Energy Strategy

for

Burnside Secondary PRU

Rev C04

Issued by:-

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Project Revision Sheet

Burnside Secondary PRU

Energy Strategy

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C01	11/10/2023	Info Exchange 3	BKR	JdB
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1 INTRODUCTION

This document set out the Energy Strategy for Burnside Secondary PRU. The document includes: a review of the planning requirements; a design stage assessment for compliance with part L of the Building Regulations; the results and data input for the concept energy model; the results and data input for the TM 54 developed energy model; and an outline of the approach to monitoring the building's performance in use.

1.1 DESCRIPTION OF SITE AND BUILDING

The site is currently occupied by a 48 pupil Secondary Alternative Provision school in a single-storey block (originally designed as a primary school), making use of the adjacent Burwood Centre building and also a separate gym / classroom block. The site is proposed to be redeveloped to provide a new Secondary Pupil Referral Unit for 48 pupils in a two-storey building to be constructed in two phases.

The area of the school is approximately 1600m².

The building has a capacity of 48 pupils with 35 full-time equivalent staff.

1.2 SCHOOL SPECIFIC BRIEF

The school specific brief requires that:

> The design of the Buildings and external space provided within the Project Brief shall take account of any School-specific Sustainable Estate Strategy issues.
>
> A sustainable approach to the design, construction, production and operation of the new Burnside Secondary School development at Feasibility Stage considers the following:
>
> - The long-term needs of the school users (considering all pupils and staff).
> - Futureproofing against the risks of climate change as defined by UK adaptation policy.
> - Achieving Net Zero Carbon in operation, as defined by the standards within the New Zero Carbon Buildings: A Framework Definition UK Green Building Council (UK GBC) recognising a development of targets over a timeline.
> - Healthy and productive whole school setting, in response to the UK's 25-year Environment Plan including biodiversity net gain.

1.3 ENERGY HIERARCHY

To demonstrate how the development is optimised to have a low energy use the approach set out in the DfE's Output Specification is followed.

Appendix 2H of the Output Specification sets out a hierarchal approach to achieving an energy efficient and low carbon building that also has low operating costs. The stages of the hierarchy are:

Use Less Energy/Reduce Demand- 'Be Lean'

- Improve insulation and the thermal envelope
- Incorporate passive heating and cooling, including the use of thermal mass
- Reduce solar gain through building form, shading, and glazing performance
- Optimise daylighting to reduce artificial lighting energy consumption
- Optimise the use of thermal mass
- Maximise the potential for natural ventilation
- Carbon efficient heating systems and heat recovery
- Passive cooling techniques
- Ventilation system and fans with low specific fan power
- Install energy efficient lighting and appliances
- Provide simple controls systems to operate the plant efficiently and monitor it performance
- Where users need to interact with the systems they should be simple to operate and a clear explanation of how the building is intended to work should be provided.

Improve Energy Efficiently - 'Be Clean

- Connect to existing heat network where possible

Use Renewable Energy - 'Be Green'

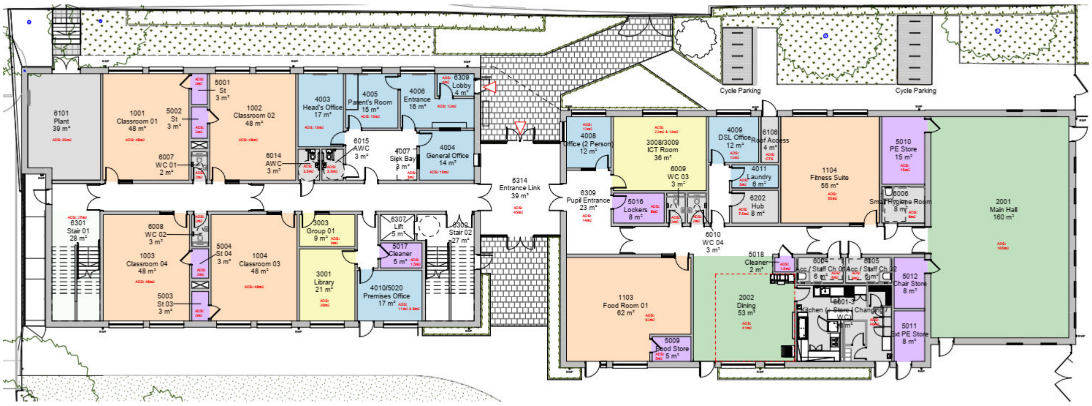
- Generate heat using, in order of preference; ground source heat pumps, air source heat pumps, other LZC technologies, gas fire boilers.
- Install renewable energy technologies on site, for example, photovoltaic panels or wind turbines

Performance in Use – Be Seen

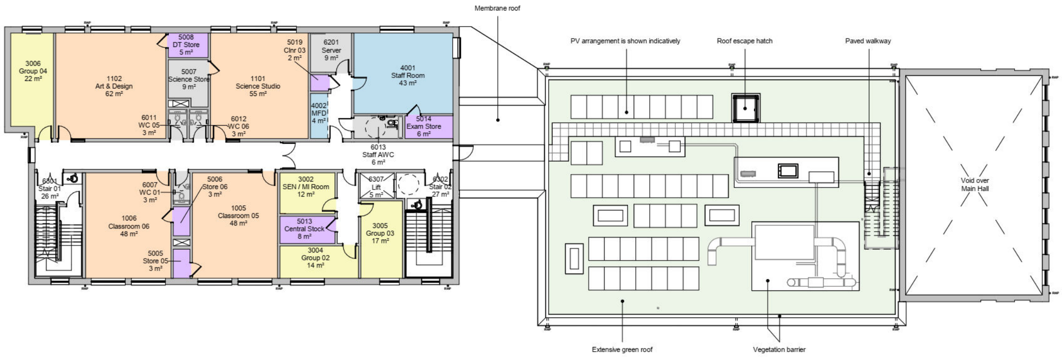
- Commission the building and support and empower the end users
- Provide the School with clear metering and monitoring protocols to ensure they can easily manage and understand their energy use.

1.4 GENERAL ARRANGEMENT DRAWINGS

Ground Floor



First Floor

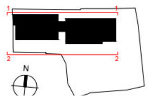


1.5 ELEVATIONS

Proposed Elevation 1 - North

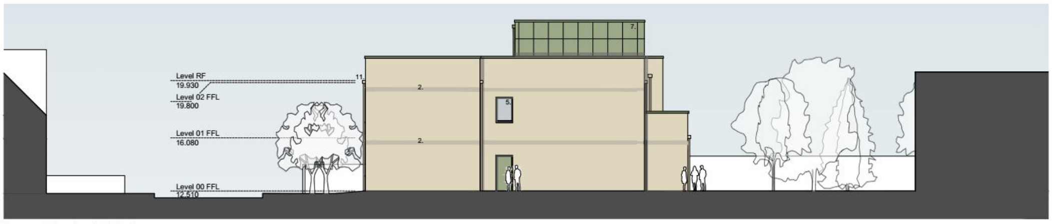
Proposed Elevation 2 - South

KEY PLAN



KEY:

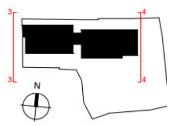
1. STANDARD BRICK WORK
2. SOLDIER COURSING
3. GLAZED BRICK WORK
4. RECESSED GLAZED BRICK WORK
5. POLYESTER POWDER COATED ALUMINIUM WINDOWS
6. LOUVERED VENT PANELS
7. ALUMINIUM RAIN SCREEN CLADDING
8. POLYESTER POWDER COATED ALUMINIUM CANOPY
9. POLYESTER POWDER COATED ALUMINIUM CURTAIN WALL
10. STAINLESS STEEL LETTERING
11. ALUMINIUM RAIN WATER PIPE
12. STEEL STAIR



Proposed Elevation 3 - West

Proposed Elevation 4 - East

KEY PLAN



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10. STAINLESS STEEL LETTERING
11. ALUMINIUM RAIN WATER PIPE
12. STEEL STAIR

1.6 BASIS OF MODEL

Model is based on the following drawings and architectural model:

SRP1055-RSS-XX-00-D-A-1210 C06 General Arrangement Proposed Ground Floor Plan

SRP1055-RSS-XX-01-D-A-1211 C07 General Arrangement Proposed First Floor Plan

SRP1055-RSS-XX-RF-D-A-1212 C06 General Arrangement Proposed Roof Plans

SRP1055-RSS-XX-ZZ-D-A-1401 C06 Proposed North & South Elevations

SRP1055-RSS-XX-ZZ-D-A-1402 C05 Proposed West & East Elevations

SRP1055-RSS-01-ZZ-M-A-0001.rvt and agreed amendments

1.7 STRUCTURE OF REPORT

This structure of this report is as below:

Section 2: Outlines the local and regional planning policies relevant to the development.

Section 3: Details the requirements set by the Department for Education (DfE).

Section 4: Describes the development's approach to optimizing energy use. It covers the 'be green' approach, along with 'be clean' and 'be green' measures to enhance sustainability.

Section 5: Assesses the development's compliance with Building Regulations after implementing the three-tier energy hierarchy steps.

Section 6: Evaluates the school's performance relative to the DfE's Concept Energy Model requirements.

Section 7: Analyses the school's performance against the DfE's Developed Energy Modelling standards, demonstrating how the building will achieve net zero carbon in operational use. This section also explains the assumptions built into these calculations.

Section 8: Provides an overview of how the building's performance during the 'Be Seen' phase (monitoring actual energy performance) will be managed.

Section 8 briefly sets out how the performance in use – Be Seen – stage will be implemented.

Appendix 1 contains the Design Stage ‚be green' BRUKL', and appendix 2 the predicted EPC.

Appendix 3 contains the GLA Tables 1-4 copied from the Part_l_2021_gla_carbon_emission_reporting_spreadsheet_v2.0_0.

2 LOCAL PLANNING REQUIREMENT

2.1 LONDON BOROUGH OF WALTHAM FOREST

Waltham Forest Local Plan Core Strategy Adopted in February 2024 includes the following policy:

Policy 85 - A Zero Carbon Borough

Greenhouse gas emissions will be minimised, the borough's carbon footprint will be reduced and energy efficiency within developments will be maximised by:

A. Requiring all development to promote low carbon energy generation and maximise the opportunity for renewable energy following the London Plan energy hierarchy;

B. Requiring all development of more than one home or greater than 100 sqm to be supported by an Energy Assessment (for major development schemes this must be undertaken in accordance with GLA's latest Energy Assessment Guidance) setting out energy information for the development to demonstrate compliance with the following:

   i. All new major development must meet or exceed the net zero-carbon emissions target in line with the London Plan energy hierarchy and in line with best practice guidance including the GLA's latest energy planning guidance.

   ii. All new build development of more than one home or greater than 100 sqm must achieve a minimum of 35% reduction below Part L of the Building Regulations on-site, targeting net zero carbon where possible, in line with the London Plan energy hierarchy and with best practice guidance, including the GLA's Energy Planning Guidance. Development should meet the following London Plan 'Be Lean' stage (energy efficiency) carbon reduction targets before other measures are incorporated to meet the overall 35% reduction target, achieving a minimum of:

      a. 10% reduction below Part L of the Building Regulations for residential development;

      b. 15% reduction below Part L of the Building Regulations for non-residential development;

   Iii. Carbon Offset Fund (COF) contributions will then be required for any shortfall in emission reductions;

The Policy's requirement for large scale development locations does not apply to this development.

2.2 REGIONAL POLICY – THE LONDON PLAN (MARCH 2021)

The London Plan includes two policies, shown below, that are relevant to this Energy Strategy.

Policy SI 2 Minimising greenhouse gas emissions

A Major development should be net zero-carbon.[151] This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

1) be lean: use less energy and manage demand during operation
2) be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly
3) be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site
4) be seen: monitor, verify and report on energy performance.

B Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.

C A minimum on-site reduction of at least 35 per cent beyond Building Regulations[152] is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:

1) through a cash in lieu contribution to the borough's carbon offset fund, or
2) off-site provided that an alternative proposal is identified and delivery is certain.

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

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

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

Policy SI 4 Managing heat risk

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

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

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

This Energy Strategy sets out how the development will respond to the local and regional planning requirements. In addition to the planning requirements, the Department For Education sets a performance standard, net zero carbon in operation, which exceeds the planning policy requirements

3 DEPARTMENT FOR EDUCATION REQUIREMENTS

3.1 ANNEX 2J REQUIREMENTS

Annex 2J includes the following requirements for energy use and carbon emissions?

3.5 ENERGY AND NET ZERO CARBON

3.5.1 General Requirements

3.5.1.1 New Buildings shall reduce their impact as part of built environment measures to limit warming to 1.5°C as secured by the Paris Agreement 2016.

3.5.2 New Buildings

3.5.2.1 New Buildings shall be designed to the Fabric First principle.

3.5.2.2 The requirements associated with External Fabric are defined within Technical Annex 2C. [

3.5.2.3 The Contractor shall design and construct the new facilities to meet the Energy Use Intensity (EUI) Targets defined in Technical Annex 2H, based on CIBSE TM54 assessment.

3.5.2.4 The Energy Use Intensity (EUI) values shall be achieved before the application of renewable technology

3.5.2.5 The Contractor shall provide roof coverage of Photovoltaic (PV) panels. The standards for PV installations are defined within Technical Annex 2G

3.6 Carbon Targets & Reporting

3.6.1 Operational Carbon

3.6.1.1 All New Buildings shall achieve Net Zero Carbon in Operation, as defined by the standards within the Net Zero Carbon Buildings: A Framework Definition, UK Green Building Council (UK GBC), using EN15978. Recognising a development of targets over a timeline.

3.6.1.2 Net Zero Carbon in Operation shall be calculated to achieve net zero carbon in operation at handover and to include regulated and unregulated energy use, following the CIBSE TM54 methodology,

3.6.1.3 Off-site off setting is not permitted

3.6.1.4 Where a school site meets all of the requirements of the Output Specification, but site-specific items or project constraints mean that it is not possible to achieve Net Zero Carbon in Operation using on-site renewables, a clear roadmap towards 2050 should be provided to the Responsible Body as part of the Strategic Brief output in Annex SS6.

3.6.1.5 Zero Carbon in operation reporting shall be part of the development of the Project at each stage of the RIBA Plan of Works 2020, for the whole life of the Project.

3.2 ANNEX 2H REQUIREMENTS

Annex 2J includes the following requirements with regard to providing an Energy Strategy:

1.2 Energy Strategy

The Contractor shall produce an Energy Strategy Report to demonstrate that thorough consideration has been given to the energy use of the Building and that it is expected to meet the Employer's energy targets. The detailed requirements are set out in the Employer's Requirements Deliverables.

As a minimum, the Energy Strategy Report shall include the following sections.

a. Introduction to the Project.

b. Assessment of local planning requirements, Part L requirements and

Employer's Requirements.

c. Approach to optimising energy use (see Section 2):

i. Be Lean

ii. Be Clean iii. Be Green

d. Concept model output data tables (see Section 4.2) or analysis of energy consumption of Existing Building(s) (see Section 6).

e. Comparison of energy targets with predicted end use energy figures (see Section 3).

f. Monitoring and targeting strategy (see Section 5).

4 OPTIMISING ENERGY USE

4.1 BUILDING FABRIC

The building design will target highly efficient U-values and air tightness that better the requirements of the Building Regulations. The proposed measures are set out in the table below:

Fabric Performance

	Fabric Performance		
Element	Building Regulations, Part L2A 2021 Limiting values	DfE Fabric Efficiency Standards	Proposed Measures
Air Tightness	8.0m³/hr per m²	3.0 m³/hr.m²	3.0 m³/hr.m²
External Wall U-Value*	0.26 W/m²K	0.15 W/m²K	0.15 W/m²K
Exposed Floor	0.18 W/m²K	0.12 W/m²K	0.12 W/m²K
Roof	0.18 W/m²K	0.12 W/m²K	0.12 W/m²K
Window U-Value	1.6 W/m²K	1.10 W/m²K	1.10 W/m²K
Glazing G-Value	0.48		0.4
Glazing LT	0.7		0.7
Thermal Bridging Alpha Value	10%		Included in average u-value above

* Average wall U-value

The above values demonstrate a series of measures that are proposed are meet the target Fabric Efficiency Standards set by the DfE.

4.1.1 Heating and Cooling

Heat Source

The space heating demand will be met by an air source heat pump installation.

For the purpose of the GLA compliant Energy Strategy following the Energy Assessment Guidance (June 2022) a gas fired boiler system with a seasonal efficiency of 94% is used within the Baseline and Lean building models.

Ground source heat pumps (GSHP) have been considered but are not adopted. The advantages and disadvantages of the two types are listed below:

Ground Source Heat Pumps	Air Source Heat Pumps
External collector area is estimated to be approximately 0.5 hectares. The external area chosen for the installation would have limited flexibility for changes of use. E.g. building over or significant change to surface.	Heat pumps located on building. No impact on ground works or future flexibility of site use.

Lower noise levels than ASHP.	Careful siting of ASHPs required to mitigate risk of noise disturbance
Less flexibility for future expansion	Easy to expand system and incorporate new technologies.
Slightly more efficient that ASHP; lower area of PV to achieve net zero carbon in operation.	Slight less efficiency than GSHP so slightly greater area of PV to achieve net zero carbon in operation. Cost of additional PV significantly lower than additional cost of GSHP.
Long term plant replacement costs lower.	Slightly higher plant replacement costs.
Higher risk - can result in ground freezing and inefficiency if annual heating load exceeds expectations.	Lower risk – more forgiving if heat load and annual heat demand exceeds expectations.
Higher construction cost. Approx 2.5 – 3 times cost of ASHP.	Lower installation and construction cost.

To maximise the efficiency of the heat pump system a variable temperature circuit will serve the heat emitters. Two port control valves will be provided on heat emitters, and the pumps will be provided with inverter drives so that the pump duty can be matched to the building's demand, saving pumping energy.

The heating system will be zoned to suit the usage pattern of the school. As a minimum, the zones will be; ground floor teaching, first floor teaching, SEN, nursery, and staff areas.

Heat Emitters

Space heating will be provided by a combination of radiators, radiant panels, and heating coils contained within the classroom ventilation units. The main hall will be heated by underfloor heating or by heating coils incorporated into the ventilation system.

The kitchen shall be provided with a minimal quantity of radiators or fan convectors (to be coordinated with final kitchen layout), to supplement as necessary the tempered warm air being supplied via the canopy.

4.1.2 Ventilation

Classrooms

Ventilation will be provided by hybrid units providing natural ventilation with fan assistance. The proposed units are Monodraught HVR Zero X + units. The natural ventilation will be crossflow, with stack ventilation via chimneys or the central circulation space. In addition, opening windows will be provided, but due to the external acoustic environment, which results in the internal acoustic criteria being exceeded when opened, these are not included in the modelling,

The hybrid ventilation units will provide the required quantity of fresh air during the winter in a manner that results in a draught-free environment in the classroom, the units also improve energy efficiency by mitigating the risk of excess fresh air ventilation. The units are provided with a passive heat exchanger with an efficiency of 42% that, during the winter, will use the exhaust air to pre-heat the incoming fresh air and reduce the heating energy requirement.

The teacher would have access to controls within the classroom to override the operation of the ventilation system.

Main Hall

The Main Hall will be ventilated via roof mounted Monodraught Windcatcher Zero ventilation unit. The units are hybrid ventilation units capable of providing natural ventilation and mechanical ventilation. The units incorporate a plate heat exchanger with a efficiency of around 60%. The unit has a low specific fan power of between 0.09 and 0.18 W/l/s depending on the air flow rate.

Staff Areas / Group Rooms

The staff and administration areas and group rooms will be will be ventilated by mechanical ventilation and heat recovery (MVHR) units.

During hot weather the supply and extract systems will operate automatically over night to purge the heat from the building. All rooms will be mechanically ventilated throughout the year.

The rooms will be provided with opening windows, however, the use of these has not been factored into the energy models due to the external noise environment.

Kitchen Ventilation

The kitchen shall be provided with a supply and extract canopy and grease filters. A dedicated variable speed drive roof mounted extract fan unit will serve the extract canopy. A supply fan complete with in duct electric heater battery shall be provided to temper the incoming fresh air. The kitchen shall be kept under negative pressure to prevent odours drifting into other parts of the school. Attenuation shall be provided on the exhaust system.

The kitchen staff will be provided with user controls that will allow ventilation rates to be adjusted if needed.

Toilets / Cleaners

The toilets and cleaners rooms will be ventilated by dedicated mechanical extract systems. The systems will be individually switched via dedicated PIR occupancy detectors, with a run-on timer. The use of presence detection will reduce the fan energy demand and the space heating load. Make up air to the space will be introduced via door transfer grilles or ducted directly into the applicable space.

4.1.3 Domestic Hot Water

Domestic hot water will be provided by local point of use water heaters in the toilet areas and classrooms. This approach prevents the high distribution losses associated with centralised domestic hot water systems, which often result in the distribution losses exceeding the energy consumed by the hot water used.

The kitchen domestic hot water will be generated by a local storage cylinder with direct electric emersion heaters.

4.1.4 Lighting

The lighting design for teaching spaces in particular will encompass both natural and artificial lighting which will make best use of available natural light and will provide comfortable well-lit and uniform artificial light when necessary.

Offices, circulation spaces, and ancillary areas will also benefit for natural daylight and be provided with controls to limit the time for which the artificial lighting is required.

Lighting control will be a combination of manual activation of lighting, together with automatic dimming when natural light levels are sufficient, and deactivation of lighting when a space becomes unoccupied,

LED lamps will be used throughout with a luminous efficacy no less than 110 lumens per circuit watt.

The aim for the lighting generally throughout the building is to create comfortable and effective conditions with additional emphasis on achieving environmental and economic objectives. Luminaire types and lamp sources shall be kept to a minimum to ease ongoing maintenance. However, selection will be appropriate to provide bright, even illumination of all surfaces.

4.2 Be Clean

There are no existing district heating networks available in the vicinity of the building. The London heat map shows proposals for potential future district heating networks, but these are currently shown as terminating a distance of around 2 km from the building.

The 'be clean' carbon emissions and energy consumption is the same as "be lean'.

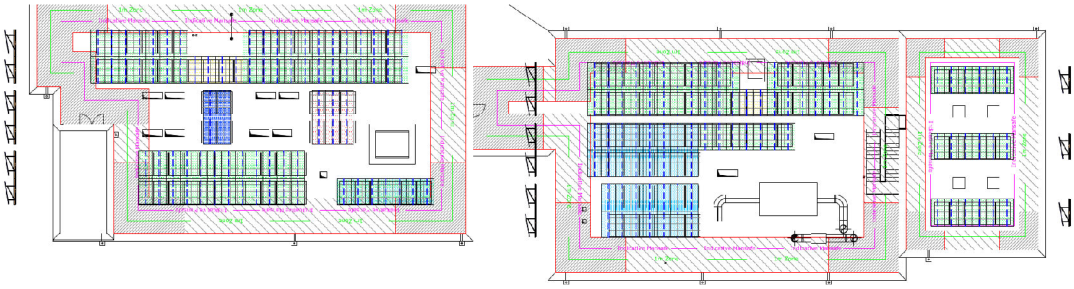
4.3 BE GREEN

Heat Production

For the purposes of the GLA compliant Energy Strategy following the Energy Assessment Guidance (June 2022) the air source heat pumps are introduced at this stage. However, for the DfE approach, the heat pumps are a fundamental element of the Strategy..

Photovoltaic Panels

Photovoltaic panels will be provided to meet the requirements of the Building Regulations and meet the Brief to achieve Net Zero Carbon in Operation. The extent of the potential PV panel installation is as indicated on the drawing below. The quantity shown provides and output of 69kWp, which will be reduced to match the final calculated energy consumption.:



5 BUILDING REGULATIONS COMPLIANCE

The building has been assessed for compliance with Part L of the Building Regulations using the guidance set out Approved Document L, Volume 2, 2021 edition incorporating 2023 amendments.

The performance of the building has been assessed using EDSL TAS software, version 9.5.6.

The input data to the compliance software is set out in the following tables.

5.1 MODELLING INPUTS

5.1.1 Building Fabric

Element or System	Modelled Value
Air Tightness	3.0 $m^3/hr.m^2$
External Wall U-Value*	0.15 W/m^2K
Exposed Floor	0.12 W/m^2K
Roof	0.12 W/m^2K
Window U-Value	1.1 W/m^2K
Glazing G-Value	0.39
Glazing LT	0.7

5.1.2 Lighting

Element or System	Modelled Value
Teaching Spaces	110 lumens/circuit Watt
Offices	110 lumens/circuit Watt
Circulation	110 lumens/circuit Watt
WC, Existing	110 lumens/circuit Watt
Storage	110 lumens/circuit Watt
Controls	Daylight control in all spaces with daylight. Average daylight factors calculated using detailed daylight illuminance light reflectance calculations. Manual on/auto off in classrooms and offices. PIR detection in circulation spaces, toilets, stores etc.

5.1.3 HVAC System Inputs

Element or System	Modelled Value
Classrooms, hall, staff room	
System Type	Mechanical ventilation
Ventilation system Heat Recovery (%)	42%

Element or System	Modelled Value
Ventilation system Specific Fan Power (W/l/s)	0.5
Heating Type	Heating coil in local ventilation unit
Offices, group rooms.	
System Type	Central mechanical ventilation. MVHR unit serving multiple or single zones
Ventilation system Heat Recovery (%)	80%
Ventilation system Specific Fan Power (W/l/s)	1.0 for MVHR serving multiple rooms 0.4 for units serving single spaces
Heating Type	Radiators or radiant panels
HVAC Toilets	
System Type	Extract only mechanical ventilation
Specific Fan Power (W/l/s)	0.3
Heating Type	N/A
Stores	
System Type	Unheated No ventilation.
Server Rooms	
System Type	Local Extract
Specific Fan Power (W/l/s)	0.2
Heating Type	No Heating
Cooling	Process cooling – not included.
Kitchen	
System Type	Local supply and extract
Ventilation system Heat Recovery (%)	No heat recovery
Specific Fan Power (W/l/s)	1
Heating Type	Radiators
Central Plant and Systems - Baseline, Be Lean and Be Clean	
Gas fired boilers	94%
Heating Pumps	Variable speed with differential pressure sensor across pump

Element or System	Modelled Value
Domestic hot water generation	Direct electric heaters
Domestic hot water distribution efficiency	100%
Renewable Energy	None
Weather File	London TRY
Central Plant and Systems - Be Green	
ASHP seasonal efficiency	320%
Heating Pumps	Variable speed with differential pressure sensor across pump
Domestic hot water generation	Direct electric heaters
Domestic hot water distribution efficiency	100%

5.1.4 Calculation of ASHP seasonal coefficient of performance

The seasonal Coefficient of Performance (COP) of 3.23 was calculated based on data from Mitsubishi's technical specifications for the CAHV units, combined with dynamic modelling data from TAS, which includes hourly heating demand and external temperature inputs. Here's a breakdown of the methodology used to determine the seasonal COP:

1. **COP Calculation Across Temperatures**: Using Mitsubishi's CAHV data, the COP was calculated for a variety of outdoor air temperatures (OAT) and water flow temperatures. This enabled the assessment of performance across different conditions.

2. **Flow Temperature Adjustment**: The Low-Temperature Hot Water (LTHW) flow temperature was adjusted based on the outdoor temperature. For instance, a flow temperature of 55°C was used for an OAT of -4°C, while 35°C was used for an OAT of 15°C.

3. **Hourly Lookup of COP Values**: For each hour, the calculated COP was determined by matching the OAT and water flow temperature with the Mitsubishi data, effectively tailoring the COP to the specific conditions at each hour.

4. **Energy Calculation**: The electrical energy used each hour was calculated based on the heating demand and the COP determined for that hour.

5. **Average COP Calculation**: Finally, the seasonal COP was determined by dividing the total annual heating demand by the total annual electrical energy use.

The calculated seasonal COP was 3.23, though a conservative value of 3.20 is used in further calculations to account for minor variations or uncertainties in the modelling or real-world conditions. This value likely aligns closely with the realistic, expected performance of the Mitsubishi CAHV units in varying conditions.

Mitsubishi Capacity Tables

1. Capacity tables

(1) Correction by temperature

• CAHV-P500YA-HPB(-BS)

(1)-1 Efficiency Priority Mode

• Capacity

		Intake air temperature °C															
		-20	-15	-10	-7	-5	0	2	5	7	10	16	20	25	30	35	40
Outlet water temperature °C	35	-	-	40.3	42.2	42.4	42.7	42.8	43.5	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	45	32.0	37.4	40.6	42.4	42.6	42.9	43.0	43.5	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	55	32.2	37.7	40.8	42.7	42.8	43.1	43.2	43.6	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	60	32.2	37.8	40.9	42.8	42.9	43.2	43.3	43.7	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	65	32.2	37.9	41.0	42.9	43.0	43.3	43.4	43.7	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	70	-	-	41.1	43.0	43.1	43.4	43.5	43.7	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0

This table shows the capacity when the relative humidity is 85%.
The intake wet-bulb temperature is fixed to 32°C when the intake dry-bulb temperature is 35°C or higher.

• Power input

		Intake air temperature °C															
		-20	-15	-10	-7	-5	0	2	5	7	10	16	20	25	30	35	40
Outlet water temperature °C	35	-	-	17.0	16.9	16.2	14.7	14.2	12.0	10.9	9.82	8.20	7.40	6.60	6.30	6.02	5.77
	45	18.4	19.4	19.4	19.5	18.7	17.0	16.4	14.2	12.9	11.9	10.1	9.08	8.05	7.73	7.44	7.17
	55	21.2	22.5	22.7	22.8	22.0	20.1	19.5	17.5	16.5	15.2	13.2	12.1	11.0	10.3	9.75	9.24
	60	22.9	24.5	24.8	25.0	24.1	22.1	21.4	19.1	17.8	16.6	14.7	13.6	12.4	11.6	10.8	10.2
	65	24.9	26.8	27.3	27.6	26.7	24.6	23.9	22.2	21.3	19.6	16.9	15.4	14.0	13.0	12.1	11.4
	70	-	-	30.2	30.8	29.8	27.6	26.9	25.7	25.6	23.9	19.9	18.0	16.0	14.8	13.8	12.9

This table shows the power input when the relative humidity is 85%.
The intake wet-bulb temperature is fixed to 32°C when the intake dry-bulb temperature is 35°C or higher.

Calculated COP values

COP																
	-20	-15	-10	-7	-5	0	2	5	7	10	16	20	25	30	35	40
35	-	-	2.371	2.497	2.617	2.905	3.014	3.625	4.128	4.582	5.488	6.081	6.818	7.143	7.475	7.799
45	1.739	1.928	2.093	2.174	2.278	2.524	2.622	3.063	3.488	3.782	4.455	4.956	5.59	5.821	6.048	6.276
55	1.519	1.676	1.797	1.873	1.945	2.144	2.215	2.491	2.727	2.961	3.409	3.719	4.091	4.369	4.615	4.87
60	1.406	1.543	1.649	1.712	1.78	1.955	2.023	2.288	2.528	2.711	3.061	3.309	3.629	3.879	4.167	4.412
65	1.293	1.414	1.502	1.554	1.61	1.76	1.816	1.968	2.113	2.296	2.663	2.922	3.214	3.462	3.719	3.947
70	-	-	1.361	1.396	1.446	1.572	1.617	1.7	1.758	1.883	2.261	2.5	2.813	3.041	3.261	3.488

5.2 PART L RESULTS - DFE

The tables below show the results for the ‘be green’ proposed building.

Consumption (kWh/m²)	Actual	Notional
Heating	5.00	1.72
Cooling	0.00	0.00
Auxiliary	2.81	5.37
Lighting	3.64	6.59
DHW	12.51	11.38
Equipment	24.50	24.50
Displaced Electricity	-50.17	0.00
Total	-1.72	49.55

CO_2 Emissions ($kgCO_2/m^2$)	Actual	Notional
Heating	0.77	0.26
Cooling	0.00	0.00
Auxiliary	0.39	0.73
Lighting	0.52	0.91
DHW	1.74	1.55
*Equipment**	3.39	3.33
Displaced Electricity	-6.30	0.00
Total*	-2.88	3.46

5.3 ENERGY AND CARBON EMISSIONS – GLA SUMMARY TABLES

The tables below are from the GLA Carbon Reporting Spreadsheet.

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-residential buildings.

	Carbon Dioxide Emissions for non-residential buildings (Tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Baseline: Part L 2021 of the Building Regulations Compliant Development	6.4	5.5
After energy demand reduction (be lean)	1.2	5.5
After heat network connection (be clean)	1.2	5.5
After renewable energy (be green)	-1.9	5.5

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-residential buildings

	Regulated non-residential carbon dioxide savings	
	(Tonnes CO_2 per annum)	**(%)**
Be lean: savings from energy demand reduction	5.2	81%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	3.1	48%
Total Cumulative Savings	**8.3**	**130%**
Annual savings from off-set payment	-1.9	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**-57**	-
Cash in-lieu contribution (£)	**-5,372**	

Site Wide Results

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2021 baseline	6.4		
Be lean	1.2	5.2	81%
Be clean	1.2	0.0	0%
Be green	-1.9	3.1	48%
Total Savings	-	8.3	130%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**-56.6**	-

6 CONCEPT ENERGY MODEL

The DfE set energy in use intensity targets in Section 3 of Annex 2H. The To meet the EUI Targets, the energy model shall have energy end use of 52kWhrs/m². This target is to be achieved before the application of renewable technologies.

Section 4 of Annex 2H sets out the modelling methodology that should be followed to demonstrate compliance with this target. For the Concept Energy Model the analysis of the building must be undertaken with some modelling parameters fixed, and others determined by the design (flexible parameters). The fixed and flexible parameters are listed below.

The following can be described as Fixed parameters:

a) School operational schedule (including opening hours and plant operating profile).

b) Room occupancy and internal gains.

c) Weather data.

d) Ventilation supply/extract rates and supply temperature.

e) HVAC system efficiencies.

f) Electrical lighting efficiency.

The following can be described as Flexible parameters:

a) Building geometry (form and orientation)

b) Shading elements.

c) Glazing ratio.

d) Thermal mass of building fabric.

e) HVAC system options]

f) HVAC system fuel.

g) Thermal transmittance (U-Value) of building fabric (with Limiting Values).

h) Building air permeability (with Limiting Values).

i) Glazing G-Value (with Limiting Values)

6.1 INPUT DATA

6.1.1 Building Fabric

Element or System	Modelled Value
Air Tightness	3.0 m³/hr.m²
External Wall U-Value*	0.15 W/m²K
Exposed Floor	0.12 W/m²K

Element or System	Modelled Value
Roof	0.12 W/m²K
Window U-Value	1.10 W/m²K
Glazing G-Value	0.4
Glazing LT	0.7

6.1.2 Lighting

Area	Modelled Value
Teaching Spaces	10 W/m²
Offices	10 W/m²
Circulation	10 W/m²
WC, Existing	10 W/m²
Storage	10 W/m²
Controls	Daylight control in all spaces with daylight. Average daylight factors calculated using detailed daylight illuminance light reflectance calculations. Manual on/auto off in classrooms and offices. PIR detection in circulation spaces, toilets, stores etc.
Car Park	10 lux illuminance. Efficacy of luminaries 100 lumens/circuit watt. Car park area = 500m² Car park lighting on every day between 07.00 and 22.00 when ambient light level below 15 lux
External Walkways	50 lux illuminance. Efficacy of luminaries 100 lumens/circuit watt. Area Served = 1000m² External lighting on every day between 07.00 and 22.00 when ambient light level below 50 lux

6.1.3 Design Temperatures

Area	Winter design temperature	Setback temperature	Summer design temperature
Teaching Spaces	20	5	25
Hall	20	5	25
Offices	20	5	25
Circulation	17	5	25
WC	19	5	15
Kitchen	16	5	26

Area	Winter design temperature	Setback temperature	Summer design temperature
Storage	12	5	25
Plant rooms	12		N/A
Server rooms	19	10	22

6.1.4 Ventilation and Heat Gains

Area	Ventilation Rate	Occupancy Density	ICT Heat Gains, W/m²
Teaching Spaces	8 l/s/person	As SSB	10
Hall	2.25 l/s/m²25	As SSB	N/A
Offices	12 l/s/person	3 people	10
Circulation	1.25 l/s/m²	N/A	N/A
WC	6 l/s/cubicle	As SSB	N/A
Kitchen	1.2 l/s/m²	10 m²/person	N/A
Storage	0.3 l/s/m²	N/A	N/A
Plant rooms	0.3 l/s/m²	N/A	N/A
Server rooms	8 l/s/person	3 people	250

Sensible heat gains 70W/person.

6.1.5 Systems

Element or System	Modelled Value
Rooms served by hybrid ventilation unit	
System Type	Heated and mechanically ventilated Zonal supply system
Auxiliary Energy	2.5 W/l/s
Offices, Group rooms, spaces served by MVHR units	
System Type	Heated and mechanically ventilated Centralised balanced mechanical ventilation
Auxiliary Energy	3 W/l/s
Naturally ventilated circulation spaces	
System Type	Heated and mechanically ventilated
Auxiliary Energy	1.23 W/m²
Toilets	

Element or System	Modelled Value
System Type	Heated and Mechanical Ventilation Local extract
Auxiliary Energy	0.75 W/l/s
Stores	
System Type	Heated and natural ventilation
Auxiliary Energy	1.23 W/m²
Server Rooms	
System Type	Fully air conditioned Local extract
Auxiliary Energy	0.75 W/l/s
Kitchen	
System Type	Heated and Mechanical Ventilation Centralised balanced mechanical ventilation
Auxiliary Energy	3 W/l/s

6.1.6 Other Parameters

Other Parameters	Modelled Value
Occupied period	As Annex 2H tables 3 and 4 194 Occupied days
Catering	100% of pupils assumed to have meals every day @ 0.3kWhrs/meal. 3kWhrs per day refrigeration.
ASHP seasonal efficiency	250%
Domestic hot water Use	5 l/day/person 48 pupils 35 full time equivalent staff Total consumption 234l/day.
Domestic hot water Generation	Direct electric heaters
Weather File	London TRY

6.2 RESULTS

Parameter	Target Value, kWhrs/m²	Building Value, kWhrs/m²
Heating	8	5.1
Hot Water	5	2.9
Internal lighting	8	4.8
Fans and pumps	5	7.9
Cooling	0	10.6
Lifts	1	0.5
Building related services	2	1.0
External Lighting	6	0.5
Small power	15	15.0
Catering	7	2.9
Total	**57**	**51.2**

The predicted energy consumption by the concept energy model betters the target value. The items which are higher than the target values are the fans and pumps, and the cooling energy use.

The fans and pumps are higher due to the fan usage resulting from the external acoustic environment and the need to ventilate the building using primarily mechanical ventilation throughout the year, as it is not possible to open the windows and take the benefit of natural ventilation.

The cooling requirement is from the hub room and server room, which are provided with cooling to meet the temperature criteria set based on heat gains from equipment of 250 W/m².

7 DEVELOPED ENERGY MODEL

The developed energy model is intended to be a realistic representation of the final design of the project.

Annex 2H states that:

The model shall reflect the final design specifications including updated values such as:

a) predicted School use patterns

b) the final construction data

c) detailed HVAC system performance specifications

d) expected DHW and other unregulated energy consumptions

e) expected controls strategy

and:

The Contractor shall prove that the design can meet the energy targets through energy modelling using the methodology defined in CIBSE TM54, as detailed in Section 4.

The developed energy model is generated using the methodology set out in CIBSE TM54.

7.1 INPUT DATA

7.1.1 Building Fabric

Element or System	Modelled Value
Air Tightness	3.0 $m^3/hr.m^2$
External Wall U-Value*	0.15 W/m^2K
Exposed Floor	0.12 W/m^2K
Roof	0.12 W/m^2K
Window U-Value	1.10 W/m^2K
Glazing G-Value	0.4
Glazing LT	0.7

7.1.2 Occupancy Period

School Hours

As Annex 2H tables 3 and 4

7.1.3 Lighting

Area	Modelled Value
Teaching Spaces	4 W/m²
Offices	4 W/m²
Circulation	2.5 W/m²
WC	2.5 W/m²
Storage	2.5 W/m²
Controls	Lighting assumed to be 'on' when rooms occupied. See occupancy input assumptions. Daylight control in all spaces with daylight. Average daylight factors calculated using detailed daylight illuminance light reflectance calculations. Manual on/auto off in classrooms and offices. PIR detection in circulation spaces, toilets, stores etc.
Car Park	10 lux illuminance. Efficacy of luminaries 100 lumens/circuit watt. Car park area = 500m² Car park lighting on every day between 07.00 and 22.00 when ambient light level below 15 lux
External Walkways	50 lux illuminance. Efficacy of luminaries 100 lumens/circuit watt. Area Served = 1000m² External lighting on every day between 07.00 and 22.00 when ambient light level below 50 lux

7.1.4 Design Temperatures

Area	Winter design temperature	Setback temperature
Teaching Spaces	20	5
Hall	20	5
Offices	20	5
Circulation	17	5
WC	19	5
Kitchen	16	5
Storage	12	5
Plant rooms	12	
Server rooms	19	10

7.1.5 Ventilation

Area	Ventilation Rate

Teaching Spaces	To suit overheating and air quality requirements.
Hall	To suit overheating and air quality requirements.
Admin Offices	To suit overheating and air quality requirements.
Staff Room	To suit overheating and air quality requirements.
Circulation	Natural ventilation
WC	6 l/s/cubicle
Kitchen	1.2 l/s/m²
Storage	Infiltration allowance
Plant rooms	0.3 air changes per hour
Server rooms	1 air change per hour

7.1.6 Occupancy

Area	Occupancy Density
Classrooms and science studio, teaching transition room	1 person – 08.00-09.00 14 people 09.00-12.00 14 people 13.00-16.00 1 person – 16.00-17.00
Art and design and food room	1 person – 08.00-09.00 10 people 09.00-12.00 10 people 13.00-16.00 1 person – 16.00-17.00
Fitness	1 person – 08.00-09.00 18 people 09.00-12.00 18 people 13.00-16.00 1 person – 16.00-17.00
Main Hall	92 people 09.00-10.00 30 people 10.00-14.00 92 people14.00-15.00 30 people15.00-16.00
Group Rooms 01-03	5 people 09.00-12.00 5 people 13.00-17.00
Group Rooms 04	11 people 09.00-12.00 11 people 13.00-17.00
Library	9 people 09.00-12.00 9 people 13.00-17.00
Staff Room	25 people – 08.00-09.00 5 people – 09.00-12.00 25 people – 12.00-13.00

Area	Occupancy Density
	5 people – 13.00-16.00 25 people – 16.00-17.00
Head teacher office	1 person – 08.00-11.00 6 people – 11.00-12.00 1 person – 12.00-15.00 4 person – 15.00-16.00 1 person – 16.00-17.00
General Office	2 people – 08.00-09.00 4 people – 09.00-12.00 2 people – 12.00-13.00 4 people – 13.00-16.00 2 people – 16.00-17.00
Parent's Room, Office/meeting rooms (2 person)	2 people – 08.00-09.00 6 people – 09.00-10.00 2 people – 12.00-13.00 4 people – 13.00-14.00 2 people – 14.00-15.00 4 people – 15.00-16.00 2 people – 16.00-17.00
Premises office	1 people – 08.00-09.00 3 people – 09.00-10.00 1 people – 12.00-13.00 2 people – 13.00-14.00 1 people – 14.00-15.00 2 people – 15.00-16.00 1 people – 16.00-17.00
Circulation, inc entrances	Unoccupied. Lighting on 08.00-16.00
WCs	Assumed WCs occupied for 2 hours per day.
Kitchen	10 m²/person
Storage	Lighting on 1 hour per day
Plant rooms	N/A
Server rooms	Unoccupied

Sensible heat gains 70W/person.

7.1.7 ICT Heat Gains

The following heat gains are allowed for to calculate the airflow rate required to avoid over-heating. The annual energy consumption for small power is calculated using the method set out in 7.1.9.

Area	Casual Heat Gains, W/m²
Teaching Spaces	10
Hall	N/A
Admin Offices	10
Staff Room	N/A
Circulation	N/A
WC	N/A
Kitchen	N/A
Storage	N/A
Plant rooms	20
Server rooms	Server 100w/m2, hub 50W/m2

7.1.8 Systems

Element or System	Modelled Value
Classrooms, staff room	
System Type	Hybrid ventilation units.
Heating Type	Heating coil in ventilation unit
Auxiliary energy	As Monodraught HVR Zero X + Boost mode SFP - 0.12 Nighttime mode SFP - 0.23 Winter heat recovery SFP - 0.305
Offices, group rooms.	
System Type	Central mechanical ventilation. MVHR unit serving multiple or single zones
Ventilation system Heat Recovery (%)	80%
Ventilation system Specific Fan Power (W/l/s)	0.8 for MVHR serving multiple rooms 0.4 for units serving single spaces
Heating Type	Radiators or radiant panels
HVAC Toilets	
System Type	Extract only mechanical ventilation
Specific Fan Power (W/l/s)	0.3

Element or System	Modelled Value
Heating Type	N/A
Stores	
System Type	Unheated No ventilation.
Server Rooms	
System Type	Local Extract
Specific Fan Power (W/l/s)	0.2
Heating Type	DX heating, SCOP 3.33
Cooling	DX cooling, SEER 3.33
Kitchen	
System Type	Local supply and extract
Ventilation system Heat Recovery (%)	No heat recovery
Specific Fan Power (W/l/s)	0.8
Heating Type	Radiators

7.1.9 Other Parameters

Other Parameters	Modelled Value
Occupied period	As Annex 2H tables 3 and 4 194 Occupied days
Catering	100% of pupils assumed to have meals every day @ 0.3kWhrs/meal. 3kWhrs per day refrigeration.
ASHP seasonal efficiency	250%
Domestic hot water Use	5 l/day/person 48 pupils 35 full time equivalent staff Total consumption 234l/day.
Renewable Energy	58.4kWp PV collector array
Domestic hot water Generation	Direct electric heaters
Weather File	London TRY

7.1.10 Small Power Energy Use

We have assumed a small power energy use of 15kWhrs/m². A detailed analysis of IT and other energy use is required to provide a TM54 model to the expected level of accuracy.

7.2 RESULTS

The table below shows the predicted energy consumption of the building

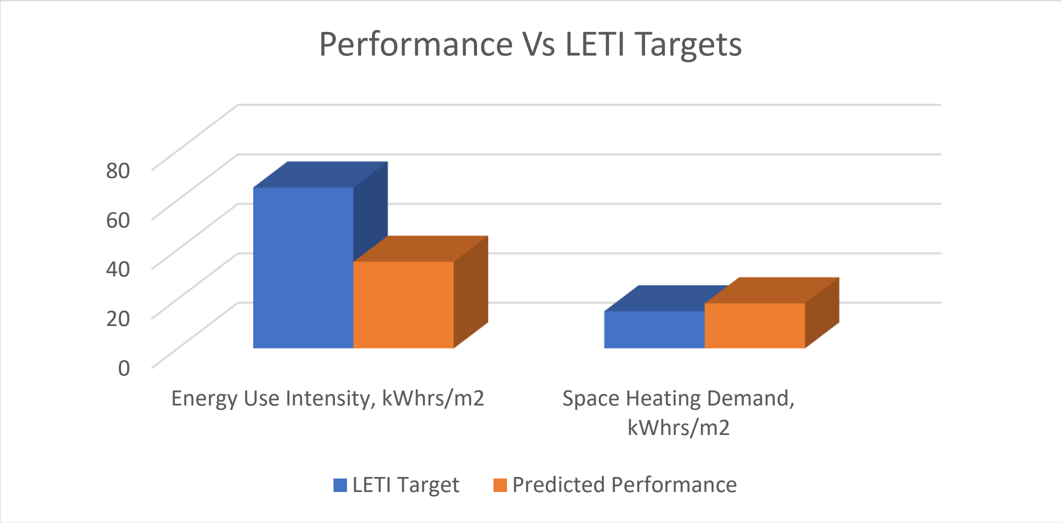
Parameter	Building Value, kWhrs/m²
Heating	5.7
Hot Water	3.4
Internal lighting	2.5
Fans and pumps	1.9
Cooling	1.6
Lifts	0.5
Building related services	1.0
External Lighting	0.5
Small power	15.0
Catering	2.9
Community Use	0
Total	**35**

Total energy consumption is predicted to be 55.4MWhrs per year.

The capacity of PV panels required to achieve net zero in use, based on the assumptions stated in this report, is 58.4kWp based on an output of 950kWhrs/kWp.

7.2.1 Comparison with LETI

The graphic below compares the predicted operational energy consumption and heating demand with the LETI targets for Schools:



7.2.2 Risks and Uncertainty

The main areas of risk and uncertainty are the energy used for external lighting, small power use, lifts, and catering. The facts are likely to make the greatest difference is the small power use, and a detailed breakdown of the likely use of IT and other power consuming equipment, along with his energy consumption, is required to assess the small power energy consumption in more detail.

In addition, a better understanding of the catering facilities and number and type of meals being served will allow a better assessment of the catering energy consumption, and also may impact the estimate of domestic hot water use.

8 PERFORMANCE IN USE – BE SEEN

Energy meters will be provided as required by Annex 2H and Annex 2L. The following will be metered.

- incoming mains water
- main electrical intake kitchen general power
- individual lighting circuits
- external lighting
- a source heat pumps
- other mechanical services items
- server rooms power
- general power to each floor in phase I and phase II
- lighting energy use on each floor in phase I and phase II
- electricity generated by solar PV panels
- EV charging points

The iSERV methodology will be used to automatically monitor and report on the energy and water use of the School. The reporting of consumption and performance in use of the buildings will be carried out using the K2n system.

A1 DESIGN STAGE ‘BE GREEN’ BRUKL

BRUKL Output Document

Compliance with England Building Regulations Part L 2021

Project name

Burnside PRU

As designed

Date: Tue Oct 29 09:54:23 2024

Administrative information

Building Details

Address: BE GREEN, London,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.6"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.6

BRUKL compliance module version: v6.1.e.0

Certifier details

Name: Barry Redman

Telephone number:

Address: , ,

Foundation area [m²]: 743.44

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	3.45	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	-1.16	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	37.17	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	-16.63	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	First surface with maximum value
Walls*	0.26	0.15	0.15	External Wall
Floors	0.18	0.15	0.15	Ground Floor
Pitched roofs	0.16	0.12	0.12	Roof
Flat roofs	0.18	-	-	No flat roofs in project
Windows** and roof windows	1.6	1.07	1.09	Food door
Rooflights***	2.2	1.07	1.08	Classroom rooflight
Personnel doors^	1.6	1.4	1.47	Int Vent opening
Vehicle access & similar large doors	1.3	-	-	No vehicle access or similar large doors in project
High usage entrance doors	3	-	-	No high usage entrance doors in project

$U_{a-Limit}$ = 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
$m^3/(h.m^2)$ 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	0.9 to 0.95

1- Heated and vent

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

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

2- Central MVHR (5 Zones)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	3.2	-	-	1	0.7
Standard value	0.93*	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 gas single boiler systems <=2 MW output and overall for multi-boiler systems. For single boiler systems >2 MW or any individual boiler in a multi-boiler system, limiting efficiency is 0.88.

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

3- Toilet systems (13 Zones)

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

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

4- Classroom Vent (15 Zones)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	3.2	-	-	-	0.42
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.

5- Hub cooling (2 Zones)

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

6- 3003 Group 01 (8 Zones)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	3.2	-	-	-	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.

7- Kitchen (6001 Kitchen)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.2	-	-	1	-
Standard value	0.93*	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 gas single boiler systems <=2 MW output and overall for multi-boiler systems. For single boiler systems >2 MW or any individual boiler in a multi-boiler system, limiting efficiency is 0.88.

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

1- New HWS Circuit

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.91	0
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**
1001 Classroom 01	-	-	-	-	0.3	-	-	-	-	-	N/A
1002 Classroom 02	-	-	-	-	0.3	-	-	-	-	-	N/A
1004 Classroom 03	-	-	-	-	0.3	-	-	-	-	-	N/A
1003 Classroom 04	-	-	-	-	0.3	-	-	-	-	-	N/A
1103 Class Food room 01	-	-	-	-	0.3	-	-	-	-	-	N/A
1104 Class Fitness Suite	-	-	-	-	0.3	-	-	-	-	-	N/A
1102 Class Art and Design Studio	-	-	-	-	0.3	-	-	-	-	-	N/A
1101 Class Science Studio	-	-	-	-	0.3	-	-	-	-	-	N/A
1005 Classroom 05	-	-	-	-	0.3	-	-	-	-	-	N/A
1006 Classroom 06	-	-	-	-	0.3	-	-	-	-	-	N/A
3001 Teach Library	-	-	-	-	0.3	-	-	-	-	-	N/A
3008 TeachTransition Room	-	-	-	-	0.3	-	-	-	-	-	N/A
3003 Group 01	-	-	-	0.4	-	-	-	-	-	-	N/A
3004 Group 02	-	-	-	0.4	-	-	-	-	-	-	N/A
3005 Group 03	-	-	-	0.4	-	-	-	-	-	-	N/A
3006 Group 04	-	-	-	0.4	-	-	-	-	-	-	N/A
4001 Office Staff room	-	-	-	-	0.3	-	-	-	-	-	N/A
4004 Office Gen Office	-	-	-	0.4	-	-	-	-	-	-	N/A

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**
4008 Office	-	-	-	0.4	-	-	-	-	-	-	N/A
4009 Office DSL	-	-	-	0.4	-	-	-	-	-	-	N/A
2001 Hall	-	-	-	-	0.3	-	-	-	-	-	N/A
6007 D1_Edu_WC01	0.3	-	-	-	-	-	-	-	-	-	N/A
6008 D1_Edu_WC02	0.3	-	-	-	-	-	-	-	-	-	N/A
6015 D1_Edu_AWC	0.3	-	-	-	-	-	-	-	-	-	N/A
6009 D1_Edu_WC03	0.3	-	-	-	-	-	-	-	-	-	N/A
6006 D1_Edu_Toilet 6	0.3	-	-	-	-	-	-	-	-	-	N/A
6010 D1_Edu_Toilet 8	0.3	-	-	-	-	-	-	-	-	-	N/A
6016 D1_Edu_Toilet 9	0.3	-	-	-	-	-	-	-	-	-	N/A
2002 Dining	-	-	-	-	0.3	-	-	-	-	-	N/A
3002 SEN MI	-	-	-	0.4	-	-	-	-	-	-	N/A
6016 D1_Edu_Toilet 10	0.3	-	-	-	-	-	-	-	-	-	N/A
6004 D1_Edu_Acc/staff	0.3	-	-	-	-	-	-	-	-	-	N/A
6005 D1_Edu_Acc/staff	0.3	-	-	-	-	-	-	-	-	-	N/A
6013 D1_Edu_Toilet 13	0.3	-	-	-	-	-	-	-	-	-	N/A
6012 D1_Edu_Toilet 14	0.3	-	-	-	-	-	-	-	-	-	N/A
6011 D1_Edu_Toilet 15	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
1001 Classroom 01	120	-	-
1002 Classroom 02	120	-	-
1004 Classroom 03	120	-	-
1003 Classroom 04	120	-	-
1103 Class Food room 01	120	-	-
1104 Class Fitness Suite	120	-	-
1102 Class Art and Design Studio	120	-	-
1101 Class Science Studio	120	-	-
1005 Classroom 05	120	-	-
1006 Classroom 06	120	-	-
3001 Teach Library	120	-	-
3008 TeachTransition Room	120	-	-
3003 Group 01	120	-	-
3004 Group 02	120	-	-
3005 Group 03	120	-	-
3006 Group 04	120	-	-
5014 D1_Edu_Store 2	110	-	-
5003 D1_Edu_Store 3	110	-	-
5001 D1_Edu_Store 4	110	-	-
4011 D1_Edu_Laundry	110	-	-
5012D1_Edu_Store 7	110	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
5010 D1_Edu_Store 8	110	-	-
5009 D1_Edu_Store 9	110	-	-
5008 D1_Edu_Store 10	110	-	-
5006 D1_Edu_Store 11	110	-	-
5013 D1_Edu_Store 12	110	-	-
4001 Office Staff room	110	-	-
4003 Office Head's office	110	-	-
4004 Office Gen Office	110	-	-
4005 Office Parent's Room	110	-	-
4010 Office Premises Office	110	-	-
4008 Office	110	-	-
4009 Office DSL	110	-	-
4006 Visitor Entrance	110	-	-
4007 Office Sick Bay	95	-	-
Main Plant	120	-	-
6202 Hub	120	-	-
6201 Server	120	-	-
2001 Hall	120	-	-
6007 D1_Edu_WC01	110	-	-
6008 D1_Edu_WC02	110	-	-
6015 D1_Edu_AWC	110	-	-
6009 D1_Edu_WC03	110	-	-
6006 D1_Edu_Toilet 6	110	-	-
6010 D1_Edu_Toilet 8	110	-	-
6016 D1_Edu_Toilet 9	110	-	-
63xx Circ Grd Phase 1	95	-	-
6302 Circ Stair 01	95	-	-
6301 Circ Stair 02	95	-	-
63xx Circ Grd Phase 2	95	-	-
63xx Circ 1st Phase 1	95	-	-
2002 Dining	120	-	-
6001 Kitchen	120	-	-
6016 Roof access	95	-	-
5017 clnr 01 D1_Edu_Store 13	110	-	-
3002 SEN MI	120	-	-
5011 D1_Edu_Store 17	110	-	-
5018 clnr 02 D1_Edu_Store 18	110	-	-
5002 D1_Edu_Store 19	110	-	-
5004 D1_Edu_Store 20	110	-	-
5005 D1_Edu_Store 21	110	-	-
6016 D1_Edu_Toilet 10	110	-	-
6004 D1_Edu_Acc/staff	110	-	-
6005 D1_Edu_Acc/staff	110	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
6013 D1_Edu_Toilet 13	110	-	-
6012 D1_Edu_Toilet 14	110	-	-
6011 D1_Edu_Toilet 15	110	-	-
5007 D1_Edu_Store 22	110	-	-
5019 clnr 03	110	-	-
5016 Lockers	110	-	-
4002 Multi function bay	110	-	-
Entrance Lobby	95	-	-
63xx 1st staff rm circ	95	-	-
63xx 1st sen circ	95	-	-

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?
1001 Classroom 01	NO (-58%)	NO
1002 Classroom 02	NO (-58%)	NO
1004 Classroom 03	NO (-39%)	NO
1003 Classroom 04	NO (-39%)	NO
1103 Class Food room 01	NO (-75%)	NO
1104 Class Fitness Suite	NO (-60%)	NO
1102 Class Art and Design Studio	NO (-64%)	NO
1101 Class Science Studio	NO (-59%)	NO
1005 Classroom 05	NO (-39%)	NO
1006 Classroom 06	NO (-39%)	NO
3001 Teach Library	NO (-50%)	NO
3008 TeachTransition Room	NO (-80%)	NO
3003 Group 01	N/A	N/A
3004 Group 02	NO (-69%)	NO
3005 Group 03	NO (-66%)	NO
3006 Group 04	NO (-94%)	NO
4001 Office Staff room	NO (-77%)	NO
4003 Office Head's office	NO (-60%)	NO
4004 Office Gen Office	N/A	N/A
4005 Office Parent's Room	NO (-82%)	NO
4010 Office Premises Office	NO (-63%)	NO
4008 Office	NO (-81%)	NO
4009 Office DSL	NO (-66%)	NO
4006 Visitor Entrance	NO (-74%)	NO
2001 Hall	NO (-56%)	NO
2002 Dining	NO (-40%)	NO
3002 SEN MI	N/A	N/A

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	1625	1625
External area [m^2]	3721	3721
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	727	908
Average U-value [W/m^{2}K]	0.2	0.24
Alpha value* [%]	34.26	19.26

* 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	3.59	1.69
Cooling	0	0
Auxiliary	2.81	5.37
Lighting	3.64	6.59
Hot water	12.51	11.38
Equipment*	24.5	24.5
TOTAL**	**22.54**	**25.03**

* 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	34.77	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*34.77*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	43.49	16.92
Primary energy [kWh$_{PE}$/m^2]	-16.63	37.17
Total emissions [kg/m^2]	-1.16	3.45

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	6.5	0	0.6	0	1.3	3.2	0	3.2	0
	Notional	11.6	0	1.2	0	1.3	2.64	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity										
	Actual	21.2	0	1.8	0	3.9	3.2	0	3.2	0
	Notional	12.1	0	1.3	0	4	2.64	0	----	----
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	4.1	0	0.4	0	12.1	3.2	0	3.2	0
	Notional	3.6	0	0.4	0	15.7	2.64	0	----	----
[ST] Central heating using air distribution, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	72.3	0	6.3	0	3.1	3.2	0	3.2	0
	Notional	23.3	0	2.5	0	7.7	2.64	0	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	34.1	0	3	0	4.7	3.2	0	3.2	0
	Notional	20.1	0	2.1	0	8.6	2.64	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity										
	Actual	72.7	0	6.3	0	7.3	3.2	0	3.2	0
	Notional	5.4	0	0.6	0	5.2	2.64	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

A2 DESIGN STAGE PREDICTED EPC

Energy Performance Certificate
Non-Domestic Building

HM Government

BE GREEN
London

Certificate Reference Number:
4623-4410-9909-2306-2412

This certificate shows the energy rating of this building. It indicates the energy efficiency of the building fabric and the heating, ventilation, cooling and lighting systems. The rating is compared to two benchmarks for this type of building: one appropriate for new buildings and one appropriate for existing buildings. There is more advice on how to interpret this information in the guidance document *Energy Performance Certificates for the construction, sale and let of non-dwellings* available on the Government's website at www.gov.uk/government/collections/energy-performance-certificates.

Energy Performance Asset Rating

More energy efficient

A+

-4 **This is how energy efficient the building is.**

Net zero CO_2 emissions

A 0-25
B 26-50
C 51-75
D 76-100
E 101-125
F 126-150
G Over 150

Less energy efficient

Technical information

Main heating fuel: Other
Building environment: Heating and Mechanical Ventilation
Total useful floor area (m^2): 1625
Building complexity: Level 5
Building emission rate ($kgCO_2/m^2$ per year): -1.16
Primary energy use (kWh_{PE}/m^2 per year): -16.63

Benchmarks

Buildings similar to this one could have ratings as follows:

12 If newly built

46 If typical of the existing stock

Administrative information

This is an Energy Performance Certificate as defined in the Energy Performance of Buildings Regulations 2012 as amended.

Assessment Software:	TAS v9.5.6 using calculation engine TAS v9.5.6
Property Reference:	UPRN-123456789012
Assessor Name:	Barry Redman
Assessor Number:	ABCD123456
Accreditation Scheme:	Information not available
Assessor Qualifications:	NOS5
Employer/Trading Name:	
Employer/Trading Address:	
Issue Date:	29 Oct 2024
Valid Until:	28 Oct 2034 (unless superseded by a later certificate)
Related Party Disclosure:	Not related to the owner

Recommendations for improving the energy performance of the building are contained in the associated Recommendation Report: 7353-7802-5072-1499-7116

About this document and the data in it

This document has been produced following an energy assessment undertaken by a qualified Energy Assessor, accredited by Information not available. You can obtain contact details of the Accreditation Scheme at Information not available.

A copy of this certificate has been lodged on a national register as a requirement under the Energy Performance of Buildings Regulations 2012 as amended. It will be made available via the online search function at www.ndepcregister.com. The certificate (including the building address) and other data about the building collected during the energy assessment but not shown on the certificate, for instance heating system data, will be made publicly available at www.opendatacommunities.org.

This certificate and other data about the building may be shared with other bodies (including government departments and enforcement agencies) for research, statistical and enforcement purposes. For further information about how data about the property are used, please visit www.ndepcregister.com. To opt out of having information about your building made publicly available, please visit www.ndepcregister.com/optout.

There is more information in the guidance document *Energy Performance Certificates for the construction, sale and let of non-dwellings* available on the Government website at: www.gov.uk/government/collections/energy-performance-certificates. It explains the content and use of this document and advises on how to identify the authenticity of a certificate and how to make a complaint.

Opportunity to benefit from a Green Deal on this property

The Green Deal can help you cut your energy bills by making energy efficiency improvements at no upfront costs. Use the Green Deal to find trusted advisors who will come to your property, recommend measures that are right for you and help you access a range of accredited installers. Responsibility for repayments stays with the property - whoever pays the energy bills benefits so they are responsible for the payments.

To find out how you could use Green Deal finance to improve your property please call 0300 123 1234.

A3 GLA TABLES 1-5, 9 AND 10

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

TABLE 2. DEVELOPMENT DETAILS		Further notes	Response	Supporting comments (or signpost sections in the energy assessment)
Application details	Date of Application	Please provide the date the application was submitted to the Local Planning Authority.		
	Local Planning Authority	Please indicate the Local Planning Authority determining the application.	*Waltham Forest*	
	Confirmed carbon offset price (£/tonne of carbon dioxide)	Please confirm the agreed carbon offset price for the Local Planning Authority. If no value is entered then the GLA's recommend price of £95 per tonne of carbon dioxide will be used.		
	Evidence of communication on the carbon offset price included in the energy assessment (Y/N).			
	Residential units number (Part L1)		*0*	
	Non-residential floor area in m^2 (Part L2)		*1625.00*	
Heat risk	CIBSE TM59 undertaken for residential development (Y/N)			
	CIBSE TM52 undertaken for non-residential development (Y/N)		*Y*	
	All sample units meet CIBSE criteria with DSY1 weather file (Y/N)			
	DSY2 and DSY3 included in overheating assessments (Y/N)		*N*	*Overheating risk assessment undertaken following DfE*
	Residential g-value			
	% Glazing Ratio over façade			
	External shading proposed (Y/N)		*N*	
Energy efficiency measures	Target Fabric Energy Efficiency met (Y/N)			
	Mechanical Ventilation with Heat Recovery included (Y/N)		*Y*	
	Waste Water Heat Recovery (Y/N)		*N*	
	Low energy lighting (Y/N)		*Y*	
District heating connection	Development in a Heat Network Priority Area (HNPA) (Y/N)		*N*	
	District Heating Network connection (Y/N)		*N*	
	Name of District Heating Network			
	Carbon factor ($kgCO_2$/ kWh)			
	Borough energy officer and Heat Network Operator contacted and evidence of correspondence included in the energy strategy (Y/N)	Applicable to all applications.	*N*	
Site heating distribution configuration	Development future proofed for DHN connection (Y/N)	Note that individual heating systems would not be appropriate for developments in HNPAs.	*N*	
	Drawings of communal system provided (Y/N)	Applicants should provide a drawings of the energy centre, on-site communal network with all building uses connected and future proofing arrangements detailed, including single point of connection.	*N*	
	Distribution type		*Individual systems*	
	Flow temperature (°C)		*55.00*	
	Return temperature (°C)		*45.00*	
	Distribution losses modelled (%)	See table 4 below for details.	*0.00*	
Heating system performance	Heat Pump (Y/N)		*Y*	
	Heat Pump source		*Air*	
	Centralised Heat Pump capacity (kWth)		*180.00*	
	Heat Pump Seasonal Heating Efficiency (SCoP)		*3.20*	
	Heat Pump SCoP calculation includes heat source and heat distribution temperature and seasonal performance factor (Y/N)	See table 5 below for details.	*Y*	
	Fraction of heat supplied by heat pump (only for hybrid systems with boilers) (%)			
	Low-emission on-site CHP enabling an area-wide heat network (Y/N)	<u>Only</u> low-emission CHP is suitable and <u>only</u> where it is facilitating an area-wide heat network. Therefore, new gas engine CHP is not suitable for any other purpose for new developments.	*N*	
	CHP (kWe)			
	Estimated end user cost (pence/kWh)			
	Energy assessment includes consideration of occupant running costs (Y/N)	Applicants should consider the estimated costs to occupants of the energy assessment and outline how they are committed to protecting the consumer from high prices.		
Solar technologies	Solar PV included (Y/N)		*Y*	
	Roof layout demonstrating solar PV technologies have been maximised included in energy strategy (Y/N)		*Y*	
	kWh generated		*55400.00*	
	kWp		*69.20*	
	Total PV panel area (m^2) installed		*297.00*	
	Solar Thermal included (Y/N)		*N*	
	Solar Thermal panel area (m^2) installed		*0.00*	
Flexibility and peak energy demand	Site-wide peak demand, capacity and flexibility potential included in energy assessment (Y/N)	Table 9 in the energy assessment guidance to be completed.	*N*	
	Interventions for achieving flexibility included in energy assessment (Y/N)	Table 10 in the energy assessment guidance to be completed.	*N*	
	Estimated peak demand (MW)			
	Electrical energy storage (kWh) capacity			
	Heat energy storage (kWh) capacity		*0.00*	
Other technologies	System type (e.g. wind turbine)			
	Capacity (kW)		*0.00*	
Cooling	Cooling proposed - Residential (Y/N)	It is not expected that 'active cooling' will be proposed for any residential developments. It will be expected that applicants can fully demonstrate that all passive design measures have been thoroughly investigated before considering 'active cooling'.		
	Cooling proposed - Non-residential (Y/N)		*N*	

	Residential Cooling consumption (kWh p.a.)	See note in cell C60.		
	Commercial Cooling consumption (MJ p.a.)			

TABLE 3. BESPOKE DH CARBON FACTOR CALCULATION METHODOLOGY

Please provide below details of the calculation methodology followed to establish the bespoke carbon factor, if applicable.

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

TABLE 5. SEASONAL COEFFICIENT OF PERFORMANCE (SCOP) CALCULATION METHODOLOGY

The seasonal Coefficient of Performance (COP) of 3.23 was calculated based on data from Mitsubishi's technical specifications for the CAHV units, combined with dynamic modeling data from TAS, which includes hourly heating demand and external temperature inputs. Here's a breakdown of the methodology used to determine the seasonal COP:

COP Calculation Across Temperatures: Using Mitsubishi's CAHV data, the COP was calculated for a variety of outdoor air temperatures (OAT) and water flow temperatures. This enabled the assessment of performance across different conditions.

Flow Temperature Adjustment: The Low-Temperature Hot Water (LTHW) flow temperature was adjusted based on the outdoor temperature. For instance, a flow temperature of 55°C was used for an OAT of -4°C, while 35°C was used for an OAT of 15°C.

Hourly Lookup of COP Values: For each hour, the calculated COP was determined by matching the OAT and water flow temperature with the Mitsubishi data, effectively tailoring the COP to the specific conditions at each hour.

Energy Calculation: The electrical energy used each hour was calculated based on the heating demand and the COP determined for that hour.

Average COP Calculation: Finally, the seasonal COP was determined by dividing the total annual heating demand by the total annual electrical energy use.

The calculated seasonal COP was 3.23, though a conservative value of 3.20 was used in further calculations to account for minor variations or uncertainties in the modeling or real-world conditions. This value likely aligns closely with the realistic, expected performance of the Mitsubishi CAHV units in varying conditions.

DEMAND MANAGEMENT

The building incorporates a 58.4kWp PV array on the building roof contributing a significant proportion of the building energy use.

The power generated will be used within the school building and any excess power will be exported. Battery storage is not proposed because it is not anticipated that the building will be used outside of daylight hours when stored power could be used.

The space heating and hot water is generated by air source heat pumps and the peak demands are reduced through the use of thermal storage, a minimum thermal store capacity of 17.5KWh will be made available.

The tables below summarise the building peak energy demands and measures to increase flexibility of energy demand.

Table 9 – Summary of Sitewide Peak Demand, Capacity and Flexibility Potential

	Electrical	Heat	Estimated through...
Estimated peak demand (MW)	0.211	0.0	Calculated estimates of connected loads, peak demand and realist diversities
Available Capacity (MW)	0.5	0.0	Engagement with regional DNO to establish available capacity.
Flexibility Potential	0.062	0.0	
Revised Peak Demand (MW)	0.149	0.0	
Percent Flexibility	30%	0.0	

Table 10 – Summary of Interventions for Achieving Flexibility

Flexibility achieved through	Yes/No	Details
Electrical energy storage (KWh) capacity	No	-
Heat energy storage (KWh) capacity	Yes	17.5KWh available from 2 no. 750L (0.75m^3) buffer vessels.
Renewable energy generation (load matching)	Yes	58.4kWp photovoltaic array located on roof of school
Gateway to enable automated demand response	No	-
Smart Systems integration (e.g. smart charge points for EV, gateway etc.)	Yes	Automatic controls provided to 95% of lighting throughout the building (presence and absence detection and daylight compensated dimming). EV charging load management was considered, not included due to the low number of EV charging points and Parking spaces.
Other initiative	No	-