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HAMPTON PRE-PREP SCHOOL EXTENSION

Energy Statement – Revision A

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NEW HALL EXTENSION
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HAMPTON PRE-PREP SCHOOL, NEW HALL EXTENSION
Energy Statement
Revision A

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Registration of Amendments

Revision	Amendment Details	Revision Prepared By	Revision Approved By
Rev A 09.11.22	Minor amendments to Executive Summary	AK	AG

EXECUTIVE SUMMARY

This Energy Statement is submitted to support the planning application for the proposed development at Hampton Pre-Prep School, in the London Borough of Richmond-upon-Thames. The strategy has been prepared in the context of the adopted Richmond Local Plan 2018, specifically Policy LP 22, which states that all developments are required to incorporate measures to improve energy conservation and efficiency and should achieve a 35% carbon emission reduction over the Part L compliant case.

The adopted policy requires all developments to integrate the principles of sustainable design and construction into the design of the new proposal. This energy strategy demonstrates the carbon reductions that can be achieved through addressing the fabric energy efficiency measures and efficient servicing solutions throughout.

The assessment of predicted carbon emissions was carried out using the revised (SAP 10) fuel carbon factors. The proposal has also been assessed against the latest version of Part L (2021) and the requirements relating to fabric and systems efficiencies included in the revised Approved Document have been applied to the development.

'Be Lean': The strategy aims to reduce energy demands by specifying a highly efficient building fabric and efficient heating and ventilation system. This is to ensure that the highest possible standards are achieved for the site. The proposal will ensure the development meets or exceeds the standards for new and replacement elements in existing buildings and extensions, according to Part L2.

'Be Clean': The opportunity for the proposed development to link into an existing or planned decentralised energy network has been considered. The development is not located within the immediate proximity of a proposed district heat network with the London Heat Map showing the closest potential heat network located 12 km away from the site. The connection to district heating has therefore not been further explored.

'Be Green': A feasibility study has been undertaken to establish suitability of the new building for integration of renewable technology on site. It has been concluded that the most feasible technology will be air source heat pump (ASHP) providing space heating and cooling in the new hall and 6 kWp photovoltaic system mounted on the flat roof of the school hall.

Conclusions: The London Borough of Richmond-upon-Thames CO2 emissions reduction requirement (35% improvement over Part L) has been met for the new part of the development. The proposed extension will achieve a reduction in carbon emissions of over 100% compared with the baseline building meeting Part L 2021 requirements (TER).

It is not financially viable to achieve a 35% reduction in CO2 emissions for the existing building. It is also not possible to undergo a deep renovation of the existing building at this time due to time constraints, posed by the operation of the building during school term time and the possible improvement works on the existing building being limited to school holidays. However, to align with the local planning policy requirements relating to resource efficiency, a number of improvements

measures are proposed for the existing building, including loft insulation, installation of draft excluders, the introduction of more efficient light bulbs and TRVs fitted to radiators where possible. Overall, the proposal is considered to comply with the requirements of the London Borough of Richmond upon Thames, Policy LP22.

1.0 INTRODUCTION

1.1 Create Consulting Engineers Ltd has been commissioned by Hampton School to prepare an Energy Statement to support a full planning application for the proposed new school hall stand-alone building and extension to the Pre-prep School in Hampton, in the London Borough of Richmond-upon-Thames.

1.2 The objective of the Energy Statement is to assess the proposed development against the policy requirements of the adopted Richmond Local Plan and specifically Policy LP22: Sustainable Design and Construction.

Site Location and Description

1.3 The Site is the existing Pre-prep and Prep School, located on Wensleydale Road. Please refer to figure 1.1 below for the Site Location Plan.

Figure 1.1: Site Location Plan

1.4 The proposed works will involve the demolition of an existing temporary building housing the kindergarten, and the erection of a new single-storey modular building housing a hall, kitchen and WCs, and a single-storey extension to the existing building to form an enlarged reception classroom and an internal link to the hall.

Objectives

1.5 The objectives of this report are to:

- Demonstrate how the proposed development has been assessed against the policy requirements of the adopted Richmond Local Plan, specifically Policy LP 22.
- Identify the most suitable passive and energy efficient design approach for the scheme, the feasibility of Low and Zero Carbon technologies and operational Best Practice.
- Identify the drivers relating to an energy efficient design over and above minimum compliance with current Building Regulations and energy targets.

2.0 CURRENT AND FUTURE PLANNING POLICIES/GOOD PRACTICE REVIEW AND PROJECT REQUIREMENTS

National Planning Policy Framework (July 2021)

2.1 The National Planning Policy Framework sets out the Government's planning policies for England and how these are expected to be applied. Taken together, these policies articulate the Government's vision of sustainable development, which should be interpreted and applied locally to meet local aspirations. The ministerial foreword of this NPPF highlights that 'the purpose of planning is to contribute to the achievement of sustainable development' and that at the heart of the framework is a presumption in favour of sustainable development.

2.2 Sustainable development is defined in the NPPF as comprising developments "meeting the needs of the present without compromising the ability of future generations to meet their own needs" in line with the definition of the Brundtland Commission ('Our Common Future', 1987). The NPPF also refers to the three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways – an economic objective, a social objective and an environmental objective.

New London Plan (March 2021)

2.3 The London Plan 2021 is the Spatial Development Strategy for Greater London. It sets out a framework for how London will develop over the next 20-25 years and the Mayor's vision for Good Growth.

2.4 Policy SI 2 within the Chapter 9: Sustainable Infrastructure confirms the London principles for minimising greenhouse gas emissions.

> *"Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:*
>
> 1) *Be lean: use less energy and manage demand during operation.*
> 2) *Be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly*
> 3) *Be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site*
> 4) *Be seen: monitor, verify and report on energy performance."*
>
> *"Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.*
>
> *"A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures."*

"Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:

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

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

"Boroughs should ensure that all developments maximise opportunities for on-site electricity and heat production from solar technologies (photovoltaic and thermal) and use innovative building materials and smart technologies."

"To meet the zero-carbon target, an on-site reduction of at least 35 per cent beyond the baseline of Part L of the current Building Regulations is required."

2.5 The above policy refers to major development and therefore is not strictly applicable to the proposed extension. The principles of the energy hierarchy will, however, be implemented in the design of the new elements.

Greater London Authority (GLA) guidance on preparing energy assessments as part of planning applications (June 2022)

2.6 The June 2022 revision to the GLA guidance on preparing energy statements explains how London Plan policies apply after Part L 2021 has taken effect.

2.7 More guidance is also given on design and reporting process for proposals involving ambient loop systems with heat pumps in individual units where there is potential to connect to a district heat network and where heat network is utilised.

2.8 The guidance confirms the London Plan energy efficiency targets which refer to <u>new major</u> developments.

2.9 As the development does not classify as major, the proposed energy efficiency targets are not mandatory for the Hampton Pre-prep school extension.

Local Planning Policy

<u>Richmond Local Plan 2033 (adopted 2018)</u>

2.10 The London Borough of Richmond Local Plan, adopted in July 2018, sets out the planning framework to guide the future development of the borough to 2033. This document replaces previous policies within the Core Strategy and Development Management Plan. The following

policies has been identified as appropriate for assessing the energy performance of new developments:

- Policy LP20: Climate Change Adaption

A. The Council will promote and encourage development to be fully resilient to the future impacts of climate change in order to minimise vulnerability of people and property.

B. New development, in their layout, design, construction, materials, landscaping and operation, should minimise the effects of overheating as well as minimise energy consumption in accordance with the following cooling hierarchy:

1) *minimise internal heat generation through energy efficient design*
2) *reduce the amount of heat entering a building in summer through shading, reducing solar reflectance, fenestration, insulation and green roofs and walls*
3) *manage the heat within the building through exposed internal thermal mass and high ceilings*
4) *passive ventilation*
5) *mechanical ventilation*
6) *active cooling systems (ensuring they are the lowest carbon options).*

C. Opportunities to adapt existing buildings, places and spaces to the likely effects of climate change should be maximised and will be supported.

- Policy LP 22: Sustainable Design and Construction

A. Developments will be required to achieve the highest standards of sustainable design and construction to mitigate the likely effects of climate change. Applicants will be required to complete the following:

1) *Development of 1 dwelling unit or more, or 100sqm or more of non-residential floor space (including extensions) will be required to complete the Sustainable Construction Checklist SPD. A completed Checklist has to be submitted as part of the planning application.*
2) *Development that results in a new residential dwelling, including conversions, change of use, and extensions that result in a new dwelling unit, will be required to incorporate water conservation measures to achieve maximum water consumption of 110 litres per person per day for homes (including an allowance of 5 litres or less per person per day for external water consumption).*
3) *New non-residential buildings over 100sqm will be required to meet BREEAM 'Excellent' standard.*
4) *Proposals for change of use to residential will be required to meet BREEAM Domestic Refurbishment 'Excellent' standard (where feasible).*

Reducing Carbon Dioxide Emissions

B. Developers are required to incorporate measures to improve energy conservation and efficiency as well as contributions to renewable and low carbon energy generation. Proposed developments are required to meet the following minimum reductions in carbon dioxide emissions:

1) *All new major residential developments (10 units or more) should achieve zero carbon standards in line with London Plan policy.*
2) *All other new residential buildings should achieve a 35% reduction.*
3) *All non-residential buildings over 100sqm should achieve a 35% reduction. From 2019 all major non residential buildings should achieve zero carbon standards in line with London Plan policy.*

Targets are expressed as a percentage improvement over the target emission rate (TER) based on Part L of the 2013 Building Regulations.

C. *This should be achieved by following the Energy Hierarchy:*

1) *Be lean: use less energy*
2) *Be clean: supply energy efficiently*
3) *Be green: use renewable energy*

Decentralised Energy Networks

D. *The Council requires developments to contribute towards the Mayor of London target of 25% of heat and power to be generated through localised decentralised energy (DE) systems by 2025. The following will be required:*

1) *All new development will be required to connect to existing DE networks where feasible. This also applies where a DE network is planned and expected to be operational within 5 years of the development being completed.*
2) *Development proposals of 50 units or more, or new non-residential development of 1000sqm or more, will need to provide an assessment of the provision of on-site decentralised energy (DE) networks and combined heat and power (CHP).*
3) *Where feasible, new development of 50 units or more, or new non-residential development of 1000sqm or more, as well as schemes for the Proposal Sites identified in this Plan, will need to provide on-site DE and CHP; this is particularly necessary within the clusters identified for DE opportunities in the borough-wide Heat Mapping Study. Where on-site provision is not feasible, provision should be made for future connection to a local DE network should one become available.*

Applicants are required to consider the installation of low, or preferably ultra-low, NOx boilers to reduce the amount of NOx emitted in the borough.

Local opportunities to contribute towards decentralised energy supply from renewable and low-carbon technologies will be encouraged where appropriate.

Retrofitting

E. *High standards of energy and water efficiency in existing developments will be supported wherever possible through retrofitting. Householder extensions and other development proposals that do not meet the thresholds set out in this policy are encouraged to complete and submit the Sustainable Construction Checklist SPD as far as possible, and opportunities for micro-generation of renewable energy will be supported in line with other policies in this Plan.*

2.11 A pre-planning consultation confirmed that due to the size of the proposed extension a BREEAM assessment will not be needed for the site.

Building Regulations Approved Document Part L2

2.12 Part L of the current Building Regulations (2021) considers the reduction of carbon emissions in new and existing buildings. The proposal consists of refurbishment with an extension of the existing building. The works will have to meet the requirements relating to change of use, refurbishments and extensions contained within the new Part L2 document.

2.13 The Approved Document L2, Sections 10 and 11 give guidance on energy efficiency requirements for retained, upgraded and new elements in existing buildings and buildings that undergo change of use or change of energy status. It also sets out the minimum requirements for the provision or extension of controlled fittings (windows, doors) and controlled services (heating, cooling, ventilation, and lighting).

2.14 The document also explains the requirements for historic and traditional buildings where energy efficiency requirements might be relaxed to avoid the improvements altering the character and appearance of the building.

Summary of Policy Requirements for the Proposed Development

2.15 The proposed development is required to meet the following standards:

- 35% reduction in CO_2 emissions over the baseline scenario where feasible;
- Part L2 standards for building fabric and services for the extension and any improved fabric;
- Submit an Energy Statement;
- Submit a Sustainable Construction Checklist;

3.0 ENERGY EFFICIENCY STRATEGY – 'BE LEAN'

Introduction

3.1 The proposed energy strategy has, as its first priority, minimised energy consumption through the performance of the building envelope and services. The following section details the energy efficiency features of the development. The cooling hierarchy set out within the London Plan has been followed.

3.2 This analysis includes:

- Building Regulations Approved Document L2 (2021) initial compliance assessment, identifying the potential for the design to comply with and exceed Building Regulations requirements.
- An energy demand assessment of the proposed scheme contained within this document provides carbon dioxide emissions estimates from the analysis of passive energy efficiency enhancements and Low and Zero Carbon potential. This will utilise Building Regulations 2021 carbon dioxide fuel factors.

3.3 In further detail, the energy efficiency strategy of the scheme has been achieved by incorporating the following design and technology features:

Energy Efficiency Features Proposed

Physical Form and Orientation of the Building

3.4 While the orientation of the development is limited due to it being erected on a small parcel of land, the facades of the new block have been optimised in order to provide a balance of thermal control, both from within and outside the buildings.

3.5 Passive solar design involves adapting the internal layout and glazing to best respond to the local climate and annual sun path, with the aim of reducing energy demands and improving occupant comfort through the use of heat and light from the sun. The new school hall building will utilise the passive solar design principles through orientation of its main windows towards south and west. This will enable daylight penetration into the new building, reducing its heating load.

Overheating

3.6 Overheating is reduced through the inclusion of openable windows to enable effective purge ventilation. Additionally, overhangs are proposed above the south and west facing windows, reducing the excessive solar gains during the summer but enabling the solar energy to penetrate the spaces during winter time.

3.7 All windows to the main hall will be utilising glazing with a low solar thermal transmittance factor of 0.4 to further reduce solar gains during summer months.

3.8 Shading control systems in the form of individually controlled interior opaque blinds will offer efficient solar control providing shading and glare control, which in turn improves occupier comfort and reduces the risk of overheating within the building.

Building Envelope Specification and Thermal Performance

3.9 The heat losses of the spaces will be reduced by optimising the thermal performance of the building fabric and limiting the air permeability through a very high standard of construction. This strategy will lead to a steady but extremely low space heating load for all of the buildings of the scheme.

3.10 The new school hall building is proposed to be constructed of modular elements, which will be manufactured to meet the desired specification.

3.11 The rear extension to the main school building will be constructed of traditional brick-block cavity wall and timber frame roof structure.

3.12 Building fabric thermal transmittance is measured by the U-value of each building element in Watts/m²/K. The U-Value is essentially a measure of the rate at which energy is lost through a building element; the greater the U-Value, the higher the rate of energy loss.

3.13 Table 3.1 below details the U-values for the development at in relation to Building Regulations notional values for new builds and table 3.2 details the U-values for the extension and the rear conservatory that will be met as minimum.

Energy Efficiency Features	Part L2: 2021 Limiting Values for Extensions or New Elements in a Building	Proposed Building
U-Value Walls (W/m²K)	0.26	0.18
U-Value Ground Floor/ Upper Exposed Floor (W/m²K)	0.22	0.15
U-Value Roof (W/m²K)	0.18	0.15
U-Value Windows (W/m²K)	1.6	1.4 g-factor = 0.4 for all windows in the hall
U-Value Doors – solid (W/m²K)	2.2	1.4
Permeability Rate (m³/hm²) @ 50Pa	3	3

Table 3.1: Proposed building fabric performance for the new extension

Energy Efficiency Features – Existing Building	Part L2 (2021) Limiting Fabric Parameter	Proposed or Retained Values
External solid brick walls (W/m^2K)	0.70	2.1
Ground Floor	0.70	0.57
Roof - Insulation at rafter level	0.35	0.35
New windows	1.6	1.4 or better
Air permeability	25 - assumed based on the age of the property	15 – assumed better due to internal lining and upgraded internal finishes carried out over the years

Table 3.2: Building Fabric Standard Specified for the Side Extension and Rear Conservatory

Air Tightness and Ventilation Strategy/Scope for Natural Ventilation

3.14 Air permeability is a measure of infiltration. It indicates how often the entire air quantity in a building is exchanged with outside air within 1 hour without any ventilation in place. Any air exchange with outside air is carrying heat energy away from the building, resulting in a higher heating load. Lower air permeability levels are desirable for conserving heat energy and in the case of mechanical ventilation systems for reducing fan power consumption. Infiltration is different from ventilation. Infiltration is essentially unwanted air exchanges through imperfections in the building fabric while ventilation is the air exchanges intended by the designer.

3.15 As detailed in Table 3.1 it is envisaged that the air permeability of the proposed new building will be in the region of $3m^3/m^2$@50PA/hr for all spaces.

3.16 The new building and the proposed extension are proposed to be naturally ventilated with extract fans provided to all wet rooms.

3.17 Mechanical ventilation with heat recovery is also proposed for the main hall to ensure adequate ventilation during colder months when the hall if fully occupied. The efficiency of the system will be very high (approx. 88%) with a low specific fan power of the system (0.9 W/l/s). The controls will include CO_2 sensors.

Overheating

3.18 Overheating is reduced through the inclusion of openable windows to enable effective ventilation and cross-ventilation of the rooms.

3.19 Additionally, the south facing windows in the proposed hall will have a low solar thermal transmittance (g-value), in the region of 0.4 limiting solar gains and preventing overheating.

3.20 Shading control systems in the form of overhangs and individually controlled interior curtains or blinds will offer additional solar control as they provide both solar shading and glare control, which in turn improves occupier comfort and reduces the risk of overheating within the rooms.

3.21 The servicing infrastructure will be designed to minimise heat gains within the occupied floor and utilising highly efficient pipe insulation to minimise distribution heat losses.

3.22 Comfort cooling will not be needed for the spaces; however it will be provided in the main hall as part of the main heating system. This system will however be used only intermittently, and its efficiency will be very high reducing the building's energy consumption.

Lighting and Appliances

3.23 High efficiency low energy lighting and controls have been specified throughout. All new spaces will utilise 100% low energy lighting.

3.24 Lighting will be designed in accordance with CIBSE (Chartered Institute of Building Service Engineers) Guide A: Environmental Design and relevant CIBSE Lighting Guides.

3.25 Unnecessary light spill will be reduced by avoiding the use of external decorative lighting; providing fittings only where they are required for security and maintenance purposes. External luminaires have been chosen to minimise sky glow and overspill and located to ensure that only the level of lighting that is required is achieved.

3.26 The lighting solution will make use of modern luminaire and lamp technology, including constant illuminance control and photoelectric dimmable LEDs in the main hall, and occupancy sensors in the toilets, stores and circulation areas. All lamp efficacies will be minimum 120 lumens/circuit Watt. The position of individual light fittings will also be chosen to minimise over-provision whilst ensuring that lux uniformity is maintained.

3.27 All appliances will be very energy efficient (A to A+++ rated). Information on the EU Energy Efficiency Labelling Scheme will be provided.

The Choice and Design of Building Systems and Plant

3.28 The building systems and plant have been chosen to optimise the efficiency of the systems by matching installed capacity to anticipated building demand. Items of equipment, which make up the building's mechanical building services installation, will be specified to achieve high annual energy efficiency in operation and will be serviced regularly to maintain their performance.

3.29 The proposed method for space heating provision in the main hall as well as cooling in this space will be via a very efficient heat pumps. Use of efficient system controls for local temperature adjustment in each occupied space will be incorporated to reflect the user demands. The heat will be distributed via wall mounted cassettes.

3.30 The proposed, indicative systems' efficiencies used in the simulation are in the region of SCOP 4.8 and SEER 7.0.

3.31 Space heating in the ancillary spaces in the new rear extension will be via direct electric panel radiant heaters.

3.32 How water provision in the new spaces will be via direct electric system. This was deemed the most appropriate system due to the low water demand in the toilets.

3.33 The proposed Reception class extension and corridor extension leading from the main building to the hall will be connected to the existing heating system. The heating controls will include room thermostat and TRVs (thermostatic radiator valves).

Energy requirement and CO_2 emissions of the development

3.34 The GLA guidance requires that the results or the energy simulation are presented separately for the refurbished part of the development and for the new extension. These can be found summarised in tables below.

3.35 The small extensions added to the ground floor (toilets, store, extension to Reception classroom) have not been included in the modelling carried out for the new hall extension as these elements would be difficult to separate from the main building for the purpose of Part L2 compliance. These spaces have been included in the modelling of the refurbished part but with building fabric standard relevant to new elements applied to them.

3.36 Simulations are based upon the latest set of plans and elevations prepared by Squires and Brown, dated August 2022. Please refer to architectural drawings for building's geometry.

<u>Simplified Building Energy Model (SBEM)</u>

3.37 IES VE uses the National Calculation Methodology (NCM) and SBEM platform to demonstrate building compliance for non-residential buildings with Part L2 of the Building Regulations 2021. It can also be used to determine the building's regulated energy demand, consumption and carbon dioxide emissions.

3.38 The calculations determine a Building Emissions Rate or 'BER'. This value is compared to the energy requirements and emissions of a notional building of the same shape and dimensions which determines a compliant building (the Target Emission Rate or 'TER'). The BER must be equal to or less than the TER.

Energy requirement and CO_2 emissions of the development

Results of the Energy Simulation – Baseline and Energy Efficiency Improvements

3.39 Table 3.3 below summarises the main results of the energy simulation for the existing and proposed scenarios modelled according to GLA guidance described above.

3.40 Total carbon dioxide emissions for the building have been derived from the Building Emission Rate and Target Emission Rate for the new hall extension, adjusted for the PV contribution on new buildings as per Part L 2021, and are as detailed in Appendix A.

Carbon dioxide emissions [tonnes/year]	Existing, altered school building [GIA = 624.8m^2]	New Extension [GIA = 127.7m^2]	Site-wide
Existing or Part L baseline scenario	15.01	0.37	15.38
Be Lean scenario	14.88	0.37	15.25
IMPROVEMENT	0.13 (1%)	Meets Part L requirements	0.13 (1%)

Table 3.3: Results of the Energy Simulation – CO_2 emissions of the existing and proposed scenarios and improvements from 'Be Lean' measures only

Results of the Energy Simulation

3.41 The regulated CO_2 emissions of the proposed scheme have been estimated as approximately 15.25 tonnes of CO_2 per year.

3.42 The estimated CO_2 emissions calculated for the 'Be Lean' scenario for the development demonstrate that the proposed building fabric and systems' efficiencies exceed those required by the Building Regulations, showing the commitment to reducing carbon emissions through incorporation of energy efficiency features in first instance.

3.43 The results of the energy simulation demonstrate that the proposal will meet the requirements for energy efficient design outlined in the adopted Local Plan Policy LP 22.

4.0 'BE CLEAN': SUPPLY ENERGY EFFICIENTLY

4.1 Connection to a decentralised energy network and the use of combined heat and power is a recognised method of generating energy more efficiently. The adopted Local Plan Policy LP 22 requires development proposals to explore the opportunities to link into an existing or planned decentralised energy network. Where an existing decentralised energy network is not present, an assessment of the feasibility of establishing a decentralised energy system for the proposed development should be undertaken; including an assessment of the feasibility of a Combined Heat and Power (CHP) communal heating system.

Decentralised Energy Networks

4.2 The London Heat Map tool is an interactive tool that allows users to identify opportunities for decentralised energy projects in London. It builds on the 2005 London Community Heating Development Study. All information has been updated and the map is now in a user friendly format using an interactive GIS system. This tool details the existing and proposed major heat loads and supplies within London as well as existing and proposed heat distribution networks.

4.3 The London Heat Map tool indicates the location of future decentralised energy networks approximately 11 kilometres from the proposed development site (Please refer to Figure 4.1). The site is not located within a viable distance of the heat networks; therefore, connection to a decentralised energy network is considered unfeasible at the present time.

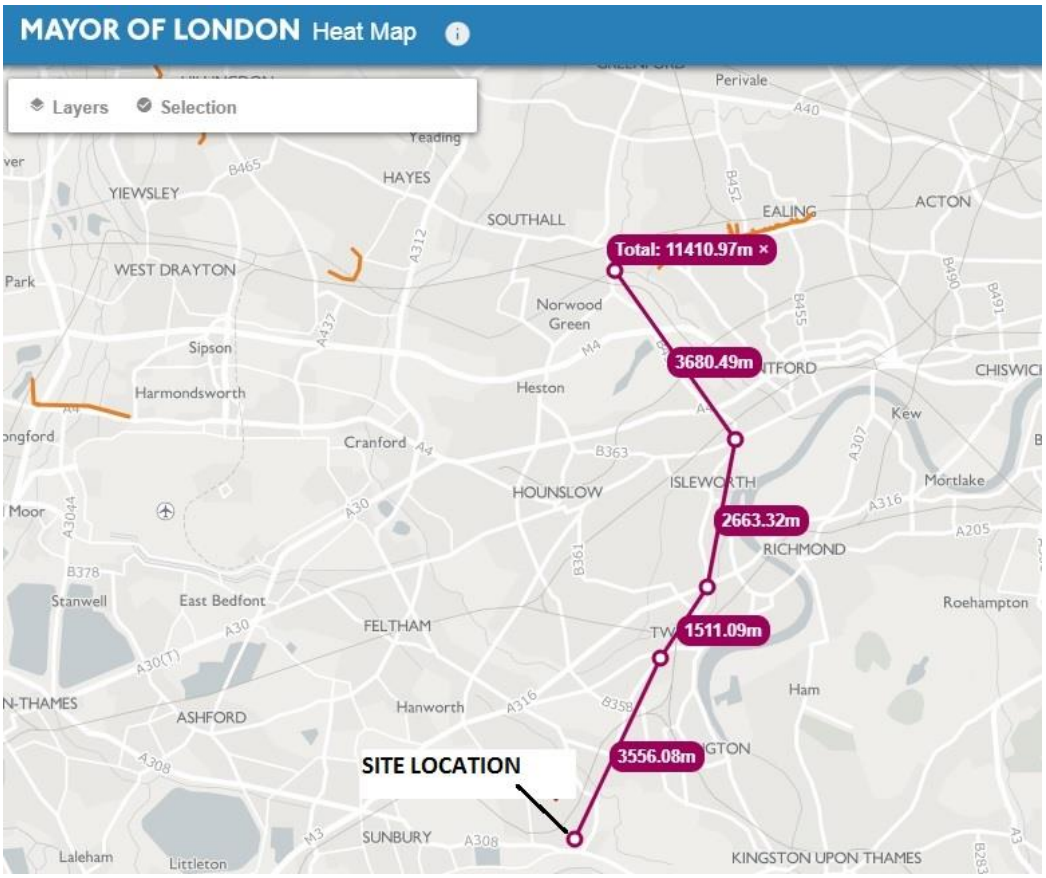

Figure 4.1: Location of the proposed site in relation to potential energy networks.

5.0 LOW AND ZERO CARBON TECHNOLOGIES – 'BE GREEN'

Overview

5.1 The final step in the energy hierarchy requires that the clean generation of energy by renewable energy technologies be examined.

5.2 A feasibility study has been undertaken to establish the most technically and economically viable renewable technology which provides the highest overall reduction in carbon dioxide emissions for the proposed development to help achieve the planning policy target. The renewable technologies reviewed in this study and their feasibility for the proposed development are summarised in Table 5.1 below.

Low and Zero Carbon Technology	Suitability for the proposed development
Photovoltaic Panels	**SUITABLE**
Heat Pumps	**SUITABLE**
Solar thermal panels	**NO**
Biomass boilers	**NO**
Wind turbines	**NO**

Table 5.1: Review of suitability of LZC technology for the site.

5.3 Key parameters which have been considered when selecting appropriate combinations of technologies include:

- Opportunities of the site and energy demand of the development;
- Visual impact of the system;
- Practical implementation considerations;
- Maintenance requirements;
- Implications for internal arrangement and space allocation, infrastructure and site layout;
- Public acceptability;
- Deliverability;
- Management options;
- Interactions of the technologies with one another;
- Client's preference.

Low and Zero Carbon Technologies – Feasibility

Air Source Heat Pumps (ASHP)

5.4 Heat Pumps, utilising low grade heat, provide high efficiency, low carbon heating. They are a thermodynamic device based on the vapour compression cycle. The four elements of the

refrigeration circuit are: the evaporator, compressor, heat exchanger and condenser. The heat, which is extracted from the medium, goes through a number of processes and is distributed throughout the building through a standard wet central heating system. Heat pumps utilise electricity to drive their pumps and compressor units. They are essentially a form of efficient electric heating. The efficiency of a heat pump is rated by its coefficient of performance (CoP).

5.5 The CoP is a measure of the electricity input to the system and the heat energy extracted. Several factors affect the CoP of a heat pump; the consistency of the heat source and the required output temperature. Heat pump efficiency is greatest when the required output temperature rise is lowest; hence heat pumps are commonly paired with under floor heating systems.

5.6 ASHPs extract energy from the air and therefore require space for external units. The flat roof on the new school hall is suitable for the location of the external units of the system, however mitigation measures to reduce noise impact of the system would have to be incorporated into the design of the ASHP enclosure.

5.7 To reduce the number of external units, it is currently proposed that air source heat pumps will be utilised to provide space heating and cooling in the new hall only. This will be delivered via ceiling mounted cassettes. The system's efficiency will be in the region of SCoP 4.8 and SEER 7.0.

Photovoltaic Panels

5.8 Photovoltaic cells directly convert sunlight into electrical current using semiconductors. The output of a cell is directly proportional to the intensity of the light received by the active surface of the cell. The location and positioning of PV cells is therefore critical to achieving acceptable performance. Exposure to sunlight causes electricity to flow through the cells. Mono-crystalline PV cells provide higher levels of electricity generating performance over other panel types. PV panels can be incorporated into a range of building designs and positions, provided they are located in a shade-free environment and facing as close to south as possible.

5.9 Photovoltaics are generally technically suitable for all types of developments.

5.10 Areas of PV modules vary between manufacturers, however on average 1 PV module covers an area of approximately 1.6 m^2. PV panels are produced in various sizes with power outputs ranging from 0.165 kWp to 1 kWp per module. The most commonly used PV modules generate approximately 0.3-0.4 kW of electricity.

5.11 It is generally recommended that solar PV modules are installed on the south, south-west (SW) or south-east (SE) orientated tilted (30-40 degrees) roofs for maximum electricity

generation. However horizontally (10-15 degrees inclination) mounted PV panels provide a good amount of electricity, only 12% less than the highest figures achieved for the most favourably located panels.

5.12 Due to the location of the proposal, surrounded by residential properties, the positioning of PV panels has to be carefully considered to have a minimal visual impact. The flat roof of the proposal is suitable for installation of PV panels. The solar collectors could be mounted at a slight tilt to avoid excessive protrusion from the building's roof. The panels' south orientation would generate a fair amount of electricity that could be used within the building or fed back to the national grid.

5.13 The proposal is to install approximately 16-18 PV panels, which can provide a total of 5.6 – 6.3 kWp output, depending on the panels' specification. The system of this size would generate 4.71MWh of electricity per year (based on 6kWp PV system assumed for ease of calculation). Overall carbon emission reductions achieved by the proposed PVs would reach 0.64 tonne per year, when calculated using current carbon factors for electricity (i.e., SAP 10.2).

5.14 The roof of the proposed school hall has enough available area to fit a sufficient number of PV panels to maximise the carbon emissions reduction (please refer to Figure 5.1 below).

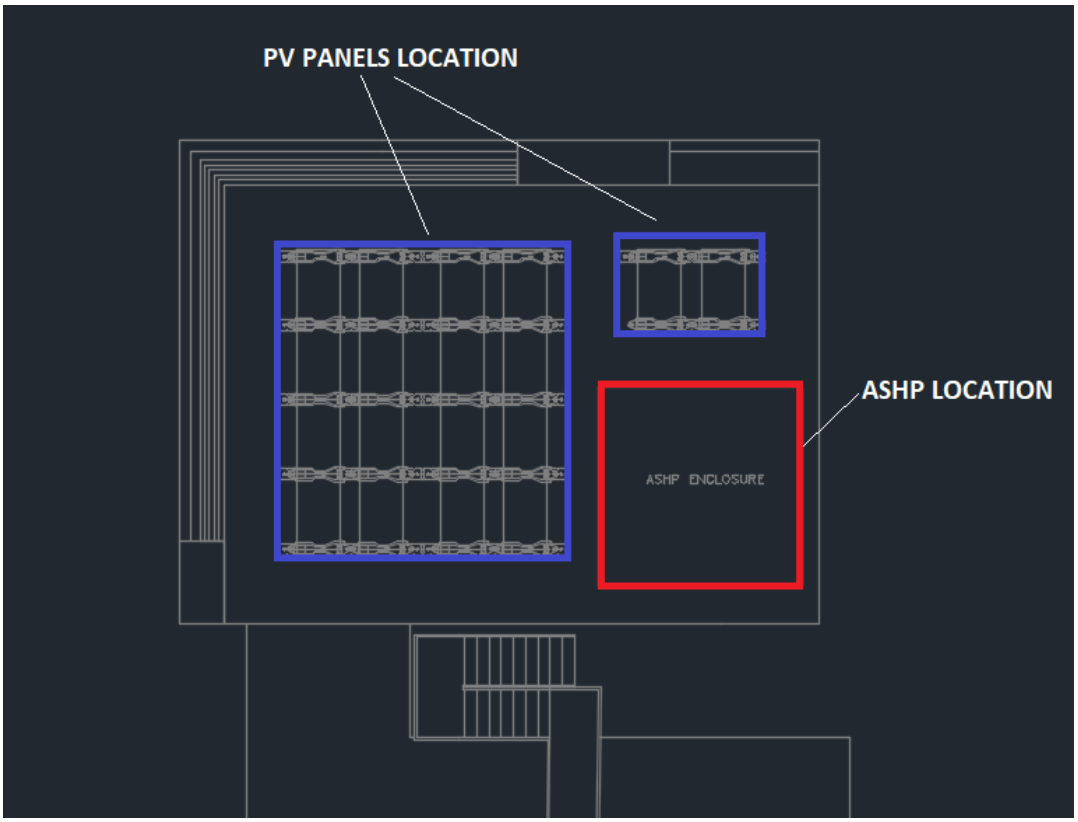

Figure 5.1: Possible location of PV panels and ASHP (sketch based on architect's drawing)

5.15 Please refer to table 5.2 for details of the savings achieved by the proposed ASHP and 6 kWp PV system and Appendix B for BRUKL document.

Carbon dioxide emissions [tonnes/year]	Existing, altered school building [GIA = 624.8m^2]	New Extension [GIA = 127.7m^2]	Site-wide
Existing or Part L 'baseline' scenario	15.01	0.37	15.38
Be Lean scenario	14.88	0.37	15.25
Be Green scenario (ASHP + PV)	14.88	-0.1	14.58
Improvement	0	0.47	0.47
% Improvement	0	**180%**	**3.05%**

Table 5.2: Carbon emissions with the proposed ASHP and PV system

5.16 The carbon emission reduction achieved for the proposal with the energy efficiency measures in place and renewable energy technologies (ASHP and PVs) will comfortably exceed the planning policy target of 35% over Part L 2021 compliant design, for the new build part of the development.

5.17 The existing school building will not meet this target due to the unfeasibility of deep retrofit works on site, while keeping the school operational during term time.

5.18 It is already proposed to insulate all loft spaces, which lack mineral wool insulation, and to install good performing windows where replacement units are necessary.

5.19 Further review of the feasible improvement measures in the old part of the school will take place gradually and will consider:

- Upgrade of the existing heating system and controls
- Installation of secondary glazing to all single-glazed windows

5.20 Please refer to Appendix C for the summary of other renewable technologies considered for the proposed development but concluded to be unfeasible.

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 This report has been developed to detail the energy efficient features of the development and assesses how they relate to the relevant planning policy, including the adopted Local Plan and its Policy LP 22.

6.2 The energy strategy of the development has been compiled to respond to and improve on the planning requirements of the adopted Richmond Local Plan Policy LP 22, requiring reduction in predicted energy demand from the development to be achieved through incorporation of energy efficient building fabric, efficient services design and low and/or renewable energy technology, where feasible.

6.3 The energy assessment follows the principles of the energy hierarchy: 'Be Lean', 'Be Clean' and 'Be Green'. The overriding objective in the formulation of the energy strategy for the scheme has been to maximise the viable reductions in total carbon dioxide emissions within the framework of the energy hierarchy.

6.4 The energy strategy of the scheme has considered measures to adapt and mitigate the effects of climate change leading to significant CO_2 emission reductions, in particular through the application of 'fabric first' approach leading to an improvement in the thermal performance of the existing building envelope.

6.5 A highly optimised energy strategy based on passive design, building fabric performance and building services systems and controls as well as installation of ASHP and 8 kWp PV system will allow the scheme to achieve an improvement over the baseline scenario of over 100% for the new part of the development and over 3% site-wide.

7.0 DISCLAIMER

7.1 Create Consulting disclaims any responsibility to the Client and others in respect of any matters outside the scope of this report.

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APPENDICES

APPENDIX A

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Hampton School - OLD SCHOOL BASELINE

As designed

Date: Wed Oct 19 14:24:35 2022

Administrative information

Building Details

Address: Address 1, Address 2, City, Postcode

Certification tool

Calculation engine: SBEM

Calculation engine version: v6.1.b.0

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.15

BRUKL compliance check version: v6.1.b.0

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Foundation area [m²]: 121.22

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

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	15.01	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	24.03	
Target primary energy rate (TPER), $kWh/m^2.annum$	83.44	
Building primary energy rate (BPER), $kWh/m^2.annum$	128.49	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	1.82	2.13	SP000007_W4
Floors	0.18	0.42	0.57	SP000009_F
Pitched roofs	0.16	0.35	0.35	SP00002C_C
Flat roofs	0.18	0.26	0.35	SP000027_C
Windows** and roof windows	1.6	3.72	5.49	SP000007_W4_O1
Rooflights***	2.2	-	-	No external rooflights
Personnel doors^	1.6	1.98	2.2	SP000001_W1_O0
Vehicle access & similar large doors	1.3	-	-	No external vehicle access doors
High usage entrance doors	3	-	-	No external high usage entrance doors

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

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

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

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

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

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

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

N.B.: 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	13.53

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 - EXISTING

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.93	-	-	-	-
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.

1- SYST0002-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	-
Standard value	N/A	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
PUPIL WC (EXISTING)	0.2	-	-	-	-	-	-	-	-	-	N/A
WC (NEW)	0.2	-	-	-	-	-	-	-	-	-	N/A
WC (EXISTING)	0.2	-	-	-	-	-	-	-	-	-	N/A
WC (EXISTING)	0.2	-	-	-	-	-	-	-	-	-	N/A
STORE (EXISTING)	0.2	-	-	-	-	-	-	-	-	-	N/A
STORE (EXISTING)	0.2	-	-	-	-	-	-	-	-	-	N/A
STORE (PART NEW)	0.2	-	-	-	-	-	-	-	-	-	N/A
STORE (EXISTING)	0.2	-	-	-	-	-	-	-	-	-	N/A
WC (EXISTING)	0.2	-	-	-	-	-	-	-	-	-	N/A
WC (EXISTING)	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
PUPIL WC (EXISTING)	100	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
WC (NEW)	100	-	-
BOILER (EXISTING)	100	-	-
RECEPTION (PART NEW)	100	-	-
HALLWAY (PART NEW)	100	-	-
WC (EXISTING)	100	-	-
WC (EXISTING)	100	-	-
RECEPTION (EXISTING)	100	-	-
RECEPTION (EXISTING)	100	-	-
HALLWAY (EXISTING)	100	-	-
SICK (EXISTING)	100	-	-
STORE (EXISTING)	100	-	-
STORE (EXISTING)	100	-	-
OFFICE (EXISTING)	100	-	-
WAITING AREA (EXISTING)	100	-	-
ART (EXISTING)	100	-	-
SEN (EXISTING)	100	-	-
KINDERGARTEN (EXISTING)	100	-	-
KINDERGARTEN (EXISTING)	100	-	-
STORE (PART NEW)	100	-	-
HEAD'S OFFICE (EXISTING)	100	-	-
STORE (EXISTING)	100	-	-
WC (EXISTING)	100	-	-
HALLWAY (EXISTING)	100	-	-
STAFF ROOM (EXISTING)	100	-	-
YEAR 2 (EXISTING)	100	-	-
LIBRARY (EXISTING)	100	-	-
MEETING ROOM (EXISTING)	100	-	-
WC (EXISTING)	100	-	-
STAIRS HALLWAY (EXISTING)	100	-	-
ROOF STORAGE SPACE	100	-	-
ROOF STORAGE SPACE	100	-	-
YEAR 1 (EXISTING)	100	-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
RECEPTION (PART NEW)	NO (-17.2%)	NO
RECEPTION (EXISTING)	N/A	N/A
RECEPTION (EXISTING)	N/A	N/A
SICK (EXISTING)	YES (+22%)	NO
OFFICE (EXISTING)	NO (-15.9%)	NO
ART (EXISTING)	NO (-20.9%)	NO
SEN (EXISTING)	YES (+7.5%)	NO
KINDERGARTEN (EXISTING)	NO (-6.2%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
KINDERGARTEN (EXISTING)	NO (-56%)	NO
HEAD'S OFFICE (EXISTING)	NO (-64.6%)	NO
STAFF ROOM (EXISTING)	NO (-66%)	NO
YEAR 2 (EXISTING)	NO (-21.8%)	NO
LIBRARY (EXISTING)	NO (-60.8%)	NO
MEETING ROOM (EXISTING)	NO (-59.3%)	NO
YEAR 1 (EXISTING)	NO (-79.4%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	NO
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]	624.8	624.8
External area [m^2]	1133.6	1133.6
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	14	3
Average conductance [W/K]	1263.58	396.73
Average U-value [W/m^2K]	1.11	0.35
Alpha value* [%]	9.97	29.26

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

Building Use

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

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

	Actual	Notional
Heating	87.5	34.11
Cooling	0	0
Auxiliary	1.99	3.21
Lighting	7.83	5.42
Hot water	26.45	36.45
Equipment*	10.98	10.98
TOTAL**	**123.76**	**79.18**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	10.05	6.48
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*10.05*	*6.48*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	310.51	157.57
Primary energy [kWh/m^2]	128.49	83.44
Total emissions [kg/m^2]	24.03	15.01

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	261.4	49.1	87.5	0	2	0.83	0	0.93	0
	Notional	105.6	52	34.1	0	1.4	0.86	0	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Hampton School - OLD SCHOOL BE LEAN

As designed

Date: Wed Oct 19 14:27:02 2022

Administrative information

Building Details

Address: Address 1, Address 2, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: SBEM

Calculation engine version: v6.1.b.0

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.15

BRUKL compliance check version: v6.1.b.0

Foundation area [m²]: 121.22

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

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	15.01	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	23.82	
Target primary energy rate (TPER), $kWh/m^2.annum$	83.44	
Building primary energy rate (BPER), $kWh/m^2.annum$	127.37	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	1.81	2.13	SP000007_W4
Floors	0.18	0.41	0.57	SP000009_F
Pitched roofs	0.16	0.35	0.35	SP00002C_C
Flat roofs	0.18	0.24	0.35	SP000027_C
Windows** and roof windows	1.6	3.58	5.49	SP000007_W4_O1
Rooflights***	2.2	-	-	No external rooflights
Personnel doors^	1.6	0.76	0.76	SP000001_W1_O0
Vehicle access & similar large doors	1.3	-	-	No external vehicle access doors
High usage entrance doors	3	-	-	No external high usage entrance doors

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

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

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

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

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

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

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

N.B.: 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	13.53

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 - EXISTING

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.93	-	-	-	-
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.

1- SYST0002-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	-
Standard value	N/A	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
PUPIL WC (EXISTING)	0.2	-	-	-	-	-	-	-	-	-	N/A
WC (NEW)	0.2	-	-	-	-	-	-	-	-	-	N/A
WC (EXISTING)	0.2	-	-	-	-	-	-	-	-	-	N/A
WC (EXISTING)	0.2	-	-	-	-	-	-	-	-	-	N/A
STORE (EXISTING)	0.2	-	-	-	-	-	-	-	-	-	N/A
STORE (EXISTING)	0.2	-	-	-	-	-	-	-	-	-	N/A
STORE (PART NEW)	0.2	-	-	-	-	-	-	-	-	-	N/A
STORE (EXISTING)	0.2	-	-	-	-	-	-	-	-	-	N/A
WC (EXISTING)	0.2	-	-	-	-	-	-	-	-	-	N/A
WC (EXISTING)	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
PUPIL WC (EXISTING)	100	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
WC (NEW)	100	-	-
BOILER (EXISTING)	100	-	-
RECEPTION (PART NEW)	100	-	-
HALLWAY (PART NEW)	100	-	-
WC (EXISTING)	100	-	-
WC (EXISTING)	100	-	-
RECEPTION (EXISTING)	100	-	-
RECEPTION (EXISTING)	100	-	-
HALLWAY (EXISTING)	100	-	-
SICK (EXISTING)	100	-	-
STORE (EXISTING)	100	-	-
STORE (EXISTING)	100	-	-
OFFICE (EXISTING)	100	-	-
WAITING AREA (EXISTING)	100	-	-
ART (EXISTING)	100	-	-
SEN (EXISTING)	100	-	-
KINDERGARTEN (EXISTING)	100	-	-
KINDERGARTEN (EXISTING)	100	-	-
STORE (PART NEW)	100	-	-
HEAD'S OFFICE (EXISTING)	100	-	-
STORE (EXISTING)	100	-	-
WC (EXISTING)	100	-	-
HALLWAY (EXISTING)	100	-	-
STAFF ROOM (EXISTING)	100	-	-
YEAR 2 (EXISTING)	100	-	-
LIBRARY (EXISTING)	100	-	-
MEETING ROOM (EXISTING)	100	-	-
WC (EXISTING)	100	-	-
STAIRS HALLWAY (EXISTING)	100	-	-
ROOF STORAGE SPACE	100	-	-
ROOF STORAGE SPACE	100	-	-
YEAR 1 (EXISTING)	100	-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
RECEPTION (PART NEW)	NO (-36.1%)	NO
RECEPTION (EXISTING)	N/A	N/A
RECEPTION (EXISTING)	N/A	N/A
SICK (EXISTING)	YES (+22%)	NO
OFFICE (EXISTING)	NO (-15.9%)	NO
ART (EXISTING)	NO (-28.2%)	NO
SEN (EXISTING)	YES (+7.5%)	NO
KINDERGARTEN (EXISTING)	NO (-6.2%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
KINDERGARTEN (EXISTING)	NO (-61%)	NO
HEAD'S OFFICE (EXISTING)	NO (-72.7%)	NO
STAFF ROOM (EXISTING)	NO (-66%)	NO
YEAR 2 (EXISTING)	NO (-28.4%)	NO
LIBRARY (EXISTING)	NO (-69.8%)	NO
MEETING ROOM (EXISTING)	NO (-59.3%)	NO
YEAR 1 (EXISTING)	NO (-79.4%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	NO
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]	624.8	624.8
External area [m^2]	1133.6	1133.6
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	14	3
Average conductance [W/K]	1227.04	396.73
Average U-value [W/m^2K]	1.08	0.35
Alpha value* [%]	10.27	29.26

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

Building Use

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

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

	Actual	Notional
Heating	86.5	34.11
Cooling	0	0
Auxiliary	1.99	3.21
Lighting	7.83	5.42
Hot water	26.45	36.45
Equipment*	10.98	10.98
TOTAL**	**122.77**	**79.18**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	10.05	6.48
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*10.05*	*6.48*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	304.61	157.57
Primary energy [kWh/m^2]	127.37	83.44
Total emissions [kg/m^2]	23.82	15.01

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	258.5	46.1	86.5	0	2	0.83	0	0.93	0
	Notional	105.6	52	34.1	0	1.4	0.86	0	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Hampton School - NEW HALL BE LEAN

As designed

Date: Wed Oct 19 13:58:46 2022

Administrative information

Building Details

Address: Address 1, Address 2, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: SBEM

Calculation engine version: v6.1.b.0

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.15

BRUKL compliance check version: v6.1.b.0

Foundation area [m²]: 121.22

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

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	2.89	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	4.48	
Target primary energy rate (TPER), $kWh/m^2.annum$	29.74	
Building primary energy rate (BPER), $kWh/m^2.annum$	42.43	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.18	0.18	SP000014_W1
Floors	0.18	0.15	0.15	SP000014_F
Pitched roofs	0.16	-	-	No heat loss pitched roofs
Flat roofs	0.18	0.15	0.15	SP000014_C
Windows** and roof windows	1.6	1.3	1.3	SP000014_W1_O0
Rooflights***	2.2	-	-	No external rooflights
Personnel doors^	1.6	0.76	0.76	SP000004_W1_O0
Vehicle access & similar large doors	1.3	-	-	No external vehicle access doors
High usage entrance doors	3	-	-	No external high usage entrance doors

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

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

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

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

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

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

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

N.B.: 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 IN HALL (BASELINE)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.5	7	-	-	-
Standard value	2.5*	1.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

2- DIRECT ELECTRIC

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
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- SYST0003-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	-
Standard value	N/A	N/A

2- SYST0001-DHW

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

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter
NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.	

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
MULTI PURPOSE HALL (NEW)	-	-	-	-	0.9	-	-	-	-	0.88	N/A
KITCHEN (NEW)	0.2	-	-	-	-	-	-	-	-	-	N/A
ACC WC (NEW)	0.2	-	-	-	-	-	-	-	-	-	N/A
WC (NEW)	0.2	-	-	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
WC (NEW)	0.2	-	-	-	-	-	-	-	-	-	N/A
WC (NEW)	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
MULTI PURPOSE HALL (NEW)	120	-	-
KITCHEN (NEW)	120	-	-
ENTRANCE LOBBY (NEW)	120	-	-
ACC WC (NEW)	120	-	-
WC (NEW)	120	-	-
WC (NEW)	120	-	-
WC (NEW)	120	-	-
PLANT (NEW)	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?
MULTI PURPOSE HALL (NEW)	NO (-32.1%)	NO
KITCHEN (NEW)	NO (-88.2%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	NO
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]	127.7	127.7
External area [m^2]	403.5	403.5
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	104.43	131.52
Average U-value [W/m^2K]	0.26	0.33
Alpha value* [%]	34.73	21.65

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

Building Use

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

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

	Actual	Notional
Heating	12.48	11.87
Cooling	4.02	4.38
Auxiliary	3.93	3.57
Lighting	3.52	5.21
Hot water	4.52	4.04
Equipment*	29.79	29.79
TOTAL**	**28.47**	**29.07**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	9.32
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*9.32*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	198.58	214.26
Primary energy [kWh/m^2]	42.43	29.74
Total emissions [kg/m^2]	4.48	2.89

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Natural Gas										
	Actual	57.4	89.9	6.5	4.8	4.3	2.45	5.23	2.5	7
	Notional	63.7	82.3	6.7	5.2	3.5	2.64	4.4	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	189.2	21.1	65.7	0	2.8	0.8	0	1	0
	Notional	281.6	74.8	58.4	0	5.6	1.34	0	----	----
[ST] No Heating or Cooling										
	Actual	0	1027.7	0	0	0	0	0	0	0
	Notional	0	1052.2	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

APPENDIX B

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Hampton School - OLD SCHOOL BE GREEN

As designed

Date: Tue Oct 18 14:10:03 2022

Administrative information

Building Details

Address: Address 1, Address 2, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: SBEM

Calculation engine version: v6.1.b.0

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.15

BRUKL compliance check version: v6.1.b.0

Foundation area [m²]: 186.49

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

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	14.56	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	25.19	
Target primary energy rate (TPER), $kWh/m^2.annum$	78.3	
Building primary energy rate (BPER), $kWh/m^2.annum$	142.6	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	1.81	2.13	SP000007_W4
Floors	0.18	0.42	0.57	SP000009_F
Pitched roofs	0.16	0.35	0.35	SP00002C_C
Flat roofs	0.18	0.26	0.35	SP000027_C
Windows** and roof windows	1.6	3.63	5.49	SP000007_W4_O1
Rooflights***	2.2	-	-	No external rooflights
Personnel doors^	1.6	1.98	2.2	SP000001_W1_O0
Vehicle access & similar large doors	1.3	-	-	No external vehicle access doors
High usage entrance doors	3	-	-	No external high usage entrance doors

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

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

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

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

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

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

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

N.B.: 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	13.53

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 - EXISTING

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.93	-	-	-	-
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.

1- SYST0002-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	-
Standard value	N/A	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
PUPIL WC (EXISTING)	0.2	-	-	-	-	-	-	-	-	-	N/A
WC (NEW)	0.2	-	-	-	-	-	-	-	-	-	N/A
WC (EXISTING)	0.2	-	-	-	-	-	-	-	-	-	N/A
WC (EXISTING)	0.2	-	-	-	-	-	-	-	-	-	N/A
STORE (EXISTING)	0.2	-	-	-	-	-	-	-	-	-	N/A
STORE (EXISTING)	0.2	-	-	-	-	-	-	-	-	-	N/A
STORE (PART NEW)	0.2	-	-	-	-	-	-	-	-	-	N/A
STORE (EXISTING)	0.2	-	-	-	-	-	-	-	-	-	N/A
WC (EXISTING)	0.2	-	-	-	-	-	-	-	-	-	N/A
WC (EXISTING)	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
PUPIL WC (EXISTING)	100	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
WC (NEW)	100	-	-
BOILER (EXISTING)	100	-	-
RECEPTION (PART NEW)	100	-	-
HALLWAY (PART NEW)	100	-	-
WC (EXISTING)	100	-	-
WC (EXISTING)	100	-	-
RECEPTION (EXISTING)	100	-	-
RECEPTION (EXISTING)	100	-	-
HALLWAY (EXISTING)	100	-	-
SICK (EXISTING)	100	-	-
STORE (EXISTING)	100	-	-
STORE (EXISTING)	100	-	-
OFFICE (EXISTING)	100	-	-
WAITING AREA (EXISTING)	100	-	-
ART (EXISTING)	100	-	-
SEN (EXISTING)	100	-	-
KINDERGARTEN (EXISTING)	100	-	-
KINDERGARTEN (EXISTING)	100	-	-
STORE (PART NEW)	100	-	-
HEAD'S OFFICE (EXISTING)	100	-	-
STORE (EXISTING)	100	-	-
WC (EXISTING)	100	-	-
HALLWAY (EXISTING)	100	-	-
STAFF ROOM (EXISTING)	100	-	-
YEAR 2 (EXISTING)	100	-	-
LIBRARY (EXISTING)	100	-	-
MEETING ROOM (EXISTING)	100	-	-
WC (EXISTING)	100	-	-
STAIRS HALLWAY (EXISTING)	100	-	-
ROOF STORAGE SPACE	100	-	-
ROOF STORAGE SPACE	100	-	-
YEAR 1 (EXISTING)	100	-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
RECEPTION (PART NEW)	NO (-17.4%)	NO
RECEPTION (EXISTING)	N/A	N/A
RECEPTION (EXISTING)	N/A	N/A
SICK (EXISTING)	YES (+22%)	NO
OFFICE (EXISTING)	NO (-15.9%)	NO
ART (EXISTING)	NO (-21%)	NO
SEN (EXISTING)	YES (+7.5%)	NO
KINDERGARTEN (EXISTING)	NO (-6.2%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
KINDERGARTEN (EXISTING)	NO (-56%)	NO
HEAD'S OFFICE (EXISTING)	NO (-64.7%)	NO
STAFF ROOM (EXISTING)	NO (-66%)	NO
YEAR 2 (EXISTING)	NO (-21.9%)	NO
LIBRARY (EXISTING)	NO (-60.9%)	NO
MEETING ROOM (EXISTING)	NO (-59.3%)	NO
YEAR 1 (EXISTING)	NO (-79.4%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	NO
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]	624.8	624.8
External area [m^2]	1133.6	1133.6
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	14	3
Average conductance [W/K]	1250.09	396.73
Average U-value [W/m^2K]	1.1	0.35
Alpha value* [%]	10.08	29.26

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

Building Use

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

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

	Actual	Notional
Heating	86.94	34.11
Cooling	0	0
Auxiliary	1.99	3.21
Lighting	7.83	5.42
Hot water	26.45	36.45
Equipment*	10.98	10.98
TOTAL**	**123.21**	**79.18**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	9.96
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*9.96*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	308.97	157.57
Primary energy [kWh/m^2]	142.6	78.3
Total emissions [kg/m^2]	25.19	14.56

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	259.8	49.2	86.9	0	2	0.83	0	0.93	0
	Notional	105.6	52	34.1	0	1.4	0.86	0	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Hampton School - EXTENSION - BE GREEN

As designed

Date: Wed Oct 26 19:04:16 2022

Administrative information

Building Details

Address: Address 1, Address 2, City, Postcode

Certification tool

Calculation engine: SBEM

Calculation engine version: v6.1.b.0

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.15

BRUKL compliance check version: v6.1.b.0

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Foundation area [m^2]: 156.19

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	2.54	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	-0.77	
Target primary energy rate (TPER), $kWh/m^2.annum$	25.78	
Building primary energy rate (BPER), $kWh/m^2.annum$	-17.39	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.18	0.18	SP000014_W1
Floors	0.18	0.15	0.15	SP000014_F
Pitched roofs	0.16	-	-	No heat loss pitched roofs
Flat roofs	0.18	0.15	0.15	SP000014_C
Windows** and roof windows	1.6	1.3	1.3	SP000014_W1_O0
Rooflights***	2.2	-	-	No external rooflights
Personnel doors^	1.6	0.76	0.76	SP000015_W1_O0
Vehicle access & similar large doors	1.3	-	-	No external vehicle access doors
High usage entrance doors	3	-	-	No external high usage entrance doors

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]

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

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

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

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

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

^ For fire doors, limiting U-value is 1.8 W/m^2K

N.B.: 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 IN HALL

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.8	7	-	-	-
Standard value	2.5*	1.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

2- DIRECT ELECTRIC

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
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- ASHP IN HALL (BASELINE)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.5	7	-	-	-
Standard value	2.5*	1.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

1- SYST0000-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	-
Standard value	N/A	N/A

2- SYST0001-DHW

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

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter
NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.	

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
MULTI PURPOSE HALL (NEW)	-	-	-	-	0.9	-	-	-	-	0.88	N/A
ACC WC (NEW)	0.2	-	-	-	-	-	-	-	-	-	N/A
WC (NEW)	0.2	-	-	-	-	-	-	-	-	-	N/A
WC (NEW)	0.2	-	-	-	-	-	-	-	-	-	N/A
WC (NEW)	0.2	-	-	-	-	-	-	-	-	-	N/A
KITCHEN (NEW)	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
MULTI PURPOSE HALL (NEW)	120	-	-
ENTRANCE LOBBY (NEW)	120	-	-
ACC WC (NEW)	120	-	-
WC (NEW)	120	-	-
WC (NEW)	120	-	-
WC (NEW)	120	-	-
KITCHEN (NEW)	120	-	-
PLANT (NEW)	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?
MULTI PURPOSE HALL (NEW)	NO (-32.1%)	NO
KITCHEN (NEW)	NO (-88.2%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	NO
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]	127.7	127.7
External area [m^2]	403.5	403.5
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	104.43	131.52
Average U-value [W/m^2K]	0.26	0.33
Alpha value* [%]	34.73	21.65

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

Building Use

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

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

	Actual	Notional
Heating	10.15	11.87
Cooling	4.02	4.38
Auxiliary	3.93	3.57
Lighting	3.52	5.21
Hot water	3.17	4.04
Equipment*	29.79	29.79
TOTAL**	**24.79**	**29.07**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	36.87	12.01
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*36.87*	*12.01*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	198.58	214.26
Primary energy [kWh/m^2]	-17.39	25.78
Total emissions [kg/m^2]	-0.77	2.54

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Natural Gas										
	Actual	57.6	91.5	3.4	4.9	4.2	4.71	5.23	4.8	7
	Notional	63.6	83.7	6.7	5.3	2.8	2.64	4.4	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	189.2	21.1	65.7	0	2.8	0.8	0	1	0
	Notional	281.6	74.8	58.4	0	5.6	1.34	0	----	----
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Natural Gas										
	Actual	55.6	77.9	6.3	4.1	4.7	2.45	5.23	2.5	7
	Notional	63.9	72.1	6.7	4.5	9.4	2.64	4.4	----	----
[ST] No Heating or Cooling										
	Actual	0	1027.7	0	0	0	0	0	0	0
	Notional	0	1052.2	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

APPENDIX C

Low and Zero Carbon Technologies Not Feasible for the Site

Solar Thermal Panels

Solar hot water systems (SHW) use the energy radiated by the sun and convert it into useful heat in the form of hot water.

Heat is transferred and stored in a central thermal store. The solar panel system would ideally supply approximately 45-55% of the development's hot water requirement; the remainder of energy required for hot water would be supplied by the gas boilers.

Solar thermal panels are ideal for buildings with a highly insulated building envelope as the energy demand for heating water is relatively high in comparison to space heating demand.

Solar thermal panels are most efficient when evacuated tube technology is used. This leads to bulky and visually less pleasing system that will be aesthetically more intrusive.

The roof of the proposed building is flat and therefore the collectors would have to be mounted on frames tilted at least 30 degrees facing south, south-west or south-east leading to an optimum hot water output.

Solar thermal panels could be specified to compliment the proposed ASHP strategy but would require a large hot water storage tank located in the cupboard. Additionally, the new building's hot water demand is not large and therefore to fully utilise the system it would have to be connected to the existing building, creating long circulation pipe runs providing hot water to all toilets. This would lead to additional losses from the system.

A SHW system alone would not reduce CO_2 emissions by 35% as required by the London Plan Policy SI2 and therefore an additional technology would have to be incorporated into the design of the building, compromising on space and increasing the overall cost of the construction.

For these reasons a solar hot water system is not recommended for the site.

Gas CHP (Combined Heat and Power)

A conventionally fuelled CHP system would utilise a prime mover such as a diesel engine or gas turbine to drive an electrical generator. The heat generated by the prime mover during this process would be utilised in a community heating network.

Gas CHP systems are energy efficient and considered as low carbon technologies. For CHP to be viable, it must run almost continuously and thus requires a permanent heat demand (hence its suitability for swimming pools, hospitals etc).

The proposed development would not fully utilise the energy generated by CHP engine and therefore would result in inefficient running of the system.

Air quality issues resulting from operation of a gas CHP system would also have to be addressed and increase of associated NOx emissions would have to be mitigated.

It is therefore not recommended that gas fired-CHP be considered for this site.

Bio-fuels

Bio-fuels have the potential to contribute to the reduction of CO2 emissions of various developments by using this fuel within a boiler or CHP plant. Biofuels are considered to have low or zero CO2 intensities as theoretically the CO2 released when these fuels are combusted is no greater than the CO2 that has been absorbed from the atmosphere when the plants grew.

However, there are a number of issues which must be considered with this type of fuel in urban locations:

- Potential air quality impacts with combusting bio-fuels in urban areas, in particular elevated NOx emissions and particulates and must be addressed.
- Transporting this type of fuel increases lorry movements into and out of London, affecting congestion and transport emissions. The relatively rapid degradation of biodiesel would require appropriately sized on-site storage tanks with regular fuel deliveries.
- Importantly, the actual bio-diesel CO2 intensity cannot be guaranteed due to variations in fuel stock supply, demand, the energy input processing the fuel and CO2 emissions due to growing, harvesting and processing the base fuel.
- Biofuel availability is currently uncertain due to unknown future supply and demand. Whilst an increase in demand for larger developments may stimulate the supply chain, availability could change with variation in demand. Transport is likely to have the most significant impact on the biofuel industry over emerging building demand.

- Socio-economic issues from growing and harvesting feedstock, with potential impacts on food production, particularly for biodiesel that is imported. Solid biofuels have a lesser impact in this area.
- On-site fuel storage requirements requiring additional space, along with regular access to the on-site fuel storage area.
- Increased plant maintenance is generally required, adding to costs and plant down-time.

Consequently, biofuels for combustion within a boiler are not appropriate for the scheme.

Wind Turbines

Although a wind turbine could be sized to meet the requirements of this development, there are numerous factors that would discount its suitability in this setting. Typically wind turbines perform poorly in urban environments as surrounding buildings and features dissipate much of the useful energy of the wind before it can be extracted by the turbine. The tower would also require a large amount of free space for the erecting and periodic maintenance of the turbine. This is likely to be an issue with this site.

Environmental concerns such as noise and shadow flicker are also problematic in populated areas. While modern turbines have low levels of noise generation, even at high rotational speeds, the noise generated may still be an issue for local residents, particularly given the close proximity of the turbine. Given the dense urban setting of this development, shadow flicker is likely to be a problem for the residents of the proposed development. A wind turbine would not be a viable option for this development.