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Brunner House

Energy Statement

Channing School

November 2023

Document History

This document has been revised and issued as below:

Revision	Date	Description	Created by	Approved by
P01	07/12/23	Energy Statement & LZC Feasibility Study	SSP	BXP

Executive Summary

Method Consulting LLP has been appointed to produce an Energy Statement as part of the Planning application for the proposed new development at Channing School. Furthermore, a Low and Zero Carbon Feasibility Study has been performed as part of the BREEAM New Construction V6 assessment. Both assessments have been conducted on behalf of Channing School

The proposed development consists of both a refurbished existing building and an extension, with this energy statement focused solely on the extension. This statement has been prepared to demonstrate only where the extension of the proposed development meets or exceeds the recommendations of the London Plan 2021 as per the GLA Energy Assessment Guidance (June 2022), and the Haringey local plan. The proposed new development is categorised as a minor development, but under local policy must still adhere to the London Plan's Energy Hierarchy for a major development. However, as noted in the 'pre-application planning advice note', this proposal does not require the "Be Seen" stage of the London Plan energy hierarchy. In addition, the LZC feasibility study contained within this report only covers spaces within the new extension.

Method Consulting LLP has also been appointed to produce a Thermal Comfort report which should be referred to for further detail in support of this document.

Energy Strategy

The development's anticipated CO₂ emissions have been calculated through the Part L2 2021 of the Building Regulations methodology based on the National Calculation Methodology (NCM) as recommended in The London Plan 2021.

It has been demonstrated how the emissions from energy use in the development will be reduced through a combination of energy efficiency measures and renewable energy sources. In line with The London Plan (2021), the Proposed Development will follow the Energy Hierarchy of 'Be Lean', 'Be Clean' and 'Be Green' to reduce the carbon dioxide emissions of the entire development.

The local Haringey planning policies refer to the London Plan SI 2 in which the regulated CO₂ emissions reduction target for non-residential developments should achieve at least a 15% improvement on Building Regulations compliant building from energy efficiency measures alone (Be Lean).

A 9% reduction in carbon emissions is achieved at the energy efficient stage (Be Lean) which unfortunately does not meet the 15% set out by the GLA. No savings are achieved at the Be Clean stage due to the absence of an existing heat network, and the limitations of providing a heat network on-site. During the Be Green stage a further 30% reduction in CO₂ emissions is achieved, resulting in a total saving of 39% of the developments regulated carbon emissions when compared to the Part L2 2021 Baseline scenario.

The graph below displays the CO₂ reductions achieved at each stage of the energy hierarchy.

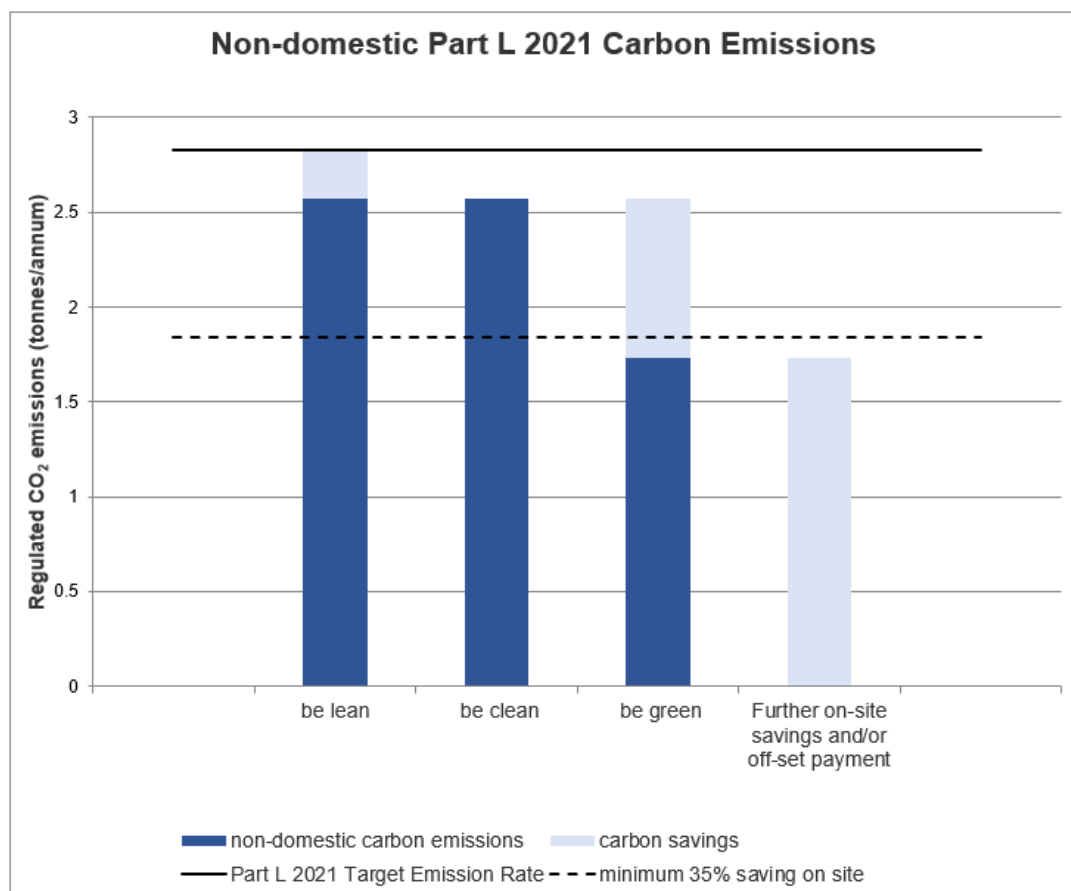


Figure 1.1: Graph showing the estimated annual carbon emissions at each stage of the Energy Hierarchy.

As part of the Be Lean strategy, a range of passive and active energy efficiency measures are to be employed within the development including:

- High-performance façade with optimising levels of insulation.
- Exposed thermal mass in external walls and soffits of classrooms.
- Solar control measures including brise soleil on the south and east facing façade as well as vertical brise soleil on the north-east façade.
- Low air permeability.

- Variable speed pumping.
- Daylighting sensor control and occupancy sensing controls for artificial lighting
- Efficient ventilation systems with heat recovery.
- Demand control ventilation via gas sensor with speed control.
- HVAC systems have provisions for metering.

As per GLA Energy Assessment Guidance (June 2022), all major developments are required to achieve a minimum 15% CO₂ reduction as part of the Be Lean strategy and an overall minimum 35% on site CO₂ reduction. The proposed design does not currently meet the Be Lean 15% reduction however, the development exceeds the 35% on site CO₂ reduction and operates at carbon net-zero with the introduction of ASHP and 7.14 kWp PV array.

In addition, as per Haringey council's policy SP4, all new developments are required to achieve a reduction in predicted carbon emissions of 20% from onsite renewable energy regeneration. The proposed design currently exceeds this target with a 34.6% reduction achieved.

Low and Zero Carbon Feasibility Study

This analysis has been carried out during RIBA stage 2.

The feasibility study has been produced to establish the most appropriate local (on-site or near-site) Low or Zero Carbon (LZC) energy source for the proposed development. This study covers:

- Energy generated from LZC energy source per year
- Carbon dioxide savings from LZC energy source per year
- Life cycle cost of the potential specification, accounting for payback
- Local planning criteria, including land use and noise
- Feasibility of exporting heat/electricity from the system
- All technologies appropriate to the site and energy demand of the development
- Reasons for excluding other technologies

The use of ASHP and PV were identified as the recommended technologies in this report. These result in a total 107.2% reduction in CO₂ emissions on the Building Emission Rate (BER) from Part L2 2021, when compared to the development without LZC technologies.

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1 Introduction

Method Consulting LLP has been appointed to produce an Energy Statement as part of the planning application for the proposed new development at Channing School.

This report covers the following:

- Relevant planning policy and its requirements.
- The baseline carbon emissions and energy demand.
- Energy efficiency measures adopted by the development.
- Feasibility of potential Low and Zero Carbon (LZC) technologies and identification of chosen technologies for this development.
- Resulting energy demand and CO₂ emissions for the proposed development.
- Discussion of proposed technology location, associated air quality and noise management, and management plans and maintenance strategies for operation of chosen technologies.

1.1 Site location

The proposed development is located on the grounds of the existing Channing School as shown highlighted in red in Figure 1.1.1 and Figure 1.1.2. Henceforth, it will be referred to as the 'Site'.



Figure 1.1.1: Location of the Site for the proposed development (red)

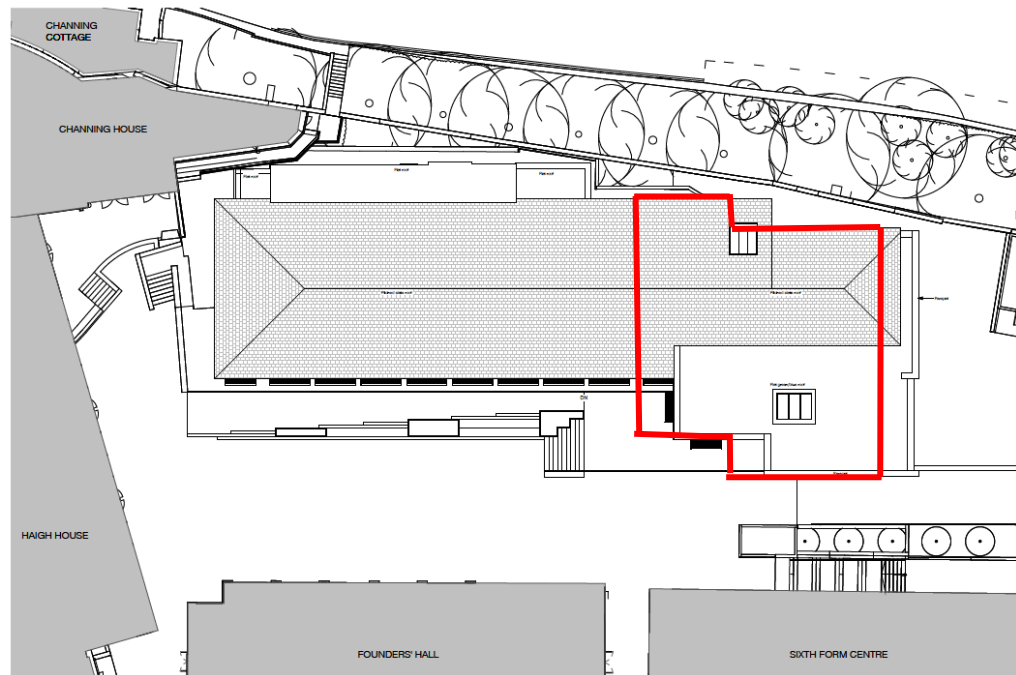


Figure 1.1.2: Location of proposed development (extension in red)

2 Assumptions

The carbon factors used in this analysis are those utilised by Part L2 2021.

The following costs of electricity and gas were assumed for this analysis:

- The cost of electricity is 33.2p/kWh
- The cost of gas is 10.3p/kWh

3 Relevant planning policy

3.1 National Policy – NPPF

The National Planning Policy Framework (NPPF) was published on 5th September 2023. This document sets out the overarching policies for development in England and states that:

‘So that sustainable development is pursued in a positive way, at the heart of the Framework is a presumption in favour of sustainable development.’ (NPPF, 2023). Paragraph 11 states, ‘all plans should promote a sustainable pattern of development that seeks to: meet the development needs of their area; align growth and

infrastructure; improve the environment; mitigate climate change (including by making effective use of land in urban areas) and adapt to its effects’.

The NPPF also references the 17 UN Sustainable Development Goals, which are illustrated below:



Key points within the NPPF of relevance and which have therefore been considered as part of this proposal are:

- Making effective use of land;
- Achieving well-designed places;
- Meeting the challenge of climate change and flooding;
- Conserving and enhancing the natural environment.

3.2 Regional Policy – The London Plan (adopted March 2021)

The latest version of the London Plan sets out an integrated economic, environmental, transport and social framework for the development of London over the next 20 – 25 years.

The following section outlines key policies set out in the London Plan which are relevant to the proposed development and this Energy Statement.

Within the following policies, “major developments” are defined as those with 10 or more units and those with >1000 m² of floorspace. The proposed development at

Channing School is therefore categorised as a minor development. However, under Haringey local planning policy, the development must still adhere to the London Plan's Energy Hierarchy for a major development.

3.2.1 Policy SI 2 – Minimising greenhouse gas emissions

The London Plan requires that all major developments should be net zero carbon, requiring that greenhouse gas emissions in operation are minimised, along with overall energy demand. This requires developments to follow the energy hierarchy of Be Lean, Be Clean, Be Green, and Be Seen.

A minimum on-site reduction of 35% beyond current Building Regulations is required for major development, and a saving of at least 15% should be achieved through fabric efficiency measures alone for non-domestic applications. Any shortfall in carbon savings on-site is to be met through agreements with the local borough.

3.2.2 Policy SI 3 – Energy infrastructure

This policy requires that developers review the feasibility of procuring energy for heating and hot water from existing heat networks, or through provision of a new heat network – be that a site-wide network, or creation of a local network with discussions being held between developers and the local borough council. Major developments should have a communal low-temperature heating system where within a Heat Network Priority Area.

3.3 Local Policy – the Haringey Development Plan DPD 2017-2026 (adopted 24 July 2017)

Haringey's development plan is currently made up of the Strategic Policies, Development Management Policies, Site Allocations and Tottenham Area Action Plan, alongside the London Plan and the North London Waste Plan. The following section outlines key policies set out in the Development Management DPD (2017-2026) and Strategic Policies (2017-2026) which are relevant to the proposed development and this Energy Statement.

Note the Haringey development plans contain references to London plan 2016 however the local plan adheres to present London Plan 2021.

3.3.1 Policy DM21: Sustainable Design, Layout and Construction

All new developments, including building and landscape works, will be expected to consider and implement sustainable design, layout and construction techniques. Proposals should:

1. Apply the energy hierarchy to minimise energy use in order to meet, and if possible, exceed minimum carbon dioxide reduction requirements;
2. Wherever possible, use building materials with high environmental performance ratings.

The London Plan requirements for major development may not be fully financially viable or technically feasible for minor and household development. Much will depend on individual site circumstances and the nature and scale of development proposed. However, the Council is mindful of the cumulative impact of development in the Borough and will therefore seek to ensure that all proposals adequately investigate and deliver opportunities for incorporating sustainable design, layout and construction principles wherever possible. Consideration should be made at the very early stage in the design process to ensure maximum use and benefit.

London Plan Policy 5.2 (London Plan 2021 SI 2) states that development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the energy hierarchy, as follows:

- 1 Be lean: use less energy
- 2 Be clean: supply energy efficiently.
- 3 Be green: use renewable energy

Existing building stock in Haringey factors significantly in local carbon emissions. The Borough's interactive heat loss map¹² indicates that many residential properties are energy inefficient. Sustainable retrofitting offers an opportunity to improve the environmental performance of existing buildings particularly where conversions, refurbishments, changes of use and extensions are proposed.

This policy seeks to encourage proposals for minor and householder development to incorporate energy efficient measures (such as internal roof, floor and wall insulation) as a cost-effective way to reduce carbon emissions. External wall insulation is also supported in principle although any such treatment must be sympathetic to character and historic significance of the existing building and surrounding area, having regard to other Local Plan policies, particularly Policies DM1 and DM9. The use of energy efficient

appliances is also strongly recommended as a simple way to reduce energy use and carbon emissions.

3.3.2 Policy SP4: Working towards a low carbon Haringey

Over the lifetime of the Local Plan, reducing energy use in buildings and working towards a low carbon borough will be one of the key challenges facing Haringey. The Council will promote the measures outlined below to reduce carbon emissions from new and existing buildings.

1. In line with London Plan policy, the Council will promote and require all new developments to take measures to reduce energy use and carbon emissions during design, construction and occupation, by incorporating the following measures:

1.b. From 2011 onwards all new non-residential development shall be built to at least BREEAM “very good” standard and should aim to achieve BREEAM “excellent” or the current nationally agreed standard. All new non-residential development shall be zero carbon from 2019.

2. The Council will promote low- and zero-carbon energy generation through the following measures:

2.d. All new developments are required, where viable, to achieve a reduction in predicted carbon dioxide emissions of 20% from onsite renewable energy regeneration, which can include connections to local sources of decentralised renewable energy.

4 Energy Strategy

4.1 Carbon factors

The GLA Energy Assessment Guidance (June 2022) relevant to calculating regulated CO₂ emissions at each stage of the energy hierarchy is detailed below:

Non-residential: a Building CO₂ Emissions Rate (BER) calculated through the Part L 2021 of the Building Regulations methodology based on the National Calculation Methodology (NCM) and implemented through Simplified Building Energy Model (SBEM) v6.1.b or later or equivalent software. Other building regulation compliance software such as IES or TAS is also acceptable.

The CO₂ emissions outputs from the Part L 2021 compliance software must be inputted into the carbon emissions reporting spreadsheet to determine the total development regulated emissions at each stage of the energy hierarchy. Applicants must ensure that the total area represented by the Part L 2021 models matches the accommodation schedule.

4.2 The Energy Hierarchy

In line with the London Plan and the Haringey Local Plan, the proposed development is seeking to reduce carbon emissions by promoting the 'energy hierarchy' as follows:

- **Be Lean:** Use less energy through energy-efficient building fabric and systems;
- **Be Clean:** Provide heating and cooling efficiently with a preference of communal heating and cooling networks;
- **Be Green:** Incorporate suitable renewable energy technologies as appropriate to the site.

A detailed description of how these principles have been applied to the project can be found in the following sections of this report.

4.3 Dynamic Simulation Model

Dynamic Part L2 simulations have been carried out using the approved software IES Virtual Environment version 2022.4.0.0. The analysis was conducted by a qualified and competent person.

The following model was used to set up the model in the Virtual Environment:

- CHA-NVB-BHR-ZZ-M3-A-0010-P06-S1-Brunner House Model.rvt (NVB Architects)

The following Revit model was used to update the model glazing in the virtual Environment:

- CHA-NVB-BHR-ZZ-M3-A-0010-P07-S1-Brunner House Model.rvt (NVB Architects)

Images of the constructed model are shown in Figure 4.3.1 and Figure 4.3.2

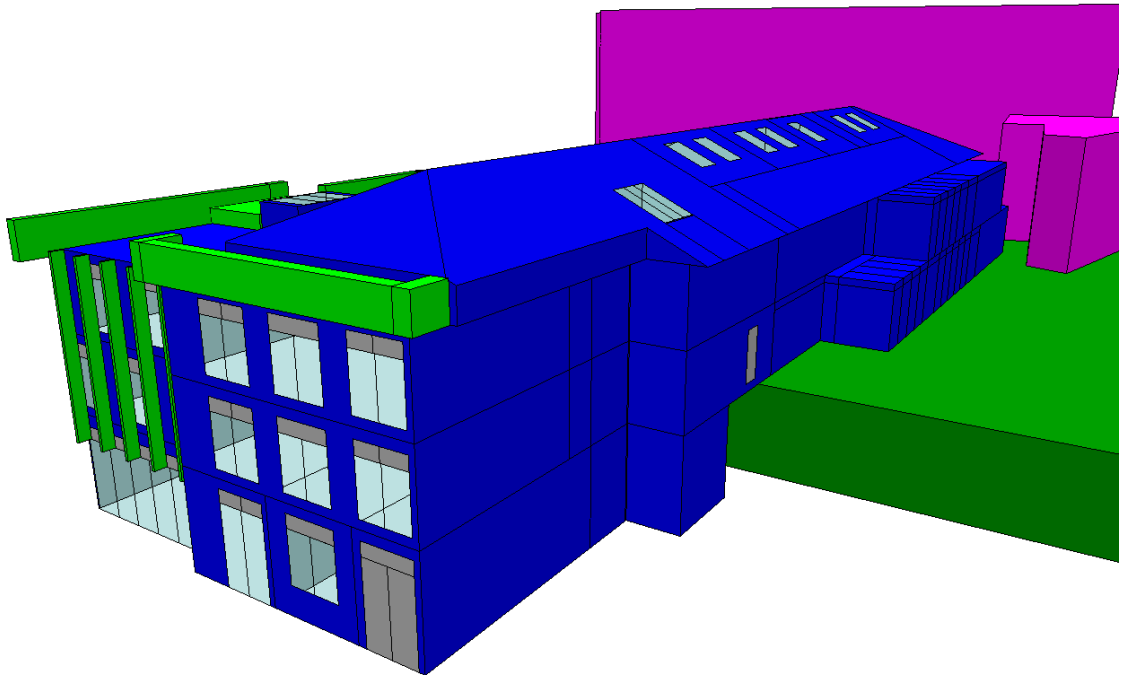


Figure 4.3.1 IES Virtual Environment model of Channing School - View from the north

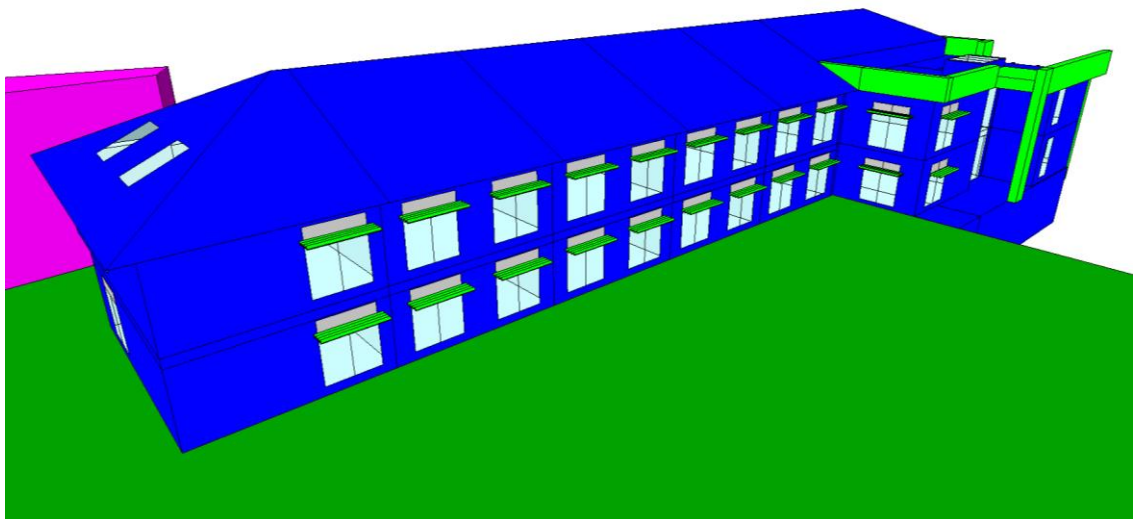


Figure 4.3.2 IES Virtual Environment model of Channing School - View from the south

4.4 Establishing baseline CO₂ emissions and energy demand

As discussed above, and in line with the London Plan (2021) policy and the supporting GLA Energy Assessment Guidance (June 2022), this report establishes the reduction in residual carbon emissions from a baseline assessment of the energy demands and associated CO₂ emissions for the proposed development.

In order to establish the baseline carbon emissions for the development, the methodology described has been used to model a 'baseline scenario' for the development, which is taken as the Building Regulations Part L2 notional building for each element. The baseline scenario utilises an ASHP heating system, assuming a notional SCoP of 2.64. The assumptions for the baseline models are detailed in the following section and Appendix A.

To determine the baseline CO₂ emissions, the Target Emission Rate (TER) from the final proposed building specification was calculated, i.e., the rate from the modelling results of the Be Green stage of the energy hierarchy. The TER was then multiplied by the building floor area to provide the regulated CO₂ emissions.

	CO ₂ emissions (Tonnes CO ₂ /year)
Baseline: Part L2 2021 of the building regulations compliant development	2.8

Table 4.4.1: Baseline CO₂ emissions

End use	Energy consumption for Baseline (kWh/year)
Heating	7,245.1
Cooling	0.0
Auxiliary	1,297.4
Lighting	4,836.5
Hot water	5877.0
Equipment*	8,908.7
Total (regulated)	28,164.9

*Equipment energy demand is not included in the total.

Table 4.4.2: Energy breakdown for the Part L2 2021 Baseline building

4.5 Demand reduction (Be Lean)

In line with the London Plan Energy Hierarchy, a number of measures are proposed in order to reduce energy demands across the development.

4.5.1 Site layout

The overall layout has been defined by the site boundaries and the proposed development being an extension of an existing building. However, this has allowed for glazing to be implemented to allow spaces to utilise natural daylight to reduce energy demand from artificial lighting. Shading has also been proposed for a large majority of

east and south facing glazing to reduce solar gains and reduce glare entering the classrooms. This has prevented mechanical cooling being required to maintain comfortable thermal conditions within the building.

4.5.2 Fabric performance

High performance fabric has been used to reduce the heating load. Proposed exposed thermal mass in external walls and soffits of classrooms reduce the need for mechanical cooling. In addition, a target air permeability of 3 m³/h/m² is targeted in line with the notional standards.

The proposed development extends from the existing building and preserves the pitched roof to maintain the visual aesthetic. However, the thermal envelope ends at the flat roof level of the extension, which has been incorporated in this assessment. The target U-values for the project are listed in Table 4.5.2.1, alongside the limiting and notional values for Part L 2021.

Element	Limiting U-value (W/m ² /K)	Notional U-value (W/m ² /K)	Target U-value (W/m ² /K)
Ground floor	0.18	0.15	0.12
External walls incl. plant	0.26	0.18	0.15
Dividing wall between existing & extension	0.26	0.18	0.26
Flat Roof	0.18	0.15	0.12
Windows & glazed doors	1.6	1.4	1.4
Personnel doors/ louvres	1.6	1.9	1.6
	Limiting (m³/h/m²)	Notional (m³/h/m²)	Target (m³/h/m²)
Air permeability	10	3	3

Table 4.5.2.1: U-values for typical building elements

The London Plan requires that the glazing percentage of the building be reported. For the proposed development, the glazing percentage is approximately 18%, calculated using the surface area of the facades (excluding the roof), and the glazed area on these surfaces.

4.5.3 System description (building services)

Information regarding the system and lighting specification for the development are shown in Appendix A – System assumptions.

4.5.4 Demand reduction results

The Be Lean model compares the notional building's Part L2 2021 TER against the proposed buildings BER with notional systems (reduced ASHP efficiency and no PV) to determine the energy reduction through energy efficiency measures alone.

Table 4.5.4.1 shows the impact of the Be Lean measures on the carbon emissions of the proposed development.

	Regulated carbon dioxide savings	
	CO ₂ emissions (Tonnes CO ₂ /year)	Percentage saving
Baseline: Part L 2021 of the building regulations compliant development	2.8	
Be Lean: Savings from energy demand reduction	2.6	9%

Table 4.5.4.1 Regulated carbon dioxide savings at the Be Lean stage of the Energy Hierarchy

Under the London Plan, a 15% saving in CO₂ emissions is required from the Be Lean case. **Error! Reference source not found.** shows a 9% saving is achieved at this stage, which does not meet compliance with London Plan energy demand reduction.

In line with the GLA Energy Assessment Guidance, the total residual energy demand following the energy efficiency measures is shown in Table 4.5.4.1.

End Use	Residual energy consumption (kWh/year) (Be Lean)
Heating	5,954.1
Cooling	0
Auxiliary	590.9
Lighting	4,303.4
Hot Water	6,288.1
Equipment*	8,908.7
Total	26,045.3

Table 4.5.4.1 Residual energy demand following energy efficiency measures

*Equipment energy demand is not included in the total.

4.6 Heating infrastructure (Be Clean)

Following the London Plan, the energy systems required on-site have been evaluated and optimised based on the development's scale and density. The London Plan outlines the following order of preference for energy generation:

- Connection to existing heating or cooling networks;
- Communal heating and cooling;
- Individual heating system.

The inclusion of a decentralised heating and cooling network has been investigated in terms of appropriateness to the development, and to be in line with the priorities for this energy strategy, whether it is the best technology to provide the greatest reductions in CO₂ emissions.

4.7 Local Networks

The potential to connect the proposed development to an existing or planned heat network has been evaluated in reference to the London Heat Map. More information can be found in section 5.2.4.

4.8 Low and Zero Carbon Technologies for Energy Production (Be Green)

The next stage of the London Plan Energy Hierarchy is Be Green, which encourages the uptake of low and/or zero carbon energy technologies where feasible, in order to reduce the development's CO₂ emissions.

4.9 Carbon Reduction Targets

The GLA expects all major development proposals to maximise on-site renewable energy generation. This is regardless of whether the 35 per cent on-site target has already been reached through earlier stages of the energy hierarchy.

As such, a study on possible low and zero carbon energy technologies has been conducted to determine suitability and feasibility for use with the development.

5 BREEAM Ene04 – LZC Feasibility Study

This section will aim to investigate and determine the most appropriate Low and Zero Carbon (LZC) technology for the development in order to comply with the requirements laid out by the GLA, as described earlier in this report.

5.1 Assessor Credentials

This BREEAM compliant LZC Feasibility study was undertaken using the experience and expertise of the following Method Consulting personnel. They are also not professionally connected to a single low and zero carbon technology or manufacturer.

5.1.1 ***Antony Bursey, Partner – Building Services Engineering, BEng, CEng, MCIBSE, BREEAM AP***

Antony is a Chartered Building Services Engineer, BREEAM Accredited Professional and a partner at Method Consulting with over 30 years of experience in developing integrated low-energy and sustainability strategies for buildings and developments and in the application of renewable energy. Antony particularly enjoys working with architects and designers in closely integrating engineering services with the building fabric and in producing innovative and creative solutions to difficult engineering problems. He has wide experience in analysing and advising on low-carbon buildings and designing and specifying LZC engineering systems, which contribute to reducing the operational energy demand of the proposed building.

5.1.2 ***Stephen Todd, Senior Building Services Engineer, BEng, MSc, PhD, LCC, LCEA, CEng, MCIBSE***

Stephen is a Building Services Engineer and is Chartered with the Institute of Mechanical Engineers. He has a passion for using passive and low energy design strategies to reduce energy usage within a building whilst also improving thermal conditions for the occupants. Stephen has an MSc Degree in Designing Sustainable Buildings and a PhD in designing Naturally Ventilated Buildings. He is also level 3, 4 and 5 accredited in Building Simulation Software IES and is an LCEA assessor. Stephen works on a variety of projects including industrial, education and healthcare. He is experienced in both traditional and D&B project procurement.

5.1.3 ***Kimberley Mason, Partner, Building Physics & Building Performance Engineer, BEng Civil Engineering, MSc Architectural Engineering***

Kimberley is a Building Physics Engineer with a master's degree in environmental design and is a certified PassivHaus Consultant. She is passionate about sustainable design of new and existing buildings, ensuring optimum performance through passive design, efficient systems, and integrating low carbon and renewable technologies to offset carbon emissions. She achieves this through energy modelling of buildings using IES VE software, while also ensuring occupant health and comfort. Kimberley has worked on numerous projects focusing on LZC, daylight and overheating strategies, as well as Part L Compliance. Kimberley works closely with the Building Services engineer to identify

potential LZC technologies and evaluate their validity for each project by looking at site factors, local planning policies, proposed building services, and the estimated energy consumption of the building for different energy uses. She then models different design scenarios, optimising the performance of each technology, to accurately evaluate each option and make a validated decision on the most appropriate technology/technologies for each project.

5.1.4 *Simon Parker – Building Physics Engineer, MSc Physics*

Simon is a Building Physics Engineer with an MSc in Physics from Cardiff University. Simon's background in physics gives him experience in computational and environmental physics. He makes use of his transferable skills in using the IES VE dynamic simulation software for computationally modelling and analysing the thermal performance and efficiency of buildings. Simon is experienced in using IES VE for Part L and overheating assessments. He is passionate about the built environment and sustainably increasing the energy performance of buildings through implementation of LZC technologies alongside passive design measures.

5.2 Low and Zero Carbon Technologies

In order to determine the validity of any LZC technologies, the CO₂ reduction, energy reduction, and a cost benefit analysis between a 'baseline' scenario and 'proposed' scenario including different LZC technologies must be conducted. The 'baseline' building is heated by gas boilers with a notional efficiency.

The following review of possible suitable technologies has been carried out to comply with the BREEAM requirements.

5.2.1 *Biomass Heating*

Biomass heating refers to burning natural, vegetative matter to produce heat, as shown in Figure 5.2.1.1. This heat can be used both to temper the building, and to meet the hot water requirements. The fuel used for the boiler is typically wood, which comes in the form of either chips or pellets. The CO₂ released when burning this matter is equivalent to the CO₂ the trees have absorbed in their lifetime. Thus, the whole process becomes almost carbon neutral. The only additional emissions will be from processing and transportation of the fuel.

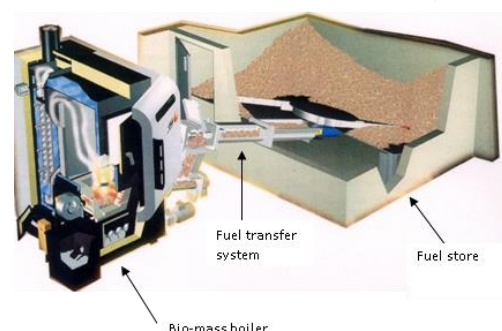


Figure 5.2.1.1: Biomass boiler

Biomass, like any solid fuel, requires storage on site and, to minimise the frequency of deliveries, significant space and associated access for delivery needs to be allowed for within the site layout. Wood pellets have a higher energy density and a more consistent size, shape and moisture content, so are better suited to smaller boiler installations and where fuel delivery access is restricted.

Currently the cost of woodchips is slightly cheaper than the cost of natural gas, whereas the cost of wood pellets is similar to that of oil. However, the price of natural gas and oil has been very volatile in recent years and for many customers has doubled in price since 2002. In contrast, the price of wood fuel has been much more stable, and it is thought that this is likely to remain the case in the medium to long term.

Suitability of Biomass for the Proposed Development

There will likely be issues associated with the location of the external flue and the required storage space for biomass fuel as the development is already constrained by the site boundary. Additionally, there were concerns regarding its negative impact on the surrounding air quality, which is particularly important as the surrounding area is primarily residential, as well as the development itself being a school for both secondary school and sixth form school children, spending time outside during recess periods.

Therefore, due to the reasons discussed, biomass has been discounted as a renewable technology.

5.2.2 Wind Turbines

Wind turbines use energy from the wind to produce electricity. This electricity can be used on site or sold back to the national grid. The suitability of installing wind turbines is largely dependent on local wind speeds. Accurately estimating the energy available from wind at a specific site is a complex task and requires knowledge of the long-term wind speeds at height, taking into account climatic variations, the effect of topological features and ground friction factors. Average wind speeds of 7 m/s or above are required for large scale wind turbines, although average speeds in the region of 4-6 m/s can be sufficient to make smaller turbines viable.

Turbines are rated by the power generated at a specific wind speed. At very low wind speeds turbines do not operate. When they reach their critical cut-in wind speed they generate at a lower level than the rating, and finally once the rated wind speed is reached the turbine is designed to maintain a fairly constant power output. As a turbine is not generating all of the time, and sometimes at part load, a good approximation of

annual output is 20-30% of that expected if the turbine was operating continuously at its rated level throughout the year. This percentage is known as the capacity factor.

Suitability of Wind Turbines for the Proposed Development

Initial investigations suggest that the site is not well suited to a wind turbine, due to potential local planning issues and wind speed. Based on typical wind speed data from the RenSMART Wind Model (data available online), the average wind speed at the site (at a height of 10m) is 5.6 m/s.

If wind turbines were to be used alongside ASHP instead of PV, the required energy generation to match the energy output of the PV needs a wind turbine with a minimum output of 2.55kW. This would require a large turbine which requires average wind speeds of at least 7m/s and a clear surrounding area. For these reasons, the wind power technology has been discounted from the analysis.

5.2.3 Combined Heat & Power (CHP)

Combined Heat and Power (CHP) machines are in effect mini power stations. When a power station burns gas, coal, or oil to generate electricity, large amounts of heat is given off as a by-product. Large power stations waste this heat (via large cooling towers – it is simply emitted to atmosphere). A CHP unit aims to make use of this waste heat by putting it into a hot water cylinder or heating system when it generates electricity. The electricity can either be used within the building or sold back to the national grid if output exceeds demand.

Suitability of CHP

The modelling has demonstrated that the heating and hot water demand are relatively high. This can be seen in *Equipment energy demand is not included in the total.

Table 4.4.2. Since there is a constant demand for heating and hot water throughout the year, CHP is a viable option.

The Haringey Local Plan proposes potential decentralised energy network hubs which would include CHP systems within the Haringey Heartlands and Crouch End area. Despite this, as seen in Figure 5.2.3.1, the proposed development falls outside of the potential connection areas to the hubs.

Additionally, there were concerns regarding its negative impact on the surrounding air quality, which is particularly important as the surrounding area is primarily residential,

as well as the development itself being a school for both secondary school and sixth form school children, spending time outside during recess periods. For these reasons, CHP has been discounted from the analysis.

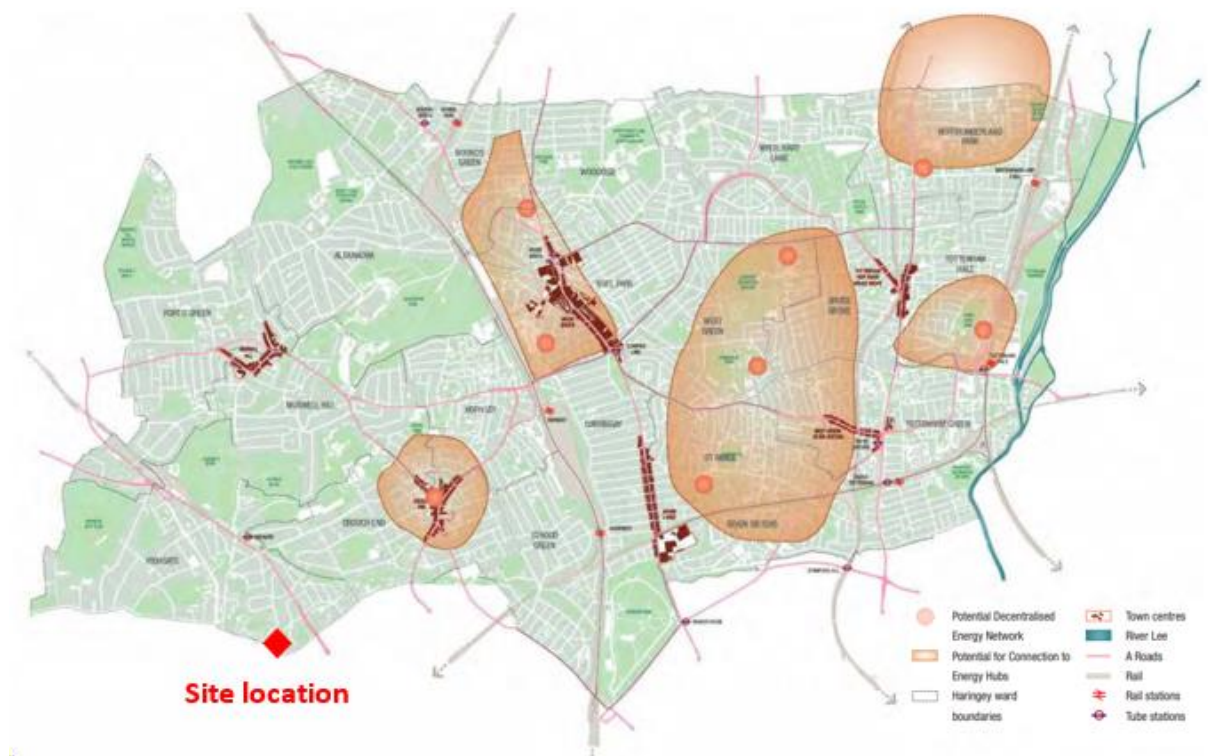


Figure 5.2.3.1: Diagram of Haringey Local Plan decentralised energy network hubs, with site location marked in red

5.2.4 District Heat Network

District Heat Networks provide local businesses and housing with heat and power from more sustainable sources. They are an efficient and cost-effective way to cut carbon emissions produced from heating new and existing buildings.

Suitability of connecting the Proposed Development to the District Heat Network

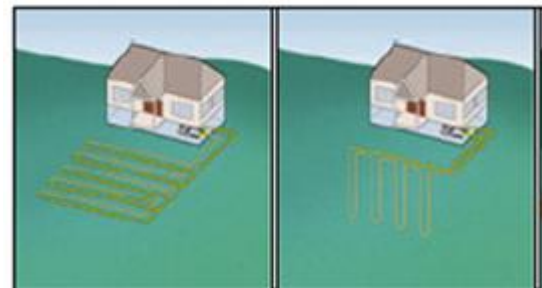
The site could benefit from connecting to the district heat network as it provides low carbon energy at lower costs.

The Haringey Local Plan proposes potential decentralised energy network hubs which would include district heat systems within the Haringey Heartlands and Crouch End area. However, as mentioned in section 5.2.3 and seen in Figure 5.2.3.1, the proposed development falls outside of the potential connection areas to the hubs.

The development is not located close enough to a DHN site at this stage and therefore connecting to a District Heat Network as a renewable technology has been discounted.

5.2.5 Heat Pumps

A heat pump uses the same ‘vapour compression’ technology that is used in a domestic refrigerator, but the cycle is reversed to provide heating and/or cooling to internal spaces. A heat pump uses electricity to transfer heat from one source to another, rather than generating heat, with most of the energy coming from the ambient ground or water to which it is connected (Figure 5.2.5.1). The coefficient of performance (COP) is the ratio of the heat output to the electricity input. With most modern equipment, the Seasonal COP will typically range from 3 to 5, i.e. for 1 kW of electrical input up to 5 kW of heating or cooling can be achieved.



Horizontal Array Vertical Boreholes

Figure 5.2.5.1: Ground source heat pumps

It should be noted that because of the higher CO₂ emissions associated with the grid electricity supply, COPs must be better than 2.5 before there is any reduction in CO₂ emissions compared to heating via gas fired condensing boilers. However, if the electricity is generated from renewable energy sources, heat pumps can be part of a carbon neutral servicing strategy providing both heating and cooling to buildings.

Heat pumps are characterised depending on the source of the heat and the sink used for the heat. In the heating mode, energy can be extracted from the air, water or the ground and delivered to the space via fan powered air supply or a water circuit (such as underfloor heating). It should be noted that high COPs are generally only obtained when the flow temperature of the heating circuit to the building is relatively low, so they are often used with underfloor heating.

Suitability of Heat Pumps for the Proposed Development

Due to the technical implications associated with the below ground works required for the function of ground source heat pumps, this option has been discounted. Air source heat pumps (ASHP) have fewer technical implications associated with their function and this will be considered further for the development.

End use	Actual energy consumption (kWh/year)
Heating	5,241.2
Cooling	0
Auxiliary	584.5
Lighting	4,303.4
Hot water	6,288.1
Equipment*	8,908.7
Total (regulated)	25,325.9

*Equipment energy demand is not included in the total.

Table 5.2.5.1: Energy consumption by end use for the proposed development using ASHP

Table 5.2.5.2 summarises the estimated costs associated with an ASHP system.

System	System size (kW)	LCC	Energy generated (kWh/year)	Carbon savings (kg/year)	Annual cost saving	Simple payback (years)
ASHP	85	£68,000	5,240	379	£53.57	1269.4

Table 5.2.5.2: Simple ASHP cost and carbon savings analysis

The use of ASHP results in a significant energy and carbon reduction, with a 27.6% reduction in CO₂ emissions achieved over the LZC baseline scenario. The use of ASHP is also marginally cheaper to run than that of a gas boiler, however, there are not enough savings for the ASHP system to pay for itself over the course of its use. Fortunately, the money saved through the installation of a PV array can contribute towards the payback of the ASHP system. See Section 5.2.6 for more details regarding photovoltaics.

5.2.6 Photovoltaics

Solar energy can be converted to electricity using the photo-electric effect. Simply, photovoltaic (PV) cells use the energy from the sun to induce a current in a circuit. The cells are encapsulated between a sheet of toughened glass at the front and a moisture sealing membrane on the back to make them weatherproof.

PV cells can be purchased in the form of Building Integrated PV (BIPV) products such as roof tiles and glazing products and, as such, is potentially the easiest of all renewable energy technologies to embed into the built environment.

In the UK, PV panels are usually installed on roofs of buildings, with the optimum position being south facing. On an angled roof, a 30° tilt is deemed as the optimum angle; whilst on a flat roof where PV panels are fitted adjacent to one another, the optimum tilt angle is 10°. This is due to factors such as wind loading, where a greater tilt angle means stronger frames and fixings are required due to increased wind loads.

These stronger frames and fittings increase the cost of the instalment. Additionally, the steeper mounting angle requires greater spacing to prevent shading of adjacent panels, therefore reducing the useable area of the roof for PV installation.

Suitability of Photovoltaics for the Proposed Development

Initial investigations suggest that photovoltaics would be a good fit for the project, as the proposed building has a flat roof with little over-shading. A 7.14 kWp PV array, generating 5,586 kWh/year, has been proposed. This is based on the assumed PV specification provided in Table 5.2.6.1 below.

PV specification	
System size	7.14
Module Nominal Efficiency	21%
Total Area	34m ²
Orientation	131° (Clockwise from north)
Inclination	25°
Shading Factor	0.9
Electrical Conversion Efficiency	95%

Table 5.2.6.1: Assumed PV specifications

System	System size (kWp)	LCC	Energy generated (kWh/year)	Carbon savings (kg/year)	Annual cost saving	Simple payback (years)
PV	7.14	£8,568	5586	713	£1,324.68	6.5

Table 5.2.6.2: Cost analysis table for PV

There is available roof space for the PV array to be mounted. The size and location of the array will be determined upon completion of a detailed PV analysis.

Additionally, the council strongly encourages the use of solar technologies in all new developments to help reduce carbon emissions.

5.2.7 Solar Hot Water Heating

There are two common types of solar collector that are used to provide hot water and space heating in domestic and commercial situations: flat plate collectors and evacuated tube collectors.

In flat plate collectors the working fluid (typically a water/glycol mixture) is directly heated as it circulates through pipework within the collector. The absorber plate and

associated pipe work usually sits below a glass cover within a heavily insulated enclosure to reduce heat loss.

Evacuated tube collectors increase the efficiency of the system by enclosing the absorber plate in a near vacuum. This dramatically reduces the heat loss by convection from the absorber surface. The fabrication of the glass tube is expensive and leads to a collector that will perform better, but at higher cost. Flat plate collectors are generally used on residential buildings and evacuated tube collectors on larger commercial buildings.

Suitability of Solar Hot Water Heating for the Proposed Development

Hot water accounts for the second largest regulated energy demand in the development, therefore solar hot water heating would be considered a good fit for the energy demand of the development. Despite this, solar hot water heating has been discounted from the analysis as it is not envisaged that the desired reduction in CO₂ emissions and the target EPC rating could be met by solar hot water heating alone and this would need to be supplemented by another technology.

In addition, solar hot water collectors cannot export energy to a heat network unless it is a very low ambient temperature loop such as a communal GSHP borehole array.

Moreover, it was felt that the roof space was better suited for PV panels due to the electricity being the highest energy demand. It is felt PV would work in better conjunction with an instantaneous electric system for DHW demand and ASHP, which is the planned technology for space heating.

Due to the reasons stated, solar hot water as a renewable technology has been discounted.

5.2.8 Energy Storage

There are two main forms of energy storage:

- Thermal storage, such as the storage of low or medium grade heat
- Electricity storage, normally in the form of battery storage

Thermal storage using inter-seasonal heat transfer

Thermal storage using inter-seasonal heat transfer can be considered on ground source heat pump schemes that incorporate a borehole array. They work by collecting excess heat in the summer from cooling applications or solar hot water systems and storing it

in the ground i.e. effectively making the ground around the borehole array warmer than it otherwise would be, ready for the wintertime heating application. The overall benefit of this arrangement is that less boreholes are required, which in turn helps reduce the cost of the borehole array and the capital cost of the GSHP installation.

The application of this type of thermal storage is therefore limited to those projects which have a GSHP with a borehole array, either a cooling application or solar hot water system and also a static water course in the location of the borehole array.

Thermal storage using HWCs

Thermal storage using hot water cylinders is normally deployed on domestic projects where there is a an LZC electricity generator, typically PV, and a hot water cylinder. A PV power diverter monitors the incoming electricity supply and when there is excess electricity generation from the LZC electricity generator, the power diverter diverts the excess electricity to the hot water cylinder's electric immersion heater, instead of exporting it to the grid. This results in the householder getting a "free" tank of hot water. When the HWC is at full temperature, excess electricity is exported to the grid.

The application of this type of thermal storage is therefore limited to domestic installations which have a hot water cylinder and LZC electricity generator.

Electricity storage

Electricity storage typically means battery storage. This works with exactly the same components as thermal storage using HWCs except that the HWC is replaced with a dedicated battery pack (or perhaps an electric vehicle). The benefit of this approach over thermal storage using HWCs is that the stored energy is stored in a higher form or grade meaning that it can be used in more applications (whereas low grade heat in hot water cylinders can only be used as low grade heat).

Suitability of Energy Storage for the Proposed Development

While energy storage has been considered, it has not been proposed for the development as it is cost-prohibitive, and this outweighs the benefits.

5.3 LZC Options Summary

ASHP and PV are the recommended technologies for the development. The estimated benefits and costs associated with each technology for the development are summarised in Table 5.3.1.

System	System size	LCC	Energy generated (kWh/year)	Carbon savings (kg/year)	Annual cost saving	Simple payback (years)
ASHP	85 kW	£68,000	5,240	379	£53.57	1269.4
PV	7.14 kWp (34m ²)	£8,568	5586	713	£1,324.68	6.5

Table 5.3.1: Chosen LZC options summary table

Simulation	Regulated energy demand (kWh/year)	Energy saving achieved (%)	Regulated CO ₂ emissions (kgCO ₂ /year)	CO ₂ reduction (%)
LZC baseline	27,604		1,371	
Proposed scheme after ASHP	16,424	40.5%	992	27.6%
Proposed Scheme after ASHP and PV	10,838	60.7%	279	79.6%
Total CO ₂ reduction beyond baseline emissions				107.2%

Table 5.3.2: Energy and CO₂ breakdown for LZC technologies

As can be seen in Table 5.3.2, a total reduction in CO₂ of 107.2% has been achieved using LZC technologies. Therefore, the development achieves one credit for low and zero carbon technologies.

5.4 Summary of Energy Results

The building has been fully modelled using IES in order to demonstrate the building complies with the Building Regulations Part L2 2021. The output from this is the BRUKL report and this is attached to this report in Appendix F – BRUKL with ASHP & 7.14 kWp PV.

This modelling process and the BRUKL then gives us an estimate of the energy consumption and CO₂ emissions from the building.

The below table demonstrates the overall results in line with London Plan 2021 using Part L2 2021 carbon factors.

	Total regulated emissions (Tonnes CO ₂ / year)	CO ₂ savings (Tonnes CO ₂ / year)	Percentage savings (%)
Part L2 2021 baseline	2.8	-	-
Be Lean: After energy demand reduction	2.6	0.3	9%
Be Clean: After heat network connection	2.6	-	-
Be Green: After renewable energy	1.7	0.8	30%
Total Savings		1.1	39%

Table 5.4.1: Summary of CO₂ savings from each stage of energy hierarchy

The proposed PV array and ASHP installation are shown to result in a 39% reduction in CO₂ emissions from on-site renewable technologies when compared to the Part L2 2021 Baseline case. In addition, the proposed PV array installation results in a reduction of regulated carbon emissions of 0.8 Tonnes/year or a total of 34.6% reduction when compared to the Part L2 2021 Baseline case.

As per GLA Energy Assessment Guidance (June 2022), all major developments are required to achieve a minimum 15% CO₂ reduction as part of the Be Lean strategy and an overall minimum 35% reduction on site CO₂ reduction.

As seen in Table 5.4.1, the proposed development currently does not meet the 15% CO₂ reduction criteria however, the development exceeds the 35% CO₂ reduction at the Be Green stage.

As per Haringey council's policy SP4, all new developments are required to achieve a reduction in predicted carbon emissions of 20% from onsite renewable energy regeneration. As also seen in Table 5.4.1, The proposed design currently exceeds this target with a 34.6% reduction achieved.

Table 5.4.2 below indicates the anticipated regulated and unregulated CO₂ emissions at each stage of the Energy Hierarchy, using Part L2 2021 Carbon Factors. Each stage of this hierarchy incorporates ASHP, with the Be Green stage (after renewable energy) accounting for any improvements in the efficiency of the space heating ASHP system when compared to the notional efficiency, as well as inclusion of PV.

	Carbon dioxide emissions (Tonnes CO ₂ /year)		
	Regulated	Unregulated	Total
Baseline	2.8	1.2	4.0
After energy demand reduction	2.6		3.8
After heat network connection	2.6		3.8
After renewable energy	1.7		3.0

Table 5.4.2 : Regulated and unregulated CO₂ Emissions following the Energy Hierarchy using Part L2 Carbon Factors

Table 5.4.2 shows that the building is not carbon net-zero when the ASHP and PV array are introduced, based on the Part L2 2021 results. However, to determine whether the building is carbon net-zero in operation a full TM54 analysis would need to be conducted. This development is not required to do an operational energy assessment and therefore the following calculations are based on Part L results.

The following design options are recommended to further reduce the shortfall in regulated carbon and strive for carbon net-zero for the proposed development:

- Increased ASHP ScoP value to 3.2
- Lower fabric u-values and air permeability to reduce the heating load of the development, meeting or exceeding LETI standards.
- Use of very high efficacy lighting (140lm/W)
- Increased PV module nominal efficiency (22-23%)
- Larger PV array size offsetting extension carbon emissions

As per the GLA Energy Assessment Guidance (June 2022) any shortfall in carbon savings on-site is to be met through agreements with the local borough. As seen in Table 5.4.2 net zero is not achieved and therefore, carbon offset payment is required.

5.5 Carbon offset payments

As shown in Table 5.4.2, the proposed development has a shortfall in regulated carbon savings of 1.7 Tonnes/year relative to the zero-carbon target.

In accordance with the GLA's Carbon Offset Funds guidance document (2018), Haringey LLDC will apply the following formula in calculating carbon offset contributions:

30 (years) x 'carbon gap' (tonnes of CO₂) x price of carbon (£) = carbon offset contribution

A value of 30 years is used in the above formula as the assumed lifetime of a development's services. Policy SI 2 of the London Plan provides that London boroughs may use a nationally recognised non-traded carbon price of £95/tonne.

Table 5.5.1 shows the calculation of the required carbon offset payment.

Parameter	Value
Carbon gap (Tonnes CO ₂)	1.7
Carbon offset contribution (£)	4,845

Table 5.5.1 : Carbon offset payment calculation.

5.6 Operational energy monitoring (Be Seen)

Although this energy strategy adheres to the London Plan's Energy Hierarchy as per Haringey local plan guidance, this proposal does not require the "Be Seen" stage of the London Plan energy hierarchy. As stated in the pre-application planning proposal document, the "Be Seen" stage is not required due to the proposed development being a minor development.

6 Conclusion

Method Consulting LLP has been appointed to produce an Energy Statement as part of the planning application for the proposed new development, Channing School. Furthermore, a Low and Zero Carbon Feasibility Study has been performed as part of the BREEAM New Construction V6 assessment. Both assessments have been conducted on behalf of Channing School.

The proposed development consists of both a refurbished existing building and an extension, with this energy statement focused solely on the extension. This statement has been prepared to demonstrate only where the extension of the proposed development meets or exceeds the recommendations of the London Plan 2021 as per the GLA Energy Assessment Guidance (June 2022), and the Haringey local plan. The proposed new development is categorised as a minor development, but under local policy must still adhere to the London Plan's Energy Hierarchy for a major development. However, as noted in the 'pre-application planning advice note', this proposal does not require the "Be Seen" stage of the London Plan energy hierarchy. In addition, the LZC feasibility study contained within this report only covers spaces within the new extension.

Method Consulting LLP has also been appointed to produce a Thermal Comfort report which should be referred to for further detail in support of this document.

Energy Statement

The development's anticipated CO₂ emissions have been calculated through the Part L2 2021 of the Building Regulations methodology based on the National Calculation Methodology (NCM) as recommended in The London Plan 2021.

It has been demonstrated how the emissions from energy use in the development will be reduced through a combination of energy efficiency measures and renewable energy sources. In line with The London Plan (2021), the Proposed Development will follow the Energy Hierarchy of 'Be Lean', 'Be Clean' and 'Be Green' to reduce the carbon dioxide emissions of the entire development.

The local Haringey planning policies refer to the London Plan SI 2 in which the regulated CO₂ emissions reduction target for non-residential developments should achieve at least a 15% improvement on Building Regulations compliant building from energy efficiency measures alone (Be Lean).

A 9% reduction in carbon emissions is achieved at the energy efficient stage (Be Lean) which unfortunately does not meet the 15% set out by the GLA. No savings are achieved at the Be Clean stage due to the absence of an existing heat network, and the limitations of providing a heat network on-site. During the Be Green stage a further 30% reduction in CO₂ emissions is achieved, resulting in a total saving of 39% of the developments regulated carbon emissions when compared to the Part L2 2021 Baseline scenario.

The graph below displays the CO₂ reductions achieved at each stage of the energy hierarchy.

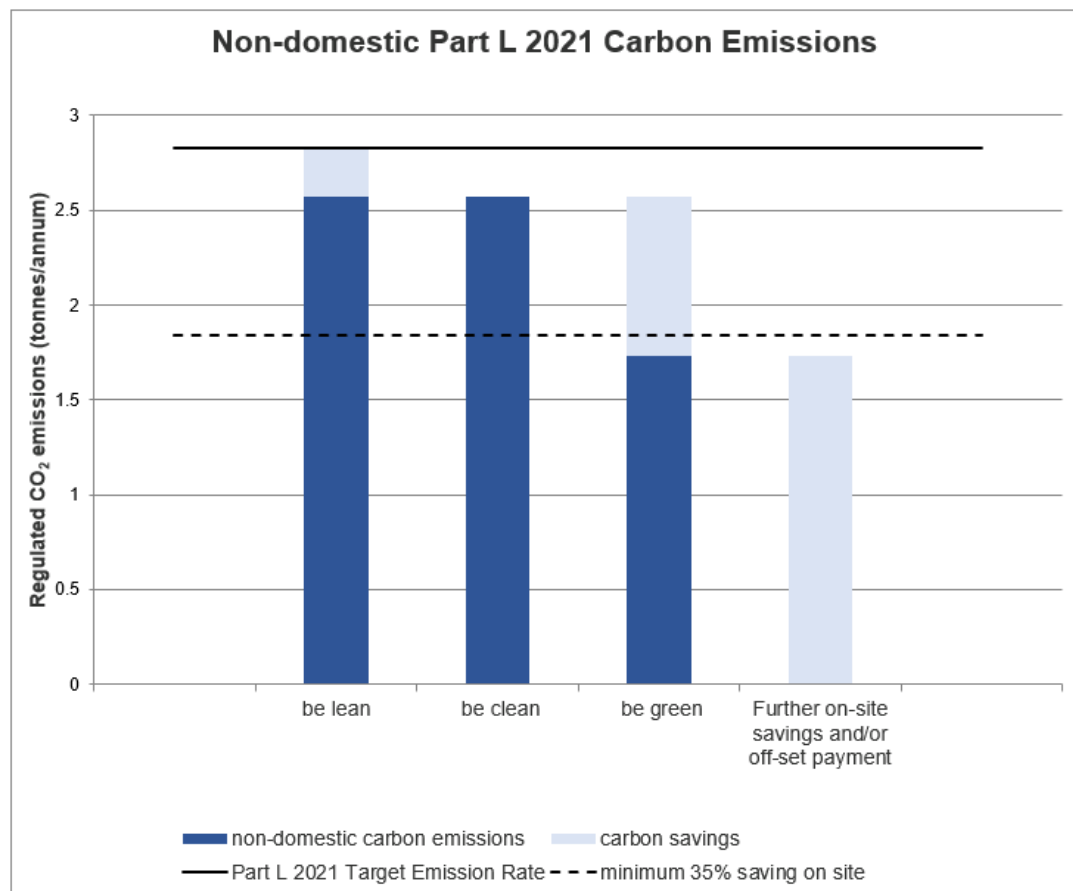


Figure 6.1 Estimated annual carbon emissions at each stage of the Energy Hierarchy

As part of the Be Lean strategy, a range of passive and active energy efficiency measures are to be employed within the development including:

- High-performance façade with optimising levels of insulation.
- Exposed thermal mass in external walls and soffits of classrooms.
- Solar control measures including brise soleil on the south and east facing façade as well as vertical brise soleil on the north-east façade.
- Low air permeability.
- Daylighting sensor control; Occupancy sensing controls and time-switch.
- Variable speed pumping.
- Efficient ventilation systems with heat recovery.
- Demand control ventilation via gas sensor with speed control.
- HVAC systems have provisions for metering.

As per GLA Energy Assessment Guidance (June 2022), all major developments are required to achieve a minimum 15% CO₂ reduction as part of the Be Lean strategy and an overall minimum 35% on site CO₂ reduction. The proposed design does not currently

meet the Be Lean 15% reduction however, the development exceeds the 35% on site CO₂ reduction and operates at carbon net-zero with the introduction of ASHP and 7.14 kWp PV array.

In addition, as per Haringey council's policy SP4, all new developments are required to achieve a reduction in predicted carbon emissions of 20% from onsite renewable energy regeneration. The proposed design currently exceeds this target with a 34.6% reduction achieved.

7 Appendices

7.1 Appendix A – System assumptions

Below are the specifications used to model the building services and HVAC systems in the proposed building model.

For the purposes of demonstrating CO₂ emission improvements in the 'Be Lean' stage of the energy hierarchy, a model was created using the notional building system type and performance values specified in the Part L 2021 baseline as determined by the final proposed building specification under Part L 2021. For a non-residential building proposing heat pumps, the TER for the Part L 2021 baseline would include heat pumps with notional performance values of 2.86 seasonal generator efficiency for hot water and 2.64 seasonal system coefficient of performance for space heating.

System details				
	System	Efficiency	Specific Fan Power (W/(l/s))	Comments
1	Heating via radiators, local extract – WCs & Cleaners	ASHP SCoP – 3	0.3	Variable speed differential sensor across pumps.
				Default ductwork leakage.
				Provision for metering
2	Heating via radiators – natural ventilation - Circulation	ASHP SCoP – 3	-	Variable speed differential sensor across pumps.
				Provision for metering
3	Heating via air distribution with hybrid NVHR – Classrooms & Offices	ASHP SCoP – 3 Heat recovery – 0.42	0.16	Default ductwork leakage.
				Provision for metering
				Demand control based on gas sensors with speed control.
4	DHW supply served by direct electric storage water heater.	Efficiency – 100%	-	Stand-alone water heater. Total 60l storage.
				0.0047kWh/l/day storage losses.

Lighting controls				
Spaces	Daylight dimming	Manual switch	Presence detection	Absence detection
Classroom	X	X	-	X
Circulation	-		X	-
WC	-	-	X	-
DT Office	X	X	-	X
DT Workshop	X	X	-	-
Plant	-	X	-	-
Store	-	X	X	-

Lighting controls have provision for metering.

Lighting is modelled with an efficacy of 120lm/W in all spaces.

7.2 Appendix B – Full LZC Comparison

Technology	Solar hot water	Biomass	Ground /air source heat pumps	Photovoltaics	Wind turbine	CHP
Recommended	No	No	Yes	Yes	No	No
Reason for exclusion	Unlikely to achieve desired CO ₂ reduction or EPC rating	Site constraints, issues with air quality, location of external flue and storage space, and would require additional equipment.	-	-	Too large for site, not enough space, average windspeeds are not strong enough.	ASHP is the preferred option as CHP would require additional equipment
Energy output (kWh/year)	Not assessed	Not assessed	5,240	5,586	Not assessed	Not assessed
Carbon dioxide savings (kgCO₂/year)	Not assessed	Not assessed	379	713	Not assessed	Not assessed
Planning Issue/criteria	Planning permission would be required if the proposed array is over 4 kW Key criteria: Visual impact (assuming roof mounted)	Compliance with Clean Air Act required. Planning permission may be required for external flue & fuel store.	GSHP: Planning unlikely to be required ASHP: Planning will probably be required including noise assessment	Planning permission would not be required as the proposed array is under 4 kW (0.64kW) Key criteria: Visual impact (assuming roof mounted)	Planning permission would be required, potential criteria could include visual impact, noise, vibration, electrical interference, safety	Planning permission would not be required

Technology	Solar hot water	Biomass	Ground /air source heat pumps	Photovoltaics	Wind turbine	CHP
Noise issues	There is no noise from this technology when operating	May be noise issues associated with delivery/loading of fuel but probably not with boiler itself.	GSHP: Noise levels generally low. ASHP: Acoustic study would need to assess noise impacts of external equipment	There is no noise from this technology when operating	Less of an issue than commonly perceived. The BWEA Reference Sound levels at 25m and 60m at an 8m/s hub height wind speed are: Lp,25m = 52.5dB(A) Lp,60m = 45dB(A)	CHP engine will generate some noise but can be mitigated by acoustic treatment of the plant room
Land use issues	If roof mounted, no additional land-use implications.	Space required on site for fuel storage and accessibility for deliveries; may require larger plant room to accommodate biomass plant; wider implications of land use for production of biofuels	GSHP: Requires sufficient area of land for horizontal array, and suitability of local geology for vertical boreholes would require assessment. ASHP: External space required if not roof mounted	If roof mounted, no additional land-use implications.	Suitable location of tower required if not on roof, and potential restrictions to land use below turbine	Plant room will need to be sized to accommodate
Feasibility of exporting heat/electricity	Unlikely to produce sufficient	Would be sized to serve baseload of building only	Not feasible for either technology	Excess electricity could be exported elsewhere on site or to the grid during	Excess electricity could be exported elsewhere on site or to the grid during periods of low	Export of excess electricity to grid feasible, and potential for export

Technology	Solar hot water	Biomass	Ground /air source heat pumps	Photovoltaics	Wind turbine	CHP
from the system	output/excess heat for export	unlikely to be surplus for export		periods of low demand such e.g., during school holidays	demand such e.g., during school holidays	of heat to local buildings possible?
Availability of grants/financial incentives (N.B. potential subject to change)	n/a Renewable heat incentive (RHI) until March 2021 latest	n/a Renewable heat incentive (RHI) until March 2021 latest	n/a GSHP: Renewable heat incentive (RHI) until March 2021 latest n/a ASHP: Renewable heat incentive (RHI) until March 2021 latest	n/a the FiT scheme closed in 2019	n/a the FiT scheme closed in 2019	n/a the FiT scheme closed in 2019
Life cycle CO₂ payback period	N/A	N/A	1269.4	6.5 years	N/A	N/A
District heat	While district heat networks have been considered, it has not been proposed for this development					
Energy storage	While energy storage has been considered, it has not been proposed for this development					

7.3 Appendix C – LZC Baseline BRUKL

Project name

Channing School

As designed

Date: Fri Nov 24 17:07:32 2023

Administrative information

Building Details

Address: The Bank, London, N6 5HF

Certifier details

Name: Method Consulting

Telephone number: 07193822044

Address: 22-24 Queen Square, Bristol, BS1 4ND

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]: 220The CO₂ 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 ² annum	8.38
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	7.83
Target primary energy rate (TPER), kWh _{PE} /m ² annum	50.1
Building primary energy rate (BPER), kWh _{PE} /m ² annum	55.31
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	0.26	0000001D:Surf[0]
Floors	0.18	0.12	0.45	PT000000:Surf[1]
Pitched roofs	0.16	0.16	0.16	PT000000:Surf[0]
Flat roofs	0.18	0.13	0.16	00000028:Surf[2]
Windows** and roof windows	1.6	1.4	1.4	0000000D:Surf[5]
Rooflights***	2.2	1.95	2	01000017:Surf[4]
Personnel doors^	1.6	1.6	1.6	0000000D:Surf[2]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

1- Gas Boiler_rads_nat vent (circulation)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0	-	-
Standard value	0.93*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* 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.					

2- Gas Boiler_HHRU_NVHR (classrooms & offices)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0	-	0.42
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					NO

3- Gas Boiler_rads_local extract (WCs & cleaners)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0	-	-
Standard value	0.93*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* 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.					

4- Gas Boiler_HHRU_NVHR (Indirect Adjacent Store)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	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					NO

1- Direct electric_DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0.005
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
00 - Classroom (General)	-	-	-	-	-	0.2	-	-	-	-	N/A
00 - Science Classroom (Chemistry)	-	-	-	-	-	0.2	-	-	-	-	N/A
00 - Science Classroom (General) 2	-	-	-	-	-	0.2	-	-	-	-	N/A
01 - Science Classroom (Chemistry)	-	-	-	-	-	0.2	-	-	-	-	N/A
01 - Science Classroom (General) 2	-	-	-	-	-	0.2	-	-	-	-	N/A
01 - Science Prep Room (Chemistry)	-	-	-	-	-	0.2	-	-	-	-	N/A
B1 - Acc. WC	0.2	-	-	-	-	-	-	-	-	-	N/A
B1 - DT Office	-	-	-	-	-	0.2	-	-	-	-	N/A
B1 - DT Workshop	-	-	-	-	-	0.2	-	-	-	-	N/A

General lighting and display lighting		General luminaire	Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m ²]
Standard value		95	80	0.3
00 - Circulation Stairs (extension)		120	-	-
00 - Classroom (General)		120	-	-
00 - Science Classroom (Chemistry)		120	-	-
00 - Science Classroom (General) 2		120	-	-
01 - Science Classroom (Chemistry)		120	-	-
01 - Science Classroom (General) 2		120	-	-
01 - Science Prep Room (Chemistry)		120	-	-
B1 - Acc. WC		120	-	-
B1 - Circulation		120	-	-
B1 - DT Office		120	-	-
B1 - DT Workshop		120	-	-
B1 - Store		120	-	-
01 - Circulation Stairs (Extension)		120	-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00 - Classroom (General)	NO (-84.6%)	YES
00 - Science Classroom (Chemistry)	NO (-79.3%)	YES
00 - Science Classroom (General) 2	NO (-82.4%)	YES
01 - Science Classroom (Chemistry)	NO (-79.2%)	YES
01 - Science Classroom (General) 2	NO (-81.3%)	YES
01 - Science Prep Room (Chemistry)	NO (-84.5%)	YES
B1 - DT Office	NO (-64.7%)	YES
B1 - DT Workshop	NO (-68.3%)	YES

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]	642.3	642.3
External area [m ²]	1222.1	1162.5
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	3	3
Average conductance [W/K]	1201.6	415.77
Average U-value [W/m ² K]	0.98	0.36
Alpha value* [%]	7.1	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	25.49	34.61
Cooling	0	0
Auxiliary	1	2.02
Lighting	6.7	7.53
Hot water	9.79	9.15
Equipment*	13.87	13.87
TOTAL **	42.98	53.31

* 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	11.27
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>0</i>	<i>11.27</i>

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	71.95	112.81
Primary energy [kWh _{PE} /m ²]	55.31	50.1
Total emissions [kg/m ²]	7.83	8.38

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 SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Other local room heater - fanned, [HS] Room heater, [HFT] Natural Gas, [CFT] Electricity										
Actual	74.6	0	27	0	0.6	0.77	0	0.96	0	
Notional	118.6	0	36.4	0	2.4	0.91	0	----	----	
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
Actual	67.6	0	21.9	0	3.5	0.86	0	0.96	0	
Notional	236.1	0	72.5	0	4.4	0.91	0	----	----	
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
Actual	55.2	0	17.9	0	2.2	0.86	0	0.96	0	
Notional	90.2	0	27.7	0	1.2	0.91	0	----	----	
[ST] Other local room heater - fanned, [HS] Room heater, [HFT] Natural Gas, [CFT] Electricity										
Actual	134.1	0	48.5	0	0.3	0.77	0	0.96	0	
Notional	134	0	41.1	0	0	0.91	0	----	----	
[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

7.4 Appendix D – Baseline BRUKL (including Be Lean)

Project name

Channing School**As designed****Date:** Fri Nov 24 16:57:06 2023

Administrative information

Building Details

Address: The Bank, London, N6 5HF

Certifier details

Name: Method Consulting**Telephone number:** 07193822044**Address:** 22-24 Queen Square, Bristol, BS1 4ND

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]:** 223.41The CO₂ emission and primary energy rates of the building must not exceed the targets

Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	4.28
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	3.9
Target primary energy rate (TPER), kWh _{PE} /m ² annum	45.07
Building primary energy rate (BPER), kWh _{PE} /m ² annum	41.11
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	0.26	0000001D:Surf[0]
Floors	0.18	0.12	0.45	PT000000:Surf[1]
Pitched roofs	0.16	0.16	0.16	PT000000:Surf[0]
Flat roofs	0.18	0.13	0.16	00000028:Surf[2]
Windows** and roof windows	1.6	1.4	1.4	0000000D:Surf[5]
Rooflights***	2.2	1.95	2	01000017:Surf[4]
Personnel doors^	1.6	1.6	1.6	0000000D:Surf[2]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

1- ASHP_rads_nat vent (circulation) - Be Lean

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.64	-	0	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

2- ASHP_HHRU_NVHR (classrooms & offices) - Be Lean

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.64	-	0	-	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					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

3- ASHP_rads_local extract (WCs & cleaners) - Be Lean

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.64	-	0	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

4- ASHP_HHRU_NVHR (Indirect Adjacent Store) - Be Lean

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.64	-	0	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

1- Direct electric_DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0.005
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
00 - Classroom (General)	-	-	-	-	-	0.2	-	-	-	-	N/A
00 - Science Classroom (Chemistry)	-	-	-	-	-	0.2	-	-	-	-	N/A
00 - Science Classroom (General) 2	-	-	-	-	-	0.2	-	-	-	-	N/A
01 - Science Classroom (Chemistry)	-	-	-	-	-	0.2	-	-	-	-	N/A
01 - Science Classroom (General) 2	-	-	-	-	-	0.2	-	-	-	-	N/A
01 - Science Prep Room (Chemistry)	-	-	-	-	-	0.2	-	-	-	-	N/A
B1 - Acc. WC	0.2	-	-	-	-	-	-	-	-	-	N/A
B1 - DT Office	-	-	-	-	-	0.2	-	-	-	-	N/A
B1 - DT Workshop	-	-	-	-	-	0.2	-	-	-	-	N/A

General lighting and display lighting		General luminaire	Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value		95	80	0.3
00 - Circulation Stairs (extension)		120	-	-
00 - Classroom (General)		120	-	-
00 - Science Classroom (Chemistry)		120	-	-
00 - Science Classroom (General) 2		120	-	-
01 - Science Classroom (Chemistry)		120	-	-
01 - Science Classroom (General) 2		120	-	-
01 - Science Prep Room (Chemistry)		120	-	-
B1 - Acc. WC		120	-	-
B1 - Circulation		120	-	-
B1 - DT Office		120	-	-
B1 - DT Workshop		120	-	-
B1 - Store		120	-	-
01 - Circulation Stairs (Extension)		120	-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00 - Classroom (General)	NO (-84.6%)	YES
00 - Science Classroom (Chemistry)	NO (-79.3%)	YES
00 - Science Classroom (General) 2	NO (-82.4%)	YES
01 - Science Classroom (Chemistry)	NO (-79.2%)	YES
01 - Science Classroom (General) 2	NO (-81.3%)	YES
01 - Science Prep Room (Chemistry)	NO (-84.5%)	YES
B1 - DT Office	NO (-64.7%)	YES
B1 - DT Workshop	NO (-68.3%)	YES

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]	642.3	642.3
External area [m ²]	1222.1	1162.5
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	3	3
Average conductance [W/K]	1201.6	415.77
Average U-value [W/m ² K]	0.98	0.36
Alpha value* [%]	7.1	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	9.27	11.28
Cooling	0	0
Auxiliary	0.92	2.02
Lighting	6.7	7.53
Hot water	9.79	9.15
Equipment*	13.87	13.87
TOTAL **	26.68	29.98

* 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.

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
<i>Displaced electricity</i>	<i>0</i>	<i>0</i>

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	71.95	112.81
Primary energy [kWh _{PE} /m ²]	41.11	45.07
Total emissions [kg/m ²]	3.9	4.28

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 SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Other local room heater - fanned, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
Actual	74.6	0	9.8	0	0.5	2.11	0	2.64	0	
Notional	118.6	0	11.9	0	2.4	2.78	0	----	----	
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
Actual	67.6	0	8	0	3.5	2.36	0	2.64	0	
Notional	236.1	0	23.6	0	4.4	2.78	0	----	----	
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
Actual	55.2	0	6.5	0	2.2	2.36	0	2.64	0	
Notional	90.2	0	9	0	1.2	2.78	0	----	----	
[ST] Other local room heater - fanned, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
Actual	134.1	0	17.6	0	0.1	2.11	0	2.64	0	
Notional	134	0	13.4	0	0	2.78	0	----	----	
[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

7.5 Appendix E – BRUKL with ASHP

Project name

Channing School**As designed****Date:** Fri Nov 24 17:14:15 2023

Administrative information

Building Details

Address: The Bank, London, N6 5HF

Certifier details

Name: Method Consulting**Telephone number:** 07193822044**Address:** 22-24 Queen Square, Bristol, BS1 4ND

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]:** 220The CO₂ emission and primary energy rates of the building must not exceed the targets

Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	4.28
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	3.73
Target primary energy rate (TPER), kWh _{PE} /m ² annum	45.07
Building primary energy rate (BPER), kWh _{PE} /m ² annum	39.34
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	0.26	0000001D:Surf[0]
Floors	0.18	0.12	0.45	PT000000:Surf[1]
Pitched roofs	0.16	0.16	0.16	PT000000:Surf[0]
Flat roofs	0.18	0.13	0.16	00000028:Surf[2]
Windows** and roof windows	1.6	1.4	1.4	0000000D:Surf[5]
Rooflights***	2.2	1.95	2	01000017:Surf[4]
Personnel doors^	1.6	1.6	1.6	0000000D:Surf[2]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building
U _{a-Limit} = Limiting area-weighted average U-values [W/(m ² K)] U _{a-Calc} = Calculated area-weighted average U-values [W/(m ² K)] U _{i-Calc} = Calculated maximum individual element U-values [W/(m ² K)] * 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 ² K 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

1- ASHP_rads_nat vent (circulation)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3	-	0	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

2- ASHP_HHRU_NVHR (classrooms & offices)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3	-	0	-	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					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

3- ASHP_rads_local extract (WCs & cleaners)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3	-	0	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

4- ASHP_HHRU_NVHR (Indirect Adjacent Store)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3	-	0	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

1- Direct electric_DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0.005
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
00 - Classroom (General)	-	-	-	-	-	0.2	-	-	-	-	N/A
00 - Science Classroom (Chemistry)	-	-	-	-	-	0.2	-	-	-	-	N/A
00 - Science Classroom (General) 2	-	-	-	-	-	0.2	-	-	-	-	N/A
01 - Science Classroom (Chemistry)	-	-	-	-	-	0.2	-	-	-	-	N/A
01 - Science Classroom (General) 2	-	-	-	-	-	0.2	-	-	-	-	N/A
01 - Science Prep Room (Chemistry)	-	-	-	-	-	0.2	-	-	-	-	N/A
B1 - Acc. WC	0.2	-	-	-	-	-	-	-	-	-	N/A
B1 - DT Office	-	-	-	-	-	0.2	-	-	-	-	N/A
B1 - DT Workshop	-	-	-	-	-	0.2	-	-	-	-	N/A

General lighting and display lighting		General luminaire	Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m ²]
Standard value		95	80	0.3
00 - Circulation Stairs (extension)		120	-	-
00 - Classroom (General)		120	-	-
00 - Science Classroom (Chemistry)		120	-	-
00 - Science Classroom (General) 2		120	-	-
01 - Science Classroom (Chemistry)		120	-	-
01 - Science Classroom (General) 2		120	-	-
01 - Science Prep Room (Chemistry)		120	-	-
B1 - Acc. WC		120	-	-
B1 - Circulation		120	-	-
B1 - DT Office		120	-	-
B1 - DT Workshop		120	-	-
B1 - Store		120	-	-
01 - Circulation Stairs (Extension)		120	-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00 - Classroom (General)	NO (-84.6%)	YES
00 - Science Classroom (Chemistry)	NO (-79.3%)	YES
00 - Science Classroom (General) 2	NO (-82.4%)	YES
01 - Science Classroom (Chemistry)	NO (-79.2%)	YES
01 - Science Classroom (General) 2	NO (-81.3%)	YES
01 - Science Prep Room (Chemistry)	NO (-84.5%)	YES
B1 - DT Office	NO (-64.7%)	YES
B1 - DT Workshop	NO (-68.3%)	YES

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]	642.3	642.3
External area [m ²]	1222.1	1162.5
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	3	3
Average conductance [W/K]	1201.6	415.77
Average U-value [W/m ² K]	0.98	0.36
Alpha value* [%]	7.1	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	8.16	11.28
Cooling	0	0
Auxiliary	0.91	2.02
Lighting	6.7	7.53
Hot water	9.79	9.15
Equipment*	13.87	13.87
TOTAL **	25.56	29.98

* 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.

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
<i>Displaced electricity</i>	<i>0</i>	<i>0</i>

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	71.95	112.81
Primary energy [kWh _{PE} /m ²]	39.34	45.07
Total emissions [kg/m ²]	3.73	4.28

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 SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Other local room heater - fanned, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
Actual	74.6	0	8.6	0	0.5	2.4	0	3	0	
Notional	118.6	0	11.9	0	2.4	2.78	0	----	----	
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
Actual	67.6	0	7	0	3.5	2.68	0	3	0	
Notional	236.1	0	23.6	0	4.4	2.78	0	----	----	
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
Actual	55.2	0	5.7	0	2.2	2.68	0	3	0	
Notional	90.2	0	9	0	1.2	2.78	0	----	----	
[ST] Other local room heater - fanned, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
Actual	134.1	0	15.5	0	0.1	2.4	0	3	0	
Notional	134	0	13.4	0	0	2.78	0	----	----	
[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

7.6 Appendix F – BRUKL with ASHP & 7.14 kWp PV

Project name

Channing School

As designed

Date: Fri Nov 24 17:02:59 2023

Administrative information

Building Details

Address: The Bank, London, N6 5HF

Certifier details

Name: Method Consulting

Telephone number: 07193822044

Address: 22-24 Queen Square, Bristol, BS1 4ND

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]: 220The CO₂ emission and primary energy rates of the building must not exceed the targets

Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	4.28
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	2.62
Target primary energy rate (TPER), kWh _{PE} /m ² annum	45.07
Building primary energy rate (BPER), kWh _{PE} /m ² annum	26.57
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	0.26	0000001D:Surf[0]
Floors	0.18	0.12	0.45	PT000000:Surf[1]
Pitched roofs	0.16	0.16	0.16	PT000000:Surf[0]
Flat roofs	0.18	0.13	0.16	00000028:Surf[2]
Windows** and roof windows	1.6	1.4	1.4	0000000D:Surf[5]
Rooflights***	2.2	1.95	2	01000017:Surf[4]
Personnel doors^	1.6	1.6	1.6	0000000D:Surf[2]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

1- ASHP_rads_nat vent (circulation)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3	-	0	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

2- ASHP_HHRU_NVHR (classrooms & offices)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3	-	0	-	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					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

3- ASHP_rads_local extract (WCs & cleaners)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3	-	0	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

4- ASHP_HHRU_NVHR (Indirect Adjacent Store)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3	-	0	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

1- Direct electric_DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0.005
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
00 - Classroom (General)	-	-	-	-	-	0.2	-	-	-	-	N/A
00 - Science Classroom (Chemistry)	-	-	-	-	-	0.2	-	-	-	-	N/A
00 - Science Classroom (General) 2	-	-	-	-	-	0.2	-	-	-	-	N/A
01 - Science Classroom (Chemistry)	-	-	-	-	-	0.2	-	-	-	-	N/A
01 - Science Classroom (General) 2	-	-	-	-	-	0.2	-	-	-	-	N/A
01 - Science Prep Room (Chemistry)	-	-	-	-	-	0.2	-	-	-	-	N/A
B1 - Acc. WC	0.2	-	-	-	-	-	-	-	-	-	N/A
B1 - DT Office	-	-	-	-	-	0.2	-	-	-	-	N/A
B1 - DT Workshop	-	-	-	-	-	0.2	-	-	-	-	N/A

General lighting and display lighting		General luminaire	Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m ²]
Standard value		95	80	0.3
00 - Circulation Stairs (extension)		120	-	-
00 - Classroom (General)		120	-	-
00 - Science Classroom (Chemistry)		120	-	-
00 - Science Classroom (General) 2		120	-	-
01 - Science Classroom (Chemistry)		120	-	-
01 - Science Classroom (General) 2		120	-	-
01 - Science Prep Room (Chemistry)		120	-	-
B1 - Acc. WC		120	-	-
B1 - Circulation		120	-	-
B1 - DT Office		120	-	-
B1 - DT Workshop		120	-	-
B1 - Store		120	-	-
01 - Circulation Stairs (Extension)		120	-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00 - Classroom (General)	NO (-84.6%)	YES
00 - Science Classroom (Chemistry)	NO (-79.3%)	YES
00 - Science Classroom (General) 2	NO (-82.4%)	YES
01 - Science Classroom (Chemistry)	NO (-79.2%)	YES
01 - Science Classroom (General) 2	NO (-81.3%)	YES
01 - Science Prep Room (Chemistry)	NO (-84.5%)	YES
B1 - DT Office	NO (-64.7%)	YES
B1 - DT Workshop	NO (-68.3%)	YES

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]	642.3	642.3
External area [m ²]	1222.1	1162.5
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	3	3
Average conductance [W/K]	1201.6	415.77
Average U-value [W/m ² K]	0.98	0.36
Alpha value* [%]	7.1	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	8.16	11.28
Cooling	0	0
Auxiliary	0.91	2.02
Lighting	6.7	7.53
Hot water	9.79	9.15
Equipment*	13.87	13.87
TOTAL **	25.56	29.98

* 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.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	8.7	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>8.7</i>	<i>0</i>

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	71.95	112.81
Primary energy [kWh _{PE} /m ²]	26.57	45.07
Total emissions [kg/m ²]	2.62	4.28

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 SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Other local room heater - fanned, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
Actual	74.6	0	8.6	0	0.5	2.4	0	3	0	
Notional	118.6	0	11.9	0	2.4	2.78	0	----	----	
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
Actual	67.6	0	7	0	3.5	2.68	0	3	0	
Notional	236.1	0	23.6	0	4.4	2.78	0	----	----	
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
Actual	55.2	0	5.7	0	2.2	2.68	0	3	0	
Notional	90.2	0	9	0	1.2	2.78	0	----	----	
[ST] Other local room heater - fanned, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
Actual	134.1	0	15.5	0	0.1	2.4	0	3	0	
Notional	134	0	13.4	0	0	2.78	0	----	----	
[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



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Victoria, St. Austell
PL26 8LG