The London Plan also requires non-domestic developments to achieve a minimum 15% improvement on Building Regulations from energy efficiency measures alone, represented by the 'Be Lean' stage.

2.2 Emission Factors

For the purposes of this energy statement the proposed development's initial baseline emissions and CO_2 reductions are calculated using the current Building Regulation Part L2 2021 approved software: IES VE Compliance software 2023.

Source	SAP 10.2
Natural Gas	0.210 kg CO_2/kWh
Grid Electricity	0.136 kg CO_2/kWh

Table 1-1 Carbon factors used in energy modelling

2.3 Summary of Results

GLA London Plan Energy Hierarchy
The GLA energy assessment uses the London Plan 2021 new SAP10.2 carbon factors.

- At the **'Be Lean'** stage the proposed development achieves a **9% reduction** below the baseline. This is below the expected 15% improvement required at this stage.
- **'Be Clean'** stage is not targeted as there is no connection to a district heating system, with on-site heating generation proposed.
- The **'Be Green'** strategy achieves a total carbon emissions reduction of **18%.** This is below the expected 20% improvement required at this stage.
- The be green reductions were achieved using ASHPs, on-site PV panels as well as implementation of off-site PV Panels outside of the red line boundary, on the Modern Languages Building.

- The **total cumulative carbon emissions reduction** amount to **27%**.
- This is below the GLA's 35% reduction requirement for new developments but the GLA Energy Assessment Guidance updates – Part L 2021 (15 June 2022) acknowledge that achieving the on-site carbon reduction may vary for different types of development.

2.4 Non-Residential Carbon Emission Results

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Baseline	14.0		
Be Lean	12.7	1.3	9%
Be Clean	12.7	0.00	0%
Be Green	10.1	2.5	18%
Total Cumulative Saving		3.8	27%

	(Tonnes CO_2)
Cumulative savings for off-set payment	304.3
Cash in-lieu contribution (£)	28,912

Table 1-3: Regulated Carbon Emissions and Savings

2.5 Site-Wide Carbon Emission Results

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2021 baseline	14		
Be Lean	12.7	1.3	9%
Be Clean	12.7	0.0	0%
Be Green	10.1	2.5	18%
Total Savings		3.8	27%
		CO2 savings off-set (Tonnes CO2)	
Off-set		**304.3**	

Table 1-4: Site Wide Regulated Carbon Emissions and Savings

	Area weighted non-residential cooling demand (MJ/m2)	Total area weighted non-residential cooling demand (MJ/year)2
Actual	14.55	45842.65
Notional	11.24	35424.98

Table 1-5: Cooling Demand Reporting

2.6 Energy Use Intensity demand

Building type	EUI (kWh/m²/year) (excluding renewable energy)	Space heating demand (kWh/m²/year) (excluding renewable energy)	EUI value from Table 4 of the guidance (kWh/m²/year) (excluding renewable energy)	Space heating demand from Table 4 of the guidance(kWh/m²/year) (excluding renewable energy)	Methodology used (e.g. 'be seen' methodology or an alternative predictive energy modelling methodology)	Explanatory notes (if expected performance differs from the Table 4 values in the guidance)
School	63.85	22.26	65	15	Part L2 - approved DSM & none	The extended area of flat roof (for tennis courts) and moderate thermal bridging performance, as well as the requirements for daylighting and natural ventilation, contribute to higher heat losses and make it more difficult to meet the space heating demand target of 15 kWh/m²/year. The proposed building form provides many other benefits in terms of health, wellbeing, and accessibility. Thermal bridging and other areas of facade / building envelope performance will be reviewed and optimised as the design progresses.

Table 1-7: Reporting EUI and space heating demand

3.0 SITE DETAILS

3.1 Site Location

The current site consists of the Giles Slaughter Wing, Fives Courts building, three outdoor tennis courts, and grounds located on the University College School (UCS) Senior School Campus in Hampstead, London Borough of Camden.

The site is located on the East side of the campus, set back from the road and backs onto residential area.

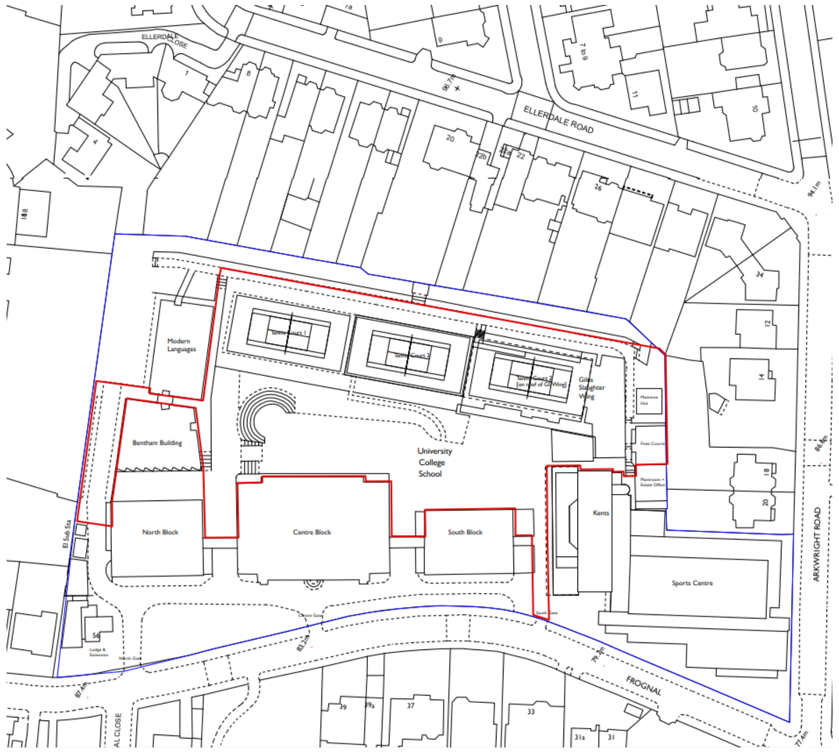


Figure 3-1: Site location plan

3.2 Proposed Development

The description of the development is as follows and Planning Permission is sought for the following:

The project is the partial demolition of the existing Giles Slaughter wing, retaining some of the structural elements, and the erection of a new 2-storey building in its' place, a one-storey extension, re-provision of tennis courts on the roof, external plant equipment and enclosures, external landscaping works.

Figure 3-2: Architectural illustration of the proposal new development (Ed Toovey Architects)

4.0 POLICY CONTEXT

4.1 Introduction

The proposed development is submitted within the context of national, regional and local planning policies that seek to address the challenges of climate change and sustainable development. The policies outline how the Government, the Mayor of London, and Camden Council are endeavouring to improve the way energy and other resources are used in London's building stock.

4.2 Policy Summary

- **Climate Change Act (2008):** 80% reduction in greenhouse gas (GHG) emissions compared to 1990 levels by 2050.
- **Current 2013 Part L of the Building Regulations for England & Wales:** Sets out maximum levels of CO_2 emissions by comparing the actual buildings, to a notional building.
- **Consideration of High-efficiency Alternative Systems**: Building Standards requires the technical, environmental and economic feasibility of high-efficiency alternative systems such as renewables, cogeneration, district heating and heat pumps to be considered and taken into account.
- **National Planning Policy Framework (2021):** Development to promote healthy and safe communities; encourage sustainable modes of transport and use of technology; support transition to low carbon future; mitigate and adapt to climate change, including taking account of flood risk, water supply and biodiversity; conserve and enhance the natural environment; and facilitate the sustainable use of materials.
- **London Plan:** The energy hierarchy to be followed: be lean, be clean, be green and be seen, all developments to be zero carbon, offsetting can still be used, CHP strongly discouraged due to air quality and grid decarbonisation.
- **Camden Local Plan 2017 and Camden Planning Guidance documents** provide guidance on a wide range of sustainability subjects
- **London Air Quality Management Areas**: The development is located within one of London's Air Quality Management Areas (AQMA)

4.3 The Climate Change Act (2008)

The Climate Change Act (2008) commits the UK to a reduction of greenhouse gas emissions (GHGs) by at least 80% by 2050 from 1990. The Act also requires annual emissions reduction targets are set. They restrict the amount of greenhouse gas the UK can legally emit in a five-year period. The UK is currently in the third carbon budget period (2018 to 2022). The 3rd Carbon budget (2018-22) is targeting a reduction of 37% by 2020 from the base year.

UK emissions were 41% below 1990 levels in 2016. The first carbon budget (2008 to 2012) was met and the UK is currently on track to outperform on the second (2013 to 2017) and third (2018 to 2022). However, it is not on track to meet the fourth (2023 to 2027).

To meet future carbon budgets and the 80% target for 2050, the UK Government will need to apply more challenging measures. The construction and operation of UK buildings account for approximately 60% of national carbon dioxide emissions. Therefore, planning legislation seeks to mitigate the impact (in particular) of new construction in order to minimise these emissions and to meet the national targets.

4.4 National Planning Policy Framework (2021)

The National Planning Policy Framework (NPPF) sets out the Government's planning policies on the delivery of sustainable development through the planning system and how these are expected to be applied. It provides a framework within which local people and their councils can produce their own local and neighbourhood plans, which reflect the needs and priorities of their communities.

14. Meeting the challenge of climate change, flooding and coastal change: Planning system should support the transition to low carbon future in a changing climate, taking full account of long term implications for flood risk, coastal change, water supply , biodiversity and landscapes, and risk of overheating from rising temperatures. Includes requirements for developing energy strategies that are compatible with renewable and low carbon energy sources

15. Conserving and enhancing the natural environment: Policies and decisions should contribute to enhance the natural and local environment.

4.5 The London Plan 2021

The London Plan 'Spatial Development Strategy for Greater London', published in March 2021, forms the statutory development plan for Greater London over the next 20-25 years. In it, the Mayor of London lays out the London-wide policy context within which London Boroughs should set their local planning policies.

All policies within the plan promote sustainable development, including mitigating and adapting to the impacts of climate change, as well as promoting health and equality within London. A number of policies directly related to energy use within buildings and energy generation, which form an integral part of the London Plan.

Policy GC6 'Increasing Efficiency and Resilience'
Help London become a more efficient and resilient city:

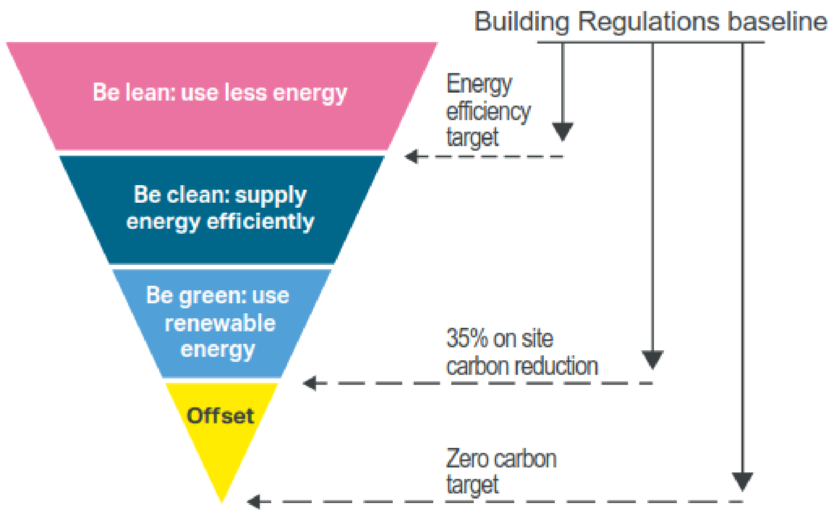
- Improve energy efficiency and support move toward a low carbon circular economy, contributing towards London becoming a zero-carbon city by 2050.
- Building and infrastructure are designed to adapt to a changing climate, making efficient use of water, reducing impacts from natural hazards like flooding and heatwaves, and avoiding contributing to the heat Island effect.

Policy G1 'Green Infrastructure'
Development proposals should incorporate appropriate elements of green infrastructure that are integrated into London's wider green infrastructure network.

Policy SI1 'Improving Air Quality'

- All major developments need to demonstrate that they will be at least air quality neutral.
- All energy proposals should have emissions lower than those generated by ultra-low NOx emission gas boilers.
- Developments in Air Quality Focus Areas (AQFA) will be under particular scrutiny.
- For major developments preliminary Air Quality Assessments (AQAs) should be carried out before designing the development to inform the design process.

Policy SI2 'Minimising Greenhouse Gas Emissions'
Major developments should be net zero carbon, which means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the Energy Hierarchy:



Be Lean: Use less energy and manage demand during operation

Be Clean: Exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly

Be Green: Maximise opportunities for renewable energy by producing, storing and using renewable energy onsite

Be Seen: Monitor, verify and report on energy performance

- Major developments to be net-zero carbon overall, although this can be achieved through off-site or offsetting payments.

- As with current London Plan at least a 35% reduction on building regulations must be achieved on site.
- For residential developments 10% of the reductions must be achieved through energy efficiency.
- For non-domestic 15% of reductions must be achieved through energy efficiency.
- Major development proposals should calculate and minimise carbon emissions of unregulated emissions.
- Development proposals referable to the Mayor should calculate whole lifecycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.
- All developments to demonstrate how the development will achieve net-zero carbon on-site by 2050.
- All major developments to monitor and report on their energy use for 5 years after completion. It has suggested that DECs might be used to do this (currently only required for public buildings).
- Gas-engine CHP will not be permissible in developments due to the new air quality standards and decarbonising electricity grid.
- The Mayor recognises that Building Regulations use outdated carbon emission factors and that this will continue to cause uncertainty until they are updated by Government. Further guidance on the use of appropriate emissions factors will be set out in the Mayor's Energy Planning Guidance to help provide certainty to developers on how these policies are implemented.
- Demand-side response, specifically through installation of smart meters, minimising peak energy demand and promoting short-term energy storage, as well as consideration of smart grids and local micro grids where feasible, required.

Policy SI3 'Energy Infrastructure'
Major development proposals within Heat Network Priority Areas should have a communal **low-temperature** heating system.

Requirement for an energy masterplan for large-scale developments (town centres and areas of multiple developments) which should consider:

1) major heat loads (including anchor heat loads, with particular reference to sites such as universities, hospitals and social housing)
2) heat loads from existing buildings that can be connected to future phases of a heat network
3) major heat supply plant including possible opportunities to utilise heat from energy from waste plants
4) secondary heat sources
5) opportunities for low temperature heat networks
6) possible land for energy centres and/or energy storage
7) possible heating and cooling network routes
8) opportunities for futureproofing utility infrastructure networks to minimise the impact from road works
9) infrastructure and land requirements for electricity and gas supplies
10) Implementation options for delivering projects, considering issues of procurement, funding and risk, and the role of the public sector.
11) opportunities to maximise renewable electricity generation and incorporate demand-side response measures

The heat source for the communal heating system should be selected in accordance with the following **heating hierarchy:**

a) connect to local existing or planned heat networks
b) use available zero-emission or local secondary heat sources (in conjunction with heat pump, if required
c) Use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network).
d) Use ultra-low NOx gas boilers.

CHP and ultra-low NOx gas boiler communal or district heating systems to meet the requirements of policy SI1 (Air Quality).

Policy SI4 'Managing Heat Risk'
Show steps to minimise overheating and avoid active cooling:

1) minimise internal heat generation through energy efficient design
2) reduce the amount of heat entering a building through orientation, shading, albedo, fenestration, insulation and the provision of green roofs and walls
3) manage the heat within the building through exposed internal thermal mass and high ceilings
4) provide passive ventilation
5) provide mechanical ventilation
6) Provide active cooling systems.

Policy SI8 Waste capacity and net waste self-sufficiency
A In order to manage London's waste sustainably:
1. the equivalent of 100 per cent of London's waste should be managed
2. within London (i.e. net self-sufficiency) by 2026
3. existing waste management sites should be safeguarded (see Policy SI 9 Safeguarded waste sites)
4. the waste management capacity of existing sites should be optimised. New waste management sites should be provided where required
5. environmental, social and economic benefits from waste and secondary materials management should be created.

B Development Plans should:
1) plan for identified waste needs
2) identify how waste will be reduced, in line with the principles of the Circular Economy and how remaining quantums of waste will be managed
3) allocate sufficient sites, identify suitable areas, and identify waste management facilities to provide the capacity to manage the apportioned tonnages of waste, as set out in Table 9.2 – boroughs are encouraged to collaborate by pooling their apportionment requirements
4) identify the following as suitable locations to manage borough waste apportionments:
a. existing waste and secondary material sites/land, particularly waste
b. transfer facilities, with a view to maximising their capacity
c. Strategic Industrial Locations and Locally Significant Industrial Sites safeguarded wharves with an existing or future potential for waste and secondary material management.

C Mayoral Development Corporations must cooperate with host boroughs to meet identified waste needs.
D Development proposals for materials and waste management sites are encouraged where they:
1) deliver a range of complementary waste management and secondary material processing facilities on a single site
2) support prolonged product life and secondary repair, refurbishment and remanufacture of materials and assets
3) contribute towards renewable energy generation, especially renewable gas technologies from organic/biomass waste, and/or
4) are linked to low emission combined heat and power and/or combined cooling heat and power (CHP is only acceptable where it will enable the
5) delivery or extension of an area-wide heat network consistent with Policy SI 3 Energy infrastructure Part D1c)

4.6 Sustainability design and construction SPG

The Sustainable Design and Construction SPG, adopted in April 2014, provides additional information and guidance to support the implementation of the Mayor's London Plan. The SPG does not set new policy, but explains how policies in the London Plan should be carried through into action.

It is applicable to all major developments and building uses so it is not technically applicable to this development, however in line with the developer's intention to implement the requirements of the London Plan it has been used to guide the design. It covers the following areas:

- Resource Management
- Adapting to Climate Change and Greening the City
- Pollution Management

This SPG provides a basis for sustainable design in London. Where additional local policies are addressed by these areas this has also been indicated.

4.7 Camden Local Plan 2017

The below sections do not include all details from these policies: relevant passages have been listed below, in some cases paraphrased for brevity.

Policy CC1 Climate change mitigation

- The Council will require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.
- Comply with the London plan plus all proposals that involve substantial demolition must demonstrate that it is not possible to retain and improve the existing building;
- All developments to optimise resource efficiency by:
    - reducing waste;
    - reducing energy and water use during construction;
    - minimising materials required;
    - using materials with low embodied carbon content; and
    - enabling low energy and water demands once the building is in use.

Policy CC2 Adapting to climate change
The Council will require development to be resilient to climate change. All development should adopt appropriate climate change adaptation measures such as:

- the protection of existing green spaces and promoting new appropriate green infrastructure;
- not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and use of Sustainable Drainage Systems;
- incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and
- measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.
- Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement

4.8 Camden Supplementary Planning Guidance

CPG Energy Efficiency and Adaptation January 2021
All development in Camden is expected to reduce carbon dioxide emissions by following the energy hierarchy in accordance with Local Plan policy CC1. Natural 'passive' measures should be prioritised over 'active' measures to reduce energy. Major residential development to achieve 10%, and non-residential development to achieve 15% reduction (beyond part Building regulations), in accordance with the new London Plan, through on-site energy efficient measures (Be lean stage).

All new major developments in Camden are expected to assess the feasibility of decentralised energy network growth.

Developments are to target a 20% reduction in carbon dioxide emissions from on-site renewable energy technologies. Energy statements are required for all developments involving 5 or more dwellings and/or more than 500sqm of any (gross internal) floorspace. Energy statements should demonstrate how a development has been designed following the steps in the energy hierarchy.

All development in Camden is expected to reduce carbon dioxide emissions through the application of the energy hierarchy and meet the London Plan carbon reduction targets for new buildings. Developments of five or more dwellings and/or more than 500sqm of any gross internal floorspace to achieve 20% reduction in carbon dioxide emissions from on-site renewable energy generation.

We will expect creative and innovative solutions to repurposing existing buildings, and avoiding demolition where feasible; All development should seek to optimise resource efficiency and use circular economy principles.

In assessing the opportunities for retention and refurbishment developers should assess the condition of the existing building and explore future potential of the site.

All developments should seek opportunities to make a positive contribution to green space provision or greening.

All developments involving 5 or more residential units or 500 sqm or more of any additional floorspace should address sustainable design and construction measures (proposed in design and implementation) in a Sustainability Statement. Applicants should detail how sustainable design and construction principles have been incorporated into the development either in their Design and Access Statement or in a Sustainability Statement.

Local Plan Policy CC2 expects non-residential developments of 500sqm or more of floorspace to achieve an Excellent BREEAM rating, achieving 60% of all available Energy and Water credits and 40% of available Materials credits. These sub-targets are included as achieving this weighting of credits is considered to result in the greatest environmental benefits. Other assessment tools such as Home Quality Mark and Passivhaus are encouraged, they can serve to demonstrate the incorporation of sustainable design principles.

5.0 'BE LEAN' – DEMAND REDUCTION

This section outlines the passive and active measures that have been applied to the project to realistically maximise the 'Be Lean' energy demands.

GLA Energy Assessment Guidance advised that domestic development should achieve at least 10% improvement and non-domestic developments should achieve at least a 15% improvement on Building Regulations from energy efficiency.

5.1 UCS Passive Design Measures

Thermal Performance & Air Tightness
For the new UCS development fabric elements are proposed to exceed current Building Regulation Part L requirements to reduce the heat loss and gains (and therefore carbon emissions attributed to space heating and cooling) passively before considering active engineering systems and renewable energy.

The proposed new construction elements for UCS performance targets are presented below.

Envelope Performance Parameters	Proposed UCS Specification	Notional Building Specification	Building Regulations Limit 2021[1]
Thermal Transmittance U-values in W/(m².K):			
Flat Roofs	0.09	0.15	0.18
External walls (solid wall construction)	0.15	0.18	0.26
External walls (opaque elements of curtain walls system)	-	0.18	0.26
Party walls	-	1.80	n/a
Floor	0.11	0.15	0.18
Windows and transparent curtain walling (whole window, i.e. inc. frames)	0.90	1.40	1.6
Horizontal roof windows and glazed roof-lights (whole window, i.e. including frames)	-	1.80	2.2
Glazed doors (inc. frames)	-	1.6	1.6
Opaque doors	1.2	1.9	2.20
Semi-glazed doors	-	1.6	1.6
Vehicle access and similar large doors	-	1.3	1.3
High-usage entrance doors	-	2.20	3
Glazing Solar and Optical Properties:			
g-value	0.34	0.28	n/a
Light transmittance	0.65	0.71	n/a
Airtightness:			
Air permeability ($m^3/(h.m^2)$ at 50 Pa)	2.0	3.0	8.0
Thermal bridging:			
Alpha value (%)	25.03% of U-value equivalent	10% of U-value equivalent	n/a

Table 5.1 Fabric performance values for Part L2A – proposed new construction
1. Values from Table 4.1 of Part L2A 2021

Air permeability
The targeted reduced air-permeability of the new building will help minimise heat loss through infiltration. Achieving an airtight building requires good attention to detailing through design and monitoring of the construction process and workmanship on site. The finished building is proposed to be tested for air leakage in accordance with CIBSE TM23, "Testing Buildings for Air Leakage". This testing will provide the following benefits:

- verifies the effectiveness of the improvements included in the Architect's fabric design and detailing
- checks the quality of construction work, identifying any areas where improvements are needed due to poorer standards of workmanship

Windows, Solar Control and Daylight Strategy
The window design has been balanced to optimise daylight and natural ventilation while not compromising too much on solar gains, glare, and heat loss. Windows are generally to be double glazed and openable. Manual blinds will allow a certain amount of occupant control of daylight and privacy.

Well-proportioned glazing and façade design provides generous natural light and views from the classrooms onto the rear courtyard / garden to the East and rest of the school site to the West. Natural light coupled with daylight dimming lighting controls will reduce artificial lighting demands at times and improve overall energy efficiency.

Shading is provided by the cloister walkway to the West and by the natural embankment (and associated planting) to the East. With the glazing designed accordingly, this helps to manage solar gains and prevent overheating.

5.2 UCS Active Design Measures

Space heating and cooling
Space heating and cooling to the building is provided by reversible 2-pipe air source heat pumps delivering low temperature and chilled water to meet building demands. The heat pump system includes buffer vessels for thermal storage and to improve the longevity and efficiency of the heat pumps.

Heat pump SCOP and chiller are based on the dynamic simulation calculations provided in Section 8.4.

Mechanical ventilation with heat recovery
Mechanical ventilation with heat recovery is provided to all mechanical fresh air supplies in order to minimise ventilation heat loss whilst ensuring sufficient fresh air rates. During warmer weather, natural ventilation in a number of spaces allows management of internal temperatures and comfort.

	MVHR-RS	MVHR-N	TEF-1/ TEF-2	KEF-1	AHU-V-S	AHU-S	AHU-RR/LT
Ventilation (type)	S+E w/ H+C	S+E w/ H+C	Toilet extract	Prep & servery extract fan	S+E w/ H+C	S+E w/ H+C	S+E w/ H+C
Ventilation SFP (W/l/s)	1.4	1.5	1.6	1.7	1.4	1.7	1.8
Ventilation Heat Recovery (%)	80	80	N/A	N/A	80	80	80

Lighting
Efficient lighting sources and controls have been provided to spaces to reduce lighting consumption:

Space Type	Luminous Efficacy (lm/W)	Lighting Controls
Offices/ Classrooms	110	Absence control and occupancy switching
Cafeteria	110	Manual
Lecture Theatre/ Recital Room	110	Manual
Plantroom/ Stores	110	Manual
Foyer	110	Manual
WC/ Prep. Servery	110	Presence detection
Circulation	110	Presence detection

Energy Management
BMS-connected heat, electrical and water meters will monitor energy use to allow the building manager and occupants to understand and monitor where energy is being used. Major plant shall be monitored and alarmed should they be operating outside of range.

5.3 UCS Energy Modelling

The proposed development areas have been modelled in the new Building Regulation Part L2 IES VE Compliance software following the GLA Energy Assessment Guidance.

5.4 Cost to Occupants

In line with the energy hierarchy, energy demand reduction has been prioritised to protection occupants from high prices. The 'be seen' post construction monitoring is another element that will play an important role in keeping running costs down.

The following quality assurance mechanisms and commitments will be put in place as part of the energy strategy:

- Following quality standard for installation and commissioning include CIBSE Code of Practice guidance and Commissioning Guides.
- Transparent billing, including the separation of the ongoing maintenance and capital replacement aspects of the standing charge.
- Aftercare support targeting BREEAM Man 05 aftercare.

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6.0 COOLING AND OVERHEATING

In line with Policy SI 4 'Managing heat risk' of the London Plan, to reduce active cooling demand and associated energy consumption, the strategy followed the cooling hierarchy, and several passive design strategies to limit the impact of the higher summertime temperature have been investigated and integrated into the building design.

6.1 The Cooling Hierarchy

The cooling hierarchy in Policy SI 4 of the London Plan has been applied to the development. The following measures are proposed to reduce the demand for cooling:

	Cooling Hierarchy	Steps taken
1	Reduce the amount of heat entering the building through orientation, shading, high albedo materials, fenestration, insulation, and the provision of green infrastructure	The external façade form and façade windows placement is designed to provide external shading using horizontal overhangs to the west façade. High performance solar controlled glass is proposed to help manage solar gains. Green roof area provided to limit conductive heat gains through the fabric.
2	Minimise internal heat generation through energy efficient design	High efficacy lighting to reduce associated waste heat. Heating distribution pipework is insulted, and main distribution routes / voids are indirectly ventilated. Major plant rooms are located in south and north parts of the building limiting unwanted internal heat gain contribution to occupied spaces. Efficient IT and AV equipment will minimise additional gains.
3	Manage the heat within the building through exposed internal thermal mass and high ceilings	High thermal mass at the Classrooms and the Common Room with natural night cooling and automatic controls based on internal and external temperatures.
4	Passive ventilation	An overheating study has been carried out to test the natural ventilation potential using the CIBSE TM52 overheating criteria. The finding show that this can be satisfied in the following rooms: - Classrooms and common room - Consultation room (west) - Meeting room (west) - Wellbeing director office - PSHE office - Counsellor study office - Staff office (2p.) - Staff office (1p.) - Rest room (west) Openable windows are provided in the façade to allow for passive ventilation/mixed mode operation in the cafeteria and the drama studio (20p.). Natural ventilation is limited by acoustic constraints at the rest of the spaces.
5	Mechanical ventilation	Spaces have mechanical ventilation with variable heat recovery system for summer mode operation. This will allow the system to make use of 'free cooling' where the outside temperature is below that in the building during summer months.
6	Provide active cooling	Active cooling is proposed for certain South-facing and high-density rooms, as well as spaces where acoustic constraints make it impractical to implement natural ventilation and cooling. Generation is provided using reversible heat pumps with buffer vessels, offering high seasonal energy efficiency ratios (exceeding the NCM notional building values).

Table 6-1: UCS summary of steps following cooling hierarchy.

6.2 Overheating Risk Analysis

An overheating assessment in accordance with the requirements of the GLA London Plan has been undertaken for the proposed UCS development. The project is the partial demolition of the existing Giles Slaughter wing, retaining some of the structural elements, and the erection of a new 2-storey building in its' place, a one-storey extension, re-provision of tennis courts on the roof, external plant equipment and enclosures, external landscaping works.

IES VE2023, an AM11 compliant software package, has been used to simulate the non-domestic spaces assessed against CIBSE TM52 criteria.

In accordance with the GLA London Plan, the London Weather Centre 2020s DSY1 weather file has been used, for the high emissions scenario at the 50th percentile.

The results of this analysis demonstrate an acceptable overheating risk for all accessed spaces within UCS, using a natural ventilation strategy and for the DSY1 weather scenario.

The key measures enabling compliance with TM52 for UCS are:

- All openings, as indicated on the architectural elevations, must be able to open to at least 30°
- A glazing G value of 0.34 to the new build areas, must be achieved
- Night ventilation must be possible to the classrooms and the common room, so where accessible, security measures must be implemented to enable openings to remain open through the night

It is critical that these measures are retained in the proposals in order to ensure an acceptable level of overheating risk.

The full overheating assessment is provided within the appendices.

6.3 Active Cooling

Active cooling is proposed for various spaces in the UCS development where, due to high internal and solar heat gains or particular acoustic requirements, passive and other measures alone will not be able to mitigate overheating. The demand for active cooling has been reduced through various measures including: applying shading over large areas of glazing, incorporating solar control glazing with optimised G-values, specifying an energy-efficient lighting and small power strategy, providing natural and mechanical ventilation with 'free cooling' wherever possible.

Building Regulations Criterion 3
A solar gain analysis was completed for Criterion 3 of the Building Regulations Part L 2021 using the IES VE-Compliance software. This is to ensure the effects of solar heat gain are limited in summer. All applicable spaces in UCS passed Criterion 3.

7.0 'BE CLEAN' – HEATING INFRASTRUCTURE

Once demand for energy has been minimised, to reduce CO_2 emissions a heat source that supplies energy efficiently and cleanly to the developments energy systems should be selected by following the heating hierarchy in London Plan Policy SI 3.

7.1 The Heating Hierarchy

To comply with London Plan Policy SI3, developments in Heat Network Priority Areas (HNPAs) should have a communal low-temperature heating system and should select a heat source in accordance with the following heating hierarchy:

a) Connect to local existing or planned heat networks
b) Use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)
c) Use low-temperature combined heat and power (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network)
d) Use ultra-low NOx gas boilers

Local existing or planned heat networks
A review has been completed for district heating networks in the vicinity of the site, either existing or planned for in the future. No existing or proposed district heat networks were identified in the vicinity of the UCS site so it is concluded that connecting to a heat network is not currently an option for this scheme.

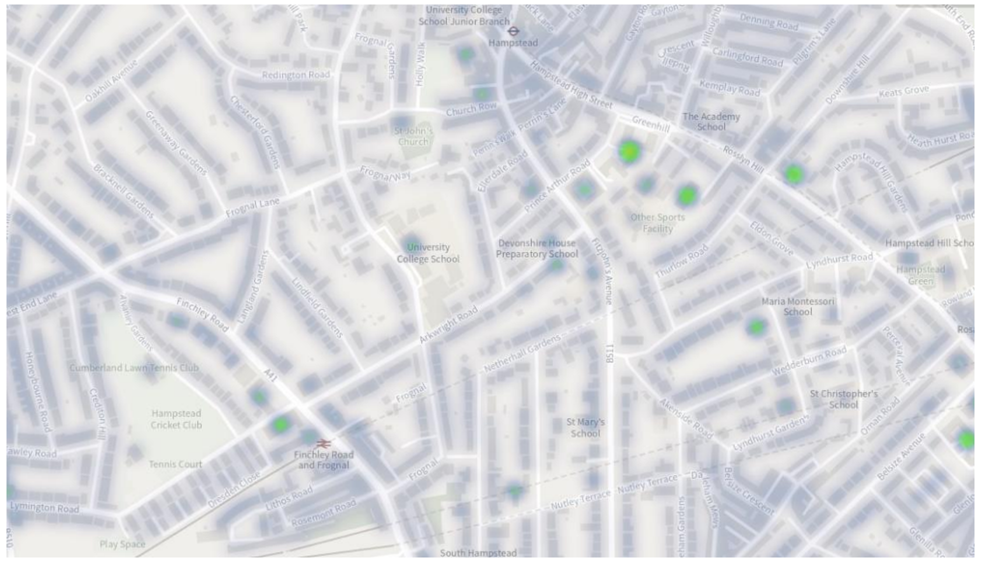


Figure 7-1: UCS London Heat Map area

Heat Network Scenario
As there is no current or planned district / site-wide heat network in the area, the development is then expected to provide a communal heat network allowing for a safeguarded single point of connection to the site.

The proposal for UCS Project 200 is to provide a building level heating and cooling system with low-carbon heat pumps. The other existing blocks on the site generally utilise gas-fired boilers so providing an all-electric heat pump system represents a significant step for UCS in terms of decarbonisation. Domestic hot water will be provided by local electric water heaters to minimise storage and distribution energy losses. Heating and cooling loads for the new development will predominantly be asynchronous so it is proposed to use reversible 2-pipe heat pumps. These do not allow for simultaneous heating and cooling with heat recovery but do generally have higher heating- / cooling-only coefficients of performance and seasonal efficiencies.

Heating and cooling buffer vessels will be incorporated to help smooth out the load profile that the central plant sees and to improve the heat pump operating efficiency. Variable speed pumps with multiple differential pressure sensors in the system will ensure responsive, demand-led control of the heating and cooling system.

7.2 Air Quality Impacts

An associate Air Quality Assessment has been carried out in relation to the proposed development. As all heating and cooling generation is by electrically powered heat pumps, there are no associated local emissions to account for. The Air Quality Impact reporting table is provided below.

Energy Source	Total predicted non-residential energy use (MWh/year)
Grid electricity	138
Gas boilers (communal/individual)	0
Gas CHP	0
Connection to existing DH network	0
Other gas use (e.g. cookers)	0

Table 7-1: Reporting Air Quality Impacts

8.0 'BE GREEN' - RENEWABLE ENERGY

The site's suitability for connection to an existing heating or cooling network has been assessed in the previous section in line with the GLA's recommended hierarchy for selecting a heat source. Since this has been deemed unfeasible, the second option in the GLA hierarchy is to use zero-emission or low carbon heat sources.

Please refer to the Appendix for the BRUKL results.

8.1 Renewable Energy Feasibility Study

An assessment of renewable energy technologies has been made bearing in mind stages one and two of the energy hierarchy. The list of possible Low and Zero Carbon Technologies (LZCTs) was reduced to a short list of the most viable options.

Step One

Broad overview of possible Low or Zero Carbon Technologies

Step one identifies those LZCT that were discounted from the outset due to site constraints. This reduced the initial list down to a size where more detailed information can be supplied in step two.

Step Two

Review project suitability of technologies not discounted in Step One

Step two looked in more detail how each LZCT suited the site and the proposed building.

8.2 Step One – High Level Appraisal

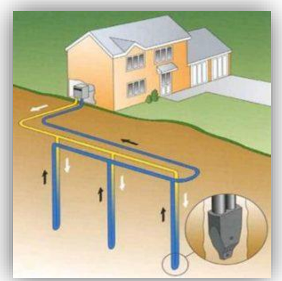
The following table shows whether each low or zero carbon technology was accepted or rejected. All rejections have been justified within the table. The criteria used to determine the sustainability of these technologies included:

1. London planning guidance
2. London Borough of Camden planning obligations (incl. land use, noise, practical feasibility, and pollution)

Proposed Technology	Initial Feasibility	Short Listed?
Combined Heat & Power (CHP)	As the electricity grid decarbonises the viability for CHP decreases. Gas fired CHP are also associated with high NOx emissions. The site is within an air quality management zone. In addition, new small-scale CHP installations are not encouraged by the GLA.	No
Photovoltaic Panels (PVs)	PV panels produce high grade energy. Available roof space is limited.	Yes
Solar Thermal Panels	Solar thermal technologies may not work well in conjunction with the ASHP systems and integration into the LTHW. The building will not have a high domestic hot water demand. Solar PV are preferred for the available limited roof areas.	No
Wind Power	Wind turbines produce high grade energy. Due to the visual and vibration issues which would arise, this technology has not been considered further	No
Biomass	The site is within an air quality management zone. Fuel would need to be sourced at a great distance from the site and delivered to site by HGV. Biomass combustion and the emissions required to transport fuel to site will likely result in an increase in local air pollution through the increased production and emission of particulates and NOx gases, therefore this technology has not been shortlisted.	No
Ground Source Heat Pump (GSHP)	A ground source heat pump would require several boreholes to accommodate the scheme. This would entail excavation of existing areas around the site, e.g. carpark, playground. The borehole, their radius of influence and pipework would struggle to avoid adjacent infrastructure.	Yes
Air Source Heat Pump (ASHP)	As the grid decarbonises the move towards electrical heating will help reduce the use of fossil fuels and improve local air quality. Air Source Heat Pumps allow an all-electrical system to be used whilst also reducing the energy running costs over time.	Yes
Anaerobic Digestion	Anaerobic digestion plant requires high level of maintenance to keep it running smoothly and though it generates energy from waste, it still produces on-site greenhouse gases and potentially air pollution. The new block is not expected to produce much waste that could be used for anaerobic digestion. Therefore, this technology is not proposed to be investigated further.	No

8.3 Step Two – Project Suitability Matrix

The summary table on the following page sets out the advantages, disadvantages, and project suitability of the LZCT deemed credible in step one. This section is set out in a matrix to make comparisons of technologies easier. The technologies deemed suitable in step two are then proposed to be included within the project.

		 Glazed fence option  Canopy option	
TECHNOLOGY NAME	**GROUND SOURCE HEAT PUMP**	**PHOTOVOLTAIC PANELS**	**AIR SOURCE HEAT PUMP**
LOCATION	Heat Pump in plant room with collector buried in the ground	For this project mainly vertical PVs will be considered located around the tennis court replacing a glazed fence (Option 1) or vertical PVs on the Eastern property bordering residential areas (Option 2). In addition to the vertical PVs there will also be a small amount of east- facing PV installed on top of the canopy along the western façade of the building and some PVs on the South wing of the building.	Mounted on the roof of the building
LOAD	Generates hot water for heating (30 to 60 °C)	Generates electricity	Generates hot water for heating (30 to 60 °C)
ADVANTAGES	• Heat is extracted from a renewable source • Suitable for low temperature heating • Zero carbon potential as grid decarbonises • Higher COPs can be achieved than with ASHP, high COP can be maintained in winter • Can be installed in internal plantrooms without access to large volumes of fresh air • Plant is discreet with little visual and acoustic impact	• Zero carbon electricity • Easy to install and connect to existing services • Light weight • Surplus energy can be sold. • Low plant space requirement. • Significant area of tennis court glazed fence available and possible implementation of bifacial solar glass PVs	• Heat is extracted from the air to heat the building and provide hot water • No boreholes are required which significantly reduces the capital cost • Heat recovery systems can provide heating and cooling simultaneously
DISADVANTAGES	• Number of boreholes and system performance is dependent on geological conditions • If groundwater is extracted from a borehole, there is no guarantee that the required flow rate can be achieved prior to borehole testing • Boreholes and test boreholes are drilled at the client's risk • High capital cost • Complex installation	• Large area of panels required to generate a meaningful amount of electricity • Requires direct sunshine to function efficiently • The Network Operator application can take some time to be approved, which needs to be done to gain permission to connect to the grid network.	• Not quite as efficient as a ground source heat pump. • High capital cost, though cheapest heat pump option • External space required • They are make noise, so additional sound attenuation can be required
PROJECT SUITABILITY	Due to the limited space on site the ground array would need to be run as vertical loops of pipework. This arrangement would be the most expensive and complex solution but other than the ASHP, the pump's work can be reversed and used for cooling without intensive energy demand. To be appropriate for this technology, the ground needs to be suitable for trench or boreholes. As GSHPs generally require less plant space than ASHPs, this technology is thought to be a good option for if / when the school progresses with decarbonising the rest of their site. For the new building, ASHPs were deemed to be preferrable.	The use of Photovoltaic Panels is promoted by the new London Plan which encourages boroughs to maximise opportunities for on-site electricity from solar technologies. The tennis courts on the roof of the new development make space for PV arrays limited but the continuous banking / retaining wall to the rear of the building provides a good opportunity for a linear array. Additionally, other buildings on the UCS site have flat roofs and the potential for supplementary PV installations. Photovoltaic Panels will be considered further in the Step 3 of the analysis.	The heat pumps have a significant role to play in provision of low carbon heat to buildings, because the carbon emissions associated with each kWh of heat generated using a heat pump are now significantly lower of those generated using gas boilers to generate heat. The new development will have space available for an ASHP installation. Air Source Heat Pump will be considered further in the Step 3 of the analysis.
STEP THREE	**No**	**Yes**	**Yes**

8.4 Heat Pump Information

This Energy Statement includes details of the proposed central heat pump COP and EER values provided in the manufacturer's data sheets. There is also information on the proposed split system for cooling to the small server room. The DHW generation is by local electric water heaters to meet the relatively low anticipated hot water demand while minimising storage and distribution losses. The central heat pumps will be located in an external plant area to the rear (North-East) of the new development. They will be largely concealed by a wooden slatted covering and acoustically treated, as necessary, to ensure they do not create noise pollution (during operational hours) for the surrounding residences.

	Unit	LTHW, 45/40°C (kW)	CHW , 7/12°C (kW)	COP (EN14511)	EER (EN14511)	Model	Refrigerant
1	ASHP (option 1)	123.0	180.0	2.00	3.16	Mitsubishi EAHV-M1800YCL	R32
2	ASHP (option 2)	85.3	88.8	3.13	2.85	Daikin EWYT-CZP-090	R32
3	ASHP (option 3) 4-pipe	142.9	132.0	3.45	2.80	Swegon OMICRON Zero S4 SLN 14.4	R290
4	IT Split System	N/A	4.23 (DX)	3.71	3.71	Mitsubishi PUZ-ZM50VKA	R32

Table 8-1: UCS proposed heat pump and IT cooling condensing unit options – manufacturer's data

The central plant specifications and system designs have not been fully developed at this stage. The final selections will look to optimise and balance key considerations such as unit efficiency, overall system efficiency, acoustic performance, refrigerant GWP, and maintainability / reliability.

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8.5 Solar Photovoltaic (PV) Panels

The GLA Planning Energy Assessment Guidance states:

'10.2: The GLA expects all major development proposals to maximise on-site renewable energy generation. This is regardless of whether the 35% on-site target has already been reached through earlier stages of the energy hierarchy. In particular, solar PV should be maximised on roof spaces'.

A low carbon and renewable technology feasibility study has been carried out for the project. The report concluded that solar PV panels were an appropriate technology for the building to reduce the carbon emissions and comply with the local planning requirement for onsite energy generation.

PV proposal
Due to the roof level tennis courts covering much of the proposed development, space for PV arrays is limited. However, the raised banking to the East of the building allows for a relatively discreet linear PV array, approximately 60 metres in length. Though not the ideal direction and orientation for PV panels, this location will still offer a significant on-site renewables benefit to the proposed development.

In addition, one of the neighbouring school buildings has been identified as suitable for a further array of PV panels mounted on the flat roof. This proposal of approximately 48m^2 of south-facing, angled PV panels is being progressed as a linked but separate project phase.

In summary the PV areas have been maximised on available and suitable roof / wall areas and the total maximum capacity of the two proposed PV arrays will be in the region of 25-30 kW.

The current PV panel design assumptions included with the energy model are:

- Panel efficiency 23%
- Inverter efficiency 90%
- PV panels are positioned to minimise shade from adjacent structures

9.0 FLEXIBILITY AND PEAK ENERGY DEMAND

In response to London Plan Policy SI 2 and SI 3 in relation to 'minimising both annual and peak energy demand', this section investigates the potential for energy flexibility, including proposals to reduce the amount of capacity required and to reduce peak demand.

9.1 Estimated Peak Demand

The existing school buildings on the UCS site are provided with mains / sub-mains electrical and gas service connections. All buildings currently utilise natural gas for heating however, as proposed, the new building is to be fully electric heat pump led, without gas or heat network supplies.

The estimated peak electrical demand has been calculated on the basis of:

- Classroom / school loads from DfE guidance
- Peak summer day cooling plant scenario
- Diversified plant and equipment loads
- Additional life safety system allowance

9.2 Available Capacity

The local electrical district network operators (DNO), UK Power Networks (UKPN), has been engaged to establish the available capacity from the local electrical network and on-site substation for the increased electrical load associated with the proposed development. The HV connection, site substation, and main switch panel have been assessed to be capable of meeting the increased electrical load resulting from the larger building and replacement of existing gas heating with electric heat pump systems.

The existing electrical connection to the Giles Slaughter wing is via one of the other school buildings and has been deemed insufficient for the new expanded P200 building. Therefore, a new sub-main electrical supply will be routed from the site switch panel to serve the proposed development via new LV infrastructure in the North plant room and distributed around the building.

9.3 Flexibility potential and revised peak demand

The potential to reduce the peak demands has been investigated and a summary of interventions is provided below.

Flexibility achieved through	Yes/No	Detail
Electrical energy storage (kWh) capacity	No	N/A
Heat energy storage (kWh) capacity	Yes	See below
Renewable energy generation (load matching)	No	See below
Gateway to enable automated demand response	Yes	See below
Smart systems integration (e.g. smart charge points for EV, gateway etc.)	No	See below
Other initiative	No	N/A

Table 9-1: Summary of interventions for achieving flexibility

9.4 Energy storage

LTHW and chilled water thermal stores shall be provided as part of the heating and cooling central plant. There shall allow an element of buffering to reduce the peak demand on heat pump and chillers. The thermal store shall also provide capacity to allow the heat pump to run at optimum efficiency for longer periods, reducing energy demand and improving the operable life of the units.

9.5 Renewables generation and integration

The PV panels installed on the roofs will be connected to their respective building's electrical distribution so the energy generated will supply various systems, as needed. The new building is electrically led so it is expected that the majority of electrical generation will be used by demand, negating the requirement for electrical storage. Any surplus generation will be exported to the electricity grid.

9.6 Smart systems gateway and integration

The energy systems are structured such that metering can be incorporated to provide a useful breakdown of energy consumption and also highlight opportunities for energy-saving measures. All meters will be compliant with Measuring Instruments Directive (MID) standards and linked to the BMS. Wherever possible, open protocol systems will be provided that allow devices to be connected without having to use proprietary systems. In addition to the metering, a range of sensors will be installed throughout the rooms and systems to enable ongoing demand response and improved energy efficiency.

9.7 Summary

While a revised site peak demand has been agreed and secured with UKPN, various measures exploring flexibility, diversity, demand control, and energy monitoring will be explored over the coming design stages to refine and hopefully reduce the peak electrical demand. Post Occupancy Evaluation (POE) is recommended to allow for (amongst numerous benefits) the review of building usage patterns and associated energy consumption, the optimisation of control strategies and maintenance regimes, and feedback to the design team regarding building performance.

10.0 APPENDICIES

10.1 Summary of non-domestic Part L2 energy modelling output

Submitted as a separate document (all energy model results are calculated using the Building Regulations Part L 2021)

- Be Lean BRUKL [13_7271_ UCS_TM52_PartL_3_BeLean_EnhancedVent_brukl]
- Be Green BRUKL [14_7271_ UCS_TM52_PartL_3_BeGreen_EnhancedVent_3_brukl]

10.2 GLA Spreadsheet Emissions Summary

Submitted as a separate electronic document as required by the GLA.

10.3 TM52 Natural Ventilation Overheating Analysis Report

2020 High Emissions (p.50th)					
TM52	**Criteria 1**	**Criteria 2**	**Criteria 3**	**Pass/ Fail**	**Natural Ventilation/ Active Cooling**
Classroom 1	1.63%	9	4	Pass	Natural ventilation
Classroom 2	1.63%	9	4	Pass	Natural ventilation
Classroom 3	1.63%	9	4	Pass	Natural ventilation
Classroom 4	1.53%	9	4	Pass	Natural ventilation
Classroom 5	1.96%	9	4	Pass	Natural ventilation
Classroom 6	2.72%	10	4	Pass	Natural ventilation
Classroom 7	1.31%	8	3	Pass	Natural ventilation
Classroom 8	1.42%	8	3	Pass	Natural ventilation
Classroom 9	1.31%	8	3	Pass	Natural ventilation
Classroom 10	1.85%	8	3	Pass	Natural ventilation
Classroom 11	2.18%	9	4	Pass	Natural ventilation
Classroom 12	2.83%	10	4	Pass	Natural ventilation
Common Room	6.86%	6	4	Pass	Natural ventilation
Consultation Room (west)	0.54%	3	2	Pass	Natural ventilation
Meeting room (west)	1.09%	6	3	Pass	Natural ventilation
Wellbeing director office	1.09%	8	3	Pass	Natural ventilation
PSHE office	1.09%	6	3	Pass	Natural ventilation
Counsellor study office	1.09%	5	2	Pass	Natural ventilation
Staff office (2p)	0.98%	5	2	Pass	Natural ventilation
Staff office (1p)	1.09%	6	3	Pass	Natural ventilation
Rest room (west)	0.87%	5	2	Pass	Natural ventilation
Lecture Theatre	90.2%	14	7	Fail	Active Cooling
Chamber Practise	100%	71	14	Fail	Active Cooling
Staff Office 1	85.08%	30	6	Fail	Active Cooling
Staff Office 2	84.86%	29	5	Fail	Active Cooling
Staff Office 3	82.79%	28	5	Fail	Active Cooling
Music Room (25p)	100%	88	17	Fail	Active Cooling
Music Room (15p)	100%	78	15	Fail	Active Cooling
Music Room (10p)	100%	75	15	Fail	Active Cooling
Prep. Servery	13.91%	23	5	Fail	Active Cooling
Practice 1	49.78%	19	4	Fail	Active Cooling
Practice 2	57.08%	21	4	Fail	Active Cooling
Practice 3	55.12%	20	4	Fail	Active Cooling
Practice 4	89.22	38	7	Fail	Active Cooling
Practice 5	89.22%	38	7	Fail	Active Cooling
Practice 6	86.71%	33	6	Fail	Active Cooling
Practice 7	85.84%	30	6	Fail	Active Cooling
Library	87.69%	32	6	Fail	Active Cooling
Threshold	3%	6	4		

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BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

13_7271_ UCS_TM52_PartL_3_BeLean_EnhancedV

As designed

Date: Tue Apr 09 15:23:25 2024

Administrative information

Building Details

Address: Frognal, London, NW36XH

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.24

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.24

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

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Foundation area [m²]: 1234.24

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	4.43	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	4.02	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	46.94	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	42.75	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	First surface with maximum value
Walls*	0.26	0.15	0.15	SP000025:Surf[0]
Floors	0.18	0.11	0.11	SP000009:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.09	0.09	SP000009:Surf[1]
Windows** and roof windows	1.6	0.92	0.94	LS000003:Surf[2]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	1.2	1.2	SP000013:Surf[2]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]

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

U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

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

** Display windows and similar glazing are excluded from the U-value check.

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

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

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

Air permeability	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	2

Building services

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

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

1- UCS_Offices (radiators,mecvent)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	2.96	-	0.2	-	0.8
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.

2- UCS_Classroom and perimeter system (convector rads,nat ven, no cooling)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	2.96	-	0.2	-	-
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.

3- UCS_Cafeteria (convector rad, mixed-mode vent,no cooling)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	2.96	-	0.2	-	0.8
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.

4- UCS_Music_1-4 system (FCU, mechvent, cooling)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	3.07	5.73	0	1.4	0.8
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

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

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

5- UCS_Lec Th/Rec R system (single-duct VAV, mechvent,cooling)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	3.29	6.61	0	1.6	0.8
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

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

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

6- UCS_Meeting Room (FCU, mechvent, cooling)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.05	5.77	0	1.5	0.8
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

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

7- UCS_WC system (rads, no cooling + Zoned MechVent)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.96	-	0.2	-	0.8
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.

8- UCS_Server Room (single cooling, mechvent, cooling)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.1	6.4	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.

9- UCS_Drama system (FCU, mechvent, cooling)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.01	5.86	0	1.7	0.8
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

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

1- UCS_Instantaneous DHW

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

Zone-level mechanical ventilation, exhaust, and terminal units

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

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
A_00_StaffXX_Office2	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_Cafeteria1	-	-	-	1.7	-	-	-	-	-	-	N/A
A_00_XX_ChamberPractise1	-	-	-	-	-	-	-	0.2	-	-	N/A
A_00_XX_Consultation1_East	-	-	-	1.5	-	-	-	-	-	-	N/A
A_00_XX_ContemplationRoom1	-	-	-	1.5	-	-	-	-	-	-	N/A
A_00_XX_Library1	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_MeetingRoom1	-	-	-	-	-	-	-	0.2	-	-	N/A
A_00_XX_MusicRoom1_25p	-	-	-	-	-	-	-	0.2	-	-	N/A
A_00_XX_MusicRoom2_15p	-	-	-	-	-	-	-	0.2	-	-	N/A
A_00_XX_MusicRoom3_10p	-	-	-	-	-	-	-	0.2	-	-	N/A
A_00_XX_Practice1	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_Practice2	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_Practice3	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_Practice4	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_Practice5	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_Practice6	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_Practice7	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_PrepServery1	-	-	-	1.7	-	-	-	-	-	-	N/A
A_00_XX_PrepWC6	-	-	-	1.6	-	-	-	-	-	-	N/A
A_00_XX_RestRoom1_East	-	-	-	1.5	-	-	-	-	-	-	N/A
A_00_XX_RockStudio1	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_StaffOffice1	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_StaffOffice3	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_WC1_Pupils	-	-	-	1.6	-	-	-	-	-	-	N/A
A_00_XX_WC2_Staff	-	-	-	1.6	-	-	-	-	-	-	N/A
A_00_XX_WC3	-	-	-	1.6	-	-	-	-	-	-	N/A
A_00_XX_WC4	-	-	-	1.6	-	-	-	-	-	-	N/A
A_00_XX_WC5	-	-	-	1.6	-	-	-	-	-	-	N/A
A_00_XX_WC7	-	-	-	1.6	-	-	-	-	-	-	N/A
A_01_XX_DramaStudio(60p)	-	-	-	-	-	-	-	0.2	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
A_00_StaffXX_Office2	110	-	-
A_00_XX_ Corridor3	110	-	-
A_00_XX_ Corridor4	110	-	-
A_00_XX_ Corridor5	110	-	-
A_00_XX_ Corridor6	110	-	-
A_00_XX_ Corridor7	110	-	-
A_00_XX_ Corridor8	110	-	-
A_00_XX_Cafeteria1	110	-	-
A_00_XX_ChamberPractise1	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
A_00_XX_ClassRoom1	110	-	-
A_00_XX_ClassRoom2	110	-	-
A_00_XX_ClassRoom3	110	-	-
A_00_XX_ClassRoom4	110	-	-
A_00_XX_ClassRoom5	110	-	-
A_00_XX_ClassRoom6	110	-	-
A_00_XX_ClassRoom7	110	-	-
A_00_XX_ClassRoom8	110	-	-
A_00_XX_ClassRoom9	110	-	-
A_00_XX_ClassRoom10	110	-	-
A_00_XX_ClassRoom11	110	-	-
A_00_XX_ClassRoom12	110	-	-
A_00_XX_CommonRoom1	110	-	-
A_00_XX_Consultation1_East	110	-	-
A_00_XX_ConsultationRoom1_West	110	-	-
A_00_XX_ContemplationRoom1	110	-	-
A_00_XX_Corridor1	110	-	-
A_00_XX_Corridor2	110	-	-
A_00_XX_EntranceFoyer1	110	80	1.35
A_00_XX_FurnitureStore3	110	-	-
A_00_XX_LectureTheatre1	110	-	-
A_00_XX_Library1	110	-	-
A_00_XX_Lobby2	110	-	-
A_00_XX_Lobby3	110	-	-
A_00_XX_Lobby4	110	-	-
A_00_XX_Lobby5	110	-	-
A_00_XX_Lobby6	110	-	-
A_00_XX_Lobby7	110	-	-
A_00_XX_Lobby8	110	-	-
A_00_XX_MeetingRoom1	110	-	-
A_00_XX_MeetingRoom2	110	-	-
A_00_XX_MusicRoom1_25p	110	-	-
A_00_XX_MusicRoom2_15p	110	-	-
A_00_XX_MusicRoom3_10p	110	-	-
A_00_XX_MusicStore1	110	-	-
A_00_XX_MusicStore2	110	-	-
A_00_XX_NorthPlantRoom1	110	-	-
A_00_XX_Office1_WellbeingDirector	110	-	-
A_00_XX_Office2_PSHE	110	-	-
A_00_XX_Office3_CounsellorStudy	110	-	-
A_00_XX_Office4_Staff2p	110	-	-
A_00_XX_Office5_Staff1p	110	-	-
A_00_XX_PlantRoom3	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
A_00_XX_Practice1	110	-	-
A_00_XX_Practice2	110	-	-
A_00_XX_Practice3	110	-	-
A_00_XX_Practice4	110	-	-
A_00_XX_Practice5	110	-	-
A_00_XX_Practice6	110	-	-
A_00_XX_Practice7	110	-	-
A_00_XX_PrepServery1	110	-	-
A_00_XX_PrepStore1	110	-	-
A_00_XX_PrepWC6	110	-	-
A_00_XX_RecitalRoom1	110	-	-
A_00_XX_RestRoom1_East	110	-	-
A_00_XX_RestRoom1_West	110	-	-
A_00_XX_RockStudio1	110	-	-
A_00_XX_ServerRoom1	110	-	-
A_00_XX_SouthPlantRoom	110	-	-
A_00_XX_StaffOffice1	110	-	-
A_00_XX_StaffOffice3	110	-	-
A_00_XX_Stair1	110	-	-
A_00_XX_Stair1	110	-	-
A_00_XX_Store1	110	-	-
A_00_XX_Store2	110	-	-
A_00_XX_WC1_Pupils	110	-	-
A_00_XX_WC2_Staff	110	-	-
A_00_XX_WC3	110	-	-
A_00_XX_WC4	110	-	-
A_00_XX_WC5	110	-	-
A_00_XX_WC7	110	-	-
A_01_XX_DramaStudio(20p)	110	-	-
A_01_XX_DramaStudio(60p)	110	-	-
A_01_XX_Lobby1	110	-	-
A_01_XX_Lobby2	110	-	-
A_01_XX_Stair	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?
A_00_StaffXX_Office2	N/A	N/A
A_00_XX_Cafeteria1	NO (-72.3%)	NO
A_00_XX_ChamberPractise1	NO (-66.3%)	NO
A_00_XX_ClassRoom1	NO (-5.2%)	NO
A_00_XX_ClassRoom2	NO (-6.5%)	NO
A_00_XX_ClassRoom3	NO (-5.7%)	NO
A_00_XX_ClassRoom4	NO (-6.4%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
A_00_XX_ClassRoom5	NO (-6.4%)	NO
A_00_XX_ClassRoom6	NO (-8.5%)	NO
A_00_XX_ClassRoom7	NO (-28.3%)	NO
A_00_XX_ClassRoom8	NO (-34.3%)	NO
A_00_XX_ClassRoom9	NO (-35.6%)	NO
A_00_XX_ClassRoom10	NO (-50.5%)	NO
A_00_XX_ClassRoom11	NO (-35.1%)	NO
A_00_XX_ClassRoom12	NO (-54.6%)	NO
A_00_XX_CommonRoom1	NO (-54.7%)	NO
A_00_XX_Consultation1_East	NO (-58.6%)	NO
A_00_XX_ConsultationRoom1_West	NO (-72.9%)	NO
A_00_XX_ContemplationRoom1	N/A	N/A
A_00_XX_EntranceFoyer1	NO (-62.5%)	NO
A_00_XX_LectureTheatre1	N/A	N/A
A_00_XX_Library1	N/A	N/A
A_00_XX_MeetingRoom1	N/A	N/A
A_00_XX_MeetingRoom2	NO (-76.4%)	NO
A_00_XX_MusicRoom1_25p	NO (-68.5%)	NO
A_00_XX_MusicRoom2_15p	NO (-31.4%)	NO
A_00_XX_MusicRoom3_10p	NO (-33.7%)	NO
A_00_XX_Office1_WellbeingDirector	NO (-80.1%)	NO
A_00_XX_Office2_PSHE	NO (-68.4%)	NO
A_00_XX_Office3_CounsellorStudy	NO (-61%)	NO
A_00_XX_Office4_Staff2p	NO (-73.7%)	NO
A_00_XX_Office5_Staff1p	NO (-66.2%)	NO
A_00_XX_Practice1	N/A	N/A
A_00_XX_Practice2	N/A	N/A
A_00_XX_Practice3	N/A	N/A
A_00_XX_Practice4	N/A	N/A
A_00_XX_Practice5	N/A	N/A
A_00_XX_Practice6	N/A	N/A
A_00_XX_Practice7	N/A	N/A
A_00_XX_RecitalRoom1	NO (-9.3%)	NO
A_00_XX_RestRoom1_East	NO (-58.6%)	NO
A_00_XX_RestRoom1_West	NO (-71.8%)	NO
A_00_XX_RockStudio1	N/A	N/A
A_00_XX_ServerRoom1	N/A	N/A
A_00_XX_StaffOffice1	N/A	N/A
A_00_XX_StaffOffice3	N/A	N/A
A_01_XX_DramaStudio(20p)	NO (-59%)	NO
A_01_XX_DramaStudio(60p)	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 [m^2]	3150.5	3150.5
External area [m^2]	7639.7	7639.7
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	2	3
Average conductance [W/K]	1236.59	1871.97
Average U-value [W/m^2K]	0.16	0.25
Alpha value* [%]	25.03	10

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	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
100	**Non-residential Institutions: Education**
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger Terminals
	Others: Emergency Services
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

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

	Actual	Notional
Heating	8.07	11.58
Cooling	0.86	0.67
Auxiliary	4.1	2.56
Lighting	6.32	7.72
Hot water	9.26	8.79
Equipment*	29.06	29.06
TOTAL**	**28.61**	**31.33**

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

Energy Production by Technology [kWh/m^2]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	95.3	127.05
Primary energy [kWh_{PE}/m^2]	42.75	46.94
Total emissions [kg/m^2]	4.02	4.43

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	31	0	3.1	0	2.9	2.78	0	2.96	0
	Notional	52.6	0	5.3	0	2	2.78	0	----	----
[ST] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	48.7	22.8	4.9	1.4	6.6	2.78	4.63	3.07	5.73
	Notional	80.3	22.5	8	1.4	8.8	2.78	4.63	----	----
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	13.3	0	1.3	0	4.9	2.78	0	2.96	0
	Notional	30.8	0	3.1	0	3	2.78	0	----	----
[ST] Central heating using water: convectors, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	189.6	0	18.9	0	0.8	2.78	0	2.96	0
	Notional	256.4	0	25.6	0	0.8	2.78	0	----	----
[ST] Central heating using water: convectors, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	7.1	0	0.7	0	3.5	2.78	0	2.96	0
	Notional	21	0	2.1	0	2.3	2.78	0	----	----
[ST] Single-duct VAV, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	30.8	54.5	3.1	3.2	19.9	2.76	4.68	3.29	6.61
	Notional	56	39.8	5.6	2.4	8.3	2.78	4.63	----	----
[ST] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	31.4	29.3	3.1	1.8	4.1	2.78	4.63	3.01	5.86
	Notional	85.8	27.6	8.6	1.7	6.9	2.78	4.63	----	----
[ST] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	9.3	67.4	0.9	4	4.6	2.78	4.63	3.05	5.77
	Notional	20	29.1	2	1.7	5.5	2.78	4.63	----	----
[ST] Single room cooling system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	0	1624.7	0	94.4	0	4.02	4.78	4.1	6.4
	Notional	0	1238.2	0	74.3	0	2.78	4.63	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

14_7271_ UCS_TM52_PartL_3_BeGreen_Enhanced

As designed

Date: Thu Apr 11 13:59:30 2024

Administrative information

Building Details

Address: Frognal, London, NW36XH

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.24

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.24

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

Foundation area [m²]: 1234.24

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	4.43	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	3.22	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	46.95	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	33.53	
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	SP000025:Surf[0]
Floors	0.18	0.11	0.11	SP000009:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.09	0.09	SP000009:Surf[1]
Windows** and roof windows	1.6	0.92	0.94	LS000003:Surf[2]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	1.2	1.2	SP000013:Surf[2]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

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

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

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

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

Air permeability	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	2

Building services

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

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

1- UCS_Offices (radiators,mecvent)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.96	-	0.2	-	0.8
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.

2- UCS_Classroom and perimeter system (convector rads,nat ven, no cooling)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.96	-	0.2	-	-
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.

3- UCS_Cafeteria (convector rad, mixed-mode vent,no cooling)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.96	-	0.2	-	0.8
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.

4- UCS_Music_1-4 system (FCU, mechvent, cooling)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.07	5.73	0	1.4	0.8
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

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

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

5- UCS_Lec Th/Rec R system (single-duct VAV, mechvent,cooling)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.29	6.61	0	1.6	0.8
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

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

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

6- UCS_Meeting Room (FCU, mechvent, cooling)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.05	5.77	0	1.5	0.8
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

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

7- UCS_WC system (rads, no cooling + Zoned MechVent)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.96	-	0.2	-	0.8
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.

8- UCS_Server Room (single cooling, mechvent, cooling)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.1	6.4	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.

9- UCS_Drama system (FCU, mechvent, cooling)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.01	5.86	0	1.7	0.8
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

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

1- UCS_Instantaneous DHW

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

Zone-level mechanical ventilation, exhaust, and terminal units

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

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
A_00_StaffXX_Office2	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_Cafeteria1	-	-	-	1.7	-	-	-	-	-	-	N/A
A_00_XX_ChamberPractise1	-	-	-	-	-	-	-	0.2	-	-	N/A
A_00_XX_Consultation1_East	-	-	-	1.5	-	-	-	-	-	-	N/A
A_00_XX_ContemplationRoom1	-	-	-	1.5	-	-	-	-	-	-	N/A
A_00_XX_Library1	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_MeetingRoom1	-	-	-	-	-	-	-	0.2	-	-	N/A
A_00_XX_MusicRoom1_25p	-	-	-	-	-	-	-	0.2	-	-	N/A
A_00_XX_MusicRoom2_15p	-	-	-	-	-	-	-	0.2	-	-	N/A
A_00_XX_MusicRoom3_10p	-	-	-	-	-	-	-	0.2	-	-	N/A
A_00_XX_Practice1	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_Practice2	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_Practice3	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_Practice4	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_Practice5	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_Practice6	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_Practice7	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_PrepServery1	-	-	-	1.7	-	-	-	-	-	-	N/A
A_00_XX_PrepWC6	-	-	-	1.6	-	-	-	-	-	-	N/A
A_00_XX_RestRoom1_East	-	-	-	1.5	-	-	-	-	-	-	N/A
A_00_XX_RockStudio1	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_StaffOffice1	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_StaffOffice3	-	-	-	1.4	-	-	-	-	-	-	N/A
A_00_XX_WC1_Pupils	-	-	-	1.6	-	-	-	-	-	-	N/A
A_00_XX_WC2_Staff	-	-	-	1.6	-	-	-	-	-	-	N/A
A_00_XX_WC3	-	-	-	1.6	-	-	-	-	-	-	N/A
A_00_XX_WC4	-	-	-	1.6	-	-	-	-	-	-	N/A
A_00_XX_WC5	-	-	-	1.6	-	-	-	-	-	-	N/A
A_00_XX_WC7	-	-	-	1.6	-	-	-	-	-	-	N/A
A_01_XX_DramaStudio(60p)	-	-	-	-	-	-	-	0.2	-	-	N/A

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
A_00_StaffXX_Office2	110	-	-
A_00_XX_ Corridor3	110	-	-
A_00_XX_ Corridor4	110	-	-
A_00_XX_ Corridor5	110	-	-
A_00_XX_ Corridor6	110	-	-
A_00_XX_ Corridor7	110	-	-
A_00_XX_ Corridor8	110	-	-
A_00_XX_Cafeteria1	110	-	-
A_00_XX_ChamberPractise1	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
A_00_XX_ClassRoom1	110	-	-
A_00_XX_ClassRoom2	110	-	-
A_00_XX_ClassRoom3	110	-	-
A_00_XX_ClassRoom4	110	-	-
A_00_XX_ClassRoom5	110	-	-
A_00_XX_ClassRoom6	110	-	-
A_00_XX_ClassRoom7	110	-	-
A_00_XX_ClassRoom8	110	-	-
A_00_XX_ClassRoom9	110	-	-
A_00_XX_ClassRoom10	110	-	-
A_00_XX_ClassRoom11	110	-	-
A_00_XX_ClassRoom12	110	-	-
A_00_XX_CommonRoom1	110	-	-
A_00_XX_Consultation1_East	110	-	-
A_00_XX_ConsultationRoom1_West	110	-	-
A_00_XX_ContemplationRoom1	110	-	-
A_00_XX_Corridor1	110	-	-
A_00_XX_Corridor2	110	-	-
A_00_XX_EntranceFoyer1	110	80	1.35
A_00_XX_FurnitureStore3	110	-	-
A_00_XX_LectureTheatre1	110	-	-
A_00_XX_Library1	110	-	-
A_00_XX_Lobby2	110	-	-
A_00_XX_Lobby3	110	-	-
A_00_XX_Lobby4	110	-	-
A_00_XX_Lobby5	110	-	-
A_00_XX_Lobby6	110	-	-
A_00_XX_Lobby7	110	-	-
A_00_XX_Lobby8	110	-	-
A_00_XX_MeetingRoom1	110	-	-
A_00_XX_MeetingRoom2	110	-	-
A_00_XX_MusicRoom1_25p	110	-	-
A_00_XX_MusicRoom2_15p	110	-	-
A_00_XX_MusicRoom3_10p	110	-	-
A_00_XX_MusicStore1	110	-	-
A_00_XX_MusicStore2	110	-	-
A_00_XX_NorthPlantRoom1	110	-	-
A_00_XX_Office1_WellbeingDirector	110	-	-
A_00_XX_Office2_PSHE	110	-	-
A_00_XX_Office3_CounsellorStudy	110	-	-
A_00_XX_Office4_Staff2p	110	-	-
A_00_XX_Office5_Staff1p	110	-	-
A_00_XX_PlantRoom3	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
A_00_XX_Practice1	110	-	-
A_00_XX_Practice2	110	-	-
A_00_XX_Practice3	110	-	-
A_00_XX_Practice4	110	-	-
A_00_XX_Practice5	110	-	-
A_00_XX_Practice6	110	-	-
A_00_XX_Practice7	110	-	-
A_00_XX_PrepServery1	110	-	-
A_00_XX_PrepStore1	110	-	-
A_00_XX_PrepWC6	110	-	-
A_00_XX_RecitalRoom1	110	-	-
A_00_XX_RestRoom1_East	110	-	-
A_00_XX_RestRoom1_West	110	-	-
A_00_XX_RockStudio1	110	-	-
A_00_XX_ServerRoom1	110	-	-
A_00_XX_SouthPlantRoom	110	-	-
A_00_XX_StaffOffice1	110	-	-
A_00_XX_StaffOffice3	110	-	-
A_00_XX_Stair1	110	-	-
A_00_XX_Stair1	110	-	-
A_00_XX_Store1	110	-	-
A_00_XX_Store2	110	-	-
A_00_XX_WC1_Pupils	110	-	-
A_00_XX_WC2_Staff	110	-	-
A_00_XX_WC3	110	-	-
A_00_XX_WC4	110	-	-
A_00_XX_WC5	110	-	-
A_00_XX_WC7	110	-	-
A_01_XX_DramaStudio(20p)	110	-	-
A_01_XX_DramaStudio(60p)	110	-	-
A_01_XX_Lobby1	110	-	-
A_01_XX_Lobby2	110	-	-
A_01_XX_Stair	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?
A_00_StaffXX_Office2	N/A	N/A
A_00_XX_Cafeteria1	NO (-66.6%)	NO
A_00_XX_ChamberPractise1	NO (-64.7%)	NO
A_00_XX_ClassRoom1	NO (-5.2%)	NO
A_00_XX_ClassRoom2	NO (-6.5%)	NO
A_00_XX_ClassRoom3	NO (-5.7%)	NO
A_00_XX_ClassRoom4	NO (-6.4%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
A_00_XX_ClassRoom5	NO (-6.4%)	NO
A_00_XX_ClassRoom6	NO (-8.5%)	NO
A_00_XX_ClassRoom7	NO (-22.8%)	NO
A_00_XX_ClassRoom8	NO (-25.7%)	NO
A_00_XX_ClassRoom9	NO (-28.4%)	NO
A_00_XX_ClassRoom10	NO (-46%)	NO
A_00_XX_ClassRoom11	NO (-28.7%)	NO
A_00_XX_ClassRoom12	NO (-51%)	NO
A_00_XX_CommonRoom1	NO (-54.7%)	NO
A_00_XX_Consultation1_East	NO (-58.6%)	NO
A_00_XX_ConsultationRoom1_West	NO (-70.7%)	NO
A_00_XX_ContemplationRoom1	N/A	N/A
A_00_XX_EntranceFoyer1	NO (-60.6%)	NO
A_00_XX_LectureTheatre1	N/A	N/A
A_00_XX_Library1	N/A	N/A
A_00_XX_MeetingRoom1	N/A	N/A
A_00_XX_MeetingRoom2	NO (-74.5%)	NO
A_00_XX_MusicRoom1_25p	NO (-67%)	NO
A_00_XX_MusicRoom2_15p	NO (-27.6%)	NO
A_00_XX_MusicRoom3_10p	NO (-30.3%)	NO
A_00_XX_Office1_WellbeingDirector	NO (-76.7%)	NO
A_00_XX_Office2_PSHE	NO (-62.6%)	NO
A_00_XX_Office3_CounsellorStudy	NO (-54.3%)	NO
A_00_XX_Office4_Staff2p	NO (-70.5%)	NO
A_00_XX_Office5_Staff1p	NO (-64.3%)	NO
A_00_XX_Practice1	N/A	N/A
A_00_XX_Practice2	N/A	N/A
A_00_XX_Practice3	N/A	N/A
A_00_XX_Practice4	N/A	N/A
A_00_XX_Practice5	N/A	N/A
A_00_XX_Practice6	N/A	N/A
A_00_XX_Practice7	N/A	N/A
A_00_XX_RecitalRoom1	NO (-9.2%)	NO
A_00_XX_RestRoom1_East	NO (-58.6%)	NO
A_00_XX_RestRoom1_West	NO (-69.4%)	NO
A_00_XX_RockStudio1	N/A	N/A
A_00_XX_ServerRoom1	N/A	N/A
A_00_XX_StaffOffice1	N/A	N/A
A_00_XX_StaffOffice3	N/A	N/A
A_01_XX_DramaStudio(20p)	NO (-56.9%)	NO
A_01_XX_DramaStudio(60p)	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 [m^2]	3150.5	3150.5
External area [m^2]	7639.7	7639.7
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	2	3
Average conductance [W/K]	1236.59	1871.97
Average U-value [W/m^2K]	0.16	0.25
Alpha value* [%]	25.03	10

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	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
100	**Non-residential Institutions: Education**
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger Terminals
	Others: Emergency Services
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

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

	Actual	Notional
Heating	8.01	11.59
Cooling	0.87	0.67
Auxiliary	4.1	2.56
Lighting	6.32	7.72
Hot water	9.26	8.79
Equipment*	29.06	29.06
TOTAL**	**28.56**	**31.34**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	6.23	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*6.23*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	94.89	127.16
Primary energy [kWh_{PE}/m^2]	33.53	46.95
Total emissions [kg/m^2]	3.22	4.43

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	30.7	0	3.1	0	2.9	2.78	0	2.96	0
	Notional	52.8	0	5.3	0	2	2.78	0	----	----
[ST] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	47.1	24.1	4.7	1.4	6.6	2.78	4.63	3.07	5.73
	Notional	80.4	22.5	8	1.4	8.8	2.78	4.63	----	----
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	13.1	0	1.3	0	4.9	2.78	0	2.96	0
	Notional	30.9	0	3.1	0	3	2.78	0	----	----
[ST] Central heating using water: convectors, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	188.4	0	18.8	0	0.8	2.78	0	2.96	0
	Notional	256.6	0	25.6	0	0.8	2.78	0	----	----
[ST] Central heating using water: convectors, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	6.7	0	0.7	0	3.5	2.78	0	2.96	0
	Notional	21.1	0	2.1	0	2.3	2.78	0	----	----
[ST] Single-duct VAV, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	30.6	54.9	3.1	3.3	19.9	2.76	4.68	3.29	6.61
	Notional	56.3	39.7	5.6	2.4	8.3	2.78	4.63	----	----
[ST] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	30.9	30.7	3.1	1.8	4.1	2.78	4.63	3.01	5.86
	Notional	86	27.5	8.6	1.6	6.9	2.78	4.63	----	----
[ST] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	9.2	69.8	0.9	4.2	4.6	2.78	4.63	3.05	5.77
	Notional	20.1	29.1	2	1.7	5.5	2.78	4.63	----	----
[ST] Single room cooling system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	0	1634.4	0	94.9	0	4.02	4.78	4.1	6.4
	Notional	0	1236.9	0	74.2	0	2.78	4.63	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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