

Highgate School MSC 4 Phases

Energy Assessment



January 2023

Peter Deer and Associates Ltd

Solar House, 282 Chase Road, Southgate, London N14 6HA

T: 020 3232 0080 • E: post@pd-a.co.uk

Registered in England No. 3022343

Document Control

Revision History

Number	Reason	Date
1	Comment	January 2023

Quality Assurance

Written by:	Checked by:
Adrian Holmes	Arshpreet Chugh

COPYRIGHT AND CONFIDENTIALITY

Copyright in this report is the property of Peter Deer and Associates. It must not be reproduced, amended, or used for the execution of any works, whether in connection with the proposed works for which it is prepared or otherwise, without Peter Deer and Associates' express consent in writing.

This document is confidential to the party to whom it is addressed and their professional advisers for the specific purpose to which it refers. No responsibility is accepted to any third parties; neither the whole, part, nor reference to it may be published or disclosed.

Contact Author

Adrian Holmes
Solar House, 282 Chase Road, Southgate, London N14 6HA
T: 020 3232 0080 • F: 020 3232 0090 • E: post@pd-a.co.uk

Contents

Executive Summary	5
GLA Reporting Spread Sheet.....	5
Be Lean	5
Be Clean	5
Be Green	6
On-site renewable energy generation	6
Carbon Offset	6
1 Introduction	8
Site.....	8
The Vision.....	8
The Proposed Works.....	8
Natural Ventilation	9
Strategy for mitigating overheating risk / TM59/TM52 overheating analysis	9
2 Planning Policies	10
National Planning Policy.....	10
London Borough of Haringey Policies	12
Policy DM21: Sustainable Design,	13
Energy Efficiency.....	13
Layout and Construction.....	13
Overheating and cooling.....	14
Enhancing biodiversity.....	14
Materials and locally sourced labour	14
Carbon Offsetting	14
3 Energy analysis	15
GLA Energy Assessment Guidance updates - Part L 2021 of building regulations.....	15
The Mayor's net-zero carbon target for major developments.....	15
National Calculation Method (SBEM 6.1a June 2022).....	15
The calculation method for estimating the building energy use and associated emissions.....	15
Notional Building Photovoltaics.	16
Carbon Emissions Electricity Factors.....	16
Zero Carbon Building.....	16
Energy Modelling Results.....	17
Building Energy Comparison with Notional Building	17
Heating	17
Cooling.....	18
Auxiliary Energy.....	18
Lighting Energy.....	18
2022 Building Regulations Terminology.....	18
Regulated Energy use	18
Base Building or Target Emission Rate (TER).....	18

Proposed Building Emission Rate (BER).....	18
4 Energy Hierarchy.....	21
Be Lean	21
Thermal Mass.....	21
Low Energy Lighting.....	21
Overheating	22
Be Clean.....	22
District Energy Networks	22
Communal Energy Network	22
Proposed Energy System.....	23
Be Green	23
Photovoltaics	23
Alternative renewable energy options	24
5 Appendices.....	25

Table of tables

Table 1 SBEM 6.1a Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings	5
Table 2 GLA Carbon Dioxide Emissions, after each stage of the Energy Hierarchy for non-residential buildings.	5
Table 3 GLA Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-residential buildings.	5
Table 4 GLA Policy SI 2 Minimising greenhouse gas emissions.....	10
Table 5 GLA Policy SI 3 Energy Infrastructure	11
Table 6 GLA Policy SI 4 Managing Heat Risk	12
Table 7 Energy emission factor changes between 2012 & 2022.	16
Table 8 2021 new month carbon emission factor (June 2022).....	16
Table 9 Estimated Energy from each stage of the Energy Hierarchy (SBEM 6.1a 2022).....	17
Table 10 Estimated Emissions from each stage of the Energy Hierarchy (SBEM 6.1a 2022).....	17
Table 11 Typical Room illuminance and Power Ratios	18
Table 12 U Values for Thermal Elements.....	21
Table 13 Efficient Water Fitting Flow rates	21
Table 14 Summary of PV Financial Assessment.....	24

Table of Figures

Figure 1 Carbon dioxide emission using GLA reporting tool.6

Figure 2 Carbon Emission using SBEM 6.1.....7

Figure 3 Arial View of the site in Red8

Figure 4 Site Location in Context (Open Street Map)8

Figure 5 London plan Energy Hierarchy.11

Figure 6 Haringey Local Plan.....12

Figure 7 London Borough of Haringey Policy Hierarchy.....13

Figure 8 MSC Energy Use.17

Figure 9 Mayor of London Heat Map22

Figure 10 Proposed Location for Renewables23

Figure 11 Electricity Generation from PV Array.24

Executive Summary

This energy assessment aims to demonstrate that the proposed climate change mitigation measures comply with the current London Plan 2021 and the relevant London Borough of Haringey energy policies, including the energy hierarchy. It also ensures that energy remains integral to the Development's design and evolution.

This energy statement is submitted in support of the planning application by Highgate School for the redevelopment of the Mallinson Sports Centre Complex located on Bishopswood Road. The phased redevelopment of the Mallinson Sports Centre. Extensive refurbishment of existing buildings and extensions to create new indoor sports, drama and assembly space (dry sports hall 2).

Type of Development

The Phase 1 swimming pool and changing room works have been completed (2021) and are in use. The swimming pool and changing room facilities will remain open during phases 2 and 3.

The proposed works will modernise this important indoor sports facility with alterations and extensions and significantly extend the life of the retained elements of the existing building, additionally providing significant improvements for accessibility, energy efficiency and reduction of the carbon footprint of the whole Development.

GLA Energy Hierarchy				
	Emission (SBEM 5.6a 2012)		SBEM6.1a 2022	
	Tonnes CO ₂	Improvement	Tonnes CO ₂	Improvement
Base	200.66		19.89	
Be Lean	198.65	1%	17.49	12%
Be Clean	198.65	1%	17.49	12%
Be Green	129.45	35%	11.43	43%

Table 1 SBEM 6.1a Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

GLA Reporting Spread Sheet.

	Carbon Dioxide Emissions for non-residential buildings (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	98.7	7.8
After energy demand reduction (be lean)	81.0	7.8
After heat network connection (be clean)	78.5	7.8
After renewable energy (be Green)	38.3	7.8

Table 2 GLA Carbon Dioxide Emissions, after each stage of the Energy Hierarchy for non-residential buildings.

	Regulated non-residential carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Be lean: savings from energy demand reduction	17.6	18%
Be clean: savings from a heat network	2.6	3%
Be green: savings from renewable energy	40.2	41%
Total Cumulative Savings	60.4	61%
Annual savings from offset payment	38.3	-
	(Tonnes CO ₂)	
Cumulative savings for offset payment	1,148	-
Cash in-lieu contribution (£)	109,059	

Table 3 GLA Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-residential buildings.

The carbon price is the GLA's recommended price of £95 per tonne of carbon dioxide.

Be Lean

The improved standards of current building regulations make it extremely difficult to better the thermal efficiency of the base building. The designers have selected the lowest practicable and achievable thermal fabric U values using readily available building materials (brick, block and mineral Wool insulation). After completing the MSC sports facilities, energy use is predicted to be lower than the original pre-developed building. The predicted energy savings reduce energy consumption from the new sports hall by installing high efficiency, ultra-low NOx condensing boilers and enhanced control systems to optimise the boiler operation.

The predicted energy requirement for lighting has increased, even though the building is designed with the latest low-energy LED lighting and integrated luminaire lighting controls. This results from the algorithms used in the energy compliance model, which does not make allowance for increased lighting required for the sports halls.

The energy required for the fans and pumps is higher than the base building as the algorithms underestimate the requirements for ventilation in sports halls.

It has not been possible to design and select building systems that match or better the base building.

Be Clean

Highgate is a residential area with no significant developments and is unlikely to be prioritised for the initial Development of the district heating scheme. There are no plans to develop a district heating or ambient loop network in the locality.

A communal heating system with Combined Heat and Power (CHP) is not proposed as CHP machines cannot meet the new building regulation emissions reduction and local air quality requirements.

The proposal is to continue using newly installed ultra-low NO_x gas boilers installed as part of the Phase 1 swimming pool refurbishment works. Integral air source heat pumps as part of new sports hall ventilation equipment. Low surface temperature radiators in the Classroom and circulation with heat from the air to water heat pumps. Dance

and fitness studios require additional ventilation from a local heat recovery mechanical ventilation unit and heating /cooling via multi-split air source heat pumps.

Be Green

A large Photo Voltaic (PV) on the new roof of sports hall 1 will reduce the site energy-related carbon dioxide emission by 27% from the 2021 target building regulation. The main advantage of using PV is that Electricity is generated during daylight hours when the school uses the indoor sports facilities and the pool plant is at peak operation. The School building along Bishopswood Road take their power from a recently installed transformer. The electrical arrangement allows the surplus power generated at the MSC Sports centre to be used in other school buildings. The interlinking of the school is the first step towards a zero-carbon status.

On-site renewable energy generation

The Photovoltaic array is predicted to generate 45% of the overall energy used in the building.

Carbon Offset

The Mayor of London has declared a climate emergency and has set an ambition for London to be net zero-carbon. The London Plan requires major developments to comply with the net zero-carbon target in Policy SI 2 by following the energy hierarchy and maximising on-site carbon reductions. The target requires meeting a minimum 10% emissions reduction from building fabric improvements (Be Lean) and the remaining 25% from energy efficient systems and zero carbon energy generation. The remaining 65% carbon emissions shortfall through a cash-in-lieu contribution to the relevant London Borough of Haringey carbon offset fund.

The Carbon offset payment is calculated using the GLA energy reporting spreadsheet at £95 per tonne of CO₂ spread over 30 years. See table 2a above.

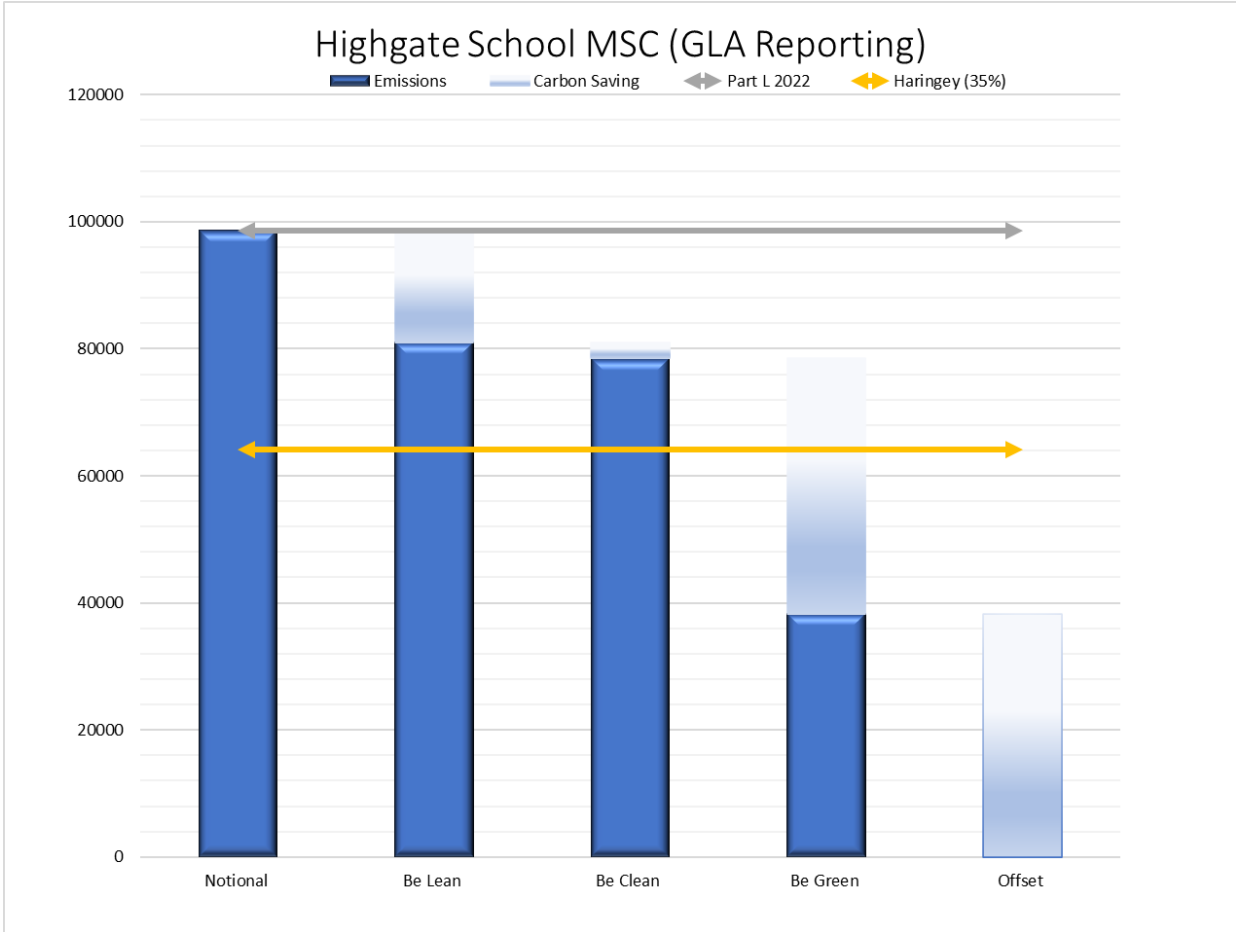


Figure 1 Carbon dioxide emission using GLA reporting tool.

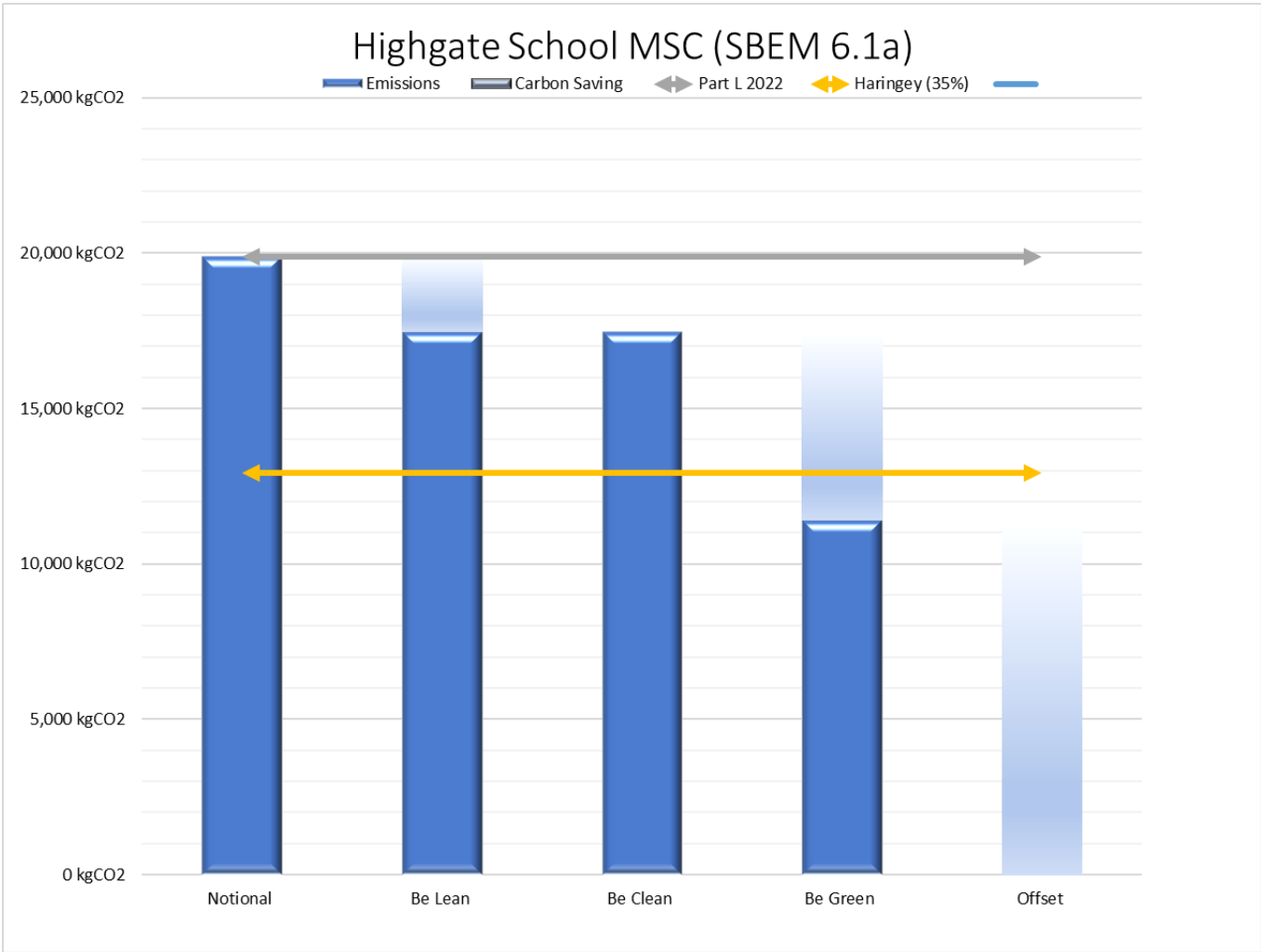


Figure 2 Carbon Emission using SBEM 6.1.

The GLA Carbon reporting tool calculates the electricity carbon emission using a fixed factor. The new building regulation considers the seasonal variability of the grid-supplied use of renewable wind energy. It applies the monthly variable factor as shown in Table 8 2021 new month carbon emission factor (June 2022).

The GLA method increases the carbon above the BRUKL report and substantially increases the carbon offset payment compared with the building regulation method.

The GLA carbon reporting tool 2022 and the Be Seen reporting tool. It is provided as separate documents.

1 Introduction

1.1 An energy assessment aims to demonstrate that the proposed climate change mitigation measures comply with the London Plan 2021 and the relevant London Borough of Haringey energy policies, including the energy hierarchy. It also ensures that energy remains integral to the Development's design and evolution.

Site

1.2 The Mallinson Sports Centre (MSC), part of the Bishopswood Road campus of the school estate, is close to other principal school buildings such as the Mills Centre, the Dining Hall, the Pre-Prep School, and the Junior School.

Site address
Mallinson Sports Centre
Bishopswood Road,
London.
N6 4PH

1.3 The main building comprises the Pool Hall and associated changing rooms, which was the first building on the site in 1969, followed by the main sports hall with associated ancillary accommodation, gym, entrance hall, central offices and other sports spaces completed in 1989.

1.4 The overriding aim of the design seeks to transform this building and create enhanced building aesthetics within the Conservation Area while providing all the sports and ancillary-related facilities that the school will need shortly.

1.5 The intention is to retain the essential elements of the existing building that have significant long-term value and condition, provide spaces of the required technical standard, and integrate them with alterations and extensions into a unified whole, a single sports centre.

1.6 The new sports hall is the principal component of the proposed Development of the school's indoor sports facilities. As part of the work, the school intends to demolish the existing Fives and Squash court buildings to open a large area within the site that can be more efficiently and architecturally developed. Integrated with these works are to build a new sports centre building comprising an indoor sports hall, teaching classrooms and staff offices.

1.7 The design of the hall is to accommodate a National standard netball court within the dry sports hall 2, one that will allow Premier League games to be played. There is an aspiration nationally for netball courts of this standard, for a sport that is increasing in popularity. Many other sports courts will fit within this same interior footprint.

The Vision

1.8 The proposed Development is auxiliary to several other applications in various parts of the school. The vision behind all the proposed developments at the school is set out in the planning statement accompanying the applications, an extract of which is reproduced as follows:

“Being both a Charity and a School, sustaining and further improving what Highgate does for the benefit of its pupils and pupils of partner schools elsewhere within the borough is never finished business.”
“The school has, over the last 15 years or so, been undertaking an extensive programme of modernising and renewing its extensive and mixed stock of buildings and facilities to meet the educational and other demands of

a 21st Century establishment. Significant funds have been invested over that period, and the programme will continue over the next decade.”
“This programme combines the continuing need to maintain, both in terms of safety and appearance, the buildings on several sites and in varying degrees of condition, with the need to provide essential, flexible, good quality and long-lasting educational facilities for its varied educational and charitable objectives, as well as catering for its diverse pupil-body, which meets the different educational and supporting requirements for each of the three Schools to satisfy Department of Education (DfE) and other statutory requirements.”



Figure 3 Aerial View of the site in Red



Figure 4 Site Location in Context (Open Street Map)

The Proposed Works

1.9 The new extensions will create a larger building with various sports facilities, including a second sports hall, which will also be used for other School events, parent evenings, examinations, and assemblies.

- 1.10 The principle of a single secure point of access at the south end is to be maintained, with a larger and more open entrance and foyer fronting the all-weather pitches. Once inside the foyer via a draught lobby, the main Sports Centre reception desk immediately controls the area, which will always be staffed during regular operational hours. The desk will be open within the space to create a friendly and welcoming impression for pupils and visitors and improve visibility. It is anticipated that turnstiles will be used to control and monitor access into the sports centre – Turnstiles are provided at the west entrance next to the second hall. Turnstiles and entry doors would all be linked to the building fire alarm and detection system and default to open in the event of a fire for emergency egress.
- 1.11 As a result of the proposed extensions, new lifts will allow complete accessibility for disabled users to all areas of the building which is not currently wheelchair accessible.
- 1.12 Generally, during the school Day, the main doors will be openable, the entry doors being on automatic electric opening systems for disabled and Part M access. After School hours, it is anticipated that the main doors at both entrances will have access security control, operated by coded entry devices with magnetic closing locks. An option being investigated is to have the entry systems operated by pupil and staff cards, which will also serve several other functions in the school.
- 1.13 The proposed works in this submission include:
- The Fives Court and Squash Courts building is being demolition at the site's north end. The removal of the outer games court area and high chain-link fencing.
 - i. New north-west extension for a second indoor sports hall with associated:
 - ii. new circulation corridor,
 - iii. viewing gallery,
 - iv. access stairs and lift,
 - v. ancillary spaces for storage and plant, and
 - vi. A teaching block extension for 'Combined Cadet Force' and 'Outdoor Education' classrooms, offices, and associated storage.
 - A new south extension to the existing sports hall for eight (8) no. New external covered Fives Courts with run-off area.
 - New southwest extension and alterations to the existing building to create an enhanced entrance with a foyer, reception, and café. Including a bespoke staircase down to the current changing rooms.
 - New roof to sports hall 1 with new roof lights adding natural daylight to the and improved thermal comfort.
 - The courtyard between the pool hall and sports hall 1 will be covered to provide additional space. The space provides new dance studio and weights gym spaces and forms connections back to the changing rooms, with ancillary external storage for sports.
 - The external surrounding is improved with new hard and soft landscaping around the site's perimeter, including removing three trees. The trees will be replaced with new semi-mature trees and form an entrance courtyard area at the new south main entrance.
- 1.14 The recently completed swimming pool project is the first phase of these works and provides the changing room facilities for the following sports hall phases.

Natural Ventilation

- Maintain natural air temperature and balanced humidity when the space is not in use.
- Remove summer heat trapped in the sports hall
- Provide natural night-time purge ventilation to cool the building structure

Demand controlled mechanical ventilation system with heating and heat recovery is required to:

- Quickly heat the sports halls
- Remove moisture and maintain space humidity when fully occupied or during high-activity sports.
- Recover heat energy from the sports hall
- Aid heat removal from the space in the summer months

Strategy for mitigating overheating risk / TM59/TM52 overheating analysis

- 1.15 The dynamic overheating analysis is not complete at this early planning design stage. A preliminary thermal model has been constructed and shows low risk for summer overheating. Further work is required to identify and size the natural ventilation openings and model air movement to develop the purge ventilation control strategy.

Heating/cooling system description

- Fast Acting air distribution heating in the sports halls. To avoid heating the space when not in use.
- Multi-split air source heat pumps to provide heating and cooling in the fitness, dance studio, and cardio room.
- Heating from low surface temperature radiators in the Classroom and circulation spaces. Heating is provided by air to water, air source heat pumps.
- Domestic hot water uses the swimming pool gas boiler and fast heat recovery energy-efficient plate heat exchanger hot water cylinders.

Location of mechanical ventilation fans/heat recovery units/heat pumps.

- No plant is visible from Bishopwood and Broadlands Roads.
- The air handling plant for sports hall (2) is located on the flat roof of the corridor between the sports hall and the swimming pool viewing gallery.
- The proposal is to relocate the air handling unit supplying the second swimming pool changing room.
- The Plan is to replace Sport hall (1) heating and ventilation equipment with a new energy-efficient unit with variable speed fans, heat recovery and ductwork.
- The designer will select the external heat pump condenser unit for low noise operation and, where required, fit the additional acoustic attenuation.

2 Planning Policies

National Planning Policy

- 2.1 The National Planning Policy Framework ('NPPF') was published in July 2021 and superseded the previous versions. Paragraphs 2, 5 and 12 within the Framework confirm that the NPPF must be considered as a material planning consideration in planning decisions.
- 2.2 To ensure that sustainable Development is pursued positively, a presumption favouring sustainable Development is at the heart of the NPPF. Sustainable Development is explained in more detail in NPPF paragraph 11, which requires Local Planning Authorities to:
- 2.3 Approve development proposals that accord with an up-to-date development plan without delay; or
- 2.4 Where there are no relevant development plan policies or the policies which are most important for determining the application are out-of-date, granting permission unless:
- i) The application of policies in the framework that protect areas or assets of particular importance provides an apparent reason for refusing the Development proposed; or
 - ii) Any adverse impacts of doing so would significantly and demonstrably outweigh the benefits when assessed against the policies in this framework when taken as a whole
- 2.5 The NPPF includes a 'presumption in favour of sustainable Development. It states that for plan-making, the presumption means that local authorities should positively seek opportunities to meet the development needs of their area and that plans should meet objectively assessed needs. Plans should also be based on the Local Plan.

London Plan

- 2.6 The London Plan is the Mayor's planning strategy for Greater London. It sets borough-level housing targets and identifies locations for future growth of London-wide importance.
- 2.7 The London Plan is the overall strategic Plan for London, setting out an integrated economic, environmental, transport and social Framework for the Development of London over the next 20 to 25 years.
- 2.8 The London Plan is part of the Development Plan. The policies have been drafted to allow London to implement this ambitious London Plan as soon as possible. There is no requirement for the policies to be repeated locally. However, some instances require a local approach within the overall policy context. The London Plan sets out where this is the case.
- 2.9 The London Plan provides the strategic framework for making all these decisions. It guides boroughs' Development Plans to ensure they work toward a shared vision for London. It establishes policies that allow everyone involved in new developments to know what is expected.

Policy SI 2 Minimising greenhouse gas emissions

- A) Major Development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand under the following energy hierarchy:
- 1) be lean: use less energy and manage demand during operation
 - 2) be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly
 - 3) be green: maximise opportunities for renewable energy by producing, storing, and using renewable energy on-site
 - 4) be seen: monitor, verify and report on energy performance.
- B) Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.
- C) A minimum on-site reduction of at least 35 per cent beyond Building Regulations 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 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 cash in lieu contribution to the Borough's carbon offset fund, or
 - 2) off-site provided that an alternative proposal is identified and delivery is certain.
- D) Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported annually
- E) Major development proposals should calculate and minimise carbon emissions from any other part of the Development, including plant or equipment, that are not covered by Building Regulations, i.e., unregulated emissions.
- F) Development proposals to the Mayor should calculate whole lifecycle carbon emissions through a nationally recognised Whole Lifecycle Carbon Assessment and demonstrate actions to reduce lifecycle carbon emissions.

Table 4 GLA Policy SI 2 Minimising greenhouse gas emissions

- 2.10 The Mayor is committed to London becoming a zero-carbon city. Becoming zero-carbon will require reducing all greenhouse gases, of which carbon dioxide is the most prominent. London homes and workplaces are responsible for producing approximately 78 per cent of its greenhouse gas emissions. New Development must meet the framework's requirements if London aims to become a zero-carbon city by 2050. Development involving major refurbishment should also strive to meet this framework.
- 2.11 The energy hierarchy should inform new buildings' design, construction, and operation. The priority is to minimise energy demand and address how energy will be supplied and renewable technologies incorporated. An essential aspect of managing demand will be to reduce peak energy loadings.
- 2.12 Boroughs should ensure that all developments maximise on-site Electricity and heat production opportunities from solar technologies (photovoltaic and thermal) and use innovative building materials and smart technologies. This approach will reduce carbon emissions, reduce energy costs to occupants, improve London's energy resilience and support the growth of green jobs.
- 2.13 A zero-carbon target for significant residential developments has been in place for London since October 2016 and applies to significant non-residential developments on the final publication of this Plan.
- 2.14 Meeting 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.
- 2.15 The minimum improvement over the Target Emission Rate (TER) will increase over time to achieve the net zero-carbon London ambition and reflect the costs of more efficient construction methods. The net-zero target costs will be reflected in future updates to the London Plan.
- 2.16 The Mayor recognises that Building Regulations use outdated carbon emission factors and that this will continue to cause uncertainty until Government updates them. Interim guidance has been published in the Mayor's Energy Planning Guidance on using appropriate emissions factors. The GLA guidance will be updated once Building Regulations are updated to help developers determine how these policies are implemented.
- 2.17 Developments are expected to achieve carbon reductions beyond Part L from energy efficiency measures alone to reduce energy demand as far as possible. Residential Development should achieve 10 per cent, and non-residential Development should achieve 15 per cent over Part L.

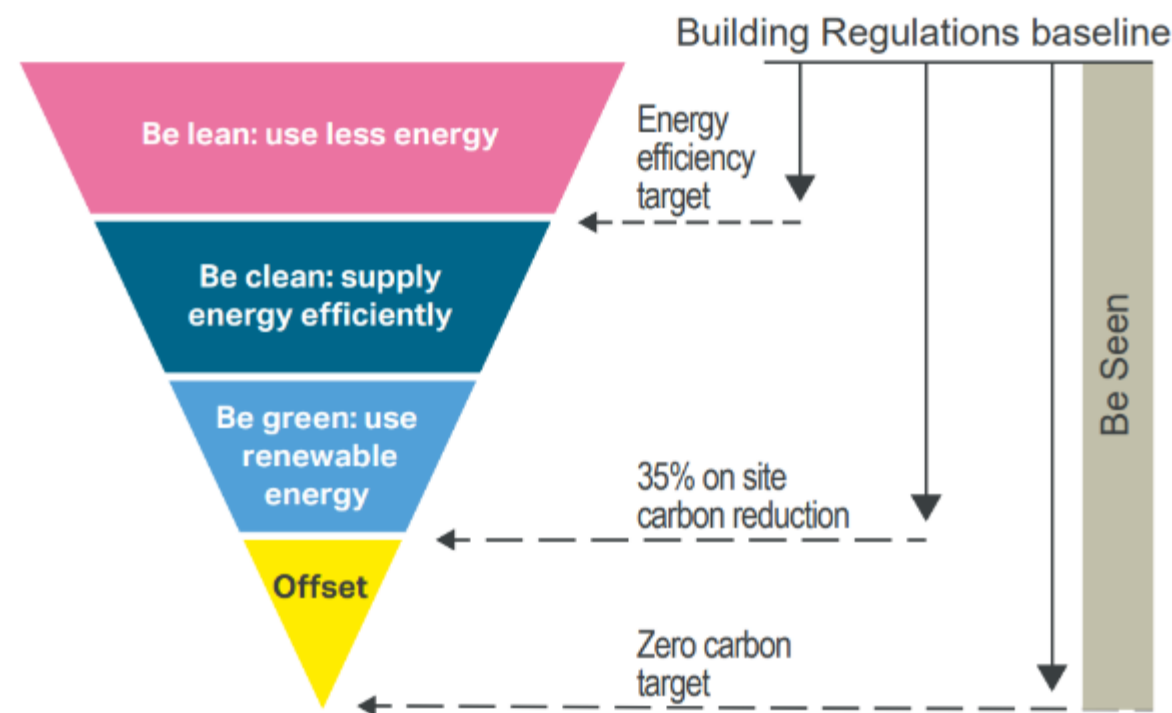


Figure 5 London plan Energy Hierarchy.

- 2.18 The price for offsetting carbon is regularly reviewed. Changes to the GLA's suggested carbon offset price will be updated in future guidance. The new Development is expected to get as close as possible to zero-carbon on-site, rather than relying on offset payments to make up for any shortfall in emissions. However, offset funds can unlock carbon savings from the existing building stock through energy efficiency programmes and by installing renewable technologies – typically more expensive to deliver in London due to the building's age, type, and tenure.
- 2.19 The Mayor will work with boroughs, energy companies, and major developers to promote London's energy system's timely and effective Development (energy production, distribution, storage, supply, and consumption).
- 2.20 London is part of a national energy system and currently sources approximately 95 per cent of its energy from outside the GLA boundary. Meeting the Mayor's zero-carbon target by 2050 requires changes to how we use and supply energy to generate power and heat for our buildings and transport from clean, low-carbon, and renewable sources. London will need to shift from relying on natural gas as its primary energy source to a diverse range of low and zero-carbon sources, including renewable energy and secondary heat sources. Decentralised energy and local secondary heat sources will become an increasingly important element of London's energy supply. They will help London become more self-sufficient and resilient concerning its energy needs.

Policy SI 3 Energy Infrastructure

- A) Boroughs and developers should engage with relevant energy companies and bodies early to establish the future energy and infrastructure requirements arising from large-scale development proposals such as Opportunity Areas, Town Centres, other growth areas or clusters of significant new Development.
- B) Energy masterplans should be developed for large-scale development locations (such as those outlined in Part A and other opportunities), establishing the most effective energy supply options. Energy masterplans should identify:
- 1) significant heat loads (including anchor heat loads concerning sites such as universities, hospitals, and social housing)
 - 2) heat loads from existing buildings that can be connected to future phases of a heat network
 - 3) major heat supply plant, including opportunities to utilise heat from energy from waste plants
 - 4) secondary heat sources, including both environmental and waste heat
 - 5) opportunities for low and ambient temperature heat networks
 - 6) possible land for energy centres and/or energy storage
 - 7) possible heating and cooling network routes
 - 8) opportunities for futureproofing utility infrastructure networks to minimise the impact of road works
 - 9) infrastructure and land requirements for electricity and gas supplies
 - 10) implementation options for delivering feasible projects, considering issues of procurement, funding and risk, and the role of the public sector
 - 11) opportunities to maximise renewable Electricity generation and incorporate demand-side response measures.
- C) Development Plans should:
- 1) Identify the need for, and suitable sites for, any necessary energy infrastructure requirements, including energy centres, energy storage and upgrades to existing infrastructure
 - 2) identify existing heating and cooling networks, identify proposed locations for future heating and cooling networks and identify opportunities for expanding and interconnecting existing networks and establishing new networks.
- D) Major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system:
- 1) The heat source for the communal heating system should be Electricity following the following heating hierarchy:
 - a) connect to local existing or planned heat networks
 - b) use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)
 - c) use ultra-low NOx gas boilers
 - 2) CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements in Part B of Policy SI 1 Improving air quality
 - 3) where a heat network is planned but not yet in existence, the Development should be designed to allow a cost-effective connection later.
- E) Heat networks should achieve good practice design and specification standards for primary, secondary, and tertiary systems comparable to those in the CIBSE/ADE Code of Practice CP1 or equivalent.

Table 5 GLA Policy SI 3 Energy Infrastructure

- 2.21 The heating system should be designed to facilitate cost-effective future connections where developments are proposed within Heat Network Priority Areas but are beyond existing heat networks. Future connections may include, for example, allocating space in plant rooms for heat exchangers and thermal stores, safeguarding suitable routes for pipework from the site boundary and making provision for connections to the future network at the site boundary. The Mayor is taking a more direct role in delivering district-level heat networks. Newer communally-heated developments will connect to them and develop a comprehensive decentralised energy support package. Further details are available in the London Environment Strategy.
- 2.22 Electricity is essential for the functioning of any modern city. Demand is expected to rise in London in response to a long-term growing population and economy, the increased take-up of electric vehicles, and the switch to electric heating systems (such as through heat pumps). The Electricity network and substations are at or near capacity in several areas, especially in central London. The Mayor will work with the Electricity and heat industry, boroughs, and developers to ensure that appropriate infrastructure is integrated within a more comprehensive smart energy system designed to meet London's needs.

Policy SI 4 Managing Heat Risk.

- A) Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials, and green infrastructure.
- B) Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems following the following cooling hierarchy:

1) reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation, and the provision of green infrastructure

2) minimise internal heat generation through energy-efficient design

3) manage the heat within the building through exposed internal thermal mass and high ceilings

4) provide passive ventilation

5) provide mechanical ventilation

6) provide active cooling systems.

Table 6 GLA Policy SI 4 Managing Heat Risk

- 2.23 Climate change means London is already experiencing higher than historical average temperatures and more severe hot weather events. Higher temperatures combined with a growing population, urbanisation, and the urban heat island effect, means London must manage heat risk in new developments, using the cooling hierarchy above. The cooling hierarchy applies to major developments, and the principles can also be applied to minor Development.
- 2.24 In managing heat risk, new developments in London face two challenges – the need to ensure London does not overheat (the urban heat island effect) and that individual buildings do not overheat. The urban heat island effect is caused by extensive built-up areas absorbing and retaining heat day and night, leading to parts of London being several degrees warmer than the surrounding area. The extra-urban heat can become problematic on the hottest days of the year as daytime temperatures can reach well over 30°C and not drop below 18°C at night. These circumstances can lead many people to feel too hot or not sleep, but for specific health conditions and 'at risk' groups, such as some young or elderly Londoners, the effects can be severe and worsen health conditions. Green infrastructure can mitigate this effect by shading roof surfaces and through evapotranspiration. Development proposals should incorporate green infrastructure in line with Policy G1 Green Infrastructure and Policy G5 Urban Greening.

London Borough of Haringey Policies

- 2.25 Haringey's Local Plan is made up of several individual planning policy documents. These are Haringey's Local Plan Strategic Policies 2013 – 2026 (formerly the Core Strategy) March 2013. Consolidated with alterations since 2017 – sets out the Council's spatial strategy and critical policies for the future Development of the Borough through to 2026;

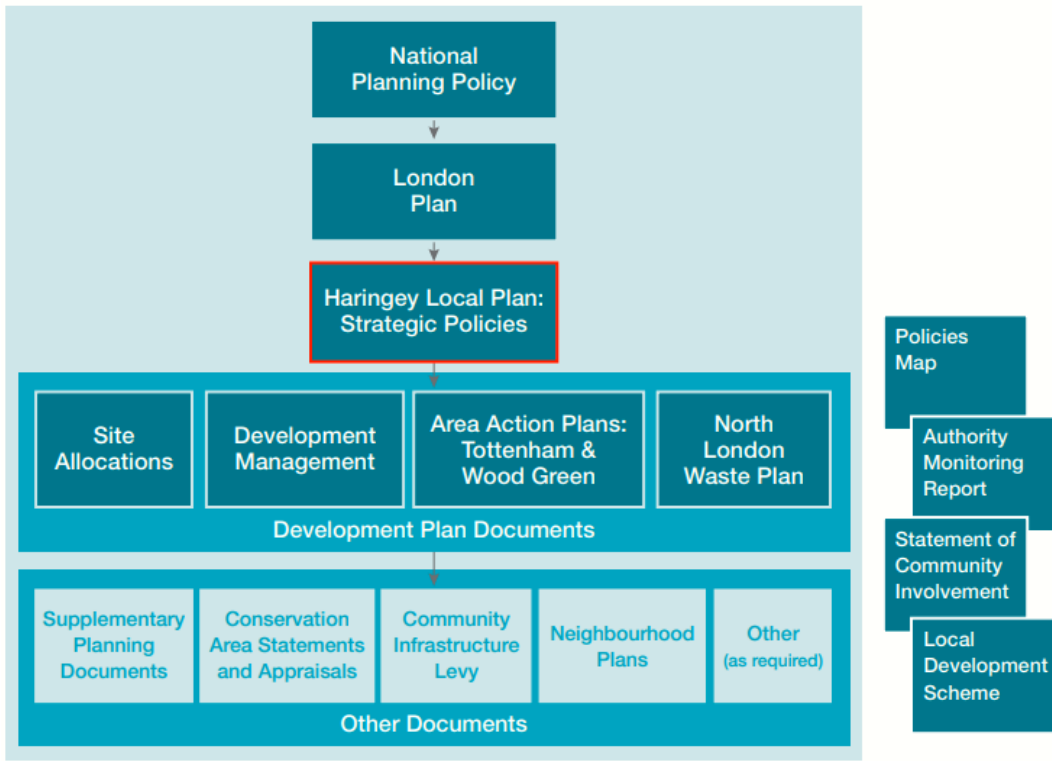


Figure 6 Haringey Local Plan

- 2.26 SP4 Working towards a Low Carbon Haringey - The Local Plan has an essential role in reducing Haringey's environmental impact and achieving sustainable Development – meeting Haringey's social, environmental, and economic needs in ways that protect the environment and do not harm our ability to meet our needs in the future. An environmentally sustainable future is one of the priorities of Haringey's Sustainable Community Strategy.

SP 4 Working towards a Low Carbon Haringey

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

1)

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

a)

From 2011 onwards, all new residential Development will achieve a minimum 25% reduction in total (regulated) CO2 emissions in line with Code for Sustainable Homes Level 4 energy standards and should aim to achieve Level 6. All new residential Development shall be zero carbon from 2016 onwards; and

b)

From 2011 onwards, all new non-residential Development shall be built to at least BREEAM "very good" standard and aim to achieve BREEAM "excellent" or the current nationally agreed standard. All new non-residential Development shall be zero carbon from 2019.

2)

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

a)

Requiring all developments to assess, identify and implement, where viable, site-wide, and area-wide decentralised energy facilities, including the potential to link into a wider network;

b)

Establishing local networks of decentralised heat and energy facilities by requiring developers to prioritise connection to existing or planned networks where feasible;

c)

Working with neighbouring boroughs and other partners to explore ways of implementing sub-regional decentralised energy networks, including the potential in the Upper Lee Valley Opportunity Area; and

d)

Where viable, all new developments are required to reduce predicted carbon dioxide emissions by 20% from on-site renewable energy regeneration, including connections to local sources of decentralised renewable energy.

Development Management DPD (Adopted July 2017)

2.27 The Development Management Plan sets out Haringey's spatial strategy for managing Development and growth in the Borough up to 2026. The Local Plan provides a positive framework for ensuring that housing, employment, infrastructure, and other needs are met to contribute to sustainable Development in both the

Highgate School MSC 4 Phases
4309-230123ac ~ HGS MSC Phase 2-4 - Energy Assessment.docx

Highgate School

12 of 40

Borough and Greater London. Several key objectives, which are set across five overarching themes, as follows, guide the Local Plan:

- People at the heart of change;
- An environmentally sustainable future;
- All share economic vitality and prosperity;
- Safer for all; and
- Healthier people with a better quality of life.

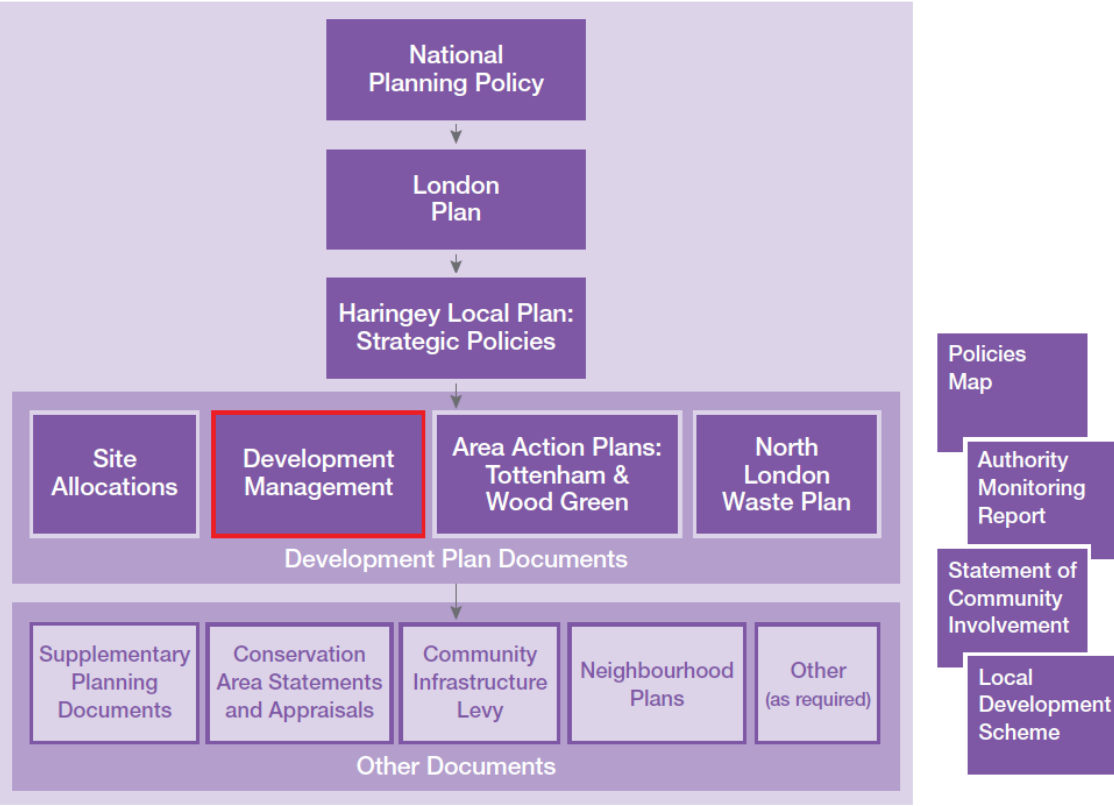


Figure 7 London Borough of Haringey Policy Hierarchy

Policy DM21: Sustainable Design,

2.28 The principles of sustainable design, layout and construction are set out in London Plan (2021). The principles cut across a few policies in this Local Plan, and all proposals should positively respond to them by engaging with the Haringey Development Charter (see Policy DM1). Applying sustainable design principles can help improve the environmental performance of buildings, making them more resilient to climate change and mitigating their effect on it. Sustainable design and construction, therefore, provide clear environmental advantages. It also offers social and economic benefits. Sustainable design results in more efficient buildings with cheaper operating costs, which benefits future owners or occupiers, particularly those at risk of fuel poverty.

Policy DM21: Sustainable Design, Layout and Construction

- A) All new Development, including building and landscape works, will be expected to consider and implement a sustainable design, layout, and construction techniques. Proposals should:
- a) Apply the energy hierarchy to minimise energy use to meet and, if possible, exceed minimum carbon dioxide reduction requirements;
 - b) Apply the cooling hierarchy to reduce the potential for overheating and limit reliance on mechanical air conditioning systems;
 - c) Maximise opportunities to enhance biodiversity on-site, including through appropriate landscaping, Sustainable Drainage Systems, living roofs and green walls
 - d) Wherever possible, use building materials with high environmental performance ratings; and
 - e) Seek opportunities for locally sourced labour.
- B) The Council will support appropriate measures to retrofit existing homes and non-residential buildings sustainably.
- C) Proposals that fail to demonstrate adequate consideration for sustainable design, layout and construction techniques will be resisted.
- D) Consideration will be given to using carbon offset payments, to be secured by planning obligations, where it can be demonstrated that proposals cannot meet carbon dioxide emission reduction targets on-site.

Energy Efficiency

2.29 London Plan Policy SI 2 states that all new development proposals should make significant contributions to minimising greenhouse gas emissions following the energy hierarchy, as follows:

- Be lean: use less energy
- Be clean: supply energy efficiently
- Be green: use renewable energy

2.30 The first step in the hierarchy should be met by adopting sustainable design principles and reducing energy demand. The second step should be met by fulfilling energy requirement of the development efficiently by prioritising decentralised energy, for which local requirements are set below (see Haringey DPD Policy DM22). The third step is to use renewable energy.

Layout and Construction

Policy DM22: Decentralised Energy

- A) Subject to other policy requirements, proposals contributing to the provision and use of Decentralised Energy network infrastructure will be supported.
- Communal energy systems**
- B) All Development that incorporates site-wide communal energy systems should examine opportunities for extending such systems, irrespective of whether it is connected to a DE Network.
- C) All Development incorporating site-wide communal energy systems should optimise opportunities for extending such systems beyond the site boundary to supply energy to neighbouring existing and planned future developments.
- Existing and planned future DE networks**
- D) All development proposals should prioritise connection to existing or planned future DE networks.
- E) All major Development located within 500 metres of an existing DE Network, and minor new-build Development located within 25 metres, will be expected to secure connection to that network subject to demonstration of technical feasibility and financial viability.
- F) All major Development located within 500 metres of a planned future DE Network, considered by the Council likely to be operational within 3 years of a grant of planning permission, will be expected to secure connection to that network subject to demonstration of technical feasibility and financial viability.
- DE network' connection zones.'**
- G) All major Development located within 500 metres of a DE network' connection zone' should be designed for connection to a DE network.
- H) All minor new-build Development located within 25 metres of a DE network' connection zone' should be designed for connection to a DE network.
- Customer charters**
- I) Where site-wide communal and district heating systems are operational, the Council strongly encourages heat and energy service providers to enter customer charters with domestic and micro-business customers.

- 2.31 Decentralised energy is supported by national and regional policy as a means of meeting the requirements of the Climate Change Act on carbon emission reduction. The London Plan aims to shift from the use of natural gas to a more diverse range of low carbon and renewable sources. Decentralised energy and secondary heat sources will become and increasingly important element of London's energy supply in the future. Decentralised energy will help London become more self-sufficient and resilient in relations to its energy needs.
- 2.32 Policy SP4 broadly supports DE networks as part of a package of measures to assist in delivering more energy efficient Development and working towards a low-carbon Borough. In line with the London Plan, all development proposals will be expected to select energy systems following the Mayor's energy hierarchy. This policy sets further detailed requirements to assist with implementing these strategic objectives.
- 2.33 All major Development should incorporate site-wide communal energy systems that serve all energy demands within the Development from a standard system, irrespective of whether it is connected to a DE network. Proposals should consider systems connecting different uses and building groups within and extending beyond the development site.

Overheating and cooling

- 2.34 Development proposals should seek to integrate the cooling hierarchy following sustainable design, layout, and construction principles. Helping to ensure that buildings are better equipped to manage their cooling needs in Energy efficient ways over their lifetime. This policy applies the cooling hierarchy set out in the London Plan:
2. Minimise internal heat generation through Energy efficient design
 3. Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls
 4. Manage the heat within the building through exposed internal thermal mass and high ceilings
 5. Passive ventilation
 6. Mechanical ventilation
 7. Active cooling systems (ensuring they are the lowest carbon options)
 8. Sustainable retrofitting
- 2.35 Existing building stock in Haringey factors significantly in local carbon emissions. The Borough's interactive heat loss map 12 indicates that many properties in the area are energy inefficient. Sustainable retrofitting offers an opportunity to improve existing buildings' environmental performance, particularly where conversions, refurbishments, changes of use and extensions are proposed.

Enhancing biodiversity

- 2.36 Urban greening can contribute to biodiversity, amenity, and climate change adaptation. Living roofs (Green and brown roofs) and green walls offer many environmental benefits, such as improving the thermal performance of buildings, reducing on-site energy demands, and limiting the 'urban heat island effect. They also contribute to sustainable drainage by absorbing rainfall, reducing run-off and improving water quality.

Materials and locally sourced labour

- 2.37 The type and source of materials used for the construction of buildings have a major impact on sustainability. It is common for building materials and their components to be assessed regarding their environmental impact across their entire life cycle, including through energy ratings. The Council encourages applicants to use materials with high environmental performance ratings wherever possible.

Carbon Offsetting

- 2.38 The London Plan provides that boroughs may establish carbon offsetting arrangements to maximise carbon emission reductions. Carbon costing will be established using a recognised carbon price in line with London Plan supplementary planning guidance or further local guidance as appropriate. Subject to Government and regional policy, the Council will consider using carbon offsetting payments where it can be suitably demonstrated that proposals cannot meet carbon emissions reduction targets on-site. Further details in this regard are set out in the Council's Planning Obligations SPD.

3 Energy analysis

GLA Energy Assessment Guidance updates - Part L 2021 of building regulations.

- 3.1 The Mayor has declared a climate emergency and has set a target for London to be net-zero by 2030. The climate emergency puts London at the forefront of global cities and UK action on climate change. The Mayor's London Plan ensures that the planning system plays its part in achieving the net-zero target.
- 3.2 On 15th June 2022, national building regulations were updated to enhance energy performance standards for new buildings through Part L 2021. A new part L (2021) has introduced new requirements to tackle overheating.
- 3.3 The Mayor's Energy Assessment Guidance has been updated in 2022 to explain how the London Plan policy should be applied now that these regulations have taken effect. An updated spreadsheet to report carbon emissions has also been published, which planning applicants should submit as part of the energy strategy.

The Mayor's net-zero carbon target for major developments

- 3.4 As of 15th June 2022, all major developments in London must meet the London Plan net zero carbon target by following the energy hierarchy (Policy SI 2), the heating hierarchy (Policy SI 3) and by maximising on-site carbon reductions. Planning applicants are expected to demonstrate that at each stage of the energy hierarchy, they have maximised opportunities for carbon reduction to achieve as close to zero as possible. An on-site carbon reduction of at least 35 per cent beyond Part L 2021 of building regulations should be achieved. Once it is demonstrated that carbon reductions are maximised, any remaining emissions to zero should be offset by contributing to the relevant Borough's carbon offset fund. Applicants should also continue to meet the energy efficiency targets (Policy SI 2) and undertake dynamic modelling as part of their energy strategy to reduce the risk of overheating (Policy SI 4).

National Calculation Method (SBEM 6.1a June 2022)

- 3.5 The National Calculation Methods, Simplified Building Energy Model (SBEM) energy model estimates the energy consumption for the non-domestic and communal areas. The SBEM energy modelling software was developed to demonstrate the energy and emission savings for compliance with the Building Regulations. The resulting output data is accepted as suitable for early design energy comparison. The SBEM energy model also predicts unregulated energy usage using nationally agreed energy benchmarks for the proposed uses of the building.
- 3.6 As part of the recent revision to the compliance requirements for building services in England, as published by DLUHC to the Approved Document Part L2-2021 document, which is due to come into force on 15th June 2022. The main changes in the technical requirements of software since the issue of the previous NCM Modelling Guide are as follows:
 - i. The 2021 compliance target is for both CO₂ emissions and primary energy.
 - ii. New specifications of the Notional building for the 2021 edition, used to determine the CO₂ emissions and primary energy targets, have been defined to deliver a 27% reduction in CO₂ emissions on average across the new non-domestic building mix relative to Part L 2013.
 - iii. The new classification of high and low hot water demand activities determines the specifications for the Notional building's water heating system.
 - iv. On-site electricity generation by PV in the Notional building.

- v. A new set of fuel emission and primary energy factors for buildings other than dwellings is provided in Table 7 of this document, including monthly factors for Electricity. Also offered is a set of fuel factors specifically for district heating networks.
- vi. Revised approach for determining the illuminance level for a zone in the Notional building using minimum and maximum lighting levels for the activity type in the NCM Activity Database.
- vii. Revised approach for accounting for primary energy due to Electricity generated on-site by renewables.
- viii. Upgrade to the 2016 CIBSE TRY weather data sets.
- ix. Updated options for HVAC systems in the Actual building and calculation of the corresponding fan energy.
- x. Revised approach for calculating the fan energy associated with demand control of ventilation.

3.7 The new ISBEM of iSBEM v6.1.b (29th April 2022) is to model the final proposal to confirm compliance with the building regulations.

3.8 The National Calculation Methods Simplified Building Energy Model (SBEM) Version 5.4 2013 is used to estimate the energy consumption for the building, regulated and unregulated energy consumption. The SBEM energy modelling software was developed to demonstrate the energy and emission savings for compliance with the 2013 Building Regulations. The resulting output data is accepted as suitable for early design energy comparison.

The calculation method for estimating the building energy use and associated emissions.

- 3.9 The following approach is followed to calculate the building CO₂ emission rate.
 - A. Calculate the monthly electrical energy used by the Notional building irrespective of the source of supply. Multiply that energy use by the monthly CO₂ emission factors for grid-supplied Electricity and sum the monthly values to produce the annual figure.
 - B. Calculate the annual energy associated with any other fuels used in the Notional building and multiply the energy use by the respective CO₂ emission factors for the fuels.
 - C. Calculate the monthly Electricity generated by the on-site PV system; if applicable, multiply that by the monthly CO₂ emission factors for grid-displaced Electricity by PV generated on-site. The sum of monthly values to produce the annual figure.
 - D. The net figure of 'A plus B minus C' above is the annual CO₂ emissions used to establish the TER. If 'A plus B minus C' is a negative value, then the TER is set to 0.
- 3.10 The net primary energy of the Notional building and the TPER are calculated using the same approach.

Notional Building Photovoltaics.

- 3.11 The Notional building will have a roof-mounted PV array whose peak power (kWp) is the product of 0.2 kWp/m² and an array area (m²) calculated using the following equation:

$$APV = (A_{foundation} \times 20\% \times A_{side-lit\&unlit} / A_{total}) + (A_{foundation} \times 40\% \times A_{top-lit} / A_{total})$$

Where:

APV = area of PV array, **A_{foundation}** = area of building's foundation (as input by the user), **A_{side-lit&unlit}** = total area of side-lit and unlit zones, **A_{top-lit}** = total area of top-lit zones, and **A_{total}** = total area of all zones in the building.

The area of the building's foundation is calculated using the following equation:

$$A_{foundation} = A_{conditioned} \times N_{storeys}$$

Where:

A_{conditioned} = the total floor area of all the spaces in the modelled building which are conditioned or intended to be conditioned, e.g., after fit-out, by a space heating or space cooling system (i.e., areas of permanently unconditioned spaces are excluded), and **N_{storeys}** = the total number of stores in the entire structure that encases the modelled building, including partial storeys and storeys containing dwellings and buildings other than dwellings (whether or not they are part of the building being assessed, i.e., represented in the software model).

- 3.12 Suppose any HVAC system in the Actual building provides space heating using a heat pump. In that case, the area of the PV array in the Notional building is reduced pro-rata by the proportion of the building's space heating demand which is met by a heat pump in relation to the building's total space heating demand.
- 3.13 For example, if a heat pump meets 30% of the space heating demand in the Actual building, then the area of the PV array in the Notional building will be reduced by 30% from the value.
- 3.14 Therefore, if a heat pump meets 100% of the space heating demand in the Actual building, then the Notional building will have no PV system.

Carbon Emissions Electricity Factors

	2012 (SBEM 5.6b)		2022 (SBEM 6.1a)	
	Energy Emission	Primary Energy	Energy Emission	Primary Energy
Fuel type	kgCO ₂ /kWh		kgCO ₂ /kWh	kWhPE/kWh
Natural gas	0.216	1.22	0.21	1.126
Grid supplied Electricity	0.519	3.07	Variable Month	Variable Month
Grid displaced Electricity	0.519	3.07	PV; Variable Month	PV; Variable Month

Table 7 Energy emission factor changes between 2012 & 2022.

- 3.15 The new non-domestic building regulation grid and displace electricity Carbon Dioxide factor are calculated monthly to consider that at different seasons more Electricity is generated from sun or wind than at other times. The Carbon emission factors vary with seasons.
- 3.16 The GLA reporting tool calculates the carbon offset payment and compliance with the GLA energy hierarchy. The reporting tool uses domestic SAP 10 carbon emission factors, resulting in higher carbon dioxide emissions than the non-domestic building regulation method.

- 3.17 The GLA method increases the cost of Carbon Offset payment compared with the building regulation carbon dioxide factors.

	Grid Supplied Electricity		Grid Displaced Electricity	
	Energy Emission	Primary Energy	Energy Emission	Primary Energy
Month	kgCO ₂ /kWh	kWhPE/kWh	kgCO ₂ /kWh	kWhPE/kWh
Jan	0.163	1.602	0.196	1.715
Feb	0.16	1.593	0.19	1.697
Mar	0.153	1.568	0.175	1.645
Apr	0.143	1.53	0.153	1.567
May	0.132	1.487	0.129	1.478
Jun	0.12	1.441	0.106	1.389
Jul	0.111	1.41	0.092	1.33
Aug	0.112	1.413	0.093	1.336
Sep	0.122	1.449	0.11	1.405
Oct	0.136	1.504	0.138	1.513
Nov	0.151	1.558	0.169	1.623
Dec	0.163	1.604	0.197	1.718

Table 8 2021 new month carbon emission factor (June 2022).

Zero Carbon Building

- 3.18 National building regulations are changing on 15th June 2022. As of this date, the Mayor's net-zero carbon target set out in London Plan Policy SI 2 will continue to apply to all major developments. Applicants will be expected to continue to follow the energy hierarchy, with a minimum 35% improvement over Part L 2021 from on-site carbon savings. Once on-site carbon savings have been maximised, any remaining emissions should continue to be offset via a cash-in-lieu contribution to the relevant Borough's carbon offset fund. Further details will be provided in an update to the Energy Assessment Guidance once national regulations have taken effect. If you have any questions, please contact

Energy Modelling Results

	Base	Be Lean	Be Clean	Be Green
	kWh	kWh	kWh	kWh
Electric Heating	52,162	17,269	17,269	17,269
Heating (gas)	28,644	23,692	23,692	23,692
Cooling	3,474	1,873	1,873	1,873
Aux Energy	25,029	39,925	39,925	39,925
Lighting	24,528	29,344	29,344	29,344
Hot water (gas)	37,527	41,988	41,988	41,988
Displaced	-72,555	-70,496	-70,496	-115,737
Equipment	56,026	56,026	56,026	56,026
Total	154,835	139,622	139,622	94,380
Regulated	98,809	83,596	83,596	38,355
Primary energy	214,450	187,078	187,078	124,405
Electricity	161,219	144,437	144,437	144,437
GAS	66,171	65,681	65,681	65,681
Displaced	-72,555	-70,496	-70,496	-115,737

Table 9 Estimated Energy from each stage of the Energy Hierarchy (SBEM 6.1a 2022).

	Base	Be Lean	Be Clean	Be Green
	kgCO ₂	kgCO ₂	kgCO ₂	kgCO ₂
Electric Heating	7,840	2,725	2,725	2,725
Heating (gas)	6,015	4,975	4,975	4,975
Cooling	421	421	421	228
Aux Energy	3,481	3,481	3,481	5,562
Lighting	3,595	3,595	3,595	4,112
Hot water (gas)	7,881	7,881	7,881	8,818
Displaced	-9,341	-5,587	-5,587	-14,993
Equipment	7,802	7,802	7,802	7,802
Total	27,693	25,293	25,293	19,229
Regulated emission	19,891	17,491	17,491	11,427
saving		12%	12%	43%
Carbon Offset (SBEM)				£54,803
Electricity	23,138	18,024	18,024	20,429
GAS	13,896	12,856	12,856	13,793
Displaced	-9,341	-5,587	-5,587	-14,993

Table 10 Estimated Emissions from each stage of the Energy Hierarchy (SBEM 6.1a 2022).

3.19 The site energy reduces at each stage of the mayor hierarchy, and the site emissions increase.

- The energy consumption of the lighting increase because the energy calculation for the base building is an area-related formula which cannot take into account the use of the zone. The proposed building is based on current luminaire efficiencies and light requirements for each zone. For example, the sports hall requires high-quality light levels. In contrast, the base building sports hall assumes a general lighting level.
- The auxiliary energy for fans and pumps increases as the assumed equipment efficiency within the base building is not reflected by the currently available equipment manufacturers.

3.20 In conclusion, the building will consume less energy than the base building and emissions are offset by renewable energy.

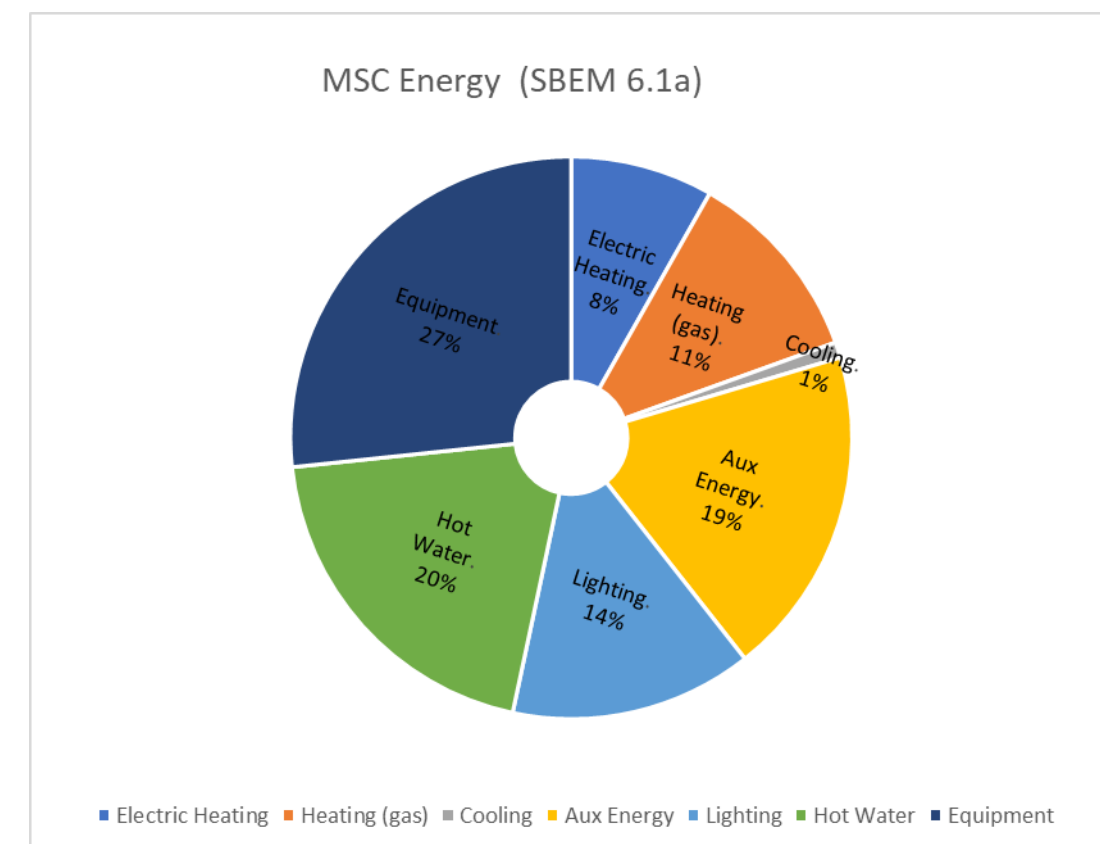


Figure 8 MSC Energy Use.

Building Energy Comparison with Notional Building

3.21 The table below compares the SBEM predicted delivered energy use in the building. That is the energy used in the rooms (without the influence of plant efficiency).

3.22 Comparing the required energy allows the assessment of the energy-saving made through sustainable building design.

Heating

3.23 The improved building thermal element of the building fabric reduces the building's predicted heating energy by 18% from the National Building.

Cooling

3.24 The site has dictated the orientation of the building, approximately north entrance and South facing. The direction of the building has adversely increased the cooling energy compared with the notional building. The SBEM energy model over-predicts the use of cooling in the bedrooms as the room activity profile assumes 80% occupancy during the day.

Auxiliary Energy

3.25 Auxiliary Energy is the energy used to distribute heating, cooling, and ventilation through the building.

3.26 The pump energy is required to move heating and coolth from the boiler and chiller plant to fan coil units in bedrooms and function areas

3.27 Fan energy supplies fresh air and extracts moist air from wet room areas.

3.28 VRF heat pumps circulate refrigerant gasses around the building without requiring pumps, reducing auxiliary energy consumption. Not requiring pumps is a significant advantage over a boiler or chiller, which needs water to be pumped around to transfer heat and coolth.

3.29 The extra energy varies with the selection of heating and cooling plants.

Lighting Energy

3.30 The room activity database sets the illuminance levels and the scheduled lighting operation. The designers select the luminaires' type, efficiency, and operating control. In this case, high-efficiency LED lighting, infra-red sensor control in public areas, and manual switching in the hotel bedrooms and bathrooms. The efficiency of the luminaires is limited to the available domestic/hotel luminaires, which have a typical efficiency of 100 lumens per circuit watt. The marginally higher efficiency luminaries are available for the public areas at 110 lumens per circuit watt

3.31 An algorithm is used to calculate the lighting energy in the notional building. This algorithm is based on commercial office lighting and sets a challenging target for the hotel bedrooms, which cannot be met with available luminaires.

Room	Illuminance	Power	Control
Public area	200 lux	6 W/m²	Timed and daylight control
Corridors/ stair access routes	100 lux	3 W/m²	Timed, reduced lighting between 23:00 and 06:00
Bedroom & bathrooms	100 lux	3 W/m²	Manual on and off lights off when key card is removed
Office meeting rooms	300 lux	9 W/m²	Manual On, PIR off
Store & plant rooms	100 lux	3 W/m²	Manual On, PIR off
WC	200 lux	6 W/m²	Manual On, PIR off

Table 11 Typical Room illuminance and Power Ratios

3.32 The lighting designers must provide illuminance calculations in inline Table 11 above.

3.33 Hot Water

3.34 The new SBEM has reclassified hot water demand and now considers the installation of a reduced Flowrate shower.

3.35 The changing room is newly installed as part of the swimming pool refurbishment and uses low flow rate shower heads. Changing room hot water is generated in fast recover low volume high flowrate hot water cylinders using the same boiler as the swimming pool.

3.36 The room activity database sets the water usage, which assumes a 100% room occupancy rate within each room using 130 litres of hot water per day (8l/m²/day), the BRE estimated water use. The water usage is the equivalent of two 15-minute showers in every room and is the equivalent of 100% capacity daily. The new water regulations limit the flow rates of shower heads to 8 litres/minute.

3.37 As 75% of the floor area of this hotel is allocated to bedrooms, the SBEM model overestimates the energy related to hot water production.

3.38 The design inputs related to hot water are:

- Efficiency and fuel choice of the hot water generation plant.
- Storage heat losses
- Circulation heat losses.

3.39 The notional building and actual building model use the same gas-fired hot water generation plant with localised hot water storage on each floor. Therefore, the predicted energy use is similar.

2022 Building Regulations Terminology

Regulated Energy use

3.40 Regulated energy is used for the SBEM calculation to demonstrate building control compliance.

- Heating
- Hot Water
- Fans and Pumps
- Lighting
- Unregulated Energy

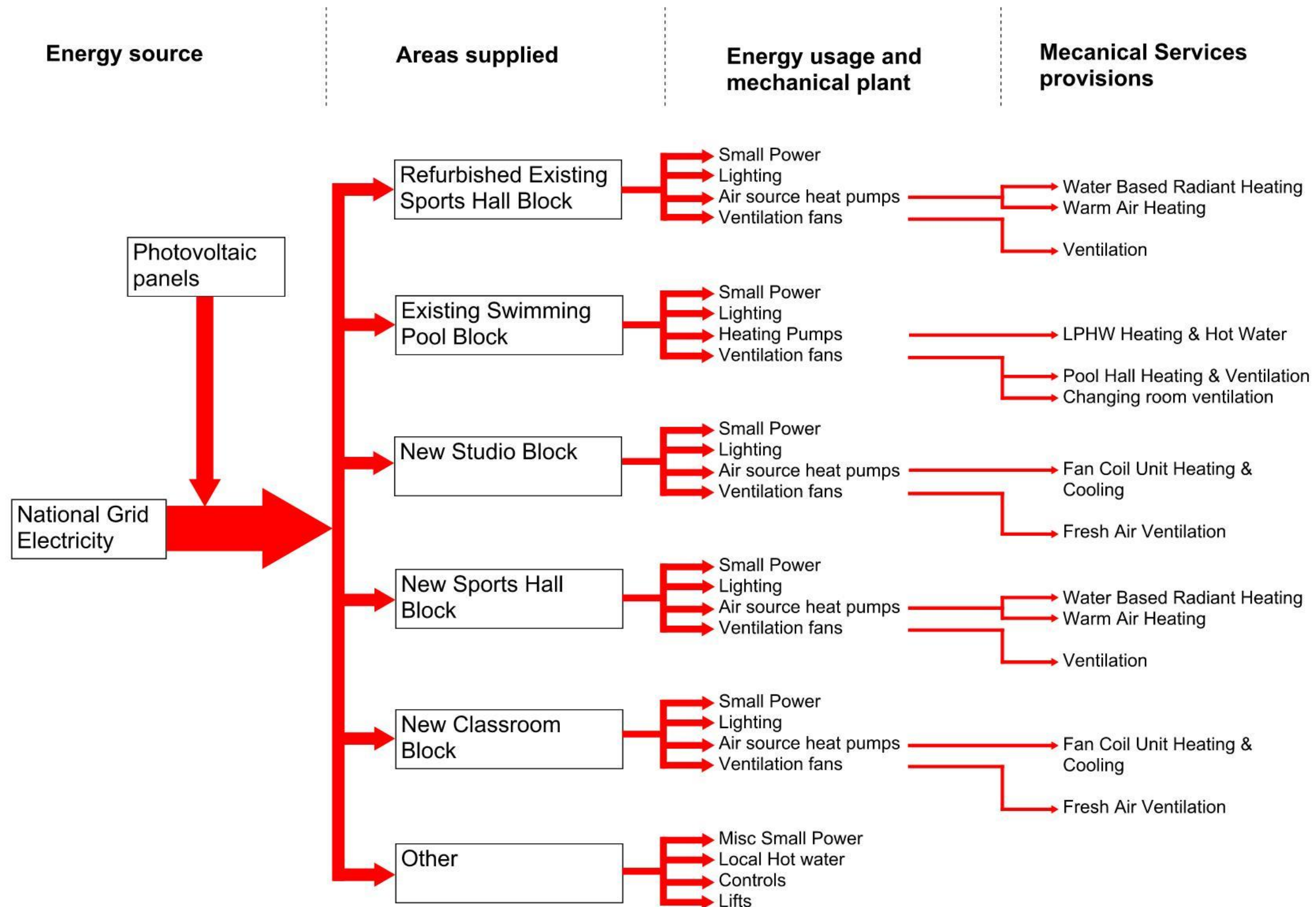
3.41 Unregulated energy is the energy the occupants use for cooking appliances and entertainment. This energy is not regulated (included/calculated for the DER), as it depends on the occupants and their lifestyles.

Base Building or Target Emission Rate (TER)

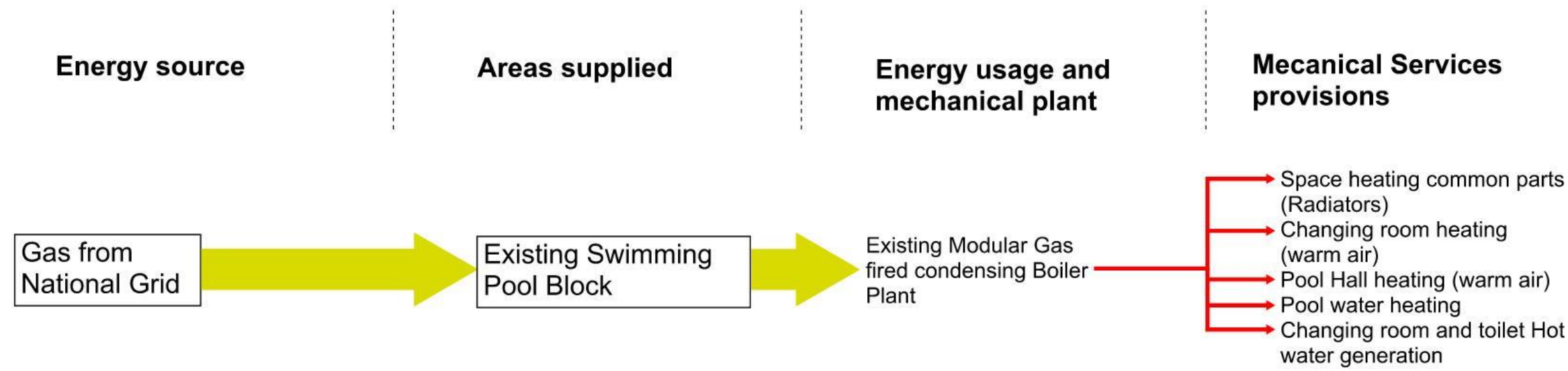
3.42 The building has been designed to comply with the standards of the 2022 Building Regulations and meet the GLA target of 15% (Be Lean) emission reduction from improvement in the building fabric and 20% from energy-efficient (Be Clean) and renewable energy generation (Be Green).

Proposed Building Emission Rate (BER).

3.43 The Building Emission rate is the regulated energy-related Carbon Dioxide emission rate from the building services design of the proposed building.



Electricity Usage Diagram



Gas Usage Diagram

4 Energy Hierarchy

Be Lean

Thermal Elements

- 4.1 Wall construction is generally in solid masonry cavity wall construction, with external clay-facing bricks or Portland stone facings.
- 4.2 Windows are to be aluminium or aluminium/timber composite windows or curtain walling systems, with double-glazed glass units. The glazing will include security glazing tape, dedicated security sealant or gasket and a secure mechanical fixing system – in general, all glass units will consist of safety glass, laminated, and toughened in compliance with Part N and beyond – this will apply to glass at all levels, as the sports activities will also require safety glass.
- 4.3 Roofs are constructed with a base which might be CLT panels or profiled metal sheeting, fixed to the main structural frame, and finished with rigid insulation and bituminous flat roof weatherproofing systems. In many cases, this will be combined with green roof systems, including extensive roof build-ups and drainage layers.
- 4.4 The table below shows that the proposed U-values for the new build part of the Development are in line with Appendix C of ADL2a of building regulations. These values, from a buildability aspect, can be achieved with standard building materials

Element	Proposed U Values	Base (Notional)	Better Than Typical
Wall	0.15 W/m²K	0.26 W/m²K	0.23 W/m²K
Windows	1.40 W/m²K	1.60 W/m²K	1.50 W/m²K
Glass G factor	0.4	0.4	
Roof	0.12 W/m²K	0.18 W/m²K	0.15 W/m²K
Floor	0.14 W/m²K	0.22 W/m²K	0.20 W/m²K
Air permeability Rates	3.0 m³/m².h @50Pa	3.0 m³/m².h @50Pa	5.0 m³/m².h @50Pa

Table 12 U Values for Thermal Elements

- 4.5 The proposed U-values combined with the high-efficiency heating plant reduce the energy required to heat the building even further than the base building.

Airtightness

- 4.6 Building air tightness is a major saving of heating energy, which now has higher importance than external wall U values. Non-domestic buildings can be constructed to achieve permeability rates as low as 4m³/(h.m²) @50Pa.
- 4.7 The buildings are designed to achieve an air tightness of less than 4m³/m²h@50Pa, which is a challenging but achievable target as the design team has specified sealing and jointing fabric openings at external element junctions. Leakage is usually caused either by a lack of awareness of the importance of airtightness or by a lack of contractual responsibility for this requirement.
- 4.8 Airtightness must be prioritised throughout the construction process – before, during and after. The contractor must apply suitable construction quality assurance methods, and it is recommended to undertake early air tests to identify air leakage paths.

Thermal Mass

- 4.9 Thermal mass is the ability of a material to absorb and store heat energy. Significant heat energy is required to change the temperature of high-density materials like concrete, bricks, and tiles. They are therefore said to have a high thermal mass. Lightweight materials such as timber have a low thermal mass. Appropriate use of thermal mass throughout the building can significantly affect thermal comfort.
- 4.10 Thermal mass can store solar energy during the day and radiate it at night and, when correctly used, contributes towards moderating internal temperatures by averaging out diurnal (day–night) extremes. The thermal mass contributes toward thermal comfort and reduces energy costs.
- 4.11 The new construction is a low thermal mass design. The low thermal mass allows the building to respond quickly to bedroom heating and cooling control changes. External summer heat is kept out of the building through the thick internal insulation layer and a large cavity between the outer brick skin and the inner insulation layer. On average, the window wall area ratio is 25% of the external wall area. The proposal is to use solar glass, having the ability to reduce the heat gain without significant loss of light or discolouration of the glass.
- 4.12 The sports halls require a light thermal mass structure with a fast-response heating system. The highly insulated walls and the roof protects the internal space from outside weather conditions. When the sports hall heats up quickly, the wall temperatures respond to reduce the risks of condensation. The occupants have a better thermal comfort experience as they do not feel the extreme radiant effects of the building structure.
- 4.13 Highly insulated low thermal mass structures allow rapid heating with a more extended cool-down period. The ability to retain heat is required to enable reduced ventilation for sports where internal air movement should be kept low.

Water

- 4.14 The UK has less water per person than most other European countries. London is drier than Istanbul, and the South East of England has less water available per person than Sudan and Syria.
- 4.15 As our population grows, more people are sharing this limited resource. Also, the more water consumed, the less available for the environment. Therefore, it is essential that we use water wisely and not waste it.
- 4.16 Approved Document Part G of the Building Regulations in April 2010 sets a whole building standard of 125 litres per person per day for domestic buildings. This comprises internal water use of 120 litres per person per day and an allowance of 5 litres per person per day for outdoor water use.

. Installation	Description	Water Use
WC	Dual Flush Cistern	5 Litres and 3 litres
Wash Hand Basin	Low Flow Regulators or Aerating Taps	3.0 Litres/Min
Shower	Low Flow Rate Between	8 litres / minute
Cleaner Sink	Standard Monoblock At 2/3 Maximum Flow rate	3.25 Litres/Min

Table 13 Efficient Water Fitting Flow rates

Low Energy Lighting

- 4.17 All lighting will be low-energy integrated LED light fittings and controls
- 4.18 LED lighting technology with the Development of multichip LED Lamps means it is now possible to install high-quality, low-energy lights with short warm-up periods and low fading loss over the life of the lamps.

- The lighting industry is continually developing new stylish compact LED luminaires that can replace all the less efficient incandescent and fluorescent lights.
- 4.19 The external lighting designer will include input from a metropolitan police officer to ensure the exterior lighting design provides good quality, safe lighting, which can help prevent crime and will not cause a nuisance to the neighbours.
- 4.20 The selected luminaires will include the following integrated controls to avoid wasting energy
- Automatic presence detection to turn light fitting on and off.
 - BMS-compatible time clock controls
 - Daylight Sensing dimming control,
 - Automated self-test to give warning of when luminaire requires replacing.
 - Automated and self-testing emergency lighting and record-keeping tracked through the BMS.
 - The strength of external lighting was reduced after midnight and before six am.
- 4.21 The lighting energy required in most areas of the building is generally less than the base building; however, the lighting requirements for some areas, such as the sports hall, will be greater than the base building because of the lighting levels required for the sports hall.

Overheating

Elevation	Wall Area	Windows Area	Wall Window ratio
North	344.5 m²	82.7 m²	24%
East	860.7 m²	74.0 m²	9%
South (Five Courts)	415.0 m²	44.0 m²	11%
West (Bishopwood Road)	815.3 m²	260.2 m²	32%

- 4.22 Sports centres, like any other building, are prone to overheating during prolonged heatwave conditions. The designer has reduced the risk through the following measures.
- Green Roof. Living roofs effectively reduce heat transfer in a large industrial shed-type building. The new sports hall living roof is designed to retain rainwater for plant irrigation. The combination of plants' soil and stored water slows the heat transfer and the heat gain into the sports hall.
 - Openable roof lights, lower air vents, and windows allow hot air to escape the sports halls.
 - Solar shading motorised blinds enable the occupants to reduce solar through the windows.
 - Mechanical ventilation and use purge the sport so heat using the overnight cooling
 - The windows are mainly located along access corridors and high with the sports hall.

Be Clean

District Energy Networks

- 4.23 The London Borough of Haringey Energy Master Plan (2016)

"It appears unlikely that a network in Highgate or Hornsey will be viable based on the existing loads/development plans. Hence, these areas should be reviewed only when significant additional Development emerges."

The school is in Highgate Conservation Area. It is unlikely that the school could get planning consent for a large boiler house and combined heat/power unit, as this would be potentially unsightly in the heritage context and have implications on the local air quality. Combined Heat and Power units emit high quantities of NO_x, a gas, that are monitored as part of the London air quality target gasses. The recent guidance for flue gas emission from CHP has exceeded the capabilities of the smaller market CHP machines.

- 4.24 The design team have reviewed the London Heat map, and the site is in a location with no potential for the future Development of a district heating network.

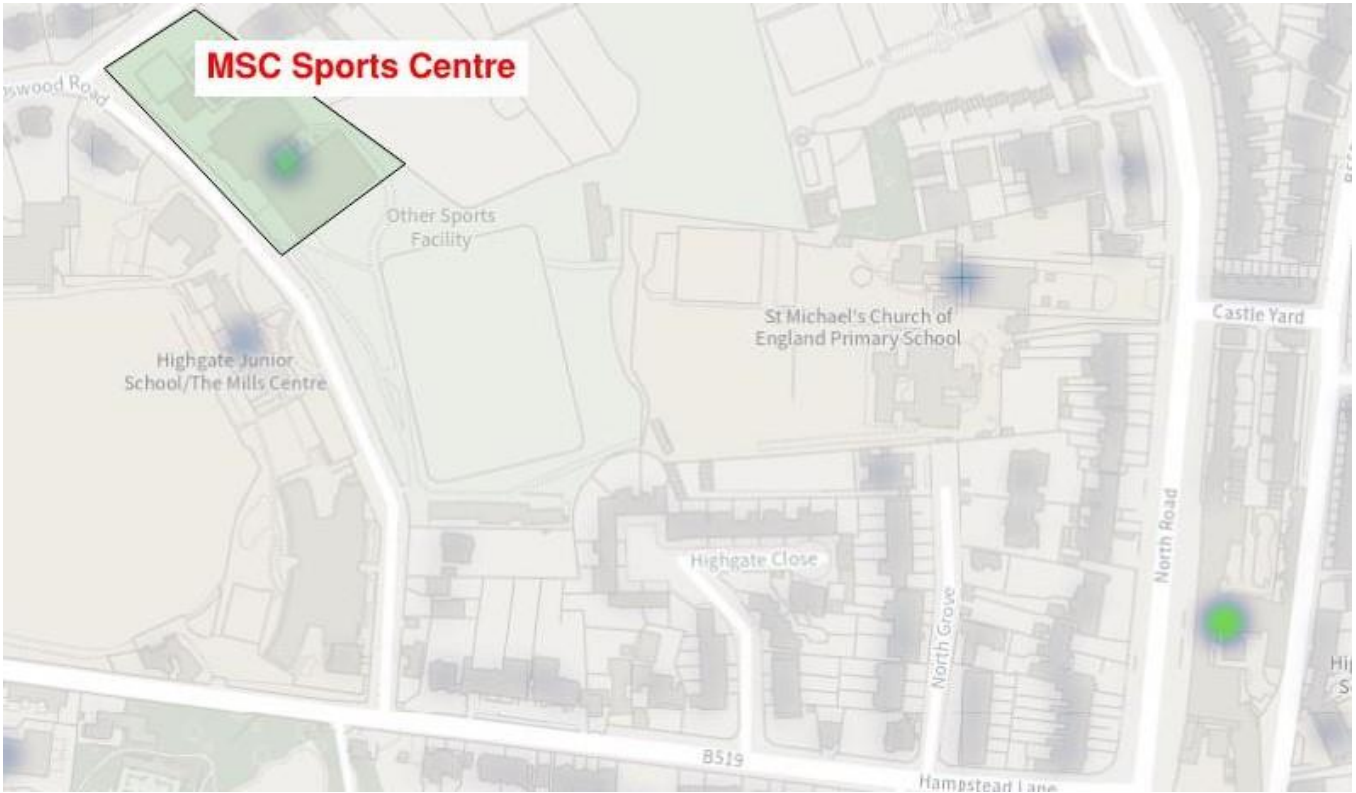


Figure 9 Mayor of London Heat Map

- 4.25 Highgate School, as part of the environmental strategy plan (2019), the school has set a challenge to become a net-zero emissions emitter. For the school to become net-zero will require a complete change in how it provides heat and power. An energy review of the various school buildings is to be undertaken, and where possible, the heating system is converted to electric heating. One of the low carbon heating solutions is a low-temperature ambient loop that interlinks buildings with low-temperature (heat pump) heating systems.

Communal Energy Network

- 4.26 The Highgate School estate has low building density with a wide variety of building types and uses. The buildings are in a continual process of change of use, refurbishment, and remodelling in response to the ever-changing requirements of the modern school estate. All the buildings have separate heating systems and power supplies that enable the facility to operate independently.
- 4.27 There is no energy advantage in connecting the heating system to a single energy centre on-site, as the system heat loss would far exceed the benefits of a communal heating system. The distance between buildings and the energy centre creates heating system losses. There is no advantage in using Combined

Heat and Power as heat demand occurs between 06:00 and 09:00 in the morning while peak electrical demand occurs around the middle of the day, limiting the opportunity to supply heat and power simultaneously. It is not environmentally beneficial to operate a Combine heat power where 30% of the produce is heating the ground between the building, and the Electricity is not used on sit.

- 4.28 The improving London air quality targets now require ultra-Low NO_x flue gas emissions from boilers and combined heat power machines. The new requirements of less NO_x than 30mg/kWh of dry emission are below many gasses engines' ability to combine heat and power.
- 4.29 The school's recent investment in a new transformer connecting multiple buildings' power supplies to a single incoming supply. The transformer allows the surplus power from CHP tracking heating to supply multiple buildings with electrical power.
- 4.30
- 4.31 The whole site is to be developed in different phases. Separate heating plants and power supplies are required to serve each construction phase.
- 4.32 In conclusion, an estate energy centre would increase the energy required to heat all estate buildings resulting in higher CO₂ and NO_x emissions. Therefore, the communal heating system is not proposed.

Proposed Energy System

- 4.33 The proposal is to keep the recently installed low NO_x Gas boilers as these boilers provide heat to the swimming pool, ventilation and domestic hot water system. During the refurbishment process, the designer relocated and reduced the size of the plantroom and added new ventilation to the changing rooms. The changes required a compact system that is achieved by designing a system with a higher flow water temperature 65°C and a low return 30°C achieved, achieved by heating the pool water and ventilation system. The large temperature difference between the flow and return is not compatible with the operation of the current air-to-water heat pumps. Replacing the plant with heat pumps requires substantial alteration and replacement of much of the newly installed and energy-efficient plant. Adopting heat pumps will result in higher operational costs and loss of the embodied carbon of the existing plant. As part of the design package, heat pumps are often used to heat swimming pools and associated ventilation systems. The ventilation plant generally has more significant air volumes to accommodate the heat pump design parameters. It is not practical until the plant requires replacing to swap the boiler for heat pumps. New designs for air-to-water heat pumps using natural refrigerants are being developed for this application. It may become possible to replace the boilers with a similar-sized high-temperature heat pump.
- 4.34 Natural ventilation is required to reduce air velocities in sports halls for competition badminton use. Additional air shafts are included in the north wall. A very similar system is proposed for the dry sports hall with supplementary radiant heating for when the sports hall is used for examination.
- 4.35 Air-to-water heat pumps will provide the heat source for the low surface temperature radiators used to heat classrooms, circulation spaces and store rooms.

Be Green

- 4.36 **GLA Policy 5.7 Renewable Energy** - There is a presumption by the GLA that all major development proposals will seek to reduce carbon dioxide emissions by at least 20% by using on-site renewable energy generation wherever feasible. Development proposals should seek to utilise renewable energy technologies such as biomass heating, cooling, and Electricity; renewable energy from waste; photovoltaics; solar water heating; wind and heat pumps. The mayor encourages the usage of a full range

of renewable energy technologies, which should be incorporated wherever site conditions make them feasible and where they contribute to the highest overall and most cost-effective carbon dioxide emissions savings for a development proposal.

Photovoltaics

- 4.37 The proposal is to utilise the whole swimming pool building roof and part of the existing sports hall roof for the Photovoltaic (PV) array. PV is the only reliable renewable energy option that will guarantee emissions reduction.
- 4.38 PV is the most practical renewable energy technology that results in the best financial return with help from Feed-in Tariffs. 1kWp of PV generally generates around 700kWh in an average year. The variation from the norm is generally around 100kWh/annum, making PV a predictable renewable energy source. The only limitation is the available roof space.

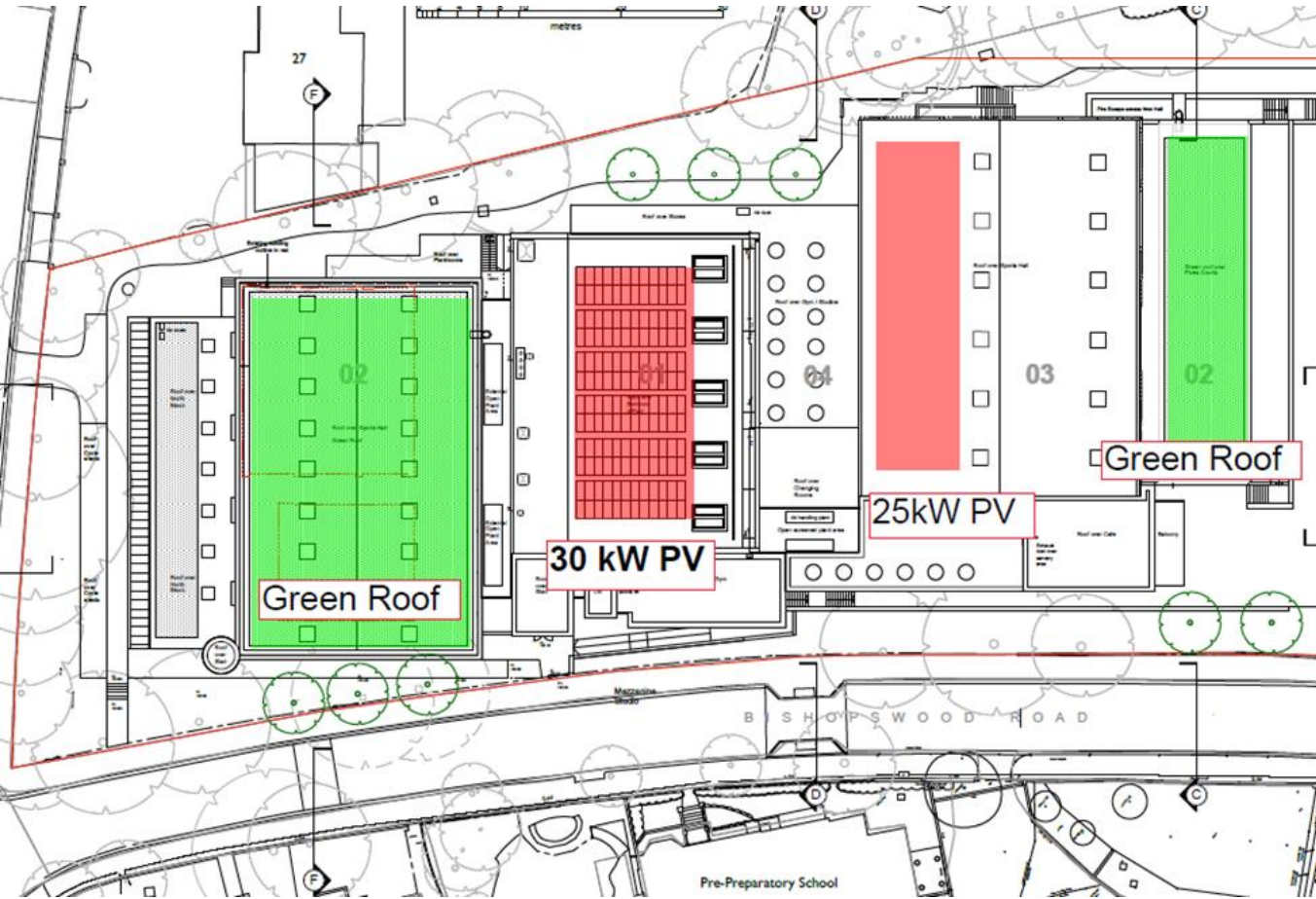


Figure 10 Proposed Location for Renewables

Financial Inputs		Financial Inputs	
System Size	54.0 kW	FiT	£5,122.75
System Cost	-£97,124.6	Exported	£717.19
RPI	2.70%	Saving	£2,776.48
Fuel inflation	0.25%	Total income	£8,616.41
Number of years	20 years	Yield	8.87%
Feed in Tariff	12.50 p/kWh	Payback (years)	11 years
Cost of Electricity	16.00 p/kWh	PV Variables	
Export Price	3.50 p/kWh	Location	Thames
Electricity Exported	50.00%	Direction	ENE/WNW
Electricity Used In-House	50.00%	Panel Angle	20°
Generated Electricity	40,982 kWh	Shading Factor	None or very little
Export	20,491 kWh	Array Sizes	54.0 kW
Used	20,491 kWh	Annual Electricity	40,982 kWh
Return after 20 years	£107,030.83	Size of array	540 m²

Table 14 Summary of PV Financial Assessment

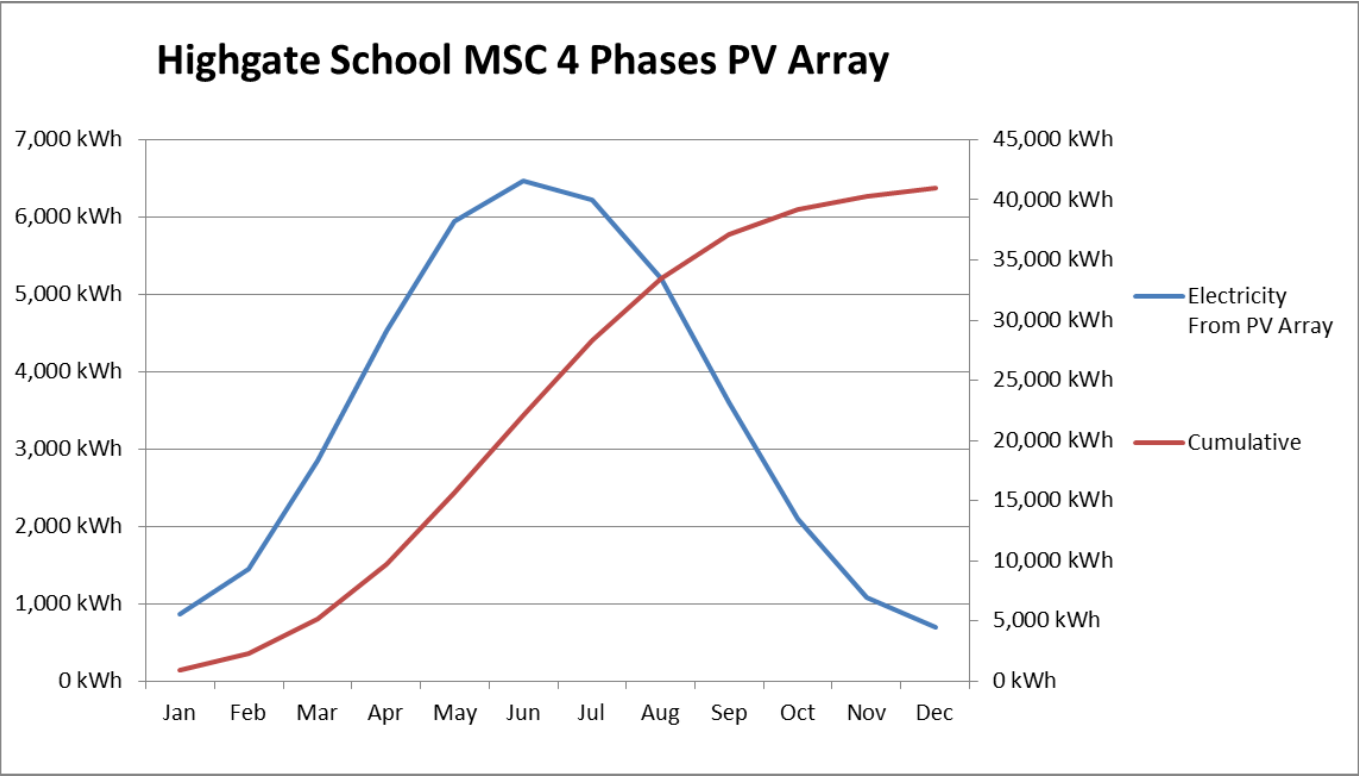


Figure 11 Electricity Generation from PV Array.

Alternative renewable energy options

4.39 The following alternative renewable options that have been considered but found not to be appropriate are:

- **Biomass** – Not suitable for the urban location as installation will reduce local air quality through smoke emission and increase vehicle movement from the transportation of biomass fuel.

- **Air Source Heat pumps** - Is recommended as the primary heating system for sry sports halls, Classrooms and ventilation space. The heat pumps are designed as integral within the air handling units or air to water units connected to the low surface temperature radiators.
- **Solar Thermal** – There is only a tiny hot water requirement for the sports hall as the changing rooms are in the swimming pool complex have a recently installed plant. Solar thermal offset domestic hot water use in the summer months when school is fully operational. There is a more significant energy saving by utilising the available roof space for Photovoltaics generating Electricity. There is always an electricity demand for the operation of pumps, fans, and lighting.
- **Wind Turbines** – unsuitable in an urban location with turbulent airflow around buildings, generating a reasonable amount of electricity requires a substantial unit with a blade diameter over 6m.

5 Appendices

Appendix A BRUKL Reports26

Appendix B Data Reflection Report30

Appendix C SBEM 6.1a Simulation files31

Appendix D Building Services Plant Layouts.32

Appendix A BRUKL Reports

BRUKL Output Document HM Government
Compliance with England Building Regulations Part L 2021

Project name
Highgate School MSC Be Lean As designed

Date: Fri Jul 01 13:05:37 2022

Administrative information

Building Details

Address: LONDON, N6 4AY

Certifier details

Name:

Telephone number:

Address: , ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v6.1.b.0

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v7.1.0

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

Foundation area [m²]: 4753.59

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

Target CO ₂ emission rate (TER), kgCO ₂ /m²annum	4.2
Building CO ₂ emission rate (BER), kgCO ₂ /m²annum	3.68
Target primary energy rate (TPER), kWh/m²annum	27.47
Building primary energy rate (BPER), kWh/m²annum	22.24
Do the building's emission and primary energy rates exceed the targets?	BER ≤ TER BPER ≤ TPER

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

Fabric element	U _a -Limit	U _a -Calc	U _i -Calc	First surface with maximum value
Walls*	0.26	0.15	0.18	SWIMMING POOL - SWIMMING POOL_P_4
Floors	0.18	0.11	0.18	FF CORR N - FF P WC_F_13
Pitched roofs	0.16	0.13	0.13	SWIMMING POOL - SWIMMING POOL_R_21
Flat roofs	0.18	0.13	0.13	SP HALL 2 - SP Hall 2_R_4
Windows** and roof windows	1.6	1.1	1.1	SWIMMING POOL - SWIMMING POOL_G_5
Rooflights***	2.2	1.4	1.4	SWIMMING POOL - SWIMMING POOL_G_19
Personnel doors^	1.6	1.5	1.5	FF CORR M - FF CORR M_D_9
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 -Limit = Limiting area-weighted average U-values [W/(m²K)] U _a -Calc = Calculated area-weighted average U-values [W/(m²K)] U _i -Calc = Calculated maximum individual element U-values [W/(m²K)] * Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows. ** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position. ^ For fire doors, limiting U-value is 1.8 W/m²K 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		
m³/(h.m²) at 50 Pa	8	3		

BRUKL Output Document HM Government
Compliance with England Building Regulations Part L 2021

Project name
Highgate School MSC Be Clean As designed

Date: Fri Jul 01 12:59:15 2022

Administrative information

Building Details

Address: LONDON, N6 4AY

Certifier details

Name:

Telephone number:

Address: , ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v6.1.b.0

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v7.1.0

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

Foundation area [m²]: 4753.59

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

Target CO ₂ emission rate (TER), kgCO ₂ /m²annum	4.2
Building CO ₂ emission rate (BER), kgCO ₂ /m²annum	2.48
Target primary energy rate (TPER), kWh/m²annum	27.47
Building primary energy rate (BPER), kWh/m²annum	8.32
Do the building's emission and primary energy rates exceed the targets?	BER ≤ TER BPER ≤ TPER

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

Fabric element	U _a -Limit	U _a -Calc	U _i -Calc	First surface with maximum value
Walls*	0.26	0.15	0.18	SWIMMING POOL - SWIMMING POOL_P_4
Floors	0.18	0.11	0.18	FF CORR N - FF P WC_F_13
Pitched roofs	0.16	0.13	0.13	SWIMMING POOL - SWIMMING POOL_R_21
Flat roofs	0.18	0.13	0.13	SP HALL 2 - SP Hall 2_R_4
Windows** and roof windows	1.6	1.1	1.1	SWIMMING POOL - SWIMMING POOL_G_5
Rooflights***	2.2	1.4	1.4	SWIMMING POOL - SWIMMING POOL_G_19
Personnel doors^	1.6	1.5	1.5	FF CORR M - FF CORR M_D_9
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 -Limit = Limiting area-weighted average U-values [W/(m²K)] U _a -Calc = Calculated area-weighted average U-values [W/(m²K)] U _i -Calc = Calculated maximum individual element U-values [W/(m²K)] * Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows. ** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position. ^ For fire doors, limiting U-value is 1.8 W/m²K 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		
m³/(h.m²) at 50 Pa	8	3		

BRUKL Output Document

 HM Government
Compliance with England Building Regulations Part L 2021**Project name****Highgate School MSC Be Green** As designed**Date:** Fri Jul 01 13:01:17 2022**Administrative information****Building Details****Address:** LONDON, N6 4AY**Certification tool****Calculation engine:** SBEM**Calculation engine version:** v6.1.b.0**Interface to calculation engine:** DesignBuilder SBEM**Interface to calculation engine version:** v7.1.0**BRUKL compliance check version:** v6.1.b.0**Certifier details****Name:****Telephone number:****Address:** , ,**Foundation area [m²]:** 4753.59**The CO₂ emission and primary energy rates of the building must not exceed the targets**

Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	4.2
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	2.48
Target primary energy rate (TPER), kWh/m ² annum	27.47
Building primary energy rate (BPER), kWh/m ² annum	8.32
Do the building's emission and primary energy rates exceed the targets?	BER ≤ TER BPER ≤ TPER

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

Fabric element	U _a -Limit	U _a -Calc	U _i -Calc	First surface with maximum value
Walls*	0.26	0.15	0.18	SWIMMING POOL - SWIMMING POOL_P_4
Floors	0.18	0.11	0.18	FF CORR N - FF P WC_F_13
Pitched roofs	0.16	0.13	0.13	SWIMMING POOL - SWIMMING POOL_R_21
Flat roofs	0.18	0.13	0.13	SP HALL 2 - SP Hall 2_R_4
Windows** and roof windows	1.6	1.1	1.1	SWIMMING POOL - SWIMMING POOL_G_5
Rooflights***	2.2	1.4	1.4	SWIMMING POOL - SWIMMING POOL_G_19
Personnel doors^	1.6	1.5	1.5	FF CORR M - FF CORR M_D_9
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 -Limit = Limiting area-weighted average U-values [W/(m ² K)] U _a -Calc = Calculated area-weighted average U-values [W/(m ² K)] U _i -Calc = Calculated maximum individual element U-values [W/(m ² K)] * Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows. ** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position. ^ For fire doors, limiting U-value is 1.8 W/m ² K 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	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- Swimming Pool Warm air heating

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	1.44	0.85
Standard value	0.93*	N/A	N/A	1.9^	N/A

Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system YES

* Standard shown is for gas single boiler systems ≤2 MW output and overall for multi-boiler systems. For single boiler systems >2 MW or any individual boiler in a multi-boiler system, limiting efficiency is 0.88.

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

2- Dry Sport Hall Warm air heating

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.5	-	-	1.44	0.85
Standard value	2.5*	N/A	N/A	1.9^	N/A

Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system NO

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

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

3- Heat Pump with UFH

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.5	-	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A

Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system YES

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

4- VRF with Fan coil

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.5	6	-	1.44	0.85
Standard value	2.5*	5	N/A	2^	N/A

Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system YES

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

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

1- DHW from Electric

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

2- DHW from Boiler

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.96	0.01
Standard value	0.91	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		Zone	Standard
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1			
GF REST - CHANGING RM S	-	-	-	-	1.5	-	-	-	-	-	-	N/A
FF CORR N - FF P WC	0.3	-	-	-	-	-	-	-	-	-	-	N/A
FF CORR S - FF STF WC	0.3	-	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting		General luminaire	Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3	
SWIMMING POOL - SWIMMING POOL	229	-	-	
SP HALL 2 - SP Hall 2	232	-	-	
SP HALL 1 - SP HALL 1	238	-	-	
GF REST - CHANGING RM S	153	-	-	
FF CORR N - FF P WC	140	-	-	
FF CORR M - FF CORR M	124	-	-	
FF CORR S - FF STF WC	395	-	-	
GF REST - STUDIO	237	-	-	
FF CORR N - FF OFF N	291	-	-	
FF CORR N - FF C RM	243	-	-	
MZ CAFE - MAZ CAFE	179	-	-	

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?
SWIMMING POOL - SWIMMING POOL	NO (-25.2%)	NO
SP HALL 2 - SP Hall 2	NO (-23.3%)	NO
SP HALL 1 - SP HALL 1	NO (-65.4%)	NO
FF CORR S - FF STF WC	N/A	N/A
GF REST - STUDIO	NO (-60%)	NO
FF CORR N - FF OFF N	NO (-41%)	NO
FF CORR N - FF C RM	NO (-36.4%)	YES
MZ CAFE - MAZ CAFE	NO (-35.6%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Appendix B Data Reflection Report

SBEM Data Reflection Report — Actual Building

Date: Fri Jul 01 12:18:57 2022

Project name: MSC

Building type: Non-residential Inst.: Education

Building area [m2]: 4753.59

General

Building address

LONDON
N6 4AY

Building / Foundation areas [m2]

4753.58 / 4753.59

Weather

LON

Building rotation [degrees]

0

Maximum no. of storeys

1

Accredited person/Energy assessor

Name

Telephone number

Address

Email

Analysis

Compliance with

England Building Regulations Part L 2021

Asset rating

None

Stage

As designed

Shell & core building

NO

Modular & portable building

NO

Planned time of use

-

Distress purchase

-

Manufacture date of subassemblies

-

Software

SBEM version

v6.1.b.0

Interface to SBEM

DesignBuilder SBEM

Interface version

v7.1.0

Project building services

Electric power factor

<0.9

Submetering and M&T for lighting systems

YES

Emission factor for district heating [kgCO2/kWh]

.293

Primary energy factor for district heating [kWh/kWh]

1.2

New district heating network

NO

Summary of objects

Object type

Total number

Total related area [m2]

Envelope/Door constructions

12

-

Window/Rooflight constructions

3

-

HW systems

0

-

Shower types

2

-

SE systems

0

0

PV systems

10

981.762

Wind generators

0

-

CHP generators

0

-

Solar collectors

0

0

HVAC systems

4

-

Zones

11

4753.58

Envelopes

196

18279.2

Doors

4

23

Windows/Rooflights

43

818.7

Envelope/Door constructions

Name

U-value [W/m2K]

Adjusted U-value

Km [kJ/m2K]

Metal clad

Project external door

1.500

NO

0

NO

Project external floor

0.149

NO

6.294

NO

Project semi-exposed floor

0.177

NO

134.8

NO

Project pitched roof

0.130

NO

6.412

NO

Project flat roof

0.130

NO

32.614

NO

Project internal floor

2.929

NO

88.2

NO

Project partition

1.639

NO

22.5

NO

Project below grade wall

0.150

NO

134.8

NO

Project wall

0.150

NO

134.8

NO

Project semi-exposed wall

0.177

NO

134.8

NO

Project semi-exposed ceiling

0.130

NO

32.614

NO

Project ground floor

0.150

NO

93.96

NO

Window/Rooflight constructions

Name

U-value [W/m2K]

Solar transmittance

Light transmittance

Project roof glazing

1.1

0.400

0.400

Project internal glazing

1.1

0.500

0.500

Project external glazing

1.1

0.500

0.500

Notes

Page 1 of 23

Highgate School MSC 4 Phases
4309-230123ac ~ HGS MSC Phase 2-4 - Energy Assessment.docx

Highgate School

30 of 40

Appendix C SBEM 6.1a Simulation files

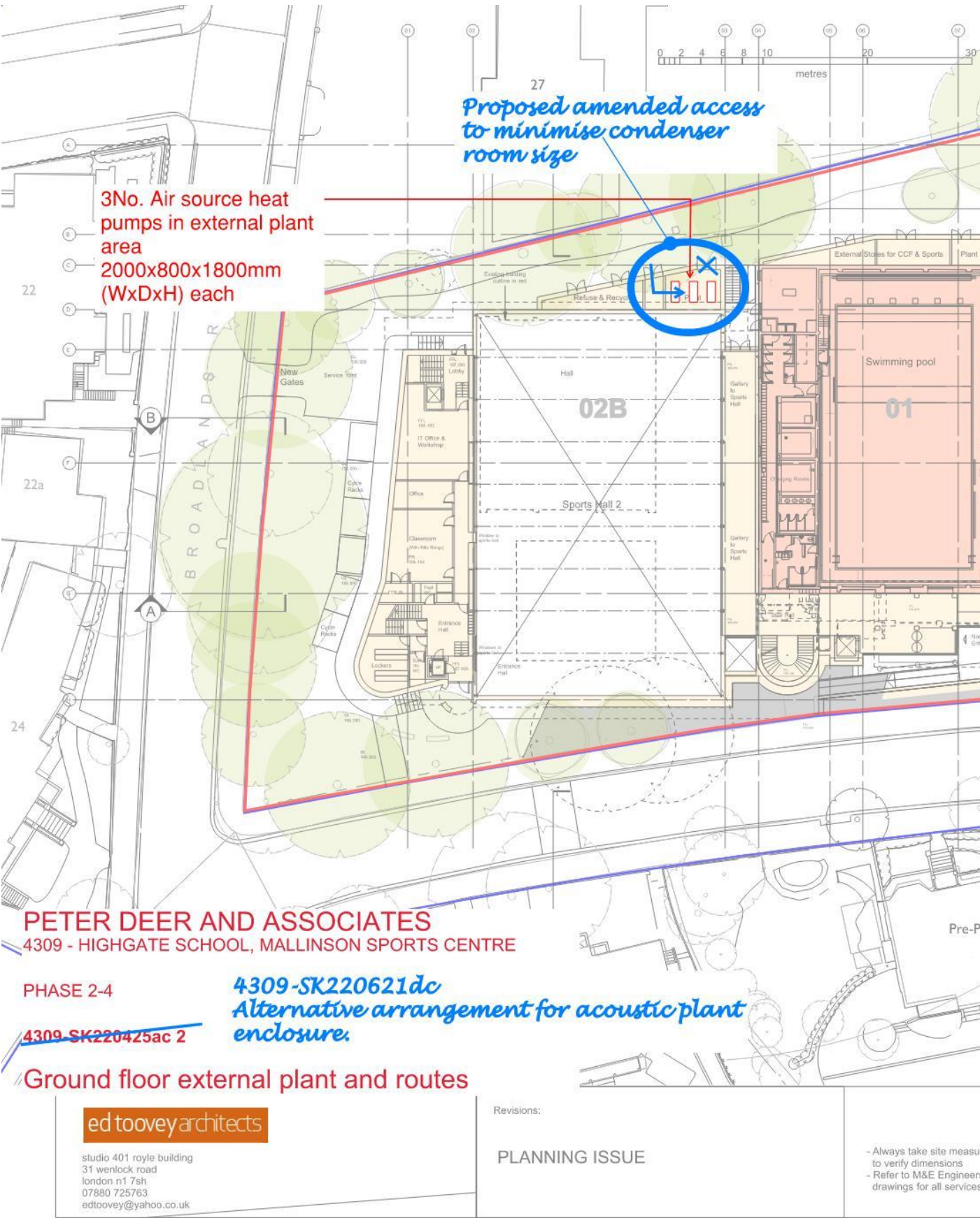
Notional (base)

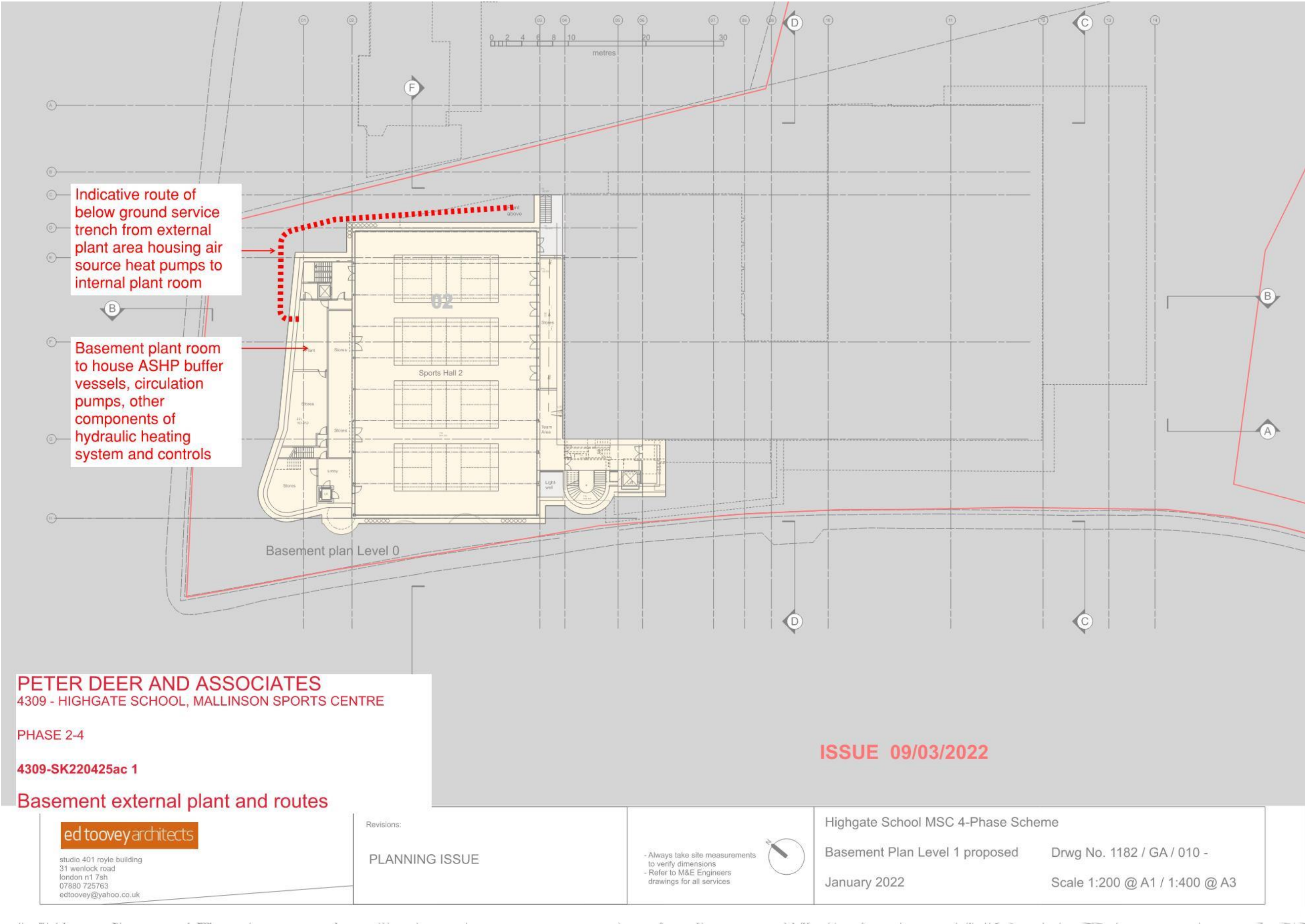
Notional	Heating (electric)	Heating (gas)	Cooling	Aux Energy	Lighting	Hot Water	Displaced	Equipment		NatGas	GridSupplyElec
4753.58	kWh/m2	kWh/m3	kWh/m2	kWh/m2	kWh/m2	kWh/m2	kWh/m2	kWh/m2		kWh/m2	kWh/m2
Month											
JAN	2.0759	1.4659	0.0000	0.4468	0.7607	0.6694	0.3772	1.0012		2.1353	3.2835
FEB	1.4502	1.1214	0.0000	0.4069	0.4992	0.6133	0.7104	0.9142		1.7347	2.3563
MAR	1.1784	0.9144	0.0037	0.4349	0.3888	0.6493	1.1459	0.9602		1.5637	2.0057
APR	0.7935	0.4897	0.0290	0.4416	0.2749	0.6640	1.5940	0.9947		1.1538	1.5390
MAY	0.4191	-0.0381	0.1233	0.4649	0.2384	0.6993	1.9106	1.0579		0.6613	1.2457
JUN	0.3610	-0.1936	0.1843	0.4475	0.2256	0.6741	2.1293	1.0176		0.4805	1.2185
JUL	0.3627	-0.2502	0.1872	0.4529	0.2281	0.6793	1.9748	1.0193		0.4291	1.2309
AUG	0.2637	-0.1661	0.0856	0.3508	0.1529	0.5091	1.9585	0.6877		0.3430	0.8530
SEP	0.3628	-0.0634	0.0836	0.4476	0.3524	0.6741	1.5388	1.0152		0.6107	1.2465
OCT	0.5598	0.3741	0.0204	0.4588	0.5251	0.6892	0.9779	1.0422		1.0633	1.5641
NOV	1.3788	1.0430	0.0136	0.4715	0.7206	0.7140	0.5291	1.0972		1.7571	2.5845
DEC	1.7673	1.3287	0.0000	0.4409	0.7934	0.6593	0.4167	0.9783		1.9880	3.0021
SUM	10.9732	6.0258	0.7308	5.2653	5.1600	7.8944	-15.2632	11.7856		13.9202	22.1297
Primary	17.0755	6.7851	1.0572	7.9726	7.9569	8.8891	-22.4760			15.6742	34.0629
Output	38.4061	6.6218	3.2888	5.2653	5.1600	7.1839	-15.2632				
Emissions	1.65 kgCO ₂ /m ²	1.27 kgCO ₂ /m ²	0.09 kgCO ₂ /m ²	0.73 kgCO ₂ /m ²	0.76 kgCO ₂ /m ²	1.66 kgCO ₂ /m ²	-1.97 kgCO ₂ /m ²			2.92 kgCO ₂	3.23 kgCO ₂

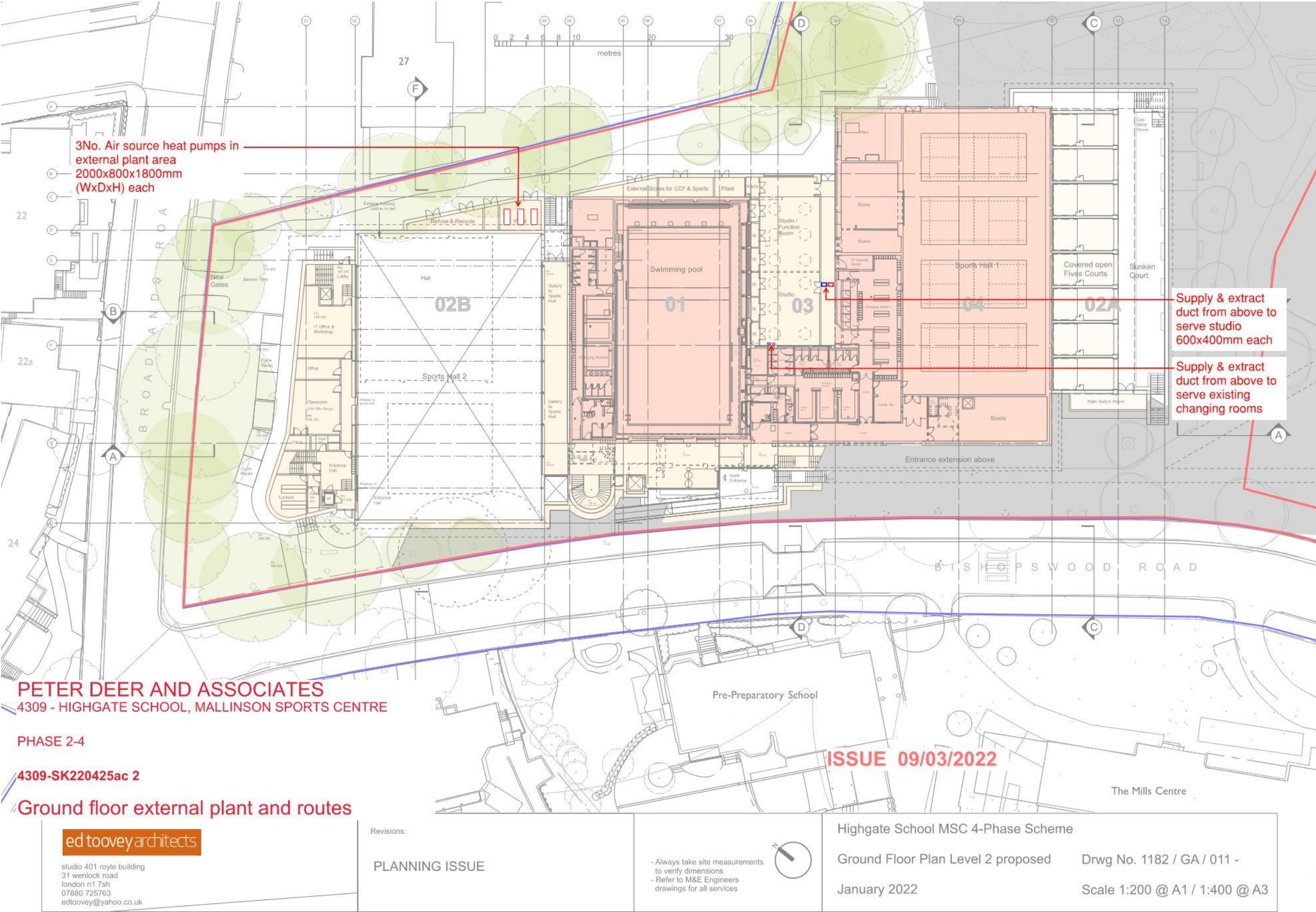
Proposed (Be Green)

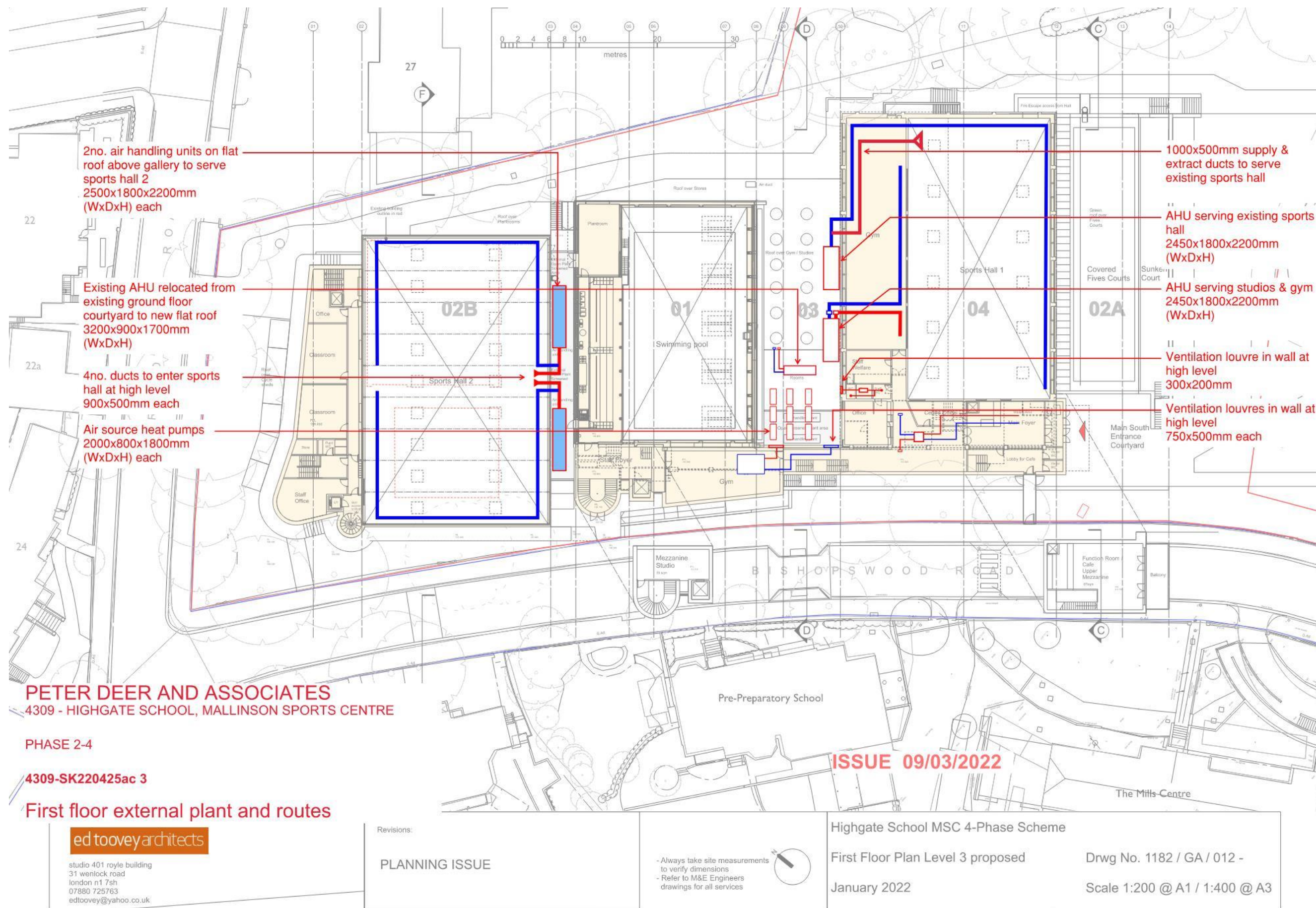
	Heating (electric)	Heating (gas)	Cooling	Aux Energy	Lighting	Hot Water	Displaced	Equipment		NatGas	GridSupplyElec
4753.6 m ²	kWh/m2	kWh/m3	kWh/m2	kWh/m2	kWh/m2	kWh/m2	kWh/m2	kWh/m2		kWh/m2	kWh/m2
Month											
JAN	1.0121	1.0531	0.0010	0.7125	0.5761	0.7454	0.5051	1.0012		1.7985	2.3017
FEB	0.6183	0.7714	0.0019	0.6515	0.4989	0.7008	0.9969	0.9142		1.4722	1.7706
MAR	0.3914	0.5921	0.0026	0.6841	0.5047	0.7250	1.7598	0.9602		1.3172	1.5828
APR	0.1343	0.3133	0.0132	0.7114	0.4914	0.7440	2.5409	0.9947		1.0573	1.3503
MAY	0.0228	0.0785	0.0611	0.7555	0.5082	0.7756	3.2676	1.0579		0.8541	1.3475
JUN	0.0108	0.0230	0.1067	0.7255	0.4885	0.7542	3.6848	1.0176		0.7772	1.3315
JUL	0.0071	0.0118	0.1186	0.7269	0.4937	0.7554	3.4037	1.0193		0.7672	1.3462
AUG	0.0056	0.0136	0.0355	0.4843	0.3620	0.5833	3.2150	0.6877		0.5969	0.8874
SEP	0.0180	0.0782	0.0369	0.7256	0.5171	0.7542	2.3582	1.0152		0.8324	1.2977
OCT	0.0596	0.3203	0.0090	0.7410	0.5591	0.7654	1.3743	1.0422		1.0858	1.3686
NOV	0.5155	0.7676	0.0064	0.7825	0.6008	0.7946	0.7238	1.0972		1.5622	1.9053
DEC	0.8375	0.9611	0.0008	0.6985	0.5721	0.7352	0.5171	0.9783		1.6963	2.1089
SUM	3.6329	4.9841	0.3940	8.3990	6.1730	8.8330	-24.3473	11.7860		13.8172	18.5985
Primary	5.7549	5.6121	0.5693	12.7237	9.3720	9.9460	-35.6602	17.8532		15.5581	28.4200
Output	12.7150	5.4770	1.7730	8.3990	6.1730	9.7066	-24.3473	11.7860		11.7446	
Emissions	0.57 kgCO ₂ /m ²	1.05 kgCO ₂ /m ²	0.05 kgCO ₂ /m ²	1.17 kgCO ₂ /m ²	0.87 kgCO ₂ /m ²	1.85 kgCO ₂ /m ²	-3.15 kgCO ₂ /m ²	1.64 kgCO ₂ /m ²		2.97 kgCO ₂ /m ²	2.66 kgCO ₂ /m ²

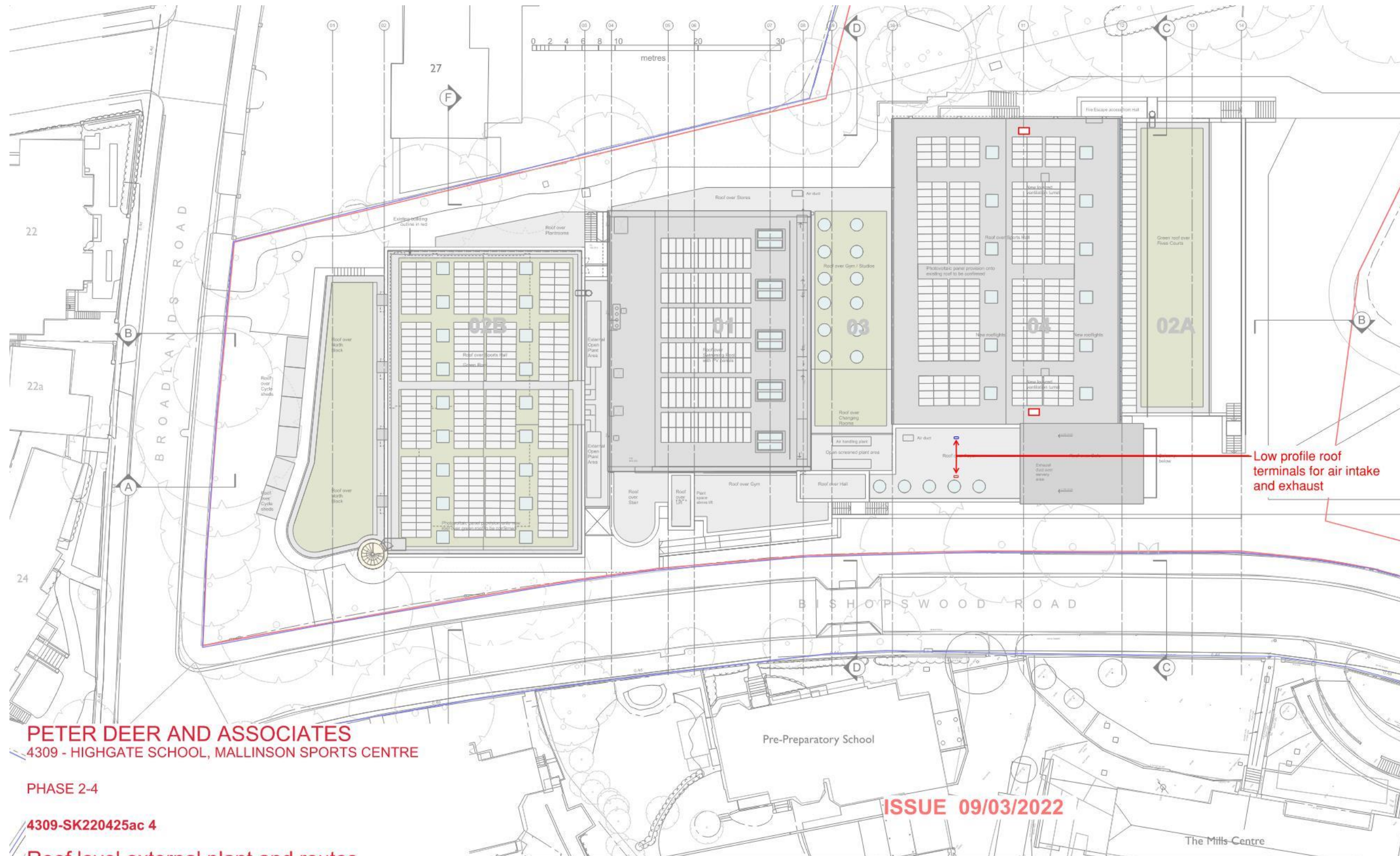
Appendix D Building Services Plant Layouts.











PETER DEER AND ASSOCIATES

4309 - HIGHGATE SCHOOL, MALLINSON SPORTS CENTRE

PHASE 2-4

4309-SK220425ac 4

Roof level external plant and routes

ed toovey architects

studio 401 royle building
31 wenlock road
london n1 7sh
07880 725763
edtoovey@yahoo.co.uk

Revisions:

PLANNING ISSUE

- Always take site measurements to verify dimensions
- Refer to M&E Engineers drawings for all services

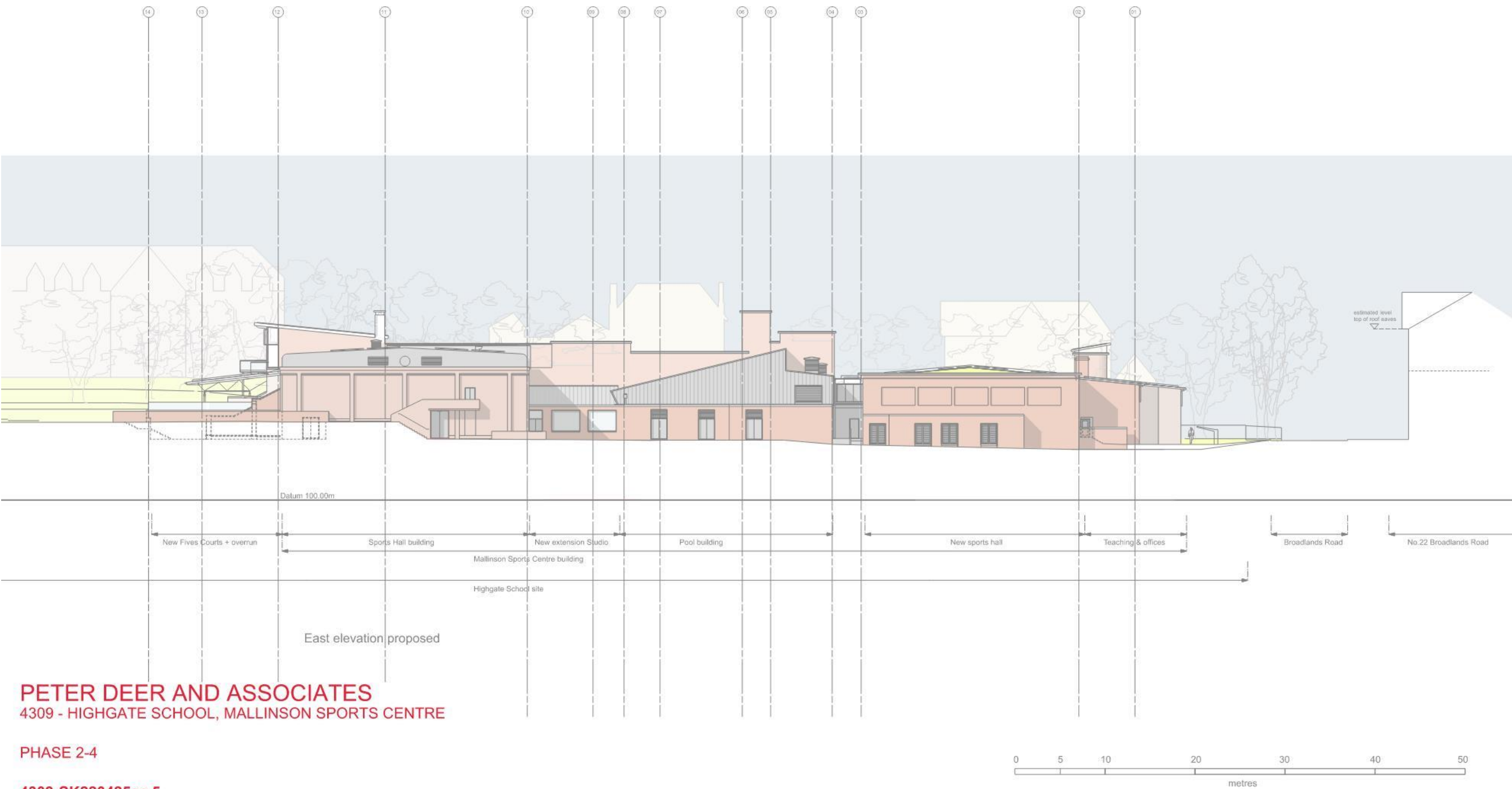
Highgate School MSC 4-Phase Scheme

Roof Plan Level proposed

January 2022

Drwg No. 1182 / GA / 014 -

Scale 1:200 @ A1 / 1:400 @ A3



PETER DEER AND ASSOCIATES
4309 - HIGHGATE SCHOOL, MALLINSON SPORTS CENTRE

PHASE 2-4

4309-SK220425ac 5

East elevation external plant and routes

ed toovey architects

studio 401 royle building
31 wenlock road
london n1 7gh
07880 725763
edtoovey@yahoo.co.uk

REVISIONS

PLANNING ISSUE

- Always take site measurements
to verify dimensions
- Refer to M&E Engineers
drawings for all services

Highgate School MSC 4-Phase Future Development

Elevation East proposed

January 2022

Drwg No. 1182 / GE / 014

Scale 1:400 @ A3 ; 1:200 @ A1

