Dukes Education – 81 Belsize Park Gardens

MEP Energy & Sustainability Statement

Planning

16 August 2023

MAX FORDHAM

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1.0 SUMMARY

This Energy & Sustainability Strategy has been prepared for Dukes Education to summarise the initiatives utilised throughout the 81 Belsize Park Gardens project and explain how the project responds to local, regional, and national planning policies relating to energy and sustainability.

The design approach for the building follows the widely recognised hierarchy for energy reduction within the built environment.

This approach looks to first minimise the energy use of the building promoting passive measures to reduce energy consumption before introducing LZCTs and/or renewable generation.

Be Lean
The energy demands of the building have been reduced by paying careful consideration to the internal layout and improving the fabric performance of existing elements and providing high performing new elements. Existing elements have wherever feasible been detailed to meet current standards. In addition, the detailing has aimed to reduce the unwanted infiltration and minimise energy loss associated with poor airtightness.

- The building is to be provided with a new roof that meets current U-Values set by the NCM
- The building is to be provided with new windows/roof lights that meet the current U-Values set by the NCM
- The walls are to be provided with internal linings and insulation to meet the current U-Values set by the NCM
- The Air tightness will be improved (when the above measures are carried out) and is expected to at least meet and potentially exceed the current infiltration rate set out in the NCM

The new MEP installations have also been designed to further reduce the energy demands of the building by

- Controlling ventilation and providing heat/cooling recovery. MVHR units are provided to all occupied spaces to control the ventilation load and recover >75% of the energy from the exhaust air greatly reducing the heating load.
- Running ventilation systems at lower speeds to promote higher efficiency (both electrical and heat recovery)
- Targeting higher luminous efficacy for the new lighting installations and providing daylight linked controls where spaces have access to good daylight factors

Be Clean
There are to be no fossil fuel burning appliances within the building. The building will be served by Air Source Heat Pumps (ASHPs) with electricity generation from PVs installed at Roof level to reduce the grid electricity usage.

Be Green
The building is served by an ASHP installation with a PV array providing 100% of the building's energy demands are provided by LZCT technologies.

Be Seen
An extensive metering network of Energy meters (heat and power) and water meters will be provided to the building linked to a BEMS system to allow energy use to be monitored, recorded and reported to the building users and maintenance staff to enable the building to be run efficiently and any unexpected energy and or water use to be investigated.

Camden's Energy and Sustainability Proforma
Camden's Energy and Sustainability Proforma (Major Refurbishment Non-Dwelling) has been completed and submitted as part of the planning application. This report should be read alongside the submitted proforma.

2.0 LOCAL POLOCIES & PLANNING

2.1 Local Policies and Planning

There are several key policies that the proposed development must comply with in its approach to energy use and sustainability. How the development adheres to these policies is outlined in Section 3 of this statement.

- Climate Change Act (2008)
- Camden Local Plan (2017)
- National Planning Policy Framework (2021)
- GLA London Plan (2021)
- Green Action For Change
- London Air Quality Management Plan
- Climate Change levy
- BREEAM

Climate Change Act (2008)
The UK Climate Change Act was passed in 2008. It is the primary legislation that underpins action to address climate change by the UK. It provides a comprehensive framework for climate change mitigation and adaptation, underpinned by legally binding emissions targets for 2050 and the coming 15 years.

London Plan March 2021
The Policies S1 and S2 of the London plan 2021 define the strategy set out to reduce carbon emissions in London and improve air quality. Developments should be as a minimum Air Quality Neutral and should follow the design hierarchy; Be lean; Be Clean; Be Green; Be Seen.

Camden local Plan 2017
Camden's local planning document Policies CC1 climate change Mitigation and CC2 Adapting to climate change requires non-domestic developments reduce carbon emissions and for those of 500 sqm of floorspace or above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019

Green Action for Change:
Camden's environmental sustainability plan (2011- 2020) commits Camden to a 27% borough wide Carbon Dioxide (CO2) reduction by 2017 and a 40% borough wide CO2 reduction by 2020 (London carbon reduction target). Over 90% of Camden's carbon dioxide emissions are produced by the operation of buildings.

London Air Quality Management Areas:
The development is located within one of London's Air Quality Management Areas (AQMA).

Climate Change Levy:
CCL is forecast to increase, which will make heating supplied by fossil fuels even more expensive over time. Electricity generated from renewable sources are exempt from CCL.

BREEAM:
Required by the Camden local plant the refurbishment will need to achieve a BREEAM 'Excellent' rating when assessed against the BREEAM 2014 Refurbishment and Fit out methodology.

2.2 The Climate Change Act 2008

The Act contains a legally binding goal for reducing UK greenhouse gas (GHG) emissions by 2050. Initially, this was 'at least 80%' below 1990 levels, based on advice from CCC.

In 2019, in recognition of the 2015 UN Paris Agreement and following CCC advice, the long-term goal was updated to 'at least 100%' below 1990 levels (i.e. Net Zero GHG emissions).

The Act is used to inform policy makers and local planning documentation to ensure that a sustained reduction in CO_2 emissions is achieved.

2.3 The London Plan March 2021

The proposal for the redevelopment of the building has taken the approaches set out in the document as the core ethos for the design.

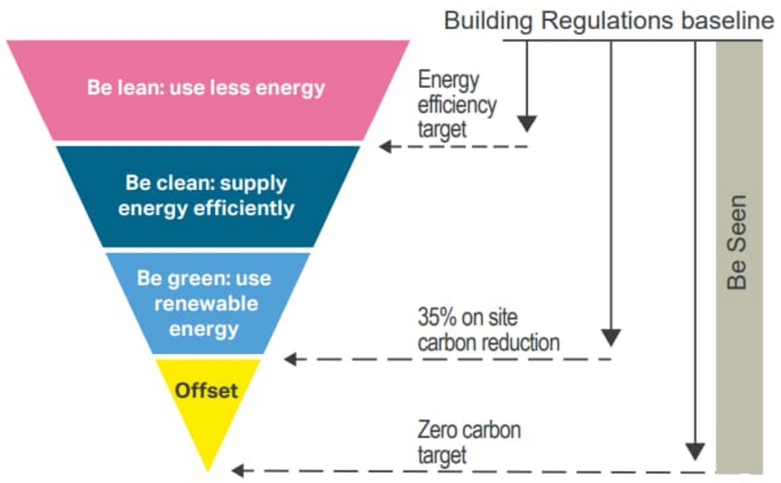
Policy SI 1 – Improving Air Quality
The London Plan Policy S1 requires as a minimum for development proposals to be Air Quality Neutral.

The proposed design exceeds this target as there will be no fossil fuel burning plant or equipment in the redeveloped building. In addition, the use of LZCTs has significantly reduced the overall energy consumption of the building as demonstrated earlier in this report.

Policy SI 2 – Minimising Greenhouse Gas Emissions
The London plan Policy S2 requires that A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development.

Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures.

Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either: 1) through a cash in lieu contribution to the borough's carbon offset fund, or 2) off-site provided that an alternative proposal is identified, and delivery is certain.



The redeveloped building will provide significant reductions in the CO_2 emissions due to the following approach:

2.4 The Camden Local Plan

The Camden local plan dovetails with the London Plan and sets out the planning requirements at a local level. The Local Plan acknowledges that 90% of Camden's CO_2 emissions are produced by the operation of its buildings. It also references Camden's commitment to It's Green Action for Change programme

Policy CC1 Climate change mitigation
The key parts of this policy require all development to:

- reduce carbon dioxide emissions through following the steps in the Energy Hierarchy (as set out in the London Plan)
- demonstrate how London Plan targets for carbon dioxide emissions have been met.

the building has not been assessed against its previous form/use as the building use will be substantially different from its pre refurbished use. The building has not been occupied for the last 6 years with some significant areas of dilapidation and damage as a result.

The building has been assessed against a building that has the same characteristics./usage class of the refurbished building

With the be lean an be green measures introduced including the switch to ASHP technology a the building achieves a 33.4% reduction in CO_2 emissions.

Policy CC2 Adapting to climate change
The key parts of this policy require non-residential developments f 500 sqm of floorspace or above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019

Policy CC4 Air quality
The key part of this policy is its requirement to mitigate any impact on the local air quality as a result of any development.

2.5 Green Action for Change

Green Action for Change (GAC) was initially a 10-year programme for CO_2 emissions reduction in the borough of Camden. The GAC targets a 40% absolute CO2 emissions reduction across Camden by 2020 and a 27% borough-wide per capita CO2 reduction by 2017. It ties in with both the London Plan and Camden own planning polices in order to keep CO_2 emissions reductions on target. The programme is regularly reviewed, and the performance published.

The latest published version of their review against their target indicates that in 2020 there was a 39% reduction n CO_2 emissions compared to the 2005 emission rates.

2.6 London Air Quality Management Areas (AQMAs)

Local Authorities within the UK have been responsible for monitoring air pollution within their area since 1997. The results are reviewed against the national air quality objectives and if any area is identified as unlikely to meet the objective, they must Declare an AMQA.

This will inform local planning conditions and the aims of the London Plan. In turn the Local plans have set out measures to address this. One of the major causes of air pollution is the burning of fossil fuels within the built environment.

The development will have no fossil fuel burning appliances in the redeveloped building and a significant proportion of its energy use has been reduced by switching to LZCTs demonstrated earlier in this report.

2.7 Climate Change levy

The climate change levy is an environmental tax that is paid on the energy that a business uses and has been in place since April 2021.

Any business in the industrial, public services, commercial and agricultural sectors will be charged CCL at the main rate on electricity, gas and solid fuel use. The energy supplier is responsible for charging the Climate change levy and the collected revenue is provided to HMRC.

The levy is intended to de-incentivise the use of Fossil Fuels and promote the use of Low and Zero Carbon Technologies (LZCTs). The rate is set to increase over time making it more attractive for building owners and operators to switch to LZCTs to reduce their operational costs.

2.8 BREEAM

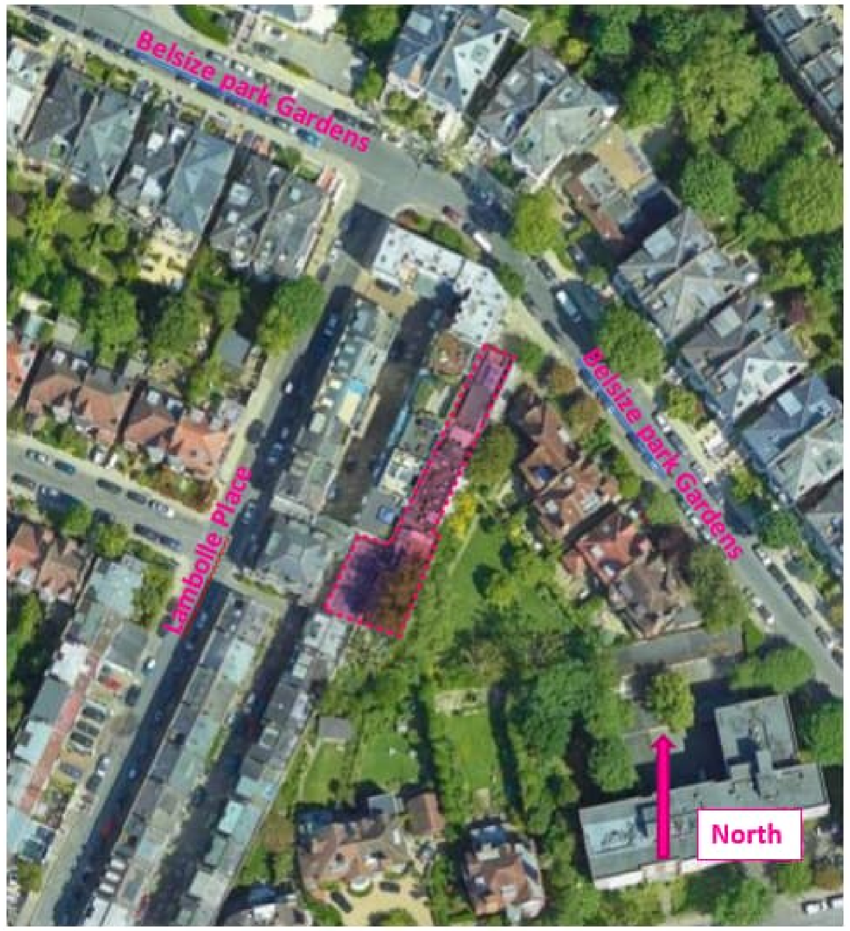
Belsize Studio is being assessed under BREEAM 2014 Refurbishment and Fit Out. It will be required as a minimum to meet a BREEAM 'Excellent rating. For further details relating to the BREEAM assessment reference should be made to the preliminary BREEAM Assessment prepared by Eight Versa and submitted as pat of the planning application.

3.0 INTRODUCTION

3.1 Dukes Education, former Belsize Park gym building

The proposal is to provide a new home to Hampstead Fine Arts college and will provide new 6th Form/College education facilities. The building is located at 81 Belsize Park Gardens, London NW3 4NJ

The approximate location of the building is at coordinates 51.54663, -0.16433. The outline of the building is indicated on the following aerial photograph. What three words reference is ///crust.groups.filer.



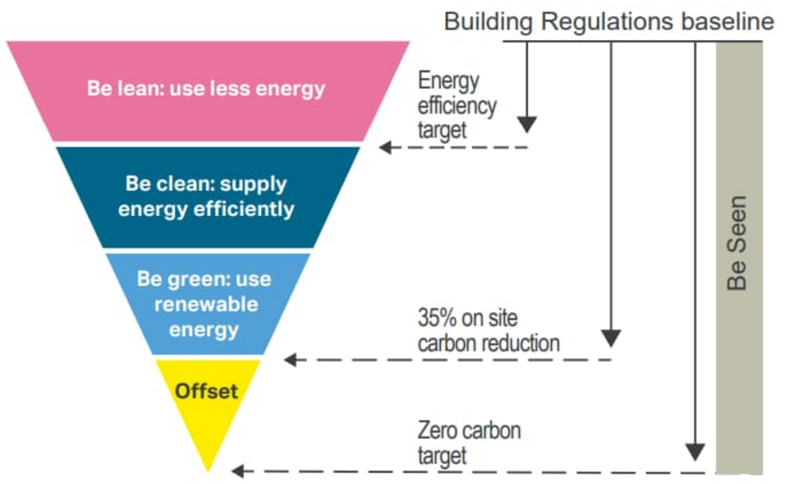
3.2 Redevelopment Description

The planning application seeks permission for the change of use of the building from the existing Gym/pool/health spa use (Class E) to education use (use Class F1).

The existing building is to be substantially retained and refurbished with the internal layouts being adapted to suit the new building use. The reuse of the existing Building will reduce the embodied carbon for the project but will require some interventions to be made to improve the existing buildings performance.

4.0 ENERGY STATEMENT

The approach taken for the design of the refurbished building has followed the Energy Hierarchy



4.1 Be Lean (Reduce Energy Demand)

The aim of the energy hierarchy is to first reduce the overall energy use of the building by utilising Passive measures. The nature of the site and the retention of the existing building means that some elements remain fixed and there would be no opportunity to change them but those that could be influenced by the redevelopment have been.

Building Orientation and Internal Layout
Whilst the form and orientation of the envelope could not be influenced due to its retention consideration has been given to the internal spaces and their functions to best utilise the existing building form.

The internal layouts have been coordinated to provide most internal circulation along the party wall running northeast as at the lower levels the party wall prevents openings being made in this boundary. Similarly there are issues with overlooking to the neighbouring property on the opposite façade and this has been considered where the forming of new openings to this façade has been required. Therefore, functions that either do not require natural light or require lighting conditions to be extensively controlled e.g. photography dark rooms and studios have been located along this edge to help minimise the need to form new openings.

Daylight modelling and reporting was carried out during stage 2 to inform the architectural design and highlight where spaces required more access to daylight or where there was potentially an issue with overheating due to existing glazed lanterns.

Building Fabric
The existing building fabric is not up to current standard with non-insulated walls, much of which are expected to be solid masonry. It is therefore important for these to be insulated and internal insulation will be provided to these walls to improve their thermal performance. The minor downside to this approach is the isolation of internal thermal mass. Consideration will be given to the use of PCM boarding where new internal linings are introduced to provide some thermal buffering of the spaces.

This improvement will help reduce the overall energy demand of the building and to facilitate the use of LZC heating technologies in the form of Air Source Heat Pumps operating with flow and return temperatures with closer to ambient flow and return temperatures.

The precise details of all fabric elements are not known due to a varying age of construction and inconsistency around the building along with a lack of record information for the building. We have proposed that the elements are upgraded in line with the following recommendations, and these were used to inform our initial modelling and sizing of the heating equipment.

Table 1 - Table of U-Values

Element	U-Value			
	Assumed Current	Part L2 Limiting	NCM Notional Limit	Proposed Improved U-Value
	$W/m^2.K$	$W/m^2.K$	$W/m^2.K$	$W/m^2.K$
New Insulated Flat Roof	N/A	0.18	0.15	0.16
New Insulated External Walls	N/A	0.26	0.18	0.18
Existing External Walls	1.70	0.26	0.18	0.18
Windows (inc Glass Blocks)	2.50 - 2.70	N/A	N/A	1.40
Roof Lights	2.70	2.2	2.1	2.10
Pedestrian/High access doors	5.00	3.0	1.9	1.90
Party walls improved to meet or exceed	Expected uninsulated solid	N/A	1.8	1.80
Ground Floor	1.4	0.18	0.15	0.18
Air Permeability	10 m^3/m^2 .hr @50Pa	8 m^3/m^2 .hr @50Pa	3 m^3/m^2 .hr @50Pa	3 m^3/m^2 .hr @50Pa

Notably air permeability is expected to be improved by a range of improvements including:

- New internal linings as a result if internal insulation
- New insulated roof construction
- New windows, window seals and fit of windows
- New external doors and door seals

Solar Shading & Glazing Positions
Control of solar gain is critical to minimise the run time of active cooling and minimise the overall load. Thermal modelling has been undertaken with different façade options in terms of glazing ratios.

Development of the facades has been via an iterative process of architectural issues, guidance from the MEP consultant, further iterations and then modelling.

The reduction of some glazing areas from the existing roof lanterns and architects' initial proposals. and reconfiguration of internal functions was as a direct result of this process.

Internal blinds will be provided as part of the interior fit out. It is acknowledged that external shading would be better but access to the external façade of the building requires access to third party land. Placing elements on the outside of the building creates an ongoing need to routinely access the neighbour's property in order to maintain.

Daylight Optimisation
The level of daylighting needs to be balanced along with the need to minimise excessive solar gains. Providing good daylighting can reduce the level of artificial lighting required as well as enhancing the pleasantness of spaces, however, this needs to be balanced against the cooling loads.

At stage 2 the existing opening were reviewed and tested against a 2% and 5% daylight factor to determine the access available to daylight for the adjacent internal spaces. Glass with a performance of with 70/40 (VLT/g-value) was assessed for daylight levels and overheating.

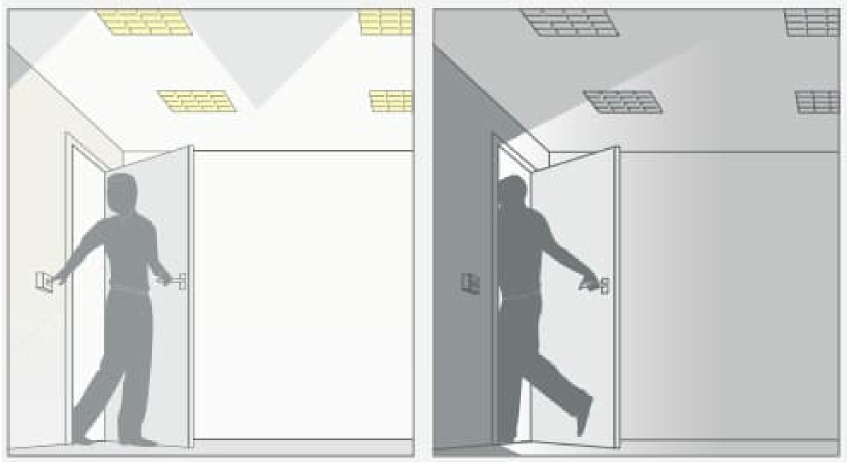
These were presented in the stage 2 Report and were used to determine best placement for the space functions against the internal layout. It will also be used to determine if/where glazing areas are to be reduced and where new opening will be required.

The locations where access to daylight is compromised by the party wall line to the northwest façade have been utilised for the circulation spaces.

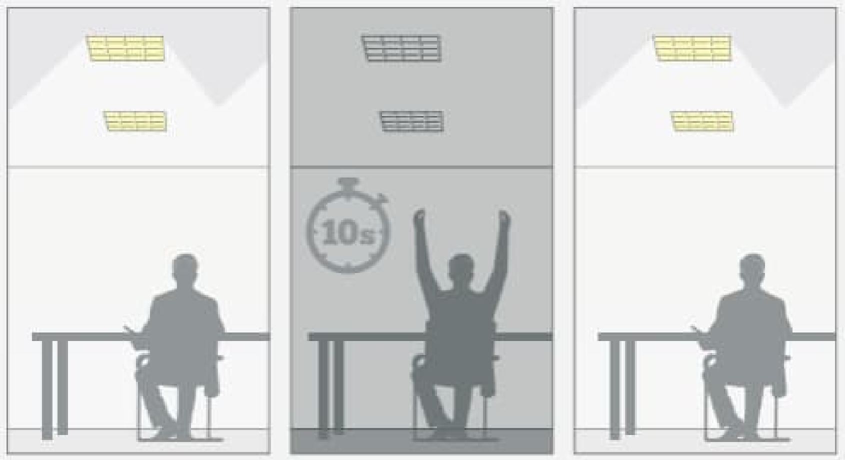
Energy Efficient Lighting
The existing lighting installations were a mixture of Incandescent, Halogen, Liner Fluorescent and Compact fluorescent fittings.

As a matter of course all new lighting installations will be installed as LED fittings and the installation will have a target average luminous efficacy of >100 Lumens per circuit watt.

Controls will be provided to minimise energy consumption via the use of Absence Recovery. In absence detection installations the user can interact with the lighting in the same way as they would with conventional switching turning on an off by a wall switch, but it has the added benefit of switching off after a predetermined period of absence in order to prevent lights remaining on in unoccupied spaces.



Absence Detection: Upon entering the room the person switches on the light as normal, but on leaving the detector switches off the lighting automatically. Lights can also be switched off manually.



Absence Recovery: After an occupancy time out period has elapsed in absence mode, the unit temporarily enters a presence mode for 10 seconds allowing the occupants movement to bring the lights back on.

Where spaces have an appropriate daylight factor daylight dimming will be provided to reduce the output of the artificial lighting installations when there is still a natural light component, but the spaces are below target illuminance levels.

Ventilation and Passive Cooling
As the building will no longer be served by Gas boilers the design is based around utilising the lower distribution temperatures available from the ASHPs in order to promote the highest efficiency. This requires the reduction in uncontrolled infiltration and the provision of well controlled mechanical ventilation with integral heat recovery. The refurbished building will therefore use considerably less energy to ventilate than the existing building which featured many local extract only systems or natural ventilation only coupled with VRF cooling.

It will also provide better levels of internal air quality as the ventilation flow is tightly controlled and the units feature integral filtration.

Due to the different uses and occupancies of the individual spaces there is no single solution for the ventilation that will apply to the complete building. The building has been broken down into areas by their function and treated accordingly.

A number of smaller MVHR units with global time scheduling via the BMS and active demand control based on occupancy and space temperature are being utilised for all occupied spaces (CO_2 being used as a proxy for occupancy and as a measure of indoor air quality). This will maintain good indoor air quality but without over ventilating the spaces and wasting energy.

The MVHR units will operate on a ‘summertime’/’wintertime’ protocol and are provided with ‘summertime’ bypass.

‘Wintertime’ Ventilation
In winter the mechanical ventilation will be at minimum rate required to maintain CO2 levels below target – this will minimise ventilation heat losses. The heat recovery is integral to the MVHR unit and operates at a higher heat recovery efficiency at lower flow rates meaning there is a further benefit of matching the ventilation demand to the space occupancy.

‘Summertime’ Ventilation
In summertime the heat exchanger will be bypassed and, at times that free cooling is available and rooms would benefit from the free cooling the ventilation rates will be increased to provide free cooling to the spaces.

The system will also allow for the recovery of cooling to the spaces where enhanced ventilation cannot be provided by natural ventilation due to acoustic constraints (e.g. Music Practice/Teaching rooms)

Summertime Pre-Cooling (Utilising ‘Free’ Cooling)
The location and nature of the building is unlikely to be favourable for natural ventilation openings to provide overnight/early morning precooling because of the increased security risk and associated reduction in free area required to minimise the security issues. The use of the MVHR units also allows for the spaces to be securely precooled during the summer months by reducing the internal air and fabric temperatures when free cooling is favourable. The BMS routines for this can also be adapted over time if there are changes to the climate that require the systems to utilise a longer pre-cooing period.

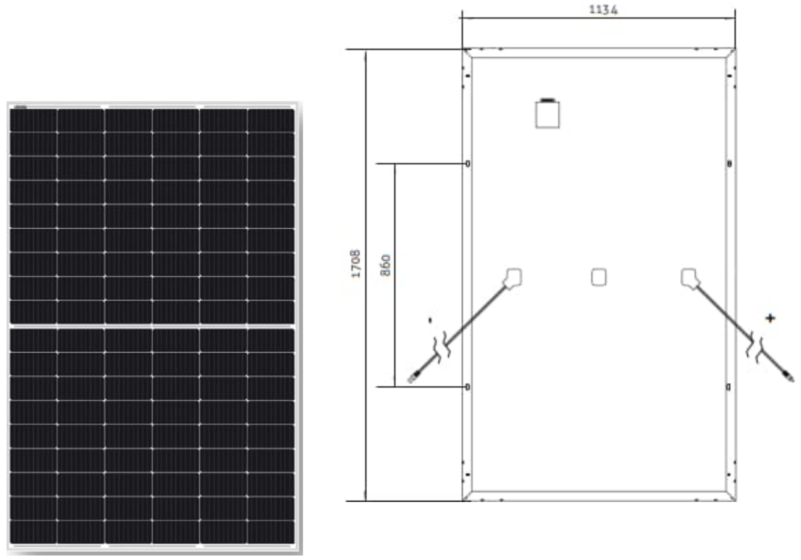
Standing Loss
The standing loss from the DHW installations has been eliminated by the utilisation of high efficiency, low water volume, Point of use electric water heaters.

4.2 Be Clean (Supply Energy Efficiently)

The closest heat network to the site with sufficient peak installed capacity to meet the sites peak demand is at the Royal Free Hospital, Pond Street. The shortest route of connection to the existing heat network site is located 767m from the site (refer to appendix 1). Further more this is a natural gas fired CHP installation generating high grade LTHW temperatures.

Should a future connection to a low carbon intensity and closer to ambient temperature heat network be feasible once the ASHPs reach the end of their service life the plant installations could be adapted to allow connection to be made to such a network.

Itis proposed that the building be provided with an ASHP and PV combination



to better match the requirements of the thermal improved building due to the significant complexity and cost associated with such a long route in the public highway to enable a connection to the Royal free hospital site .

As part of the refurbishment a new PV installation will be provided as part of a Bauder BioSolar Roof installation. Due to the constraints imposed by the existing building (it has almost no external space that is not the roof) the available space for the PV’s has had to be balanced with the space required for rooflights, green roof (urban greening) and the MVHR units.

The available space for the array has space for 15 panels with a nominal power output of 304W under NMOT ((Nominal Module Operating Temperature) conditions.

The annual yield of the array has been assessed to be approximately 4200 kWh per year.

Based on an average annual CO_2 Energy Factor of 0.1457 kg CO_2/kWh calculated from the 2021 NCM monthly values this will displace 612kg/CO_2 per year.

There will be no Fossil fuel burning equipment provided as part of the refurbishment the new heating installations will utilise ASHPS leading and with therefore have a positive effect on the local air quality.

4.3 Be Green (Utilise LZCT)

The existing Gas Fired plant & Equipment within the building will be stripped out in it’s entirety. The new building will utilise high efficiency (Air Source heat Pump) ASHP units.

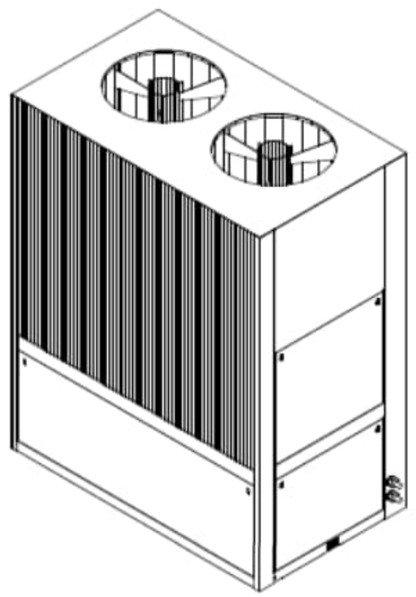
In order to reduce the overall environmental impact of utilising refrigerant-based heating systems the units have also been selected to operate using CO_2

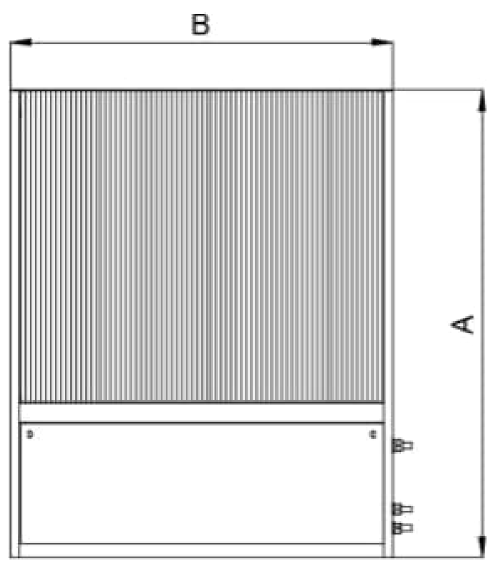
(R744) as the refrigerant having 0 ozone depletion and a Global warming Potential (GWP) of 1.

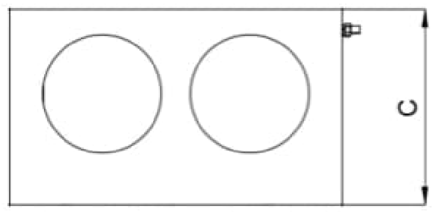
2No. units will be provided at roof level each contributing 50% of the building peak load. This will provide some resilience to the building in the event of unit maintenance.

The units feature integral acoustic enclosure to minimise sound transmission and the units will be located on anti-vibration mounts.

ASHP units are driven by electricity and by pairing the units with a PV array on the roof it further reduced the associated base load for the provision of LTHW to the building.







	Dimension	Acer 75kW
A	Height (Low Noise)	2409mm
B	Width	2815mm
C	Depth	1152mm

Unit dry weight 1260 kg

4.4 Be Seen (Allow Energy Use to Be Monitored)

Energy Metering
Extensive metering will be provided to allow the building users to track energy use and the BEMS system will allow for simple graphical analysis of the building performance.

The metering strategy provided will exceed TM39's requirements and will follow the strategy set out below.

Point	Meter Type	Units measured
Overall Building Electricity Meter	Energy Meter	kWh
Electrical DB – General Power Section	Energy Meter (Quantity to be defined during detailed design)	kWh
Electrical DB – Lighting Power Section	Energy Meter (Quantity to be defined during detailed design)	kWh
PV Generation Meter	Energy Meter	kWh
ASHP 1 Electrical Supply	Energy Meter	kWh
ASHP 2 Electrical Supply	Energy Meter	kWh
Plant & Equipment (MCP supply)	Energy Meter	kWh
Lift 1 Supply	Energy Meter	kWh
Lift 2 Supply	Energy Meter	kWh
Point of use Water heater	Energy Meter	kWh

Point	Meter Type	Units measured
	Quantity to be defined during detailed design)	
ASHP 1 Primary Flow	Heat meter (flow and temperature)	kWh
ASHP 2 Primary Flow	Heat meter (flow and temperature)	kWh
LTHW Secondary side flow to Heating	Heat meter (flow and temperature)	kWh
ASHP to Buffer Circulation ump	Energy Meter	kWh
LTHW Secondary Pump	Energy Meter	kWh
Overall Building Water supply	Energy Meter	m³

The meters will report to a BEMS system to allow the date to be recorded and presented to building users in a simple and intuitive way to allow any anomalies to be reviewed.

4.5 Adaption to Climate Change

The building is to be provided with an LTHW heating installation (generated using ASHPs) via underfloor heating to many of the spaces. Some spaces will require active cooling as their function may not allow the use of openable windows to provide enhanced ventilation for summertime free cooling (e.g. music practice rooms) and some of the windows are located within party walls or along external escape routes that require fire compartmentation to be maintained.

Cooling will be provided by the use of the ASHPs and a dedicated cooling buffer vessel. This cooling buffer vessel can also be utilised to provide underfloor cooling to occupied spaces. The output of the underfloor cooling is expected to be between 20-30 W/m² and it will be necessary for some spaces to be provided with small format Fan coil units to trim the peak summertime temperatures.

As part of the control's installation combined Temperature, CO_2 and RH temperature sensors are to be provided to the spaces as part of the current works. The temperature and RH sensors can be utilised to control the temperature of the cooled slab to provide cooling whilst maintaining the surface temperature of the floor above the dew point of the air.

5.0 LZCT FEASIBILITY STUDY

STEP 1 – POSSIBEL LOW OR ZERO CARBON TECHNOLOGIES
There are many possible LZCTs available for use. It is possible to quickly discount many of these due to site constraints which would make their use impossible or not cost effective.

The following sections aim to reduce the long list of possible LZCT down to a short list of the most viable options. To do this efficiently there will be a three-step selection process. Step 1 identifies those LZCTs that can be discounted from the outset due to site constraints. This quickly reduces the long list down to a size where the more detailed information supplied in the next step will be of a digestible volume as the technologies that have not been discounted in step 1 will go on to be looked at in more detail in step 2.

Step 2 will look at in more detail how each LZCT suits the site and the proposed building. Some LZCTs will be discounted at this stage due to incompatibility with the proposed building.

Step 3 will look at the 30 year life cycle cost analysis to determine which LZCT is best suited to achieve the project goals.

Step One

Broad overview of possible Low or Zero Carbon Technologies

↓

Step Two

Review project suitability of technologies not discounted in Step One

↓

Step Three

Perform life cycle Cost analysis on the technologies not discounted from Step Two

Overview
Table 1shows which low or zero carbon technologies have been discounted on the grounds that there are fundamental site constraints that make their use impractical or impossible. If a technology is not selected for further analysis, then a short explanation is provided to explain why.

LZCT	Consider in Step 2	Comments
Photovoltaic (PV)	Y	Limited Roof space available and some potential issues of overshadowing from large neighbouring tree but works well combined with other LZC technologies
CHP	Y	For certain installations CHP can stack up but the misalignment of heat and energy demand are likely to rule it out in step 2.
District Heating	N	No local district heat network is available to connect to
Waste Energy	N	No local waste energy streams available.
Biomass	Y	Likely to be ruled out ins step 2 due to issues of air quality
Wind	Y	Micro scale may be possible, but location will likely rule out in favour of PV's
Hydro	N	No Local source of hydroelectric power
Water Source Heat Pump (WSHP)	N	No local accessible water course and an open abstraction borehole is unlikely to be permissible in the area.
Ground Source Heat Pump (GSHP)	Y	Limited access to open area where the boreholes could be installed and likely to be ruled out in favour of ASHPs.
Air Source heat Pump (ASHP)	Y	Likely to be most suitable assuming any acoustic constraints can be addressed
Anaerobic Digestion	N	No access to waste streams for anaerobic digestions and the plant required is not feasible in the building's location.

Funding/Grants for LZCTs
There is now limited funding/grants available for LZCT technologies as the original incentive schemes have been closed to new applicants as the cost of the technology has reduced and the market size increased which was the intended outcome of these schemes

PV (Electricity Generation)
The Feed In Tariff (FIT) Scheme was closed to new applicants on 1 April 2019 it was notionally replaced by the Smart Export Guarantee which will pay users for energy they have generated but do not use. The value of this is based on actual metered export to the grid and requires the installation of a smart meter to record the exported energy.

Energy companies can now set their own rates for the energy exported back to the grid there is no longer a fixed amount that they have to pay.

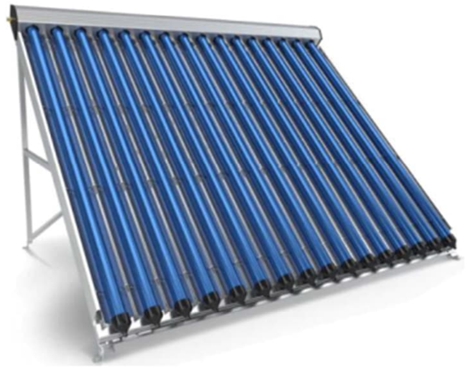
Electricity Export
The PV array will be connected back to the grid but based on the size of the array and the buildings primary energy source being electricity for all functions (following the removal of gas from the site) it is expected that there will be very minimal export back to the grid.

Heat Generation
The Renewable Heat Incentive (RHI) was a financial incentive to promote the use of renewably generated heat by helping to support the running cost and shorten the payback period for the investment.

The RHI scheme closed to new applicants on 31 March 2022 and is not being replaced.

Heat Export
The ASHP installation ahs been sized to provide heating to the building only. There will be no waste heat generated on se as part of any process.

This coupled with a lack of local infrastructure to receive any 'waste' heat make the export of heat from this development unviable.

Technology	Function		Suitability for Project	Commentary
Solar Thermal	Domestic hot Water generation only		Low/Medium	DHW demand within the building is expected to be low compare d to the electrical demand. Whilst DHW can be partially generated using solar energy it requires a store for the water that has to be topped up using an additional heat source to ensure the water quality is maintained. Utilising point of use water heaters with zero standing loss provides an overall higher efficiency installation assuming the peak load can be dealt with which in the case of this building it can. The roof space available would be better utilised by the provision of PVs to generate electricity to offset the ASHP usage and in the summer provide a proportion of the general electrical demand.
Photovoltaic	Electricity Generation		High	The PV's will work very well in tandem with heat pump installations as they will provide an offset of the electrical energy used to reduce the overall electrical demand and further improve the efficiency of a heat pump heating installation. With the corresponding use of electrical point of use water heaters the PV installation will have a direct impact on the buildings overall energy demand. Offsetting the primary energy demand for heating and providing a proportion of the general electrical demand during the summer months. Notably the space on the roof has to be shared with that of the ASHP installations as the building has virtually no land that the building is not sat directly over.
Wind Power (small Scale)	Electricity Generation		Low	Although a good way to generate zero carbon electricity the use of a Turbine even of small scale in this location would have a significant visual impact and any associated noise generation coupled with this impact is unlikely to be favourable with neighbours or local planning. Wind technology is demonstrably more effective at large scales where it generation capacity is not significantly affected by the surrounding topography.
Combined Heat and Power	Electricity and Heat Generation		Low	Unless generated from waste heat CHP rarely stacks up as the baseline load for heating energy and electricity demand rarely align. Still requires a combustion process and the associated downside of the associated fluing arrangement and particulate release in an urban environment. The true CO_2 emissions from grid generated electricity are lower than many of the metrics that are used to compare CHP which lead to it having an unfairly favourable comparison.

Technology	Function		Suitability for Project	Commentary
Biomass Heating	Heat Generation (Standard Efficiency)		Low	Concerns over true carbon cost and uncertainty in supply and unit cost of biomass fuel. Still requires a combustion process and the associated downside of all solid fuel fluing and particulate release in an urban environment. High complexity in the fuel supply mechanisms along with associated high maintenance before introducing any high performance flue gas scrubbers.
Air Source Heat Pump (ASHP	Heat Generation (High Efficiency/COP)		High	Air Source heat pumps provide heating (and Cooling) using high efficiency refrigeration cycles to extract heat from the air and upgrade it to produce the higher temperatures associated with LTHW heating and DHW production. As the source is the air there is a greatly reduced cost on the collector side of the system compared with a Ground source installation with a small trade off in efficiency. Due to the location an nature of the sit an ASHP installation will be the most effective replacement for the Gas Fired heating installations being removed from the building as part of the refurbishment. The ASHP units will require some form of acoustic treatment to reduce the operational noise of the units overnight.
Ground Source Heat Pump (GSHP)	Heat Generation (High Efficiency/COP)		Medium	A Ground source heat pump installation will have a slightly better COP than that of an Air source heat pump as during times of peak heat demand the ground temperature will be closer to the delivery temperature. However, the increased efficiency value comes at a significantly increased capital cost. Due to the intensive works required for forming the deep boreholes. In the case of this project there is limited external space where boreholes could be installed and due to the constrained area and other services expected to be present in this location make the installation significantly more difficult and costly

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6.0 MODELLING RESULTS

6.1 Energy Modelling

The building as currently designed was modelled using IES modelling software to compare to different scenarios for reporting against planning and BREEAM requirements in line with the following.

For London/Camden Planning:
Part L 2021 modelling (Be Lean, Clean & Green) vs. an 'existing building baseline' and 'B Regs compliant baseline' (i.e. max 5 model iterations). No overall CO2 reduction target, but 20% reduction from only renewables (inc. ASHPs).

For BREEAM (2014 Refurb & Fit Out):
Ene 01 Reduction of CO2 Emissions - Analysis based on the 'existing building baseline' and 'Be Green' model results from above. Min 6 credits for BREEAM Excellent but targeting 10 credits.

For BREEAM (2014 Refurb & Fit Out):
Ene 04 Passive Design Analysis - 'Proposed' building (Be Green model) vs 'Standard' building (Be Green, without proposed passive measures - note this is not the same as the baseline models above). Min requirement = 5% reduction in energy and/or CO2 emissions

For BREEAM (2014 Refurb & Fit Out):
Ene 04 LZCT Analysis - 'Proposed' building (Be Green model) vs ' Base Case' building (Be Green, without proposed renewables- i.e. with gas boiler heating). Min requirement = 5% reduction in energy and/or CO2 emissions.

The results of this modelling can be seen in the adjacent table.

Model	GLA baseline	GLA Be Lean	Proposed (GLA Be Green)	BREEAM Ene01 Existing
Model Iteration No.	102	202	002	501
Ext wall (ext or int insulation) (W/m2K)	0.3	0.18	0.18	1.7
Roof (flat roof) (W/m2K)	0.18	0.16	0.16	1
Roof (Pitched Roof) (W/m2k)	0.16	0.16	0.16	N/A
Exposed Floor (W/m2K)	0.25	0.18	0.18	1.4
Glazing (W/m2K)	1.4	1.4	1.4	2.7
Rooflight (W/m2K)	1.7	2.1	2.1	2.7
Vision element (g-value)	0.4	0.4	0.4	0.4
Air permeability (m3/hm2@50Pa)	25	3	3	25 (assumed as GLA baseline)
Thermal Bridging (W/m2K)	Default	Default	Default	Default
HVAC System (Type)	ASHP,MVHR, UFH/UFC/FCUs, radiators	ASHP,MVHR, UFH/UFC/FCUs,, radiators	ASHP,MVHR, UFH/UFC/FCUs, radiators	Gas boiler, DX units
Heating and Hot Water (%)	2.5 (ASHP heating), 100% (hot water)	2.5 (ASHP heating), 100% (hot water)	3 (ASHP heating), 100% (hot water)	Floor standing Cast iron Boiler heating Pool water Additonal Wall Hung condensing boilers and Calorifier outside building thermal line in roof top lean to for DHW production. Expected existing space heating by DX units as no evidence of other heating
Cooling (air-condition) (SEER)	4 (ASHP cooling)	4 (ASHP cooling)	4 (ASHP cooling)	DX units & Dry Air cooler Details unknown
Central ventilation SFP (W/l/s)	2.3	1.4	1.4	Individual LEV to spaces details unknown.
Terminal Unit SFP (W/l/s)	FCU Terminal - 0.4	FCU Terminal - 0.3	FCU Terminal - 0.3	N/A
Heat recovery (%)	70	70	70	N/A
Lighting (Lm/W)	60	100	100	??less than 60
PV	N/A	N/A	N/A	N/A
BER (kgCO2/m2annum)	7.48	5.19	4.98	TBC
Saving	N/A	31%	33%	TBC
Saving comment	N/A	vs GLA baseline	vs GLA baseline	improvement of proposed against existing. Expected unfair comparison.

6.2 Carbon & Cost Analysis

Following an initial suitability appraisal of LZCT systems through steps one and two, the two technologies that were deemed to be sof high suitability for the project have been assessed over 30 years to establish the amount of CO2 emissions that can be saved and the estimated payback period for each technology. These technologies are:

- Photovoltaic Panels (PV)
- Air Source Heat Pump (ASHP)

The results presented in this section are based on simple payback calculations over a period of 30 years which took the following criteria into account:

- Efficiency of each technology (COP)
- Running costs
- Capital cost
- Installation cost
- Maintenance costs
- Fuel costs
- Site energy balance (import/export)
- Revenue from government schemes (if applicable)

The fuel costs have been taken from the Department for Business, Energy & Industrial Strategy data for 'Prices of fuels purchased by non-domestic consumers in the UK (including the CCL)' published in March 2023 for Small/Very Small users. By calculating the predicted annual consumption, the new development falls into the category 'Small' size as electricity consumer, and into 'Very Small' size as gas consumer. The prices of fuels therefore considered are:

Gas	7.417 p/kWh
Electricity	20.09 p/kWh

As no quotes have been sought from technology manufacturers at this stage the following assumptions have been made over the capital cost of the feasible technologies and have been taken from previous quotes sourced for the type of technology. All technology replacement periods have been taken from CIBSE Guide M.

Grants & Funding

With the closure of The RHI and FIT schemes there are no current schemes available to provide any financial contribution towards the installation or running costs of the renewable technologies

Building Global Parameters

	Actual
Floor area [m^2]	1335.2
External area [m^2]	2707.5
Weather	LON
Infiltration [m^3/hm^2@ 50Pa]	3
Average conductance [W/K]	628.59
Average U-value [W/m^{2}K]	0.23
Alpha value* [%]	24.38

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

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

	Actual
Heating	6.78
Cooling	1.78
Auxiliary	7.34
Lighting	6.9
Hot water	13.17
Equipment*	14.55
TOTAL**	**35.98**

* 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.

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6.3 Photovoltaic Panels

Photovoltaic panel installations are simple to install, require minimal

maintenance and minimal plant space beyond the space of the array itself. Their only drawback is the limited efficiency, but this is improving slowly over time.

The array has been se such that it is not directly under the canopy of a large mature tree toa the neighbouring property. As part of the analysis overshadowing of the array has been considered and its potential yield adjusted accordingly.

Roof space is also at a premium as it also needs to allow for rooflights, rainwater attenuation and to house some other Building Services equipment including the ASHP installations. A modest array of 15 high efficiency panels with 405W peak generation per module and a module efficiency of 21% can be accommodated on the available roof space outside of the tree's canopy and other constraints (attenuation, green roof and rooflights to improve access to natural light)

Based on the predicted building annual energy demand of 67.5 MWh/Year (which will be from electricity only) and the average annual CO_2 Emissions factors from the NCM2021 tables for Grid electricity generation the CO_2 emissions per year will be 3835 kg/CO_2 per year.

The PV array will displace approximately 612 kgCO_2 per year which would equate to a 16% reduction in CO_2 emissions. The array has a simple payback period of 13 years and a 30-year life cycle cost saving of £24,270.

Photovoltaic Analysis Table 1 of 1

No. of Panels	Panel Cost	Install Cost	Maintenance Cost	Capital Cost	Annual Maintenance Cost	Replacement Period	Equipment Life	30 Year Equipment Cost	30 year Maintenance Cost	PV Generation	Electricity Cost	Annual Energy Cost Saving	30 Year Energy Cost Saving	Life Cycle Cost (30 Years)
	(£/Panel)	(£/Panel)	(£/Panel/year)	(£)	(£/Year)	(Years)	(Years)	(£)	(£)	(kWh/Year)	(p/kWh)	(£/Year)	(£)	(£)
15	400	200	20	9,000	300	25	30	18,000	9,000	4,199.0	40.7	1,709.0	51,269.8	-24,269.8

Air Source Heat Pump Analysis Table 1 of 3

Annual Heating Demand	Average Annual CO_2 Emission Factor Electricity	Average Annual CO_2 Emission Factor Gas Boiler	Gas Boiler Seasonal Efficiency	ASHP Seasonal COP	ASHP Renewable Fraction	Gas Boiler Annual energy Consumption	ASHP Annual Energy Consumption	Annual CO_2 Emissions Gas Boiler installation	Annual CO_2 Emissions ASHP installation	Annual CO_2 Saving for ASHP installation	Heating Energy C02 reduction from ASHP installation
kWh/Year	kg CO_2/kWh	kg CO_2/kWh	%			kWh/Year	kWh/Year	kg CO_2/Year	kg CO_2/Year	kg CO_2/Year	%
9,052	0.1457	0.210	97.00	3.20	0.69	9,332	2,829	1,960	412	1,548	79

6.4 Air Source Heat Pumps

Air Source Heat pump installations are relatively simple to install and provide almost the same output capabilities as Ground Source installations. Due to the limited access to land into which the boreholes can be installed ASHP is an obvious choice for this building in order to decarbonise its heat generation requirements.

The air source heat pumps will provide 100% of the Buildings LTHW demand and replace the gas boiler installations that are being removed as part of the refurbishment. Two Number 75kW CO_2 Refrigerant (R744 with GWP of 1) ASHPs are to be installed to provide resilience of supply to the building and allow maintenance to be undertaken without significant effect on the building's operation.

A seasonal COP of 3.2 has been used for these calculations based on the manufacturers data.

The ASHP Installations will displace approximately 1548 kgCO_2 per year which would equate to a 79% reduction in CO_2 emissions associated with heating. The ASHP installations have simple payback period of 10.9 years and a 30-year life cycle cost saving of £127,067.

Air Source Heat Pump Analysis Table 2 of 3

Boiler Installation Capital Cost	Boiler Service Life	Boiler Annual Service Cost	Gas Boiler Annual Running Cost	Gas Boiler 30 year Cost	ASHP Installation Capital Cost	ASHP Service Life	ASHP Annual Service Cost	ASHP 30 Year Cost	ASHP Annual Running Cost	ASHP Simple Payback on initial investment
£	years	£/year	£/year	£	£	years	£/year	£	£/year	years
26,250	15.0	800.0	70,015	76,500	127,500	15	1,500	300,000	58,330	10.9

Air Source Heat Pump Analysis Table 3 of 3

Capital Cost Difference	Annual Service Cost Difference	ASHP Annual Energy Saving	ASHP 30 year Energy Cost Saving	ASHP 30 Year Life Cycle Cost
£	years	£/year	£	£
101,250	700.0	11,686	350,567	-127,067

7.0 SUSTAINABILITY STATEMENT

Key Sustainability issues that have been addressed through the design process are referenced below

7.1 Greening and Biodiversity

A Preliminary Ecological Appraisal and Preliminary Bat Roost Assessment prepared by MKA Ecology Ltd. has been submitted as part of the planning application. Reference should be made to

- MKA Preliminary Ecological Appraisal and Preliminary Roost Assessment (Project ref 140623)
- MKA Nocturnal Bat Survey (Project ref 140623)
- MKA Biodiversity Gain Plan and Urban Greening Factor Review (Project ref 140623)

There is potential for the ecological value of the site to be elevated through a number of biodiversity enhancements including planting of native trees and shrubs, creation of green roofs and green walls, and the integration of bird and bat boxes. These features will greatly improve the ecological value of the new development.

The site is dominated by hardstanding and buildings, with one semi-mature tree and some vegetation on the walls and roof, including dense ivy. The tree is considered to be of elevated ecological value in the context of the site. It is recommended that the tree be retained under the proposals and if this is not possible, to be replaced by a native species.

Biodiversity Net Gain
The use of the Defra Biodiversity Metric 4.0 to calculate measures of biodiversity for the existing and proposed habitats confirm that the proposed development is likely to lead to the gain of 0.17 units, which equates to an overall net gain of 878.11% due to the overall absence of ecologically valuable habitats in the baseline, and the creation of a number of green infrastructure elements in the proposed design. Gains are contingent on habitats being created, managed and maintained appropriately and in line with a detailed management plan, as required under the Environment Act.

Urban Greening Factor
The Urban Greening Factor for the proposed development is 0.32. The London Plan sets out score requirements of 0.30 for predominately commercial developments. Accordingly, it can be seen that the current development proposals meet this target.

Other Measures
Other ecological features, such as bird boxes and bat boxes, are proposed to be included within development. Whilst not considered within the current metrics, these features will further enhance the Site for priority species and help deliver a sustainable development

7.2 Air quality Assessment (AQA)

An air quality assessment has been carried out by Phlorum and is submitted as part of the planning application. Refer to Phlorum Air Quality Assessment Report ref 10875.C

The proposed development does not include any new sources of on-site combustion and will adopt and all-electric energy strategy that is expected to utilise Air Source Heat Pumps (ASHP) and Photovoltaic Arrays (PV).

Therefore, the proposed development is not expected to generate building emissions of NOx or PM10 and so it is anticipated that the proposed development will achieve Air Quality Neutrality with respect to building emissions.

The operation of the proposed development is not expected to significantly impact on local air quality, nor is it anticipated to introduce new sensitive receptors into an area of existing poor air quality. Furthermore, the proposed development is anticipated to be air quality neutral in relation to both building and transport emissions.

7.3 Sustainable Urban Drainage (SUD) Measures

A Flood Risk Assessment and Surface Drainage Water Strategy has been prepared by Michal Hadi Associates (MHA) and has been submitted as part of the planning application. This provides a full assessment of the flood risk and the drainage.

SuDS will be introduced where feasible. A green roof is proposed to be installed on a large proportion of the existing roof. In addition porous paving and a rainwater garden is proposed. These measures will reduce surface water runoff as far as possible in comparison to the current drainage strategy.

7.4 Transport

A Transport Assessment has been prepared by Robert West and has been submitted as part of the planning application. Refer to the Robert West Transport Assessment ref 5907/001/002A.

The redevelopment will not introduce any new car parking. The development will be car free and new cycle provision will be provided to the front curtilage of the building.

The net increase of trips produced by the development proposals are predominately made by sustainable modes of travel by both students and staff.

There is expected to be a small net increase in car passenger trips generated by students, however these trips will not generate long stay parking demand.

The development proposals are anticipated to produce significantly fewer daily trips than the former Spring Health Leisure Club (and current permitted E class use).

A Travel Plan prepared by Robert West has also been submitted as part of the planning application. This sets out measures and targets to encourage staff and students to travel by sustainable modes of transport.

7.5 Urban Heat Island

The need for the building to use and the intensity of mechanical cooling systems has been minimised by the use of passive design philosophies.

As part of the Greening and Biodiversity strategy a green roof has been introduced for the project (discussed in section 7.1 above).

Green roofs are an ideal heat island reduction strategy. They provide direct and ambient cooling effects. They have the added benefit of improving the local air quality by reducing the heat island effect and absorbing pollutants

7.6 Cooling

There is a need to provide cooling to the building due to the proximity of the neighbouring properties and the acoustic constraints associated with music teaching and practice as well as drama activities. There are also issues with boundary walls and fir protection that makes opening windows in large parts of the façade unfeasible. The overall demand for cooling has been minimised by balancing the daylight with the solar gain (the form and orientation of the building are set for the existing structure.

Cooling will be provided using underfloor cooling and, where this approach is not sufficient to trim peak temperatures, with fan coil units.

7.7 Water Demand

The water demand for the building will be managed by the use of low water volume appliances and fittings in conjunction with Automatic Flow Limiting Valves (AFLVs) where required.

- WCs will have 4 litres effective flush volume.
- Wash hand basins will have a flow rate of no greater than 4.5 litres/min
- Showers will have a flow rate of no greater than 6 litres/min.
- Kitchen taps will have a flow rate of no greater than 5 litres/min
- Domestic dishwashers will have a capacity of no greater than 12 litres/cycle

In line with BREEAM Qat 01 this will provide a 40% reduction on the BREEAM Baseline water usage.

In addition, water monitoring and metering will be provided to ensure that water leaks are identified and reported.

Automatic shut off to communal WC areas will provided to isolate the water supply when they are not occupied.

7.8 Metering

Extensive metering will be provided to allow the building users to track energy use and the BEMS system will allow for simple graphical analysis of the building performance.

The metering strategy provided will exceed TM39's requirements. Further details can be found in the Be Seen (Section 4.4) of this document.

7.9 Responsible Sourcing of Materials

Limited materials are required as the scheme comprises the re-use of an existing building. Where materials are required, consideration will be given to the sourcing of these materials to ensure materials are resourced responsibly.

As required by London Plan Policy SI7 it is recommended and should be targeted that 95% of construction and demolition waste should be reused/ recycled and 95% beneficial use of inert evacuation waste.

8.0 CONCLUSIONS

The existing building is to be substantially retained and improved as part of the refurbishment. The building was of a very different use and the refurbished building and it's many improvements as part of the works will provide a significant improvement.

The Energy Hierarchy has been closely followed and significant improvements have been made to the building and it's energy strategy. This results in the following.

- An annual 612kg reduction in CO_2 Emissions from the introduction of a PV array. Based on the predicted annual energy demand the PV array recued the overall CO_2 emissions by 16%

- An annual 1548 kg CO_2 reduction in CO_2 Emissions from the introduction of a the AHSP installation over the existing gas boilers. Based on the predicated annual energy demand of the school (not the previous more energy intensive gym use) would equate to a 79% reduction in CO_2 emissions associated with heating.

- There is a 30.6% reduction in carbon over the Part L Building regulations for the refurbishment from be Lean measures

- There is a 33.4% reduction in carbon over the Part L Building regulations for the refurbishment including Be Green Design principles. Whilst the GLA guidance itself acknowledges that the level of practical carbon savings that can be made through refurbishment and the intent is not for refurbishments of this nature to achieve the 35% reduction every effort should be made to improve in line with the London plan. As can be seen the refurbished building only falls marginally short.

- NOx annual Emissions for the refurbished building will be zero as all fossil fuel burning equipment will be removed from the building.

- Particulate Matter emissions for the refurbished building will be zero as all fossil fuel burning equipment will be removed from the building

Camden's Energy and Sustainability Proforma (Major Refurbishment Non-Dwelling) has been completed and submitted as part of the planning application. This report should be read alongside the submitted proforma.

9.0 APPENDIX 1 – HEAT NETWORK PROXIMITY

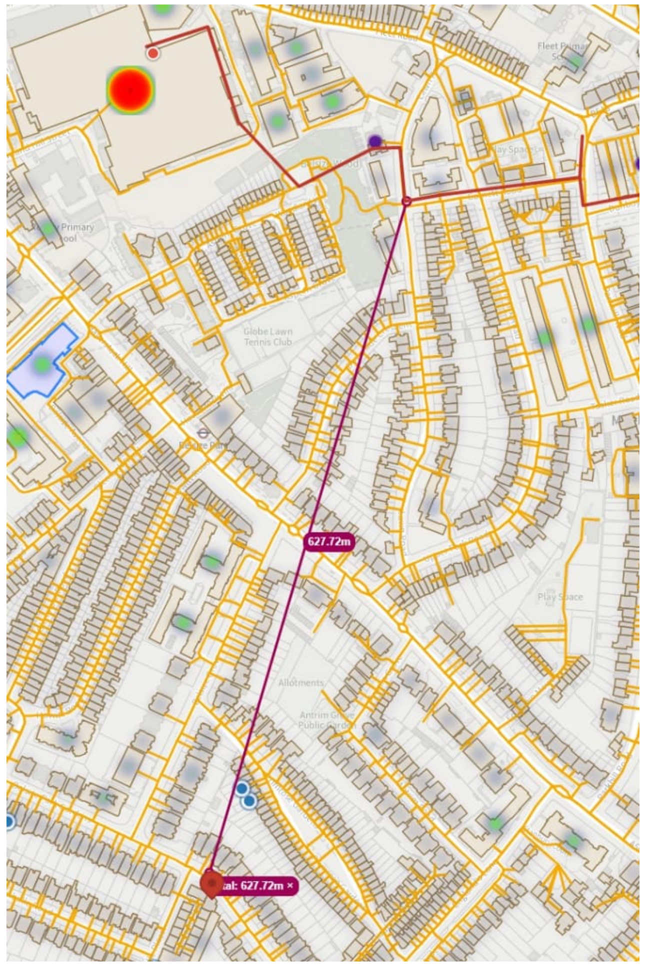

Figure 1 - Straight line route to closest heat ntwork (628m)

Figure 2 - Straight line route to origin of heat network (701m)

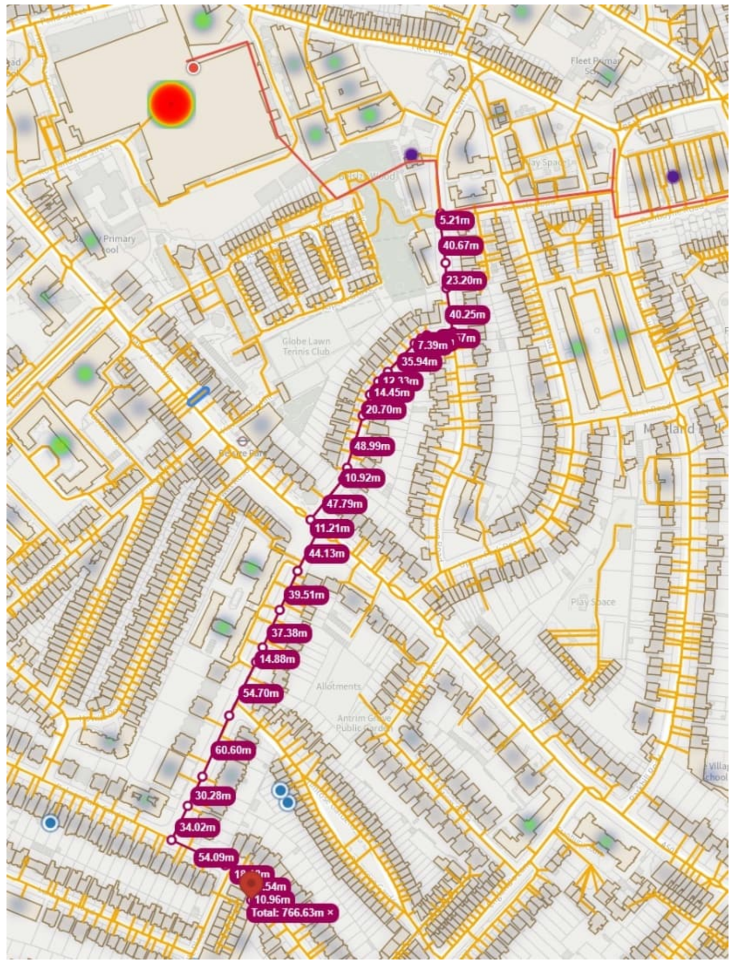

Figure 3 - Shortest route following public highway to network (767m)

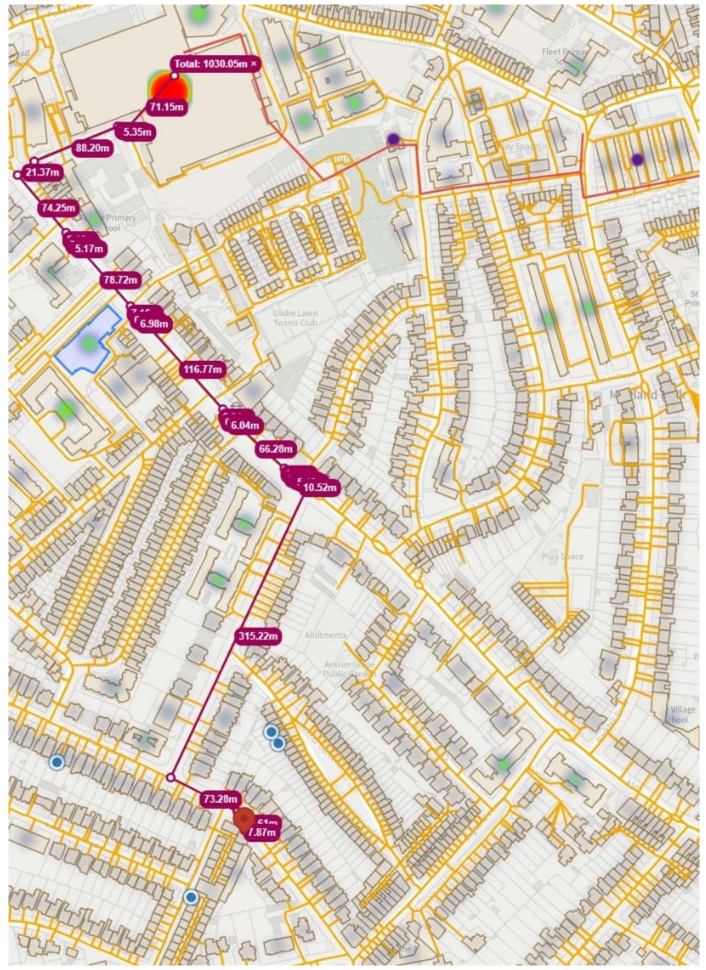

Figure 4 - Shortest route following public highway to origin of network (1030m)

10.0 APPENDIX 2 – BRUKL BASELINE

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BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

202_7268_BelsizeParkGym_PartL_BeLean

As designed

Date: Fri Aug 04 11:39:34 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.20

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.20

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

Foundation area [m²]: 404.98

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

The building does not comply with England Building Regulations Part L 2021

Target CO_2 emission rate (TER), $kgCO_2/m^2annum$	5.06	
Building CO_2 emission rate (BER), $kgCO_2/m^2annum$	5.19	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	54.03	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	55.58	
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	0.18	0.18	FF000019:Surf[0]
Floors	0.18	0.18	0.18	FF000019:Surf[3]
Pitched roofs	0.16	0.16	0.16	DM000004:Surf[1]
Flat roofs	0.18	0.16	0.16	FF000019:Surf[5]
Windows** and roof windows	1.6	1.4	1.4	FF000014:Surf[2]
Rooflights***	2.2	2.13	2.21	DM000004:Surf[0]
Personnel doors^	1.6	1.8	1.8	GF000000:Surf[6]
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 [$W/(m^2K)$]
U_{i-Calc} = Calculated maximum individual element U-values [$W/(m^2K)$]
U_{a-Calc} = Calculated area-weighted average U-values [$W/(m^2K)$]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
** Display windows and similar glazing are excluded from the U-value check.
*** Values for rooflights refer to the horizontal position.
^ For fire doors, limiting U-value is 1.8 W/m^2K

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

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

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	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- Heating circulation spaces - radiators - ASHP - NV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.5	-	0.3	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

2- Heating main occupied spaces - FCU - ASHP - MV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.5	4	0.5	1.4	0.7
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

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

3- Heating main occupied spaces - UFH - ASHP - MV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.5	4	0.5	1.4	0.7
Standard value	2.5*	N/A	N/A	1.5^	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.

4- Heating WC and showers - radiators - ASHP - MV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.5	-	0.3	-	0.7
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

1- DHW - POU

	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
FF General Classroom 2	-	-	-	-	-	-	-	0.3	-	-	N/A
FF Study Room	-	-	-	-	-	-	-	0.3	-	-	N/A
FF WC	-	-	-	1.4	-	-	-	-	-	-	N/A
FF WC	-	-	-	1.4	-	-	-	-	-	-	N/A
GF Main-use Hall	-	-	-	-	-	-	-	0.3	-	-	N/A
GF WC	-	-	-	1.4	-	-	-	-	-	-	N/A
SF WC	-	-	-	1.4	-	-	-	-	-	-	N/A
SF General Classroom 6	-	-	-	-	-	-	-	0.3	-	-	N/A
SF General Classroom 5	-	-	-	-	-	-	-	0.3	-	-	N/A
SF General Classroom 4	-	-	-	-	-	-	-	0.3	-	-	N/A
GF Staff WC	-	-	-	1.4	-	-	-	-	-	-	N/A
GF Access WC	-	-	-	1.4	-	-	-	-	-	-	N/A
FF Access WC	-	-	-	1.4	-	-	-	-	-	-	N/A
SF Access WC	-	-	-	1.4	-	-	-	-	-	-	N/A
SF Graphics Studio Store	-	-	-	-	-	-	-	0.3	-	-	N/A
SF General Classroom 3	-	-	-	-	-	-	-	0.3	-	-	N/A
SF WC	-	-	-	1.4	-	-	-	-	-	-	N/A
GF Shower/Changing Area	-	-	-	-	-	-	-	0.3	-	-	N/A
FF Multi-use Hall	-	-	-	-	-	-	-	0.3	-	-	N/A
SF Main-use Hall	-	-	-	-	-	-	-	0.3	-	-	N/A
SF Graphics Studio 02	-	-	-	-	-	-	-	0.3	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
FF CC	100	-	-
FF Circ	100	-	-
FF General Classroom 2	100	-	-
FF Lobby	100	-	-

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
FF Music Room	100	-	-
FF Music Tech Room	100	-	-
FF Photo Studio 03	100	-	-
FF Photo Studio 02	100	-	-
FF Stair core 1	100	-	-
FF Stair core 2	100	-	-
FF Study Room	100	-	-
FF WC	100	-	-
FF WC	100	-	-
GF Accounts office	100	-	-
GF Cafe/Gallery	100	-	-
GF Circulation	100	-	-
GF Circulation	100	-	-
GF Circulation	100	-	-
GF Drama/Dance Studio	100	-	-
GF Lobby	100	-	-
GF Lobby	100	-	-
GF Main-use Hall	100	-	-
GF Principals Office	100	-	-
GF Stair Core	100	-	-
GF Stair core 1	100	-	-
GF Storage	100	-	-
GF WC	100	-	-
SF Lobby	100	-	-
SF Stair core 1	100	-	-
SF Stair core 2	100	-	-
SF WC	100	-	-
SF General Classroom 6	100	-	-
SF General Classroom 5	100	-	-
SF General Classroom 4	100	-	-
GF Photo Studio (Dark)	100	-	-
GF Dark Room	100	-	-
GF Staff WC	100	-	-
GF Lobby	100	-	-
GF Welfare Room	100	-	-
GF Staff Room	100	-	-
GF Access WC	100	-	-
GF Kitchen Storage	100	-	-
GF Cafe Kitchen and Storage	100	-	-
FF Music Practice Room	100	-	-
FF Music Store	100	-	-
FF General Classroom 1	100	-	-
FF Circ	100	-	-

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
FF Lobby	100	-	-
FF Access WC	100	-	-
FF Student Common Room	100	-	-
FF Lift Lobby	100	-	-
FF Circulation	100	-	-
SF Access WC	100	-	-
SF Graphics Studio 01	100	-	-
SF Lift Lobby	100	-	-
SF Graphics Studio Store	100	-	-
SF Lobby	100	-	-
SF CC	100	-	-
SF General Classroom 3	100	-	-
SF WC	100	-	-
SF Circ	100	-	-
SF Art Studio	100	-	-
GF CC	100	-	-
GF Shower/Changing Area	100	-	-
TF Lobby	100	-	-
TF Stair core 2	100	-	-
TF Plant	100	-	-
TF Storage	100	-	-
FF Multi-use Hall	100	-	-
SF Main-use Hall	100	-	-
SF Graphics Studio 02	100	-	-
SF Lobby	100	-	-
Sawtooth	100	-	-
Sawtooth	100	-	-

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?
FF General Classroom 2	NO (-72.5%)	NO
FF Music Room	NO (-73.2%)	NO
FF Music Tech Room	NO (-53.5%)	NO
FF Photo Studio 03	NO (-58.8%)	NO
FF Photo Studio 02	NO (-88.8%)	NO
FF Study Room	NO (-69.8%)	NO
GF Accounts office	NO (-51.6%)	NO
GF Cafe/Gallery	NO (-69%)	NO
GF Drama/Dance Studio	N/A	N/A
GF Main-use Hall	N/A	N/A
GF Principals Office	NO (-42.2%)	NO
GF Storage	N/A	N/A
SF General Classroom 6	NO (-61.5%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
SF General Classroom 5	NO (-44.9%)	NO
SF General Classroom 4	NO (-73.6%)	NO
GF Photo Studio (Dark)	N/A	N/A
GF Dark Room	N/A	N/A
GF Welfare Room	N/A	N/A
GF Staff Room	NO (-83.1%)	NO
GF Kitchen Storage	N/A	N/A
FF Music Practice Room	N/A	N/A
FF Music Store	N/A	N/A
FF General Classroom 1	NO (-66.5%)	NO
FF Student Common Room	NO (-86.4%)	NO
SF Graphics Studio 01	NO (-86.8%)	NO
SF Graphics Studio Store	NO (-72.1%)	NO
SF General Classroom 3	NO (-34.6%)	NO
SF Art Studio	NO (-97%)	NO
GF Shower/Changing Area	N/A	N/A
FF Multi-use Hall	N/A	N/A
SF Main-use Hall	N/A	N/A
SF Graphics Studio 02	NO (-48.6%)	NO
Sawtooth	NO (-94.3%)	NO
Sawtooth	NO (-94.9%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m²]	1335.2	1335.2
External area [m²]	2707.5	2707.5
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	628.59	1118.92
Average U-value [W/m²K]	0.23	0.41
Alpha value* [%]	24.38	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/m²]

	Actual	Notional
Heating	8.14	7.99
Cooling	1.78	1.29
Auxiliary	7.34	9.49
Lighting	6.9	4.95
Hot water	13.17	12.51
Equipment*	14.55	14.55
TOTAL**	**37.33**	**36.24**

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

Energy Production by Technology [kWh/m²]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	89.52	101.38
Primary energy [kWh_{PE}/m²]	55.58	54.03
Total emissions [kg/m²]	5.19	5.06

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Chilled ceilings/passive chilled beams & mix. vent., [HS] ASHP, [HFT] Electricity, [CFT] Electricity									
Actual	42.5	37.5	5.3	2.8	8.7	2.21	3.69	2.5	4
Notional	49.9	33.5	5	2	14.2	2.78	4.63	----	----
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity									
Actual	88.2	0	10.4	0	1.9	2.35	0	2.5	0
Notional	103.1	0	10.3	0	1.1	2.78	0	----	----
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity									
Actual	13.1	0	1.5	0	9.4	2.35	0	2.5	0
Notional	22.1	0	2.2	0	3	2.78	0	----	----
[ST] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity									
Actual	89.8	34.9	11.1	3	13.3	2.25	3.21	2.5	4
Notional	111.5	37.1	11.1	2.2	15.3	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

MAX FORDHAM

11.0 APPENDIX 3 – BRUKL BE LEAN

BRUKL Output Document

Compliance with England Building Regulations Part L 2021

Project name

202_7268_BelsizeParkGym_PartL_BeLean

As designed

Date: Fri Aug 04 11:39:34 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.20

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.20

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

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Foundation area [m²]: 404.98

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

The building does not comply with England Building Regulations Part L 2021

Target CO_2 emission rate (TER), $kgCO_2/m^2annum$	5.06	
Building CO_2 emission rate (BER), $kgCO_2/m^2annum$	5.19	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	54.03	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	55.58	
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	0.18	0.18	FF000019:Surf[0]
Floors	0.18	0.18	0.18	FF000019:Surf[3]
Pitched roofs	0.16	0.16	0.16	DM000004:Surf[1]
Flat roofs	0.18	0.16	0.16	FF000019:Surf[5]
Windows** and roof windows	1.6	1.4	1.4	FF000014:Surf[2]
Rooflights***	2.2	2.13	2.21	DM000004:Surf[0]
Personnel doors^	1.6	1.8	1.8	GF000000:Surf[6]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
** Display windows and similar glazing are excluded from the U-value check.
*** Values for rooflights refer to the horizontal position.
^ For fire doors, limiting U-value is 1.8 W/m²K
NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

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

Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- Heating circulation spaces - radiators - ASHP - NV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.5	-	0.3	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

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

2- Heating main occupied spaces - FCU - ASHP - MV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.5	4	0.5	1.4	0.7
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

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

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

3- Heating main occupied spaces - UFH - ASHP - MV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.5	4	0.5	1.4	0.7
Standard value	2.5*	N/A	N/A	1.5^	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.

4- Heating WC and showers - radiators - ASHP - MV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.5	-	0.3	-	0.7
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

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

1- DHW - POU

	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
FF General Classroom 2	-	-	-	-	-	-	-	0.3	-	-	N/A
FF Study Room	-	-	-	-	-	-	-	0.3	-	-	N/A
FF WC	-	-	-	1.4	-	-	-	-	-	-	N/A
FF WC	-	-	-	1.4	-	-	-	-	-	-	N/A
GF Main-use Hall	-	-	-	-	-	-	-	0.3	-	-	N/A
GF WC	-	-	-	1.4	-	-	-	-	-	-	N/A
SF WC	-	-	-	1.4	-	-	-	-	-	-	N/A
SF General Classroom 6	-	-	-	-	-	-	-	0.3	-	-	N/A
SF General Classroom 5	-	-	-	-	-	-	-	0.3	-	-	N/A
SF General Classroom 4	-	-	-	-	-	-	-	0.3	-	-	N/A
GF Staff WC	-	-	-	1.4	-	-	-	-	-	-	N/A
GF Access WC	-	-	-	1.4	-	-	-	-	-	-	N/A
FF Access WC	-	-	-	1.4	-	-	-	-	-	-	N/A
SF Access WC	-	-	-	1.4	-	-	-	-	-	-	N/A
SF Graphics Studio Store	-	-	-	-	-	-	-	0.3	-	-	N/A
SF General Classroom 3	-	-	-	-	-	-	-	0.3	-	-	N/A
SF WC	-	-	-	1.4	-	-	-	-	-	-	N/A
GF Shower/Changing Area	-	-	-	-	-	-	-	0.3	-	-	N/A
FF Multi-use Hall	-	-	-	-	-	-	-	0.3	-	-	N/A
SF Main-use Hall	-	-	-	-	-	-	-	0.3	-	-	N/A
SF Graphics Studio 02	-	-	-	-	-	-	-	0.3	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m^2]
Standard value	95	80	0.3
FF CC	100	-	-
FF Circ	100	-	-
FF General Classroom 2	100	-	-
FF Lobby	100	-	-

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
FF Music Room	100	-	-
FF Music Tech Room	100	-	-
FF Photo Studio 03	100	-	-
FF Photo Studio 02	100	-	-
FF Stair core 1	100	-	-
FF Stair core 2	100	-	-
FF Study Room	100	-	-
FF WC	100	-	-
FF WC	100	-	-
GF Accounts office	100	-	-
GF Cafe/Gallery	100	-	-
GF Circulation	100	-	-
GF Circulation	100	-	-
GF Circulation	100	-	-
GF Drama/Dance Studio	100	-	-
GF Lobby	100	-	-
GF Lobby	100	-	-
GF Main-use Hall	100	-	-
GF Principals Office	100	-	-
GF Stair Core	100	-	-
GF Stair core 1	100	-	-
GF Storage	100	-	-
GF WC	100	-	-
SF Lobby	100	-	-
SF Stair core 1	100	-	-
SF Stair core 2	100	-	-
SF WC	100	-	-
SF General Classroom 6	100	-	-
SF General Classroom 5	100	-	-
SF General Classroom 4	100	-	-
GF Photo Studio (Dark)	100	-	-
GF Dark Room	100	-	-
GF Staff WC	100	-	-
GF Lobby	100	-	-
GF Welfare Room	100	-	-
GF Staff Room	100	-	-
GF Access WC	100	-	-
GF Kitchen Storage	100	-	-
GF Cafe Kitchen and Storage	100	-	-
FF Music Practice Room	100	-	-
FF Music Store	100	-	-
FF General Classroom 1	100	-	-
FF Circ	100	-	-

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
FF Lobby	100	-	-
FF Access WC	100	-	-
FF Student Common Room	100	-	-
FF Lift Lobby	100	-	-
FF Circulation	100	-	-
SF Access WC	100	-	-
SF Graphics Studio 01	100	-	-
SF Lift Lobby	100	-	-
SF Graphics Studio Store	100	-	-
SF Lobby	100	-	-
SF CC	100	-	-
SF General Classroom 3	100	-	-
SF WC	100	-	-
SF Circ	100	-	-
SF Art Studio	100	-	-
GF CC	100	-	-
GF Shower/Changing Area	100	-	-
TF Lobby	100	-	-
TF Stair core 2	100	-	-
TF Plant	100	-	-
TF Storage	100	-	-
FF Multi-use Hall	100	-	-
SF Main-use Hall	100	-	-
SF Graphics Studio 02	100	-	-
SF Lobby	100	-	-
Sawtooth	100	-	-
Sawtooth	100	-	-

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?
FF General Classroom 2	NO (-72.5%)	NO
FF Music Room	NO (-73.2%)	NO
FF Music Tech Room	NO (-53.5%)	NO
FF Photo Studio 03	NO (-58.8%)	NO
FF Photo Studio 02	NO (-88.8%)	NO
FF Study Room	NO (-69.8%)	NO
GF Accounts office	NO (-51.6%)	NO
GF Cafe/Gallery	NO (-69%)	NO
GF Drama/Dance Studio	N/A	N/A
GF Main-use Hall	N/A	N/A
GF Principals Office	NO (-42.2%)	NO
GF Storage	N/A	N/A
SF General Classroom 6	NO (-61.5%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
SF General Classroom 5	NO (-44.9%)	NO
SF General Classroom 4	NO (-73.6%)	NO
GF Photo Studio (Dark)	N/A	N/A
GF Dark Room	N/A	N/A
GF Welfare Room	N/A	N/A
GF Staff Room	NO (-83.1%)	NO
GF Kitchen Storage	N/A	N/A
FF Music Practice Room	N/A	N/A
FF Music Store	N/A	N/A
FF General Classroom 1	NO (-66.5%)	NO
FF Student Common Room	NO (-86.4%)	NO
SF Graphics Studio 01	NO (-86.8%)	NO
SF Graphics Studio Store	NO (-72.1%)	NO
SF General Classroom 3	NO (-34.6%)	NO
SF Art Studio	NO (-97%)	NO
GF Shower/Changing Area	N/A	N/A
FF Multi-use Hall	N/A	N/A
SF Main-use Hall	N/A	N/A
SF Graphics Studio 02	NO (-48.6%)	NO
Sawtooth	NO (-94.3%)	NO
Sawtooth	NO (-94.9%)	NO

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]	1335.2	1335.2
External area [m^2]	2707.5	2707.5
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	628.59	1118.92
Average U-value [W/m^{2}K]	0.23	0.41
Alpha value* [%]	24.38	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	8.14	7.99
Cooling	1.78	1.29
Auxiliary	7.34	9.49
Lighting	6.9	4.95
Hot water	13.17	12.51
Equipment*	14.55	14.55
TOTAL**	**37.33**	**36.24**

* 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]	89.52	101.38
Primary energy [kWh$_{PE}$/m^2]	55.58	54.03
Total emissions [kg/m^2]	5.19	5.06

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Chilled ceilings/passive chilled beams & mix. vent., [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	42.5	37.5	5.3	2.8	8.7	2.21	3.69	2.5	4
	Notional	49.9	33.5	5	2	14.2	2.78	4.63	----	----
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	88.2	0	10.4	0	1.9	2.35	0	2.5	0
	Notional	103.1	0	10.3	0	1.1	2.78	0	----	----
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	13.1	0	1.5	0	9.4	2.35	0	2.5	0
	Notional	22.1	0	2.2	0	3	2.78	0	----	----
[ST] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	89.8	34.9	11.1	3	13.3	2.25	3.21	2.5	4
	Notional	111.5	37.1	11.1	2.2	15.3	2.78	4.63	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

12.0 APPENDIX 4 - BRUKL BE GREEN

MAX FORDHAM

BRUKL Output Document

Compliance with England Building Regulations Part L 2021

Project name

002_7268_BelsizeParkGym_PartL_Proposed_Be Green

As designed

Date: Fri Aug 04 11:53:08 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.20

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.20

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

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Foundation area [m²]: 404.98

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	5.06	
Building CO_2 emission rate (BER), $kgCO_2/m^2$annum	4.98	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	54.03	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	53.5	
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	0.18	0.18	FF000019:Surf[0]
Floors	0.18	0.18	0.18	FF000019:Surf[3]
Pitched roofs	0.16	0.16	0.16	DM000004:Surf[1]
Flat roofs	0.18	0.16	0.16	FF000019:Surf[5]
Windows** and roof windows	1.6	1.4	1.4	FF000014:Surf[2]
Rooflights***	2.2	2.13	2.21	DM000004:Surf[0]
Personnel doors^	1.6	1.8	1.8	GF000000:Surf[6]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
** Display windows and similar glazing are excluded from the U-value check.
*** Values for rooflights refer to the horizontal position.
^ For fire doors, limiting U-value is 1.8 W/m²K

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

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

Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- Heating circulation spaces - radiators - ASHP - NV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3	-	0.3	-	0.7
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- Heating main occupied spaces - FCU - ASHP - MV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3	4	0.5	1.4	0.7
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

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

3- Heating main occupied spaces - UFH - ASHP - MV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3	4	0.5	1.4	0.7
Standard value	2.5*	N/A	N/A	1.5^	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.

4- Heating WC and showers - radiators - ASHP - MV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3	-	0.3	-	0.7
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

1- DHW - POU

	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
FF General Classroom 2	-	-	-	-	-	-	-	0.3	-	-	N/A
FF Study Room	-	-	-	-	-	-	-	0.3	-	-	N/A
FF WC	-	-	-	1.4	-	-	-	-	-	-	N/A
FF WC	-	-	-	1.4	-	-	-	-	-	-	N/A
GF Main-use Hall	-	-	-	-	-	-	-	0.3	-	-	N/A
GF WC	-	-	-	1.4	-	-	-	-	-	-	N/A
SF WC	-	-	-	1.4	-	-	-	-	-	-	N/A
SF General Classroom 6	-	-	-	-	-	-	-	0.3	-	-	N/A
SF General Classroom 5	-	-	-	-	-	-	-	0.3	-	-	N/A
SF General Classroom 4	-	-	-	-	-	-	-	0.3	-	-	N/A
GF Staff WC	-	-	-	1.4	-	-	-	-	-	-	N/A
GF Access WC	-	-	-	1.4	-	-	-	-	-	-	N/A
FF Access WC	-	-	-	1.4	-	-	-	-	-	-	N/A
SF Access WC	-	-	-	1.4	-	-	-	-	-	-	N/A
SF Graphics Studio Store	-	-	-	-	-	-	-	0.3	-	-	N/A
SF General Classroom 3	-	-	-	-	-	-	-	0.3	-	-	N/A
SF WC	-	-	-	1.4	-	-	-	-	-	-	N/A
GF Shower/Changing Area	-	-	-	-	-	-	-	0.3	-	-	N/A
FF Multi-use Hall	-	-	-	-	-	-	-	0.3	-	-	N/A
SF Main-use Hall	-	-	-	-	-	-	-	0.3	-	-	N/A
SF Graphics Studio 02	-	-	-	-	-	-	-	0.3	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
FF CC	100	-	-
FF Circ	100	-	-
FF General Classroom 2	100	-	-
FF Lobby	100	-	-

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
FF Music Room	100	-	-
FF Music Tech Room	100	-	-
FF Photo Studio 03	100	-	-
FF Photo Studio 02	100	-	-
FF Stair core 1	100	-	-
FF Stair core 2	100	-	-
FF Study Room	100	-	-
FF WC	100	-	-
FF WC	100	-	-
GF Accounts office	100	-	-
GF Cafe/Gallery	100	-	-
GF Circulation	100	-	-
GF Circulation	100	-	-
GF Circulation	100	-	-
GF Drama/Dance Studio	100	-	-
GF Lobby	100	-	-
GF Lobby	100	-	-
GF Main-use Hall	100	-	-
GF Principals Office	100	-	-
GF Stair Core	100	-	-
GF Stair core 1	100	-	-
GF Storage	100	-	-
GF WC	100	-	-
SF Lobby	100	-	-
SF Stair core 1	100	-	-
SF Stair core 2	100	-	-
SF WC	100	-	-
SF General Classroom 6	100	-	-
SF General Classroom 5	100	-	-
SF General Classroom 4	100	-	-
GF Photo Studio (Dark)	100	-	-
GF Dark Room	100	-	-
GF Staff WC	100	-	-
GF Lobby	100	-	-
GF Welfare Room	100	-	-
GF Staff Room	100	-	-
GF Access WC	100	-	-
GF Kitchen Storage	100	-	-
GF Cafe Kitchen and Storage	100	-	-
FF Music Practice Room	100	-	-
FF Music Store	100	-	-
FF General Classroom 1	100	-	-
FF Circ	100	-	-

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
FF Lobby	100	-	-
FF Access WC	100	-	-
FF Student Common Room	100	-	-
FF Lift Lobby	100	-	-
FF Circulation	100	-	-
SF Access WC	100	-	-
SF Graphics Studio 01	100	-	-
SF Lift Lobby	100	-	-
SF Graphics Studio Store	100	-	-
SF Lobby	100	-	-
SF CC	100	-	-
SF General Classroom 3	100	-	-
SF WC	100	-	-
SF Circ	100	-	-
SF Art Studio	100	-	-
GF CC	100	-	-
GF Shower/Changing Area	100	-	-
TF Lobby	100	-	-
TF Stair core 2	100	-	-
TF Plant	100	-	-
TF Storage	100	-	-
FF Multi-use Hall	100	-	-
SF Main-use Hall	100	-	-
SF Graphics Studio 02	100	-	-
SF Lobby	100	-	-
Sawtooth	100	-	-
Sawtooth	100	-	-

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?
FF General Classroom 2	NO (-72.5%)	NO
FF Music Room	NO (-73.2%)	NO
FF Music Tech Room	NO (-53.5%)	NO
FF Photo Studio 03	NO (-58.8%)	NO
FF Photo Studio 02	NO (-88.8%)	NO
FF Study Room	NO (-69.8%)	NO
GF Accounts office	NO (-51.6%)	NO
GF Cafe/Gallery	NO (-69%)	NO
GF Drama/Dance Studio	N/A	N/A
GF Main-use Hall	N/A	N/A
GF Principals Office	NO (-42.2%)	NO
GF Storage	N/A	N/A
SF General Classroom 6	NO (-61.5%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
SF General Classroom 5	NO (-44.9%)	NO
SF General Classroom 4	NO (-73.6%)	NO
GF Photo Studio (Dark)	N/A	N/A
GF Dark Room	N/A	N/A
GF Welfare Room	N/A	N/A
GF Staff Room	NO (-83.1%)	NO
GF Kitchen Storage	N/A	N/A
FF Music Practice Room	N/A	N/A
FF Music Store	N/A	N/A
FF General Classroom 1	NO (-66.5%)	NO
FF Student Common Room	NO (-86.4%)	NO
SF Graphics Studio 01	NO (-86.8%)	NO
SF Graphics Studio Store	NO (-72.1%)	NO
SF General Classroom 3	NO (-34.6%)	NO
SF Art Studio	NO (-97%)	NO
GF Shower/Changing Area	N/A	N/A
FF Multi-use Hall	N/A	N/A
SF Main-use Hall	N/A	N/A
SF Graphics Studio 02	NO (-48.6%)	NO
Sawtooth	NO (-94.3%)	NO
Sawtooth	NO (-94.9%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m²]	1335.2	1335.2
External area [m²]	2707.5	2707.5
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	628.59	1118.92
Average U-value [W/m²K]	0.23	0.41
Alpha value* [%]	24.38	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/m²]

	Actual	Notional
Heating	6.78	7.99
Cooling	1.78	1.29
Auxiliary	7.34	9.49
Lighting	6.9	4.95
Hot water	13.17	12.51
Equipment*	14.55	14.55
TOTAL**	**35.98**	**36.24**

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

Energy Production by Technology [kWh/m²]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	89.52	101.38
Primary energy [kWh_{PE}/m^2]	53.5	54.03
Total emissions [kg/m²]	4.98	5.06

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Chilled ceilings/passive chilled beams & mix. vent., [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	42.5	37.5	4.4	2.8	8.7	2.66	3.69	3	4
	Notional	49.9	33.5	5	2	14.2	2.78	4.63	----	----
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	88.2	0	8.7	0	1.9	2.82	0	3	0
	Notional	103.1	0	10.3	0	1.1	2.78	0	----	----
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	13.1	0	1.3	0	9.4	2.82	0	3	0
	Notional	22.1	0	2.2	0	3	2.78	0	----	----
[ST] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	89.8	34.9	9.2	3	13.3	2.7	3.21	3	4
	Notional	111.5	37.1	11.1	2.2	15.3	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