SYNTEGRA CONSULTING

Hillingdon Water Sports Facility and Activity Centre, London

Energy Strategy Report

July 2023

Ref: 23-10070

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Revision	*Draft Summary*	*Initial*	*Rev A*	*Rev B*	*Rev C*
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1. Executive Summary

This Energy Strategy Report demonstrates the predicted energy performance and carbon emissions of the proposed development at **Hillingdon Water Sports Facility and Activity Center, Uxbridge, UB9 6PE.** The figures presented in the study are based on the most updated information provided by the project team. The proposed development is a **water sports facility comprised of several buildings on site including the Main Building acting as a primarily social area, Boat Shed, Workshop, Activity Centres etc.**

The overall analysis took into consideration the latest national building regulations (i.e. **Part L2 2021**) and the local policy requirements (i.e. **London Borough of Hillingdon**). Based on the data, the project demonstrates compliance with the council local policies and building regulations.

1.1 Policy Requirements

Compliance with the national building regulations can be accomplished by demonstrating that the project carbon emissions are below the regulated target. In addition to the above, the local council – **Hillingdon Council** – requires new developments to incorporate certain sustainable design and construction measures. The table below summarises the best practice building regulations and local policy requirements the assessment adopted for the development.

Table 1: National and Local Policy Requirements

Policy	Requirement	Compliance
Part L 2021	The building primary energy rate (BPER) and building emission rate (BER) must not exceed the target primary energy rate (TPER) and the target emission rate (TER), respectively.	The project achieved the criteria by improving fabric thermal performance, implementing efficient building services and the use of renewable energy sources.
The London Plan 2021	Major developments must meet the requirements set out in the London Plan – a minimum 35% carbon reduction against Building Regulations Part L 2021.	The project meets the requirement and is able to produce **13 (1313%) times the energy it consumes.**
	Major developments should be net zero-carbon. Any shortfall should be addressed via off-site measures or provision of a carbon offset payment secured by legal agreement.	The project generates more energy than it is able to consume. The excess energy is to be fed into the national grid.
	Non-residential developments should aim to achieve a 15% carbon reduction through energy efficiency measures at Be Lean stage.	Through all feasible measures (good U-values/air permeability/ low energy lights etc.), **the project is unable to meet this criterion.**

	Monitor, verify and report on energy performance at be Seen Stage.	Installation of Smart Meters is recommended to monitor the actual in-use energy consumption and minimize the performance gap.
	Major developments must connect to existing or planned local heat networks, or establish a new network, wherever feasible.	Possible connection to existing district heating networks and CHP systems to be explored in further revisions.
Hillingdon Local Plan: Strategic Policies	Minimise energy consumption and emissions of carbon from new developments.	The project goes beyond carbon neutrality and generates more energy than it consumes.
	20% of energy needs to be met from renewable sources for larger applications.	Solar PV proposed beyond the requirement of the local policies i.e. approx. **280 MWh electricity generation annually.**

1.2 Assessment Methodology and Strategies

The methodology adopted to mitigate the CO_2 emissions for the development is in alignment with the London Plan's Energy Hierarchy best practice. The assessment has been carried out using SBEM method which complies with the National Calculation Methodology (NCM).

Table 2 below explains the Energy Hierarchy stages and the suggested strategies proposed to help the development achieve the required targets.

Table 2: Energy Hierarchy and suggested strategies

Stages	Strategies
BE LEAN Minimising energy demand through Energy Efficient Design	• Building fabric U-values and thermal bridging standards improved beyond Part L requirements. • Air permeability improved. • Energy efficient light fittings proposed.
BE CLEAN Availability of CHP or communal heating systems	• Opportunities for local CHPs and communal heating systems assessed. Further information can be found in the Be Clean Section.
BE GREEN On-site renewable technologies (i.e. WSHP, PVs, etc)	• Provision of efficient building services through the use of Water Source Heat Pump. Further information to be found in the Be Green section. • Extensive use of solar PV to further offset the reduced emissions. Further information will be presented in the Be Green section below.
BE SEEN In-use monitoring	• Installation of Smart Meters is recommended to monitor the actual operational energy use, manage it effectively and mitigate the performance gap.

1.3 Assessment Results

The building has been simulated under four conditions to analyse the impact of the Energy Hierarchy factors on the results. The first simulation assesses the building under the notional building specifications, as defined within Part L. The function of this first simulation is to generate the Target Emission Rate (TER) and the Target Primary Energy Rate (TPER). The second calculation analyses the carbon reductions achieved after improving the building fabric thermal performance by adopting improved thermal U-values and passive energy efficiency measures (i.e. Be Lean). The third stage of simulation assesses the effectiveness of adopting local low-carbon energy sources like CHPs (i.e. Be Clean stage). The fourth simulation analyses the carbon reductions after considering renewable technologies (i.e. Be Green). The combined strategies result in effective design measures to achieve the >35% reductions beyond Part L2 requirements, as stipulated by the London Plan.

The project has been assessed according to the latest guidelines i.e. **Part L 2021.** As the national building regulations have been revised and updated, the compliance criteria have become significantly more demanding. As such, the development fails to meet the condition that the Building Emission Rate (BER) and Building Primary Energy Rate (BPER) remain below the Target Emission Rate (TER) and the Target Primary Energy Rate (TPER) at each stage of assessment. However, the recommended reductions over Part L baseline at Be Lean and Be Green stages are being met.

After the application of all strategies based on the Energy Hierarchy, the projected carbon emission and primary energy figures have been summarized in Table 3 below:

Table 3: Emission Rate and Primary Energy after each stage of the proposed strategy

BER (Building Emission Rate) *($KgCO_2/m^2$.annum)*	**Main Building**	**Workshop**	**Boat Shed**
Baseline TER	14.81	7.59	5.23
Baseline BER	24.2	13.28	10.17
Be-Lean BER	19.35	6.9	5.4
Be-Clean BER	19.35	6.9	5.4
Be-Green BER	5.74	-187.13	-153.7

Results of the simulations show that the development is able to meet the overall criteria of the national and local policies (i.e. >35% reduction over Part L 2021 requirements). In fact, the in-situ energy production of the project is able to surpass its energy needs, resulting in the generation of surplus energy which is then fed into the grid.

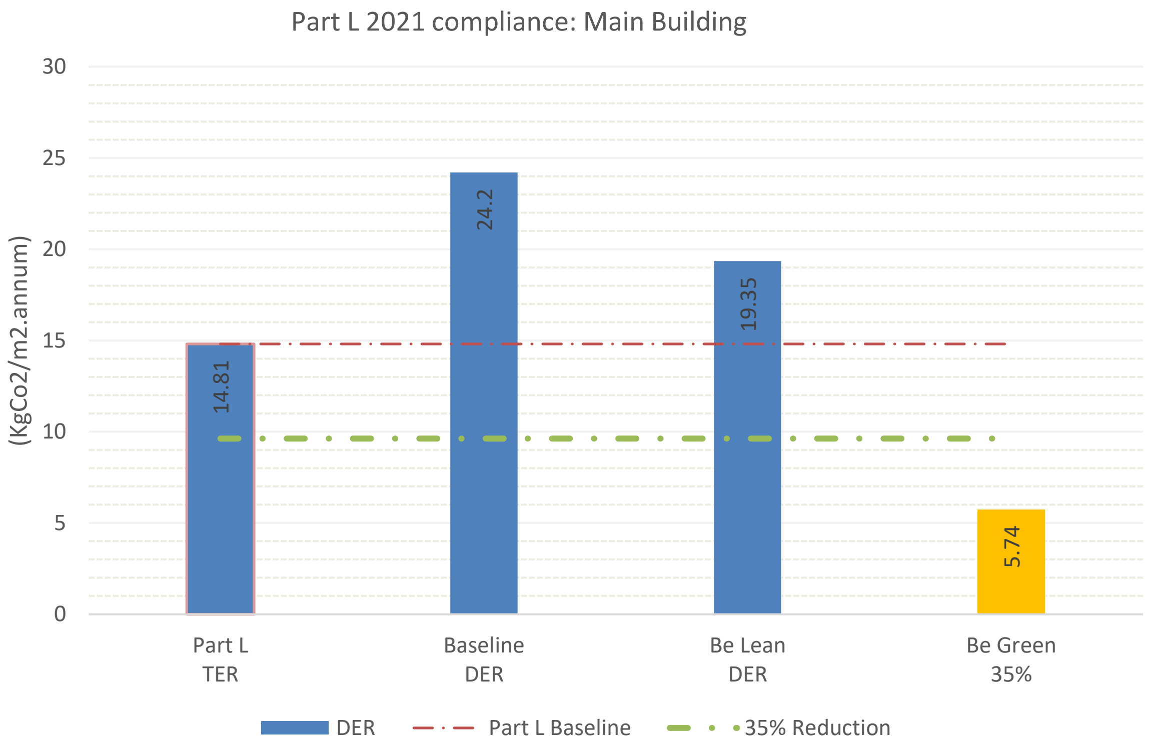

Figure 1a: Main Building - Part L compliance results for each stage of the energy hierarchy

Figure 2b: Workshop - Part L compliance results for each stage of the energy hierarchy

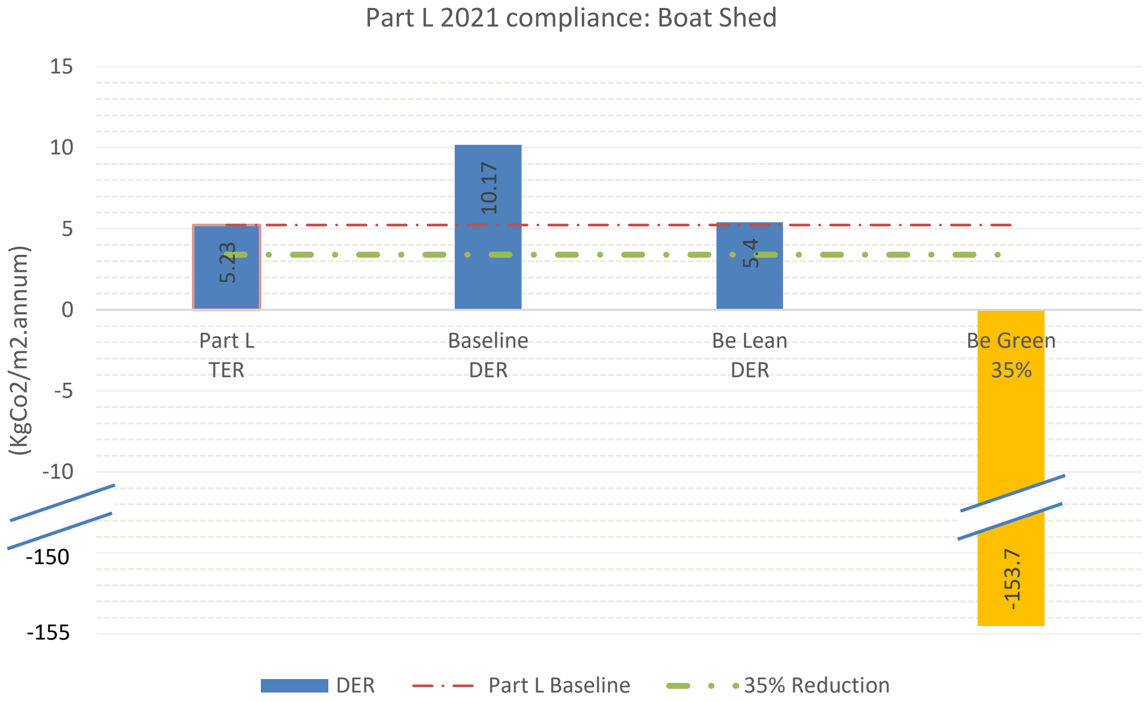

Figure 3c: Boat Shed - Part L compliance results for each stage of the energy hierarchy.

2. Introduction

This Energy Strategy Report (ESR) focuses on the strategies studied and selected for the proposed development to meet compliance with local and national regulations. The report defines how energy consumption and carbon emissions will be minimised to meet the targeted carbon emissions stipulated as per Part L 2021. Furthermore, the selected strategies also help attain the 35% reduction over Part L, as demanded by the London Plan and local planning policy.

The assessed development is located at **Hillingdon Water Sports Facility and Activity Centre, Uxbridge UB9 6PE** in the **London Borough of Hillingdon**. The development proposal has a **total built up area of approx. 4000 m^2, comprised of a main indoor activity centre with accommodation facilities for staff, outdoor activity areas, workshop, boat storage areas etc.**

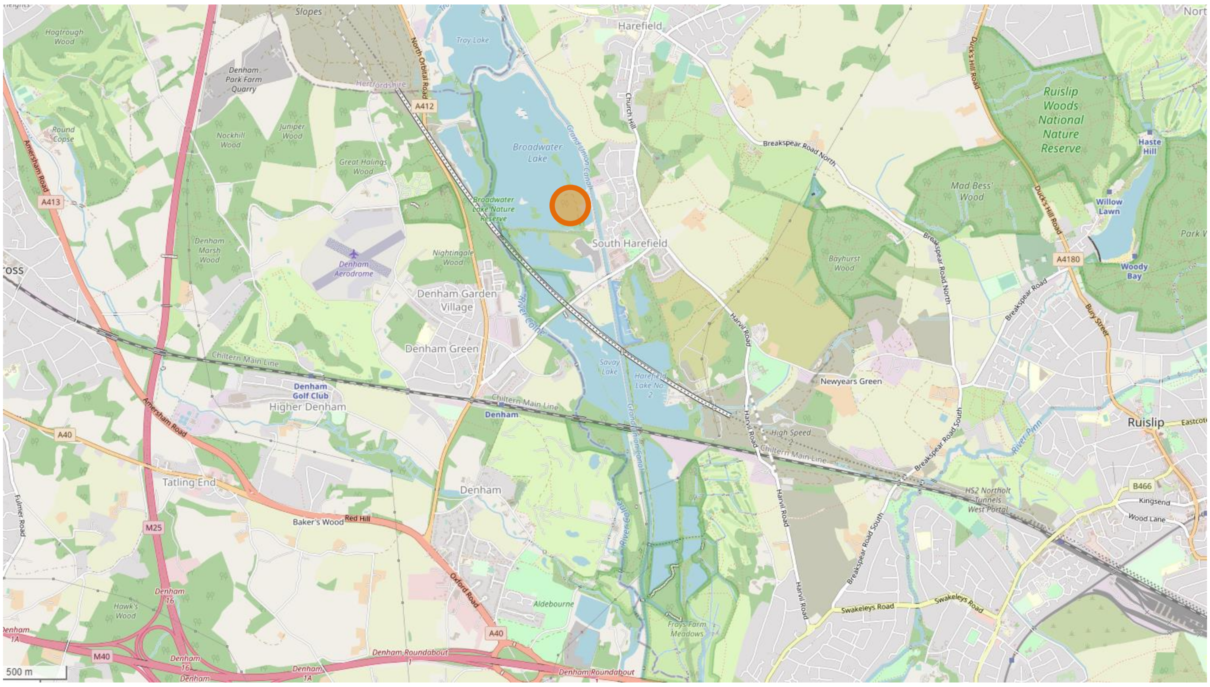

Figure 4 : Site Location (as marked in orange)

The domestic and non-domestic sectors play an important role in the UK economy, both as employer and generator of output and in providing other sectors – such as retail, finance and business – with a critical factor of production, the physical location from which to do business. This ESR report analyses the non-domestic project using research and policies guidance to make sure this major development is built up to achieve positive economic, social and environmental impacts.

3. Planning Policy

3.1 National Planning Policy Framework (NPPF, February 2021)

The National Planning Policy Framework is a key part of our reforms to make the planning system less complex and more accessible, to protect the environment and to promote sustainable growth.

3.2 The London Plan (March 2021)

Minimising greenhouse gas emissions

The London Plan is an integrated policy framework for any development being proposed in the Greater London area. It encourages projects to go beyond the national regulation targets i.e. 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.

The framework proposes that major developments should reduce the overall embodied greenhouse gas emissions and operational carbon emissions in accordance with the following energy hierarchy:

A. **Be Lean:** make buildings use less energy and manage demand during operational phases.
B. **Be Clean:** exploit local energy supply resources (i.e. District and communal heating) to deliver energy efficiently.
C. **Be Green:** exploring opportunities for renewable energy resources by producing, storing and using renewable energy on-site.
D. **Be Seen:** monitor, verify and report on energy performance (Part L Criteria 4 and 5).

Further guidance within the framework states that proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.

3.3 London Borough of Hillingdon

Hillingdon Local Plan: Strategic Policies

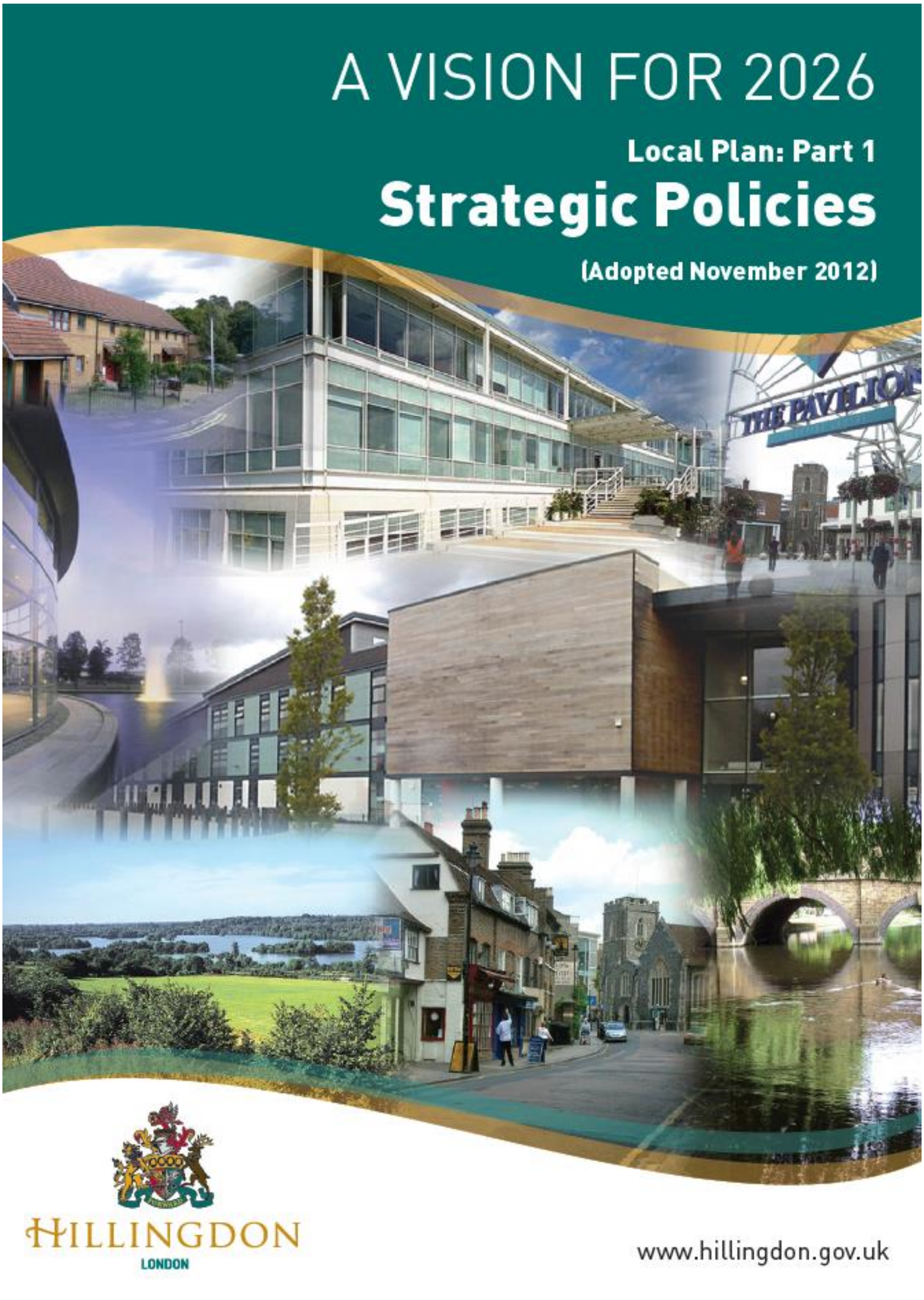

Figure 3: Hillingdon local plan (adopted November 2012)

The Hillingdon Council encourages every new development to address the climate change challenge. The Council will ensure that climate change mitigation is addressed at every stage of the development process by:

1. Prioritising higher density development in urban and town centres that are well served by sustainable forms of transport.

2. Promoting a modal shift away from private car use and requiring new development to include innovative initiatives to reduce car dependency.

3. Ensuring development meets the highest possible design standards whilst still retaining competitiveness within the market.

4. Working with developers of major schemes to identify the opportunities to help provide efficiency initiatives that can benefit the existing building stock.

5. Promoting the use of decentralised energy within large scale development whilst improving local air quality levels.

6. Targeting areas with high carbon emissions for additional reductions through low carbon strategies. These strategies will also have an objective to minimise other pollutants that impact on local air quality. Targeting areas of poor air quality for additional emissions reductions.

7. Encouraging sustainable techniques to land remediation to reduce the need to transport waste to landfill. In particular developers should consider bioremediation as part of their proposals.

8. Encouraging the installation of renewable energy for all new development in meeting the carbon reduction targets savings set out in the London Plan. Identify opportunities for new sources of electricity generation including anaerobic digestion, hydroelectricity and a greater use of waste as a resource.

9. Promoting new development to contribute to the upgrading of existing housing stock where appropriate.

10. Locating and designing development to minimise the probability and impacts of flooding.

11. Requiring major development proposals to consider the whole water cycle impact which includes flood risk management, foul and surface water drainage and water consumption.

12. Giving preference to development of previously developed land to avoid the loss of further green areas.

13. Promoting the use of living walls and roofs, alongside sustainable forms of drainage to manage surface water run-off and increase the amount of carbon sinks.

14. Promoting the inclusion of passive design measures to reduce the impacts of urban heat effects.

4. Assessment Methodology

4.1 The Energy Hierarchy

The energy hierarchy is a classification of different methods to improve energy performance in a parallel sequence. This primarily includes a focus on reducing energy use by avoiding unnecessary consumption, to then improving the efficiency of energy systems to minimise loss. This is followed by exploiting renewable energy sources and low carbon energy solutions for energy needs. Finally, any remaining demand can be catered for by conventional fuel sources and carbon offsetting solutions.

The Energy Strategy adopts a set of principles to guide design development and decisions regarding energy, balanced with the need to optimise environmental and economic benefits. The following hierarchy should be used to assess applications:

- **BE LEAN** – By using less energy and considering the further energy efficiency measure in comparison to the baseline building.
- **BE CLEAN** – By supplying energy efficiently. Clean energy use looks at further carbon dioxide emission savings over the lean building by taking into consideration the use of decentralise energy (e.g. CHP, District Heat Networks).
- **BE GREEN** – By integrating renewable energy into the scheme which can further reduce the carbon dioxide emission rate.
- **BE SEEN –** By monitoring, verifying, and reporting on energy performance to use energy mode effectively.

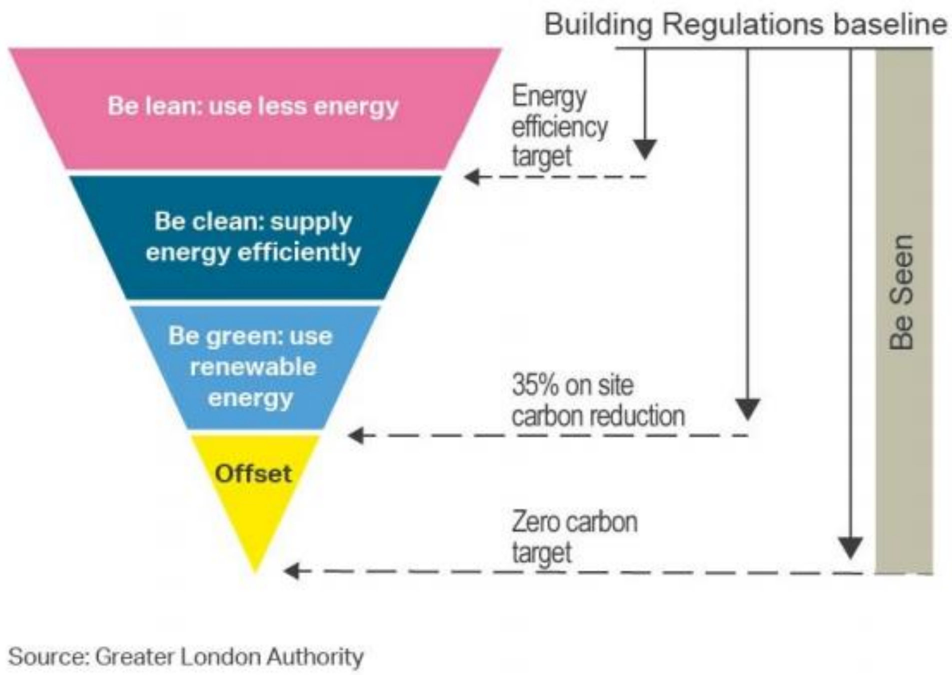

Figure 4: The Energy Hierarchy

4.2 Modelling strategy

The Government approved software; IES-VE has been utilized to carry out the project compliance simulations (SBEM) according to the National Calculation Methodology (NCM). Simulated models are built to assess the actual building BER against the notional building TER. The notional building used to determine carbon emission target (TER) is the same size and shape as the actual buildings, constructed to concurrent regulated specifications (i.e., **Part L 2021**).

The actual building has been modelled entirely to the notional building specifications in order to meet the carbon targets and the limiting fabric and buildings services parameters. However, for differences in fabric design and glazing areas, actual buildings sometimes are expected to exceed the notional TER. Therefore, further improvements to the actual building parameters (e.g., fabric, HVAC, lightings, renewables) are made to meet the required compliance targets. The approved document (Part L2) however, encourages developers to vary the specification provided the same overall level of carbon dioxide emissions is achieved or bettered. It is important to note that SBEM is not intended to be used as a building design tool but to inform design decisions.

Syntegra received architectural drawings and project relevant documents. Received information is used to undertake the ultimate energy assessments and supporting the modelling assumptions. The document references are listed in the table below.

Table 4: Reference document list

No.	Document Name	Format	Received Date
1	3859 (03(045 Rev E -Masterplan	dwg	01-11-2022
2	3859-ASP-ZZ-GF-DR-A-08 010-P01-Main Building Ground Floor Plan	dwg	01-11-2022
3	3859-ASP-ZZ-FF-DR-A-08 011-P01-Main Building First Floor Plan	dwg	01-11-2022
4	3859-ASP-ZZ-RF-DR-A-08 012-P01-Main Building Roof Plan	dwg	01-11-2022
5	3859-ASP-ZZ-XX-DR-A-03 024 Rev E-Main Building Proposed Elevation	pdf	01-11-2022
6	3859-ASP-ZZ-XX-DR-A-08 020-P01-Workshop - Ground Floor & Roof Plans	pdf	01-11-2022
7	3859-ASP-ZZ-XX-DR-A-08 021-P01-Workshop - Elevations & Sections	pdf	01-11-2022
8	3859-ASP-ZZ-XX-DR-A-08 025-P01-Boat Shed - Plans, Sections & Elevations	pdf	01-11-2022
9	3859-ASP-ZZ-XX-DR-A-08 030-P01-Activity Shelter - Plan, Sections and Elevations	pdf	01-11-2022
10	3859-ASP-ZZ-XX-DR-A-08 035-P01-Toilet Block - Plan, Sections and Elevations	pdf	01-11-2022
11	3859-ASP-ZZ-XX-DR-A-08 040-P01-Energy Centre - Plans, Sections & Elevations	pdf	01-11-2022
12	3859-ASP-ZZ-XX-DR-A-08 045-P01-Angler's Hut - Plans, Sections & Elevations	pdf	01-11-2022

5. BASELINE – Target Emission Rate

The Target Emission Rate (TER) and Target Primary Energy Rate (TPER), as calculated in line with the Building Regulation 2021, represent the maximum amount of carbon a development is allowed to emit and the maximum of amount of energy it can consume. These target values include energy consumption and carbon emissions resulting from functions covered by Part L of the Building Regulations, also known as regulated emissions (space and water heating, ventilation, lighting, pumps, fans & controls).

This first run of simulation assesses the models under the notional building specifications defined under Part L to limit the fabric thermal heat losses. The assessment results in the regulated target values for energy consumption and carbon emissions i.e. the TER and TPER, by using the Government approved methodology (SBEM).

The baseline regulated CO_2 emissions for the development is presented in the table below:

Table 5: Regulated Carbon Emissions at Baseline

Building Emission Rate *(kgCO2 /m^2.annum)*			
Analysis stage	**Main Building**	**Workshop**	**Boat Shed**
Baseline (Notional)	14.81	7.59	5.23
Baseline (Actual)	24.2	13.28	10.17

6. BE LEAN – Energy Efficient Design

This section outlines the project location, orientation and climatic conditions considered to determine the most feasible energy efficient measures taken in order to minimise the building's energy demand. The analysis helps reduce the energy use and CO_2 emissions beyond the baseline benchmark on the path to achieving compliance (**Building Regulations Part L2 2021**).

6.1 Site Location

Figure 5: 3D urban view of the site location (Source: Google Earth)

The proposed project site is located in the vicinity of Broadwater Lake in the London borough of Hillingdon. The local surrounding context is largely comprised of open spaces, green areas and water bodies with a few low-rise commercial and residential buildings to the East and South of the site.

6.2 Site Weather and Microclimate

The local weather microclimate usually influences buildings' energy performance. Urban design has a significant impact on microclimate and outdoor thermal comfort. Several studies in different climate regions have concluded that ventilation and shade are crucial to improve urban thermal comfort. Often the thermal conditions are improved as a consequence of good urban design including exist of proper shade and sufficient ventilation. This in turn leads to decreased occurrence of heat stress and heat-related diseases as well as grown performance of both mental and physical tasks.

London weather data has been used for thermal and energy simulations of this assessment. Figure 9 below represents the annual dry bulb temperature in London City. Maximum temperatures can reach up to 34.9^{o}C in late Jun, and minimum temperatures can reach down to -2.1^{o}C in late Feb. The buildings in this location are generally low rise, and the site is largely vegetated area. Therefore, it is not expected to suffer from the Urban Heat Island effects.

The site's landscape also affects the energy demand of a building. Vegetation, landform, and any existing buildings can provide shade to a new development. For instance, if located to the south of the building, deciduous trees can be advantageous, providing shade in the summer but allowing sunshine through in the winter when they lose their leaves. In this case, the context is largely comprised of dense vegetation in the immediate vicinity of the site and shading impact of trees is expected to be significant.

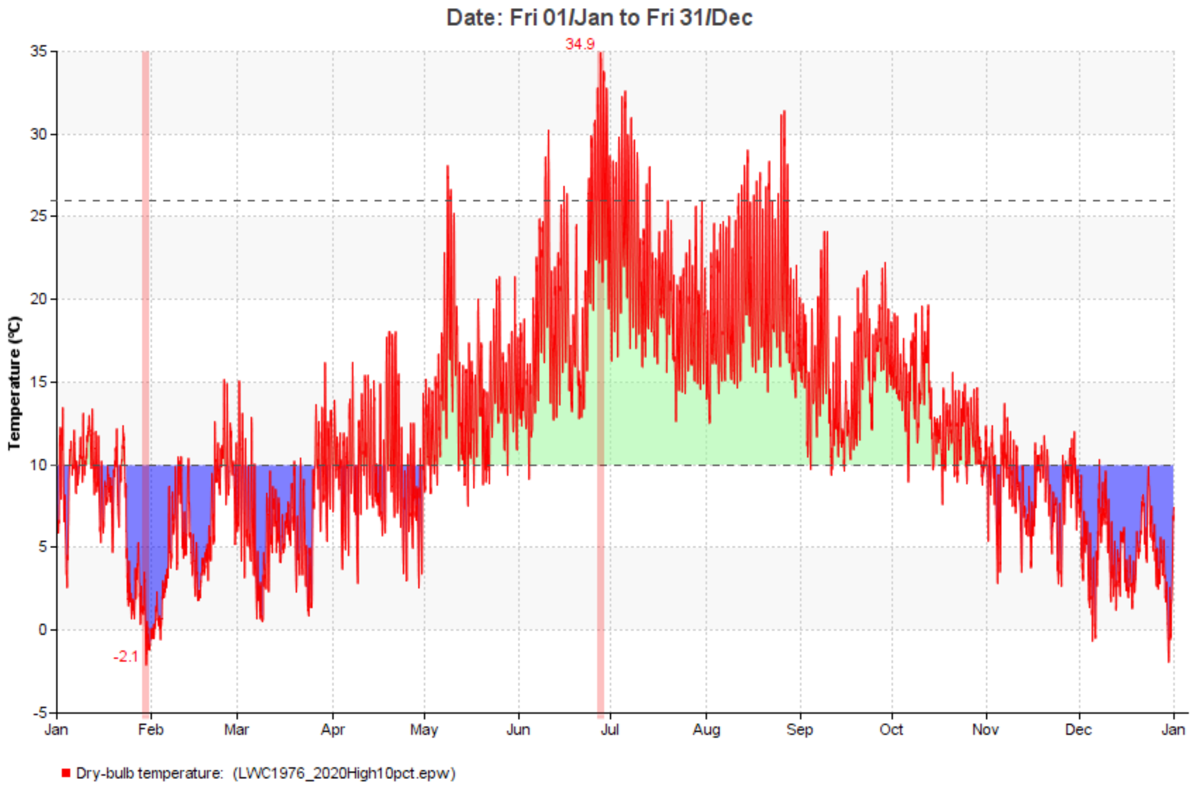

Figure 6: IES Annual Dry Bulb Temperature according to London weather file

6.3 Building Orientation, Layout and Form

Building layout, orientation and form can influence many key features of the development. The design should provide for an effective use of space and appealing layout, with opportunities to benefit from natural daylight balanced with achieving solar gain without overheating. In general, a higher thermal performance can be achieved by limiting the surface area to volume ratio as this minimises heat loss through the wall area.

It should be noted that where the building footprint is extremely tight, for example in an urban location, the building form and orientation may have to be dictated by the available space and not by implementation of best practice measures. Invariably, planning constraints and/or the functional relationships of specific areas will result in some measure of deep planning, thus reducing the opportunity for natural ventilation and daylight.

Since no such constraints exist for this particular project, passive solar gains and daylight into the Main Building have been optimised. The regularly occupied spaces that have glazing include the entrance lobbies, activity rooms, workshop, office spaces, staff cabins etc. The glazing specifications assumed for the energy modelling are summarized in the table below:

Table 6: Glazing specifications

	U-value (Including frame)	G-value	VLT

Be lean	1	0.35	0.71

The main building (maximum regularly occupied areas) is an L-shaped building oriented roughly East-West. The multipurpose activity rooms and social areas are therefore expected to receive the afternoon sunlight, based on their orientation.

Figure 7: Proposed site plan.

6.4 Building Design – Energy Efficiency Measures

At the 'BE LEAN' stage of the energy hierarchy, energy efficient building elements have been incorporated into the building design. The heat loss of different building elements is dependent upon their U-value, and air tightness. Therefore, better u-values and air permeability than the minimum values set in the **Part L2 2021** have been suggested in this stage of the assessment process.

The table below shows the proposed building fabric thermal performance. It promotes a thermally efficient building fabric in order to reduce energy consumption through passive measures. This strategy optimises the building performance prior to the consideration of renewables (LZC).

Table 7: Proposed thermal performance for construction material.

Building Type		**Non-residential**	
Category Specification		**Part L specifications**	**Be-lean Proposed values**
U-value *($W/m^2 K$)*	*Wall*	*0.26*	***0.16***
	Windows	*1.6*	***1.0***
	Floor	*0.18*	***0.11***
	Roof (pitched)	*0.16*	***0.11***
	Doors	*1.6*	***1.6***
Thermal Bridging *(W/mK)*	*Windows*	*0.16*	***0.05***
	Doors	*0.16*	***0.05***
	External Walls	*0.026*	***0.01***
Air Permeability *($m^3/h.m^2$ at 50 Pa)*		*5.00*	***2.5***

The development will be adopting the following measures for enhanced fabric thermal performance:

- Enhanced U-values for thermal elements to reduce the building's heat losses and demand.
- Providing a well-sealed envelope to minimize the infiltration of cold winter air winter and warm air in summer.
- Minimizing thermal bridging by using accredited construction details to avoid heat losses.
- Adopting a window to wall ratio that prioritizes daylight but controls solar gain and glare – to reduce electric lighting energy consumption while mitigating overheating.
- Providing exposed thermal mass to provide passive cooling – suppresses summertime overheating to acceptable levels without the need for high energy consuming mechanical cooling systems.

In order to achieve highly efficient building envelopes such as the one being suggested above, incorporating enhanced levels of insulation within the building elements is inevitable. In accordance with the client's request, only mineral wool has been used as a means of insulation to avoid the use of plastic insulating materials within the walls and roof. This has resulted in the building envelope being thicker than usual in order to meet compliance criteria. The various material assemblies are summarized below:

Table 8: Proposed construction material.

Building element	Total thickness *(mm)*	Insulation layer thickness *Mineral fibre (mm)*
Wall	*430*	*200*
Roof (pitched)	*340*	*180*

It is strongly advised that the material and construction techniques be chosen such that they minimize or entirely eliminate the instances of thermal bridging.

6.5 Building Occupancy Type

The building occupancy type is dependent on the NCM building type. A D2 class (General assembly and Leisure: Sports Centre) building type has been identified for this development. Accordingly, the occupancy capacity and profiles as well as internal gains are input in accordance with the activity type associated with each space. The NCM activity has been allocated as per the table below:

Table 9: NCM activity type selected for energy model

	Building area type
Main building	D2: General assembly and Leisure (Sports centre)
Workshop	B1: Office or Workshop
Boat Shed	B1: Office or Workshop

It should be noted that while the buildings within the development have very unique occupancy patterns (i.e. only occupied for certain parts of the year), the most befitting standard NCM occupancy profiles have been implemented for the purpose of the energy assessment. This has been done to provide standardized energy consumption results in accordance with the national policies.

6.6 Daylighting and Solar shading strategy

The glazing specification is carefully selected to ensure the internal environment is pleasant on all orientations. The spaces are recommended to make use of blinds to limit excess solar gains during the summer when the occupancy levels are expected to be the maximum, particularly for the South facing cabins on the first floor. This will help reduce the overheating risk, and subsequently the cooling demand.

6.7 Ventilation Strategy: Natural Ventilation + Heat Recovery Ventilation

All spaces will utilise Mechanical Ventilation Heat Recovery units to provide background and boost ventilation. These units utilise the warm exhausted air to pre-heat the fresh incoming supply air. This helps to significantly reduce the heat loss of the building by retaining heat within the thermal envelope.

6.8 Be Lean – Active Design Measures

The table below shows the applied 'Be Lean' active design measures incorporated within the design to demonstrate the energy strategy approach.

Table 10: Proposed active design measures adopted at the Be Lean stage.

No.	Measure	Explanation
1	**Heat recovery ventilation**	Heat recovery has been used as part of a ventilation strategy to maximise energy efficiency. The following specifications are suggested for the MVHR system - Specific Fan Power (SFP): 0.9 Efficiency: 85% It is crucial to ensure that the system is installed inside the heating envelope to ensure optimum efficiency levels.
2	**On-demand control**	The room by room heating and lighting controls ensure that energy efficiency is maximised in almost all spaces where the amount of air delivered is variable to suit the space.
3	**Low Temperature Hot Water (LTHW) system**	Heating for the building is provided by a system which features reduced flow and return temperatures, reducing thermal losses and space heat gain as comparted to a traditional system. Due to the nature of the LTHW system, should a community heat network connection become available to the site in the future, the proposed system is compatible for connection with connection points in place.
4	**Lighting Efficiency**	The proposed light fittings shall be 100% energy efficient fittings i.e., LED lighting. These have been found to be a cost-effective measure to reduce electrical energy use associated with artificial lighting.

The output from the building model confirms that upgrading the building fabric will not result in the building meeting the Part L 2021 requirements for the Be Lean stage i.e. >15% reduction against TER.

Table 11: Regulated Carbon Emissions at Be Lean stage

Building Emission Rate *(kgCO2 /m^2.annum)*			
Analysis stage	**Main Building**	**Workshop**	**Boat Shed**
Baseline (Notional)	14.81	7.59	5.23
Be Lean stage	19.35	6.9	5.4

7. BE CLEAN - Decentralised Energy Networks

The Energy Hierarchy encourages the use of a CHP system and connection to District Heating systems to reduce CO_2 emissions further.

7.1 Decentralised Energy Network

District and community heating systems are encouraged because they offer:

- Potential economies of scale in respect of efficiency and therefore reduced carbon emissions.
- Greater potential for future replacement with Low or Zero Carbon (LZC) technologies.

The feasibility of connecting into an existing heating network or providing the building with its own combined heat and power plant has been assessed alongside the **London Heat Map** as part of this assessment (refer figure 12 below). The study identifies that the site is not located near any existing or proposed district heating networks, with the nearest network being approximately >4000 m away. This is demonstrated clearly from the London Heat Map (http://www.londonheatmap.org.uk).

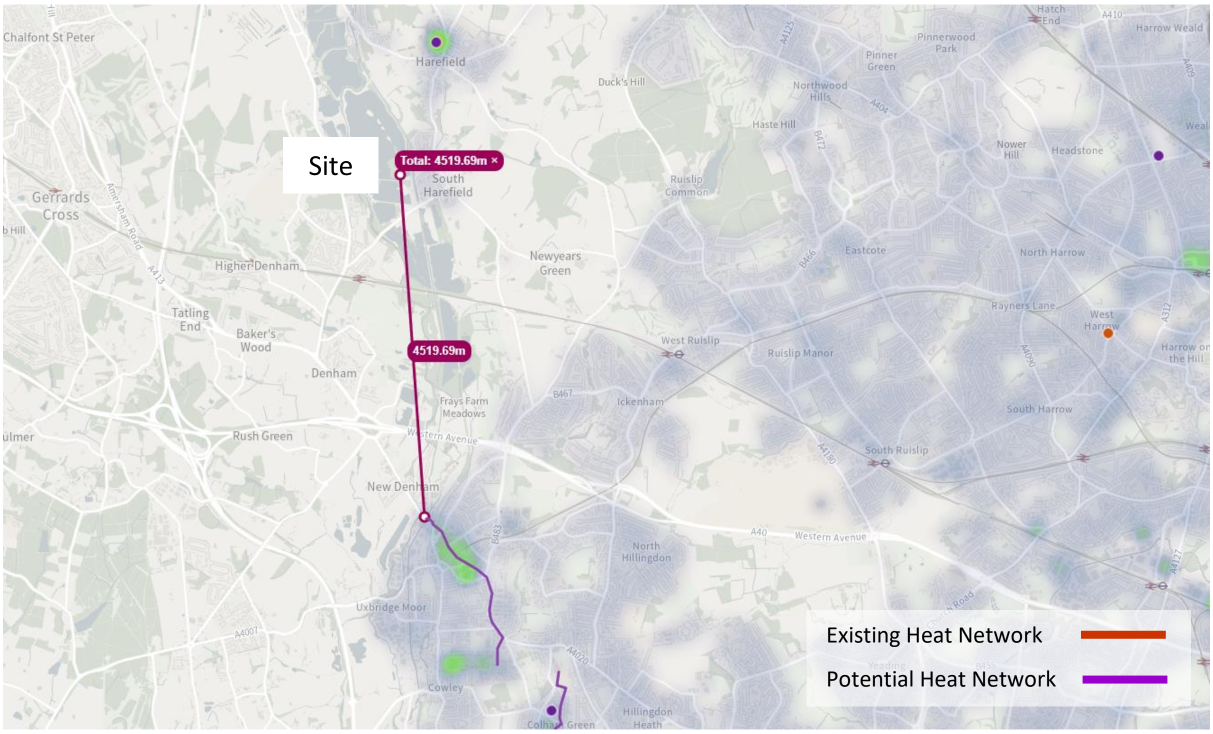

Figure 8: Existing and potential DH Network near the site

As demonstrated by the image above, no existing Heat Networks are located close to the site. To enable access to the nearest existing network (distance >4000 m), the costs involved in extending the network would outweigh the advantages the development stands to gain. **Therefore, utilisation of a local heat network is not determined as a feasible option for this development.**

7.2 Combined Heat and Power (CHP)

The Energy Hierarchy identifies the combined heat and power (CHP) as a method of producing heat and electricity with much lower emissions than separate heat and power. Also, it encourages the creation of district heating systems supplied by CHP. The implementation of a CHP strategy should be decided according to good practice design. Key factors for the efficient implementation of the CHP system are:

- Development with high heating load for the majority of the year.
- CHP operation based on maximum heat load for minimum 10 hours per day.
- CHP operation at maximum capacity of 90% of its operating period.

To ensure that CHP is financially viable it is essential that the unit is selected to meet the base heat load and that this load is maintained over a large proportion of the day (a figure of 14 – 17 hours per day is often quoted subject to the load profiles and gas and electricity prices) to ensure that the additional costs (maintenance) associated with running a CHP unit can be recovered. The need to run the CHP plant continuously as far as possible makes the building load profile of prime importance when reviewing the viability of such solutions and in particular the summertime heat load profile. To enable the CHP plant to run continuously when it is operating, a thermal store is often used so that excess CHP capacity can be used at a later time.

The feasibility of installing CHP has been assessed for this development. **Since this development is will only be used for a part of the year, installing the CHP system would not be beneficial given the cost.** According to the GLA guidance on preparing energy assessment, the development consisting around 500 residential units or more would obtain the benefits of the CHP system. **Hence, CHP system has not been considered for this development.**

Table 12: Regulated Carbon Emissions at Be Clean stage

Building Emission Rate *(kgCO2 /m^2.annum)*			
Analysis stage	**Main Building**	**Workshop**	**Boat Shed**
Baseline (Notional)	14.81	7.59	5.23
Be Clean stage	19.35	6.9	5.4

8. BE GREEN – Renewable and Low-carbon Technology Energy

In this section, viable renewable energy technologies that could reduce the development's CO_2 emissions are examined. In accordance with Policy SI 2 of the London Plan, the technical feasibility and economic viability of installing each LZC technology at the development have been assessed, so as to discount any unsuitable options at an early stage.

In determining the appropriate renewable technology for the site, the following factors were considered:

- Renewable energy resources or fuel availability of the LZC technology on the site.
- Space limitations due to building design and urban location of the site.
- Capital, operating and maintenance cost.
- Planning Permission
- Implementation with regards the overall M&E design strategy for building type
- Available Grants

The table below summarises the various low zero carbon technologies considered for the projects. Given the location and consumption patterns of the project, **Water Source Heat Pumps (WSHP) and Photovoltaic (PV)** would be the most appropriate options.

Table 13: Feasibility Study of LZC Technologies

Technology Name:	Carbon Payback	Feasibility
Photovoltaic (PV)	High	**HIGH**
Air Source Heat Pumps (ASHP)	High	**MEDIUM**
Biomass	High	**LOW**
Wind Power	Low	**LOW**
Hydro Power	None	**LOW**
Solar Thermal	Low	**MEDIUM**
Water/Ground Source Heat Pumps (WSHP)	Medium	**HIGH**

8.1 Non-feasible Technology

- **Air Source Heat Pumps (ASHP)**

An ASHP can meet space heating demands on site efficiently in comparison to gas boilers. Although this low carbon technology consumes electricity to operate, the heat output is much greater due to higher efficiency. However, it can result in noise being generated during its operation.
Given the fact that the development is within a SSSI (Sites of Special Scientific Interest) area, impact to the environment as well as ecology is to be minimized. The proximity of the site to a lake also helps strengthen the case for a Water Source Heat Pump over an Air Source one.

- **Solar Thermal**

The use of solar thermal for this development would be limited to domestic hot water only. It would not be practical for space heating as it is not required when solar thermal is at its most effective during the summer months. Moreover, the amount of carbon offset from the system is generally lower than other technologies. Therefore, it has been deemed unsuitable for this development.

- **Hydro power**

The project site is not close to natural water resources. Therefore, small scale hydro-electric will not be studied any further because of the location and the spatial limitations of the development.

- **Biomass**

A biomass system designed for this development would be fueled by wood pellets which have a high energy content. However, a biomass system would not be an appropriate technology for the site for the following reasons:

A. The burning of wood pellets releases substantially more NOx emissions when compared to similar gas boilers. As the development is situated within an urban area, the installation of a biomass boiler would further impact on the air quality in this area.
B. the lack of spaces for pellet boiler and storage on the site.
C. Pellets would need to be transported from local pellet suppliers, which causes carbon emissions into the air.

However, if the biomass system is considered at detailed design stage, local suppliers can be found near the site as shown in the map below (http://biomass-suppliers-list.service.gov.uk).

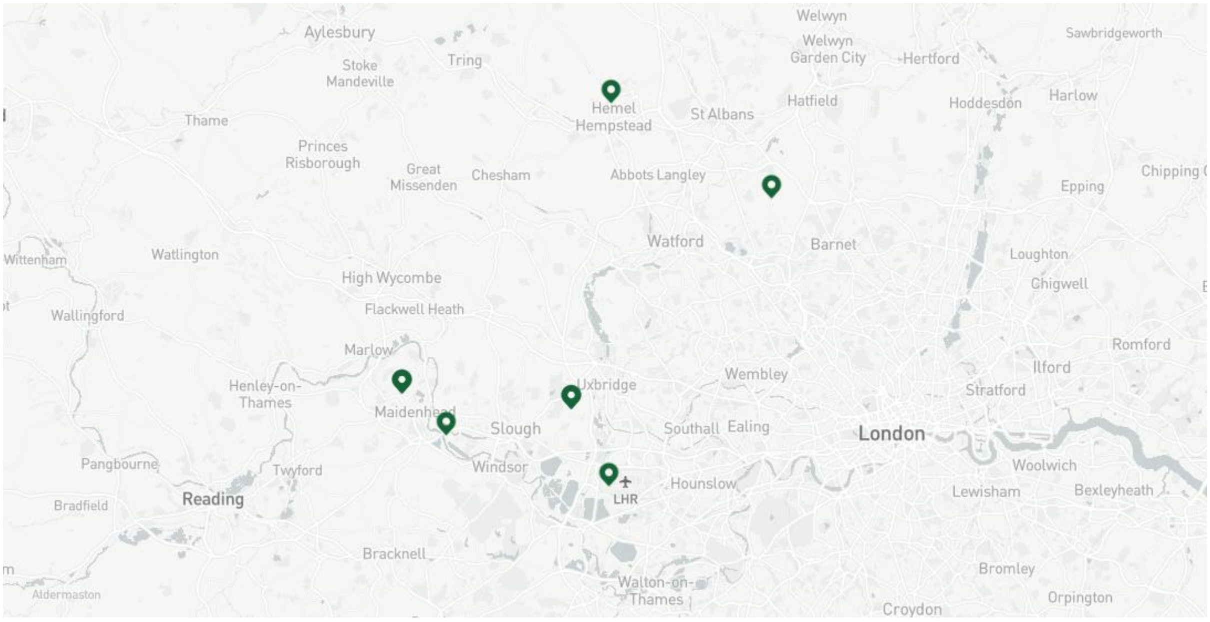

Figure 9: Biomass suppliers' locations in proximity to the project location.

- **Wind Power**

Wind turbines need extensive planning requirements, and they are only feasible at consistent wind speed. Moreover, since the development is located in an urban area, the site does not have sufficient wind speed to operate wind turbine at the height of 10 meters as shown below (Source: https://www.rensmart.com/Maps#NOABL). Hence this option has been discounted.

Information

Location

- Latitude: 51.58832261850525
- Longitude: -0.4802438186221379
- Height above sea level: 60 m

Wind Speeds

estimates from NOABL data

- At 10m above ground level 4.6 m/s
- At 25m above ground level 5.4 m/s
- At 45m above ground level 5.9 m/s

Solar

falling on a optimally oriented panel

- Annual Energy per m^2 1131 kWh
- Daily Energy per m^2 3099 Wh

Please note that the NOABL windspeed dataset used here is a model of windspeeds across the country, assuming completely flat terrain. It isn't a database of measured windspeeds. Other factors such as hills, houses, trees and other obstructions in the vicinity need to be considered as well since they can have a significant effect. If the installation of a wind turbine is considered, windspeed measurements using an anemometer need to be performed to determine what the actual figures are.

8.2 Feasible Technology

- **Water Source Heat Pumps (WSHP)**

Water source heat pumps are a feasible option to meet space heating and cooling requirements by transferring heat from a body of water (or ground) into a water-based system. However, it requires proximity to a water source to extract the heat. The technology has been proposed for the project due to its location next to the Broadwater Lake as well as the aspiration for the achievement of a highly efficient HVAC system.

The proposed heat generation system is represented in the schematic below (Appendix B):

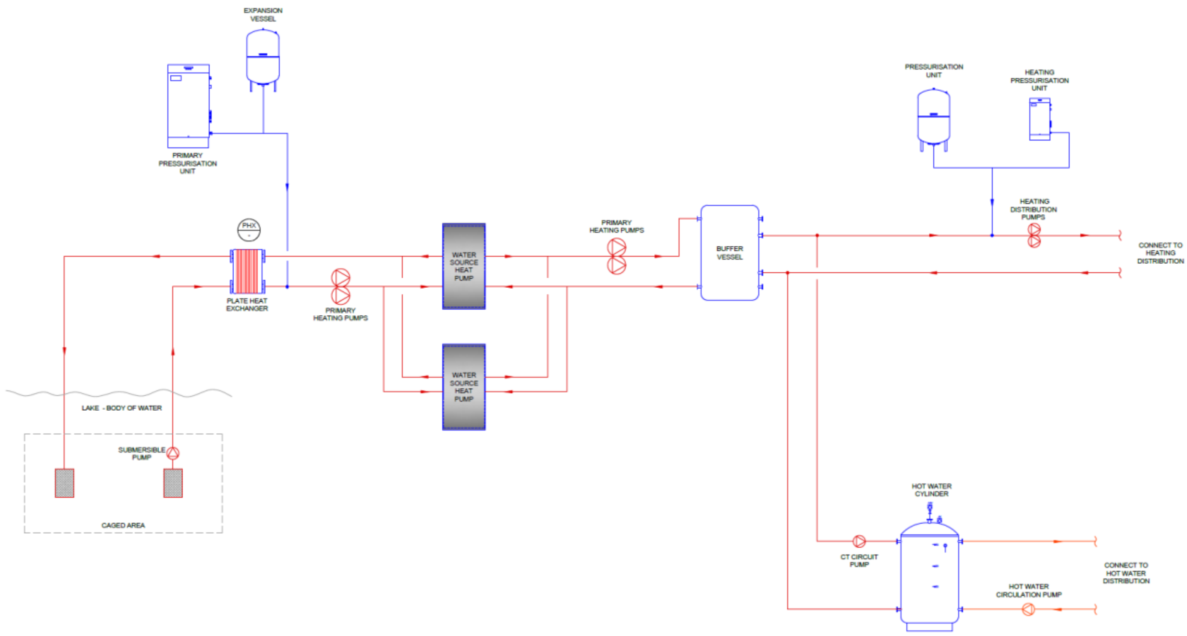

Figure 10: Proposed Water Source Heat Pump scheme

The design stage specifications used for energy calculations are in the table below. However, these figures were used only for simulation purposes and detailed specifications should be provided by mechanical engineers during the design development. The system must be certified under the Microgeneration Certification Scheme (MCS).

Table 14: WSHP system specs, as assumed for energy modelling.

Systems	General Specification	Control
Heating and Cooling	Air Source Heat Pump (SCOP 3.5, SEER 4.5)	• System SFP 0.9 W/l/s and Local supply SFP 0.3 W/l/s • Pump type – variable speed multiple pressure sensors • Heat recovery (plate heat exchanger) efficiency 0.85
Hot Water	100% demand being met by WSHP	• Storage losses – 0.0047 kWh/l.day

- **Photovoltaic (PV)**

Solar PV could be one of the suitable renewable technologies for the project due to the following reasons:

A. The installation of PV is much simpler when compared to other renewable technologies.
B. There is sufficient roof space available to install PV modules and have a significant impact on carbon emissions of the development.
C. PV panels sited on the roof within an open area are less visually intrusive when compared to wind turbines.

In summary, a 300 kWp installed capacity solar PV plant is recommended in order to maximise the PV potential of the site. Assuming an ideal output of 900 kWh annually per kWp, this plant would be able to provide approx. 280 MWh every year. Monocrystalline silicon panels (435 W per panel) spread over approximately 1400 m^2 (including roof space and carport sheds) should be able to provide the required output. Proposed PV panels are subject to further consideration at detailed design stages. In order to qualify both the installer and the equipment, the system must be certified under the Microgeneration Certification Scheme (MCS).

Table 15: Proposed solar PV specifications.

Property	General specification
Installed DC Power	300.05 kWp
Annual Energy Production	278.83 MWh
Array size	706 panels @ 435 W per panel
Total PV area	1404.09 m^2

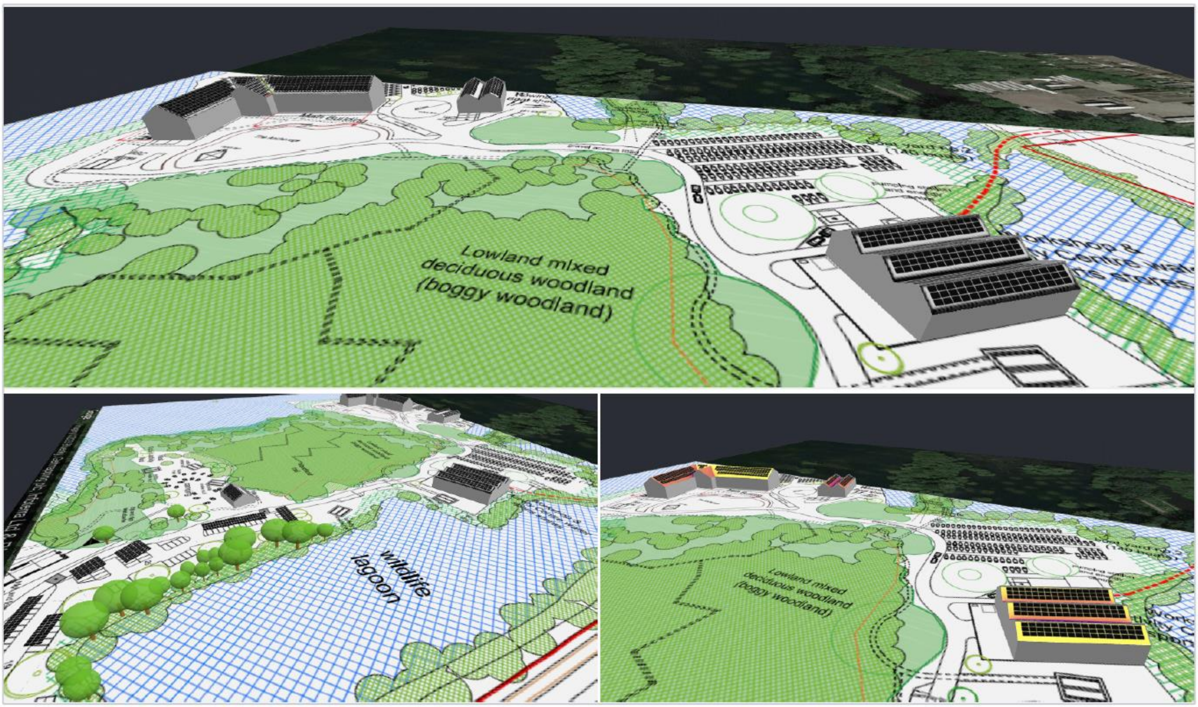

Figure 11a: 3D representative images for rooftop solar PV on site

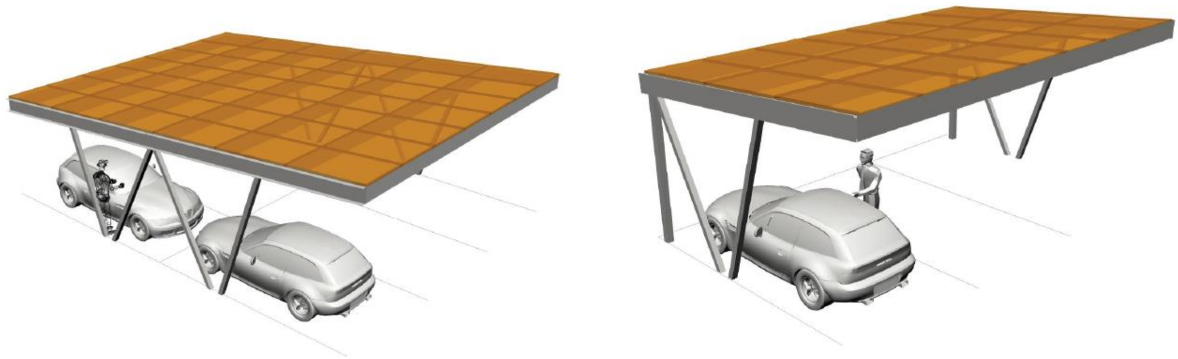

Figure 11b: 3D representative images for carport solar PV on site

An additional feature of the significantly sized solar PV infrastructure on site is the ability to store energy using a battery storage facility. While it is anticipated that solar PV generated energy could be used directly on-site during long periods of sunshine (i.e. summer months), there is also a provision for excess energy to be stored for use later. Further details on this facility can be found within the Utilities Strategy report, as prepared by Stuart McCurry & Partners Ltd.

Given the proposed LZC technologies on the site (ASHPs), the overall CO_2 reduction at this stage can be calculated as shown below:

Table 16: Regulated carbon reduction at Be Green stage.

Building Emission Rate *(kgCO2 /m^2.annum)*			
Analysis stage	**Main Building**	**Workshop**	**Boat Shed**
Baseline (Notional)	14.81	7.59	5.23
Be Green stage	5.74	-187.13	-153.7

9 Conclusion

This report assesses the predicted energy performance and carbon dioxide emissions of the proposed development at **Hillingdon Water Sports Facility and Activity Centre, Uxbridge, UB9 6PE.**

Based on the information provided by the design team, the study has been done for the proposed development comprised of **a main indoor activity centre with accommodation facilities for staff, outdoor activity areas, workshop, boat storage areas etc.** The study results demonstrate that the enhanced building fabric thermal performance and implementation of a Water Source Heat Pump is key to achieve building regulations compliance. Moreover, significant use of solar PV proved to be an efficient measure for the new build to go beyond the recommended **>35%** reduction over **Part L TER** requirements and produce more energy on-site than it consumes.

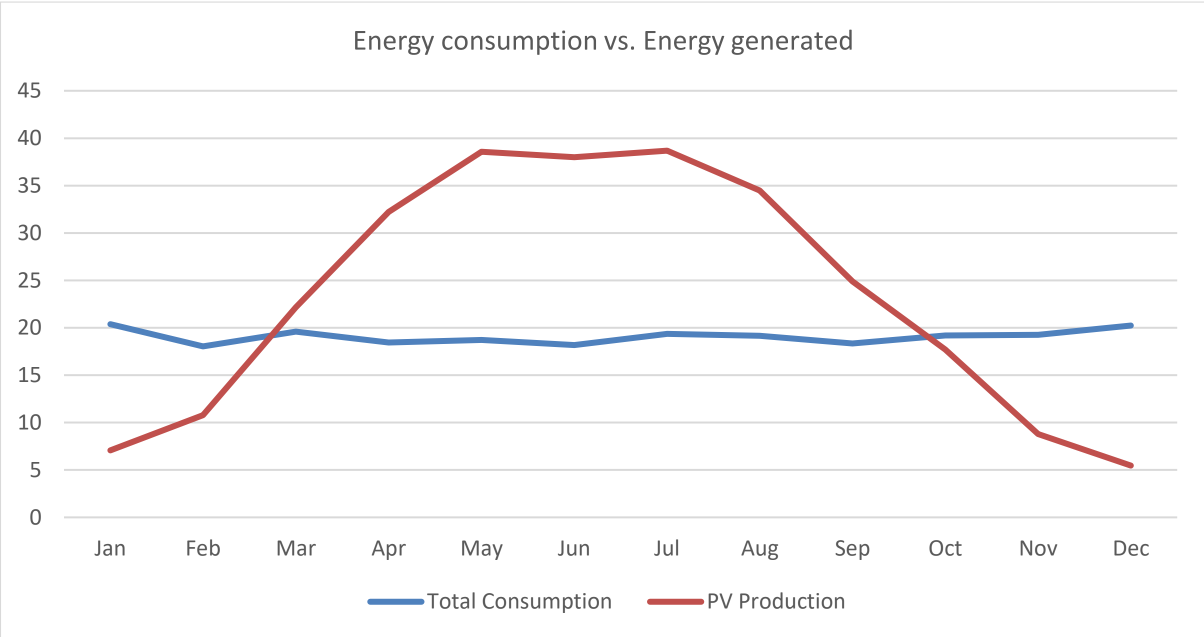

Figure 12a: Monthly breakdown of total energy consumption vs. on-site energy generation.

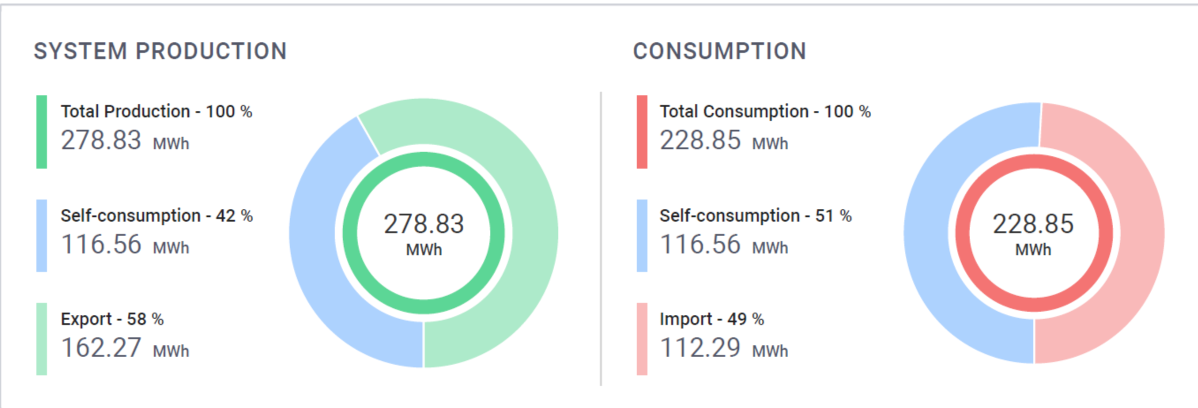

Figure 12b: Total export capacity.

The carbon savings from each stage are shown in the chart below. Given the cumulative carbon savings and output, the proposed development shall meet the planning requirements on the site.

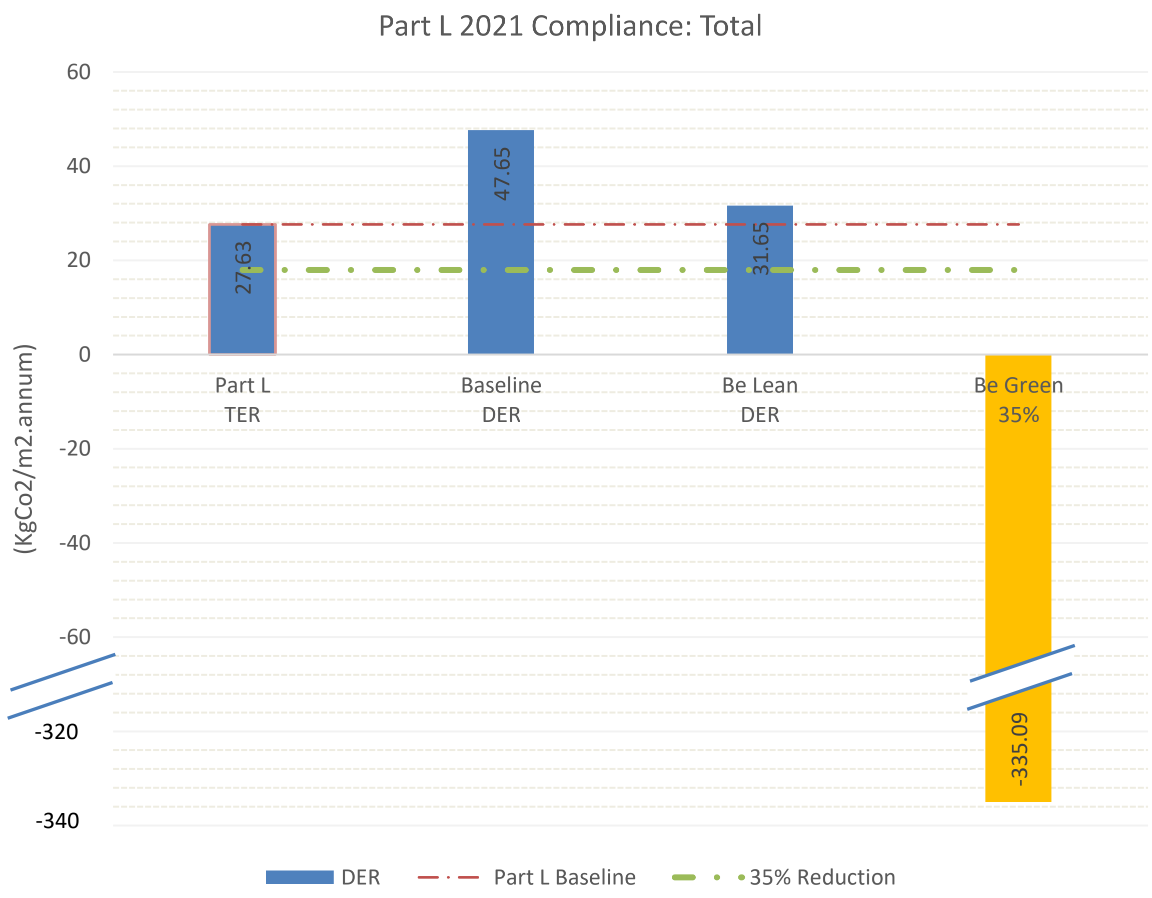

Figure 13: Carbon Emissions Reductions after each stage of the Energy Hierarchy

Table 17: Overall carbon reductions

BER (Building Emission Rate) *($KgCO_2/m^2$.annum)*	**Main Building**	**Workshop**	**Boat Shed**	**Total**
Baseline TER	14.81	7.59	5.23	27.63
Baseline BER	24.2	13.28	10.17	47.65
Be-Lean BER	19.35	6.9	5.4	31.65
Be-Clean BER	19.35	6.9	5.4	31.65
Be-Green BER	5.74	-187.13	-153.7	-335.09

10 Appendix A – BRUKL reports

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Hillingdon London

As designed

Date: Mon Jul 17 10:34:29 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.18

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.18

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

Foundation area [m²]: 1112.74

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

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	14.81	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	24.2	
Target primary energy rate (TPER), $kWh/m^2.annum$	161.42	
Building primary energy rate (BPER), $kWh/m^2.annum$	261.79	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.26	0.26	FF00002D:Surf[0]
Floors	0.18	0.18	0.22	FF000008:Surf[2]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.18	0.18	GF000004:Surf[0]
Windows** and roof windows	1.6	1.6	1.6	GF000000:Surf[1]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	1.59	1.59	GF000002:Surf[1]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

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

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

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

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- GSHP_Baseline

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	2.5	2	0	2	-
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					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.

"No HWS in project, or hot water is provided by HVAC system"

Zone-level mechanical ventilation, exhaust, and terminal units

ID	**System type in the Approved Documents**
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

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

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
GF-Office	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Emg Staircase	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Tea Station	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-First Aid	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Operations	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-WC	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Staff Change 1	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Staff Change 2	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Shower 2	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Female Change	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Plant Boil Room	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Female WC	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Male WC	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Lobby 1	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Lobby 2	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Change	-	-	-	-	-	-	-	0.3	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
GF-Meter Room	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Cleaners St.	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Shower 1	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Male Change	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Change 1	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Shower 3	-	-	-	-	-	-	-	0.3	-	-	N/A
GF- Lobby	-	-	-	-	-	-	-	0.3	-	-	N/A
GF- Lobby 3	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-ACC Shower Change	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-WC 2	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-WC 1	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Training Room	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin13	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin14	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Lounge	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Laundry	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Emg Staircase	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Galley	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cleaners Locker	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 1	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 2	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 3	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 4	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 5	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 6	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 7	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 8	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 9	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Circulation 1	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-cleaners & gen. Locker	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Galley	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Female WC	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Male WC	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-ACC. WC	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Emg Staircase	-	-	-	-	-	-	-	0.3	-	-	N/A
Staircase	-	-	-	-	-	-	-	0.3	-	-	N/A
Lift well	-	-	-	-	-	-	-	0.3	-	-	N/A
Multipurpose activity room	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Change 2	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Shower 3	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Machinery Room 1	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Machinery Room 2	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Cleaners Locker	-	-	-	-	-	-	-	0.3	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
Multipurpose activity room	-	-	-	-	-	-	-	0.3	-	-	N/A
Staircase	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Circulation 2	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Circulation 3	-	-	-	-	-	-	-	0.3	-	-	N/A
Social area	-	-	-	-	-	-	-	0.3	-	-	N/A
Multipurpose room	-	-	-	-	-	-	-	0.3	-	-	N/A
Staircase	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Circulation 4	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 7	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 8	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 9	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin10	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin11	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin12	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 1	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 2	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 3	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 4	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 5	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 6	-	-	-	-	-	-	-	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
GF-Office	95	-	-
GF-Emg Staircase	95	-	-
GF-Tea Station	95	-	-
GF-First Aid	95	-	-
GF-Operations	95	-	-
GF-WC	95	-	-
GF-Staff Change 1	95	-	-
GF-Staff Change 2	95	-	-
GF-Shower 2	95	-	-
GF-Female Change	95	-	-
GF-Plant Boil Room	95	-	-
GF-Female WC	95	-	-
GF-Male WC	95	-	-
GF-Lobby 1	95	-	-
GF-Lobby 2	95	-	-
GF-Change	95	-	-
GF-Meter Room	95	-	-
GF-Cleaners St.	95	-	-
GF-Shower 1	95	-	-

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
GF-Male Change	95	-	-
GF-Change 1	95	-	-
GF-Shower 3	95	-	-
GF- Lobby	95	-	-
GF- Lobby 3	95	-	-
GF-ACC Shower Change	95	-	-
GF-WC 2	95	-	-
GF-WC 1	95	-	-
FF-Training Room	95	-	-
FF-Cabin13	95	-	-
FF-Cabin14	95	-	-
FF-Lounge	95	-	-
FF-Laundry	95	-	-
FF-Emg Staircase	95	-	-
FF-Galley	95	-	-
FF-Cleaners Locker	95	-	-
FF-Toilet 1	95	-	-
FF-Toilet 2	95	-	-
FF-Toilet 3	95	-	-
FF-Toilet 4	95	-	-
FF-Toilet 5	95	-	-
FF-Toilet 6	95	-	-
FF-Toilet 7	95	-	-
FF-Toilet 8	95	-	-
FF-Toilet 9	95	-	-
FF-Circulation 1	95	-	-
FF-cleaners & gen. Locker	95	-	-
FF-Galley	95	-	-
FF-Female WC	95	-	-
FF-Male WC	95	-	-
FF-ACC. WC	95	-	-
FF-Emg Staircase	95	-	-
Staircase	95	-	-
Lift well	95	-	-
Multipurpose activity room	95	-	-
GF-Change 2	95	-	-
GF-Shower 3	95	-	-
GF-Machinery Room 1	95	-	-
GF-Machinery Room 2	95	-	-
GF-Cleaners Locker	95	-	-
Multipurpose activity room	95	-	-
Staircase	95	-	-
FF-Circulation 2	95	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
FF-Circulation 3	95	-	-
Social area	95	-	-
Multipurpose room	95	-	-
Staircase	95	-	-
FF-Circulation 4	95	-	-
FF-Cabin 7	95	-	-
FF-Cabin 8	95	-	-
FF-Cabin 9	95	-	-
FF-Cabin10	95	-	-
FF-Cabin11	95	-	-
FF-Cabin12	95	-	-
FF-Cabin 1	95	-	-
FF-Cabin 2	95	-	-
FF-Cabin 3	95	-	-
FF-Cabin 4	95	-	-
FF-Cabin 5	95	-	-
FF-Cabin 6	95	-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
GF-Office	NO (-73.5%)	NO
GF-Emg Staircase	N/A	N/A
GF-Tea Station	N/A	N/A
GF-First Aid	N/A	N/A
GF-Operations	NO (-56.1%)	NO
GF-WC	N/A	N/A
GF-Staff Change 1	N/A	N/A
GF-Staff Change 2	N/A	N/A
GF-Shower 2	N/A	N/A
GF-Female Change	N/A	N/A
GF-Plant Boil Room	N/A	N/A
GF-Female WC	N/A	N/A
GF-Male WC	N/A	N/A
GF-Lobby 1	N/A	N/A
GF-Lobby 2	N/A	N/A
GF-Change	N/A	N/A
GF-Meter Room	N/A	N/A
GF-Cleaners St.	N/A	N/A
GF-Shower 1	N/A	N/A
GF-Male Change	N/A	N/A
GF-Change 1	N/A	N/A
GF-Shower 3	N/A	N/A
GF- Lobby	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
GF- Lobby 3	N/A	N/A
GF-ACC Shower Change	N/A	N/A
GF-WC 2	N/A	N/A
GF-WC 1	N/A	N/A
FF-Training Room	NO (-72.4%)	NO
FF-Cabin13	NO (-78.6%)	NO
FF-Cabin14	NO (-77.3%)	NO
FF-Lounge	NO (-64.5%)	NO
FF-Laundry	N/A	N/A
FF-Emg Staircase	NO (-91.7%)	NO
FF-Galley	NO (-60.4%)	NO
FF-Cleaners Locker	N/A	N/A
FF-Toilet 1	N/A	N/A
FF-Toilet 2	N/A	N/A
FF-Toilet 3	N/A	N/A
FF-Toilet 4	N/A	N/A
FF-Toilet 5	N/A	N/A
FF-Toilet 6	N/A	N/A
FF-Toilet 7	N/A	N/A
FF-Toilet 8	N/A	N/A
FF-Toilet 9	N/A	N/A
FF-Circulation 1	N/A	N/A
FF-cleaners & gen. Locker	N/A	N/A
FF-Galley	N/A	N/A
FF-Female WC	N/A	N/A
FF-Male WC	N/A	N/A
FF-ACC. WC	N/A	N/A
FF-Emg Staircase	NO (-92.8%)	NO
Staircase	NO (-88.5%)	NO
Lift well	N/A	N/A
Multipurpose activity room	NO (-26.6%)	NO
GF-Change 2	N/A	N/A
GF-Shower 3	N/A	N/A
GF-Machinery Room 1	N/A	N/A
GF-Machinery Room 2	N/A	N/A
GF-Cleaners Locker	NO (-60.3%)	NO
Multipurpose activity room	NO (-78.7%)	NO
Staircase	NO (-93.2%)	NO
FF-Circulation 2	N/A	N/A
FF-Circulation 3	N/A	N/A
Social area	NO (-27.7%)	NO
Multipurpose room	NO (-12.3%)	NO
Staircase	NO (-94.3%)	NO
FF-Circulation 4	N/A	N/A
FF-Cabin 7	NO (-73.2%)	NO
FF-Cabin 8	NO (-73.2%)	NO
FF-Cabin 9	NO (-73.2%)	NO
FF-Cabin10	NO (-73.2%)	NO
FF-Cabin11	NO (-73.2%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
FF-Cabin12	NO (-73.2%)	NO
FF-Cabin 1	NO (-83.8%)	NO
FF-Cabin 2	NO (-83.8%)	NO
FF-Cabin 3	NO (-83.8%)	NO
FF-Cabin 4	NO (-83.8%)	NO
FF-Cabin 5	NO (-83.8%)	NO
FF-Cabin 6	NO (-83.8%)	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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m²]	2225.5	2225.5
External area [m²]	4353.6	4353.6
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	8	3
Average conductance [W/K]	1270.58	1314.88
Average U-value [W/m²K]	0.29	0.3
Alpha value* [%]	28.03	10

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

Building Use

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

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	23.73	3.63
Cooling	6.12	3.14
Auxiliary	29.3	17.47
Lighting	17.74	9.05
Hot water	95.42	76.11
Equipment*	28.73	28.73
TOTAL**	**172.3**	**109.4**

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

Energy Production by Technology [kWh/m²]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	218.63	88.76
Primary energy [kWh/m²]	261.79	161.42
Total emissions [kg/m²]	24.2	14.81

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	186.7	31.9	23.7	6.1	29.3	2.19	1.45	2.5	2
	Notional	36.3	52.4	3.6	3.1	17	2.78	4.63	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Hillingdon London_Be Lean2

As designed

Date: Wed Jul 19 12:10:24 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.18

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.18

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

Foundation area [m²]: 1112.74

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

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	14.65	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	19.35	
Target primary energy rate (TPER), $kWh/m^2.annum$	159.43	
Building primary energy rate (BPER), $kWh/m^2.annum$	210.92	
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	0.16	0.16	GF000000:Surf[4]
Floors	0.18	0.11	0.11	GF000000:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.12	0.12	GF000004:Surf[0]
Windows** and roof windows	1.6	1.01	1.01	GF000000:Surf[1]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	1.59	1.59	GF000002:Surf[1]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

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

** Display windows and similar glazing are excluded from the U-value check.
*** Values for rooflights refer to the horizontal position.

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

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

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	2.5

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- GSHP_Be Lean

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.5	2	0	2	0.85
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					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.

1- GSHP_Be Lean

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	2.5	-
Standard value	2*	N/A

* Standard shown is for all types except absorption and gas engine heat pumps.

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
GF-Office	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Emg Staircase	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Tea Station	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-First Aid	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Operations	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-WC	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Staff Change 1	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Staff Change 2	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Shower 2	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Female Change	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Plant Boil Room	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Female WC	-	-	-	-	-	-	-	0.3	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
GF-Male WC	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Lobby 1	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Lobby 2	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Change	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Meter Room	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Cleaners St.	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Shower 1	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Male Change	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Change 1	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Shower 3	-	-	-	-	-	-	-	0.3	-	-	N/A
GF- Lobby	-	-	-	-	-	-	-	0.3	-	-	N/A
GF- Lobby 3	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-ACC Shower Change	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-WC 2	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-WC 1	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Training Room	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin13	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin14	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Lounge	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Laundry	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Emg Staircase	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Galley	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cleaners Locker	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 1	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 2	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 3	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 4	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 5	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 6	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 7	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 8	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 9	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Circulation 1	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-cleaners & gen. Locker	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Galley	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Female WC	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Male WC	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-ACC. WC	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Emg Staircase	-	-	-	-	-	-	-	0.3	-	-	N/A
Staircase	-	-	-	-	-	-	-	0.3	-	-	N/A
Lift well	-	-	-	-	-	-	-	0.3	-	-	N/A
Multipurpose activity room	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Change 2	-	-	-	-	-	-	-	0.3	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
GF-Shower 3	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Machinery Room 1	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Machinery Room 2	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Cleaners Locker	-	-	-	-	-	-	-	0.3	-	-	N/A
Multipurpose activity room	-	-	-	-	-	-	-	0.3	-	-	N/A
Staircase	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Circulation 2	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Circulation 3	-	-	-	-	-	-	-	0.3	-	-	N/A
Social area	-	-	-	-	-	-	-	0.3	-	-	N/A
Multipurpose room	-	-	-	-	-	-	-	0.3	-	-	N/A
Staircase	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Circulation 4	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 7	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 8	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 9	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin10	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin11	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin12	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 1	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 2	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 3	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 4	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 5	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 6	-	-	-	-	-	-	-	0.3	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m^2]
Standard value	95	80	0.3
GF-Office	150	-	-
GF-Emg Staircase	150	-	-
GF-Tea Station	150	-	-
GF-First Aid	150	-	-
GF-Operations	150	-	-
GF-WC	150	-	-
GF-Staff Change 1	150	-	-
GF-Staff Change 2	150	-	-
GF-Shower 2	150	-	-
GF-Female Change	150	-	-
GF-Plant Boil Room	150	-	-
GF-Female WC	150	-	-
GF-Male WC	150	-	-
GF-Lobby 1	150	-	-
GF-Lobby 2	150	-	-

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
GF-Change	150	-	-
GF-Meter Room	150	-	-
GF-Cleaners St.	150	-	-
GF-Shower 1	150	-	-
GF-Male Change	150	-	-
GF-Change 1	150	-	-
GF-Shower 3	150	-	-
GF- Lobby	150	-	-
GF- Lobby 3	150	-	-
GF-ACC Shower Change	150	-	-
GF-WC 2	150	-	-
GF-WC 1	150	-	-
FF-Training Room	150	-	-
FF-Cabin13	150	-	-
FF-Cabin14	150	-	-
FF-Lounge	150	-	-
FF-Laundry	150	-	-
FF-Emg Staircase	150	-	-
FF-Galley	150	-	-
FF-Cleaners Locker	150	-	-
FF-Toilet 1	150	-	-
FF-Toilet 2	150	-	-
FF-Toilet 3	150	-	-
FF-Toilet 4	150	-	-
FF-Toilet 5	150	-	-
FF-Toilet 6	150	-	-
FF-Toilet 7	150	-	-
FF-Toilet 8	150	-	-
FF-Toilet 9	150	-	-
FF-Circulation 1	150	-	-
FF-cleaners & gen. Locker	150	-	-
FF-Galley	150	-	-
FF-Female WC	150	-	-
FF-Male WC	150	-	-
FF-ACC. WC	150	-	-
FF-Emg Staircase	150	-	-
Staircase	150	-	-
Lift well	150	-	-
Multipurpose activity room	150	-	-
GF-Change 2	150	-	-
GF-Shower 3	150	-	-
GF-Machinery Room 1	150	-	-
GF-Machinery Room 2	150	-	-

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
GF-Cleaners Locker	150	-	-
Multipurpose activity room	150	-	-
Staircase	150	-	-
FF-Circulation 2	150	-	-
FF-Circulation 3	150	-	-
Social area	150	-	-
Multipurpose room	150	-	-
Staircase	150	-	-
FF-Circulation 4	150	-	-
FF-Cabin 7	150	-	-
FF-Cabin 8	150	-	-
FF-Cabin 9	150	-	-
FF-Cabin10	150	-	-
FF-Cabin11	150	-	-
FF-Cabin12	150	-	-
FF-Cabin 1	150	-	-
FF-Cabin 2	150	-	-
FF-Cabin 3	150	-	-
FF-Cabin 4	150	-	-
FF-Cabin 5	150	-	-
FF-Cabin 6	150	-	-

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?
GF-Office	NO (-77.1%)	NO
GF-Emg Staircase	N/A	N/A
GF-Tea Station	N/A	N/A
GF-First Aid	N/A	N/A
GF-Operations	NO (-62.3%)	NO
GF-WC	N/A	N/A
GF-Staff Change 1	N/A	N/A
GF-Staff Change 2	N/A	N/A
GF-Shower 2	N/A	N/A
GF-Female Change	N/A	N/A
GF-Plant Boil Room	N/A	N/A
GF-Female WC	N/A	N/A
GF-Male WC	N/A	N/A
GF-Lobby 1	N/A	N/A
GF-Lobby 2	N/A	N/A
GF-Change	N/A	N/A
GF-Meter Room	N/A	N/A
GF-Cleaners St.	N/A	N/A
GF-Shower 1	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
GF-Male Change	N/A	N/A
GF-Change 1	N/A	N/A
GF-Shower 3	N/A	N/A
GF- Lobby	N/A	N/A
GF- Lobby 3	N/A	N/A
GF-ACC Shower Change	N/A	N/A
GF-WC 2	N/A	N/A
GF-WC 1	N/A	N/A
FF-Training Room	NO (-76.2%)	NO
FF-Cabin13	NO (-81.7%)	NO
FF-Cabin14	NO (-80.5%)	NO
FF-Lounge	NO (-69.6%)	NO
FF-Laundry	N/A	N/A
FF-Emg Staircase	NO (-92.8%)	NO
FF-Galley	NO (-66.1%)	NO
FF-Cleaners Locker	N/A	N/A
FF-Toilet 1	N/A	N/A
FF-Toilet 2	N/A	N/A
FF-Toilet 3	N/A	N/A
FF-Toilet 4	N/A	N/A
FF-Toilet 5	N/A	N/A
FF-Toilet 6	N/A	N/A
FF-Toilet 7	N/A	N/A
FF-Toilet 8	N/A	N/A
FF-Toilet 9	N/A	N/A
FF-Circulation 1	N/A	N/A
FF-cleaners & gen. Locker	N/A	N/A
FF-Galley	N/A	N/A
FF-Female WC	N/A	N/A
FF-Male WC	N/A	N/A
FF-ACC. WC	N/A	N/A
FF-Emg Staircase	NO (-93.8%)	NO
Staircase	NO (-90.1%)	NO
Lift well	N/A	N/A
Multipurpose activity room	NO (-36.9%)	NO
GF-Change 2	N/A	N/A
GF-Shower 3	N/A	N/A
GF-Machinery Room 1	N/A	N/A
GF-Machinery Room 2	N/A	N/A
GF-Cleaners Locker	NO (-65.8%)	NO
Multipurpose activity room	NO (-81.6%)	NO
Staircase	NO (-94.2%)	NO
FF-Circulation 2	N/A	N/A
FF-Circulation 3	N/A	N/A
Social area	NO (-37.4%)	NO
Multipurpose room	NO (-24.5%)	NO
Staircase	NO (-95.1%)	NO
FF-Circulation 4	N/A	N/A
FF-Cabin 7	NO (-77.1%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
FF-Cabin 8	NO (-77.1%)	NO
FF-Cabin 9	NO (-77.1%)	NO
FF-Cabin10	NO (-77.1%)	NO
FF-Cabin11	NO (-77.1%)	NO
FF-Cabin12	NO (-77.1%)	NO
FF-Cabin 1	NO (-86.1%)	NO
FF-Cabin 2	NO (-86.1%)	NO
FF-Cabin 3	NO (-86.1%)	NO
FF-Cabin 4	NO (-86.1%)	NO
FF-Cabin 5	NO (-86.1%)	NO
FF-Cabin 6	NO (-86.1%)	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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	2225.5	2225.5
External area [m^2]	4353.6	4353.6
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	838.06	1314.88
Average U-value [W/m^2K]	0.19	0.3
Alpha value* [%]	12.08	10

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

Building Use

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

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

	Actual	Notional
Heating	2.18	3.61
Cooling	1.72	1.76
Auxiliary	28.68	17.47
Lighting	11.38	9.05
Hot water	95.42	76.11
Equipment*	28.73	28.73
TOTAL**	**139.37**	**107.98**

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

Energy Production by Technology [kWh/m^2]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	26.08	54.03
Primary energy [kWh/m^2]	210.92	159.43
Total emissions [kg/m^2]	19.35	14.65

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] GSHP/WSHP, [HFT] Electricity, [CFT] Electricity										
	Actual	17.1	9	2.2	1.7	28.7	2.19	1.45	2.5	2
	Notional	36.1	18	3.6	1.8	17	2.78	2.84	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Hillingdon London_Be Green PV3

As designed

Date: Mon Jul 24 17:03:12 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.18

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.18

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

Foundation area [m²]: 1112.74

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	14.65	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	5.74	
Target primary energy rate (TPER), $kWh/m^2.annum$	159.43	
Building primary energy rate (BPER), $kWh/m^2.annum$	56.93	
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	0.16	0.16	GF000000:Surf[4]
Floors	0.18	0.11	0.11	GF000000:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.12	0.12	GF000004:Surf[0]
Windows** and roof windows	1.6	1.01	1.01	GF000000:Surf[1]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	1.59	1.59	GF000002:Surf[1]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

U_{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

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

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	2.5

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- WSHP_Be Green

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.5	4.5	0	0.9	0.85
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					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.

1- WSHP_Be Green

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	3.5	-
Standard value	2*	N/A

* Standard shown is for all types except absorption and gas engine heat pumps.

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
GF-Office	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Emg Staircase	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Tea Station	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-First Aid	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Operations	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-WC	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Staff Change 1	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Staff Change 2	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Shower 2	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Female Change	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Plant Boil Room	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Female WC	-	-	-	-	-	-	-	0.3	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
GF-Male WC	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Lobby 1	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Lobby 2	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Change	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Meter Room	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Cleaners St.	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Shower 1	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Male Change	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Change 1	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Shower 3	-	-	-	-	-	-	-	0.3	-	-	N/A
GF- Lobby	-	-	-	-	-	-	-	0.3	-	-	N/A
GF- Lobby 3	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-ACC Shower Change	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-WC 2	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-WC 1	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Training Room	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin13	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin14	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Lounge	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Laundry	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Emg Staircase	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Galley	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cleaners Locker	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 1	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 2	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 3	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 4	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 5	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 6	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 7	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 8	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Toilet 9	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Circulation 1	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-cleaners & gen. Locker	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Galley	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Female WC	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Male WC	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-ACC. WC	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Emg Staircase	-	-	-	-	-	-	-	0.3	-	-	N/A
Staircase	-	-	-	-	-	-	-	0.3	-	-	N/A
Lift well	-	-	-	-	-	-	-	0.3	-	-	N/A
Multipurpose activity room	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Change 2	-	-	-	-	-	-	-	0.3	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
GF-Shower 3	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Machinery Room 1	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Machinery Room 2	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Cleaners Locker	-	-	-	-	-	-	-	0.3	-	-	N/A
Multipurpose activity room	-	-	-	-	-	-	-	0.3	-	-	N/A
Staircase	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Circulation 2	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Circulation 3	-	-	-	-	-	-	-	0.3	-	-	N/A
Social area	-	-	-	-	-	-	-	0.3	-	-	N/A
Multipurpose room	-	-	-	-	-	-	-	0.3	-	-	N/A
Staircase	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Circulation 4	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 7	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 8	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 9	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin10	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin11	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin12	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 1	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 2	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 3	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 4	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 5	-	-	-	-	-	-	-	0.3	-	-	N/A
FF-Cabin 6	-	-	-	-	-	-	-	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
GF-Office	150	-	-
GF-Emg Staircase	150	-	-
GF-Tea Station	150	-	-
GF-First Aid	150	-	-
GF-Operations	150	-	-
GF-WC	150	-	-
GF-Staff Change 1	150	-	-
GF-Staff Change 2	150	-	-
GF-Shower 2	150	-	-
GF-Female Change	150	-	-
GF-Plant Boil Room	150	-	-
GF-Female WC	150	-	-
GF-Male WC	150	-	-
GF-Lobby 1	150	-	-
GF-Lobby 2	150	-	-

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
GF-Change	150	-	-
GF-Meter Room	150	-	-
GF-Cleaners St.	150	-	-
GF-Shower 1	150	-	-
GF-Male Change	150	-	-
GF-Change 1	150	-	-
GF-Shower 3	150	-	-
GF- Lobby	150	-	-
GF- Lobby 3	150	-	-
GF-ACC Shower Change	150	-	-
GF-WC 2	150	-	-
GF-WC 1	150	-	-
FF-Training Room	150	-	-
FF-Cabin13	150	-	-
FF-Cabin14	150	-	-
FF-Lounge	150	-	-
FF-Laundry	150	-	-
FF-Emg Staircase	150	-	-
FF-Galley	150	-	-
FF-Cleaners Locker	150	-	-
FF-Toilet 1	150	-	-
FF-Toilet 2	150	-	-
FF-Toilet 3	150	-	-
FF-Toilet 4	150	-	-
FF-Toilet 5	150	-	-
FF-Toilet 6	150	-	-
FF-Toilet 7	150	-	-
FF-Toilet 8	150	-	-
FF-Toilet 9	150	-	-
FF-Circulation 1	150	-	-
FF-cleaners & gen. Locker	150	-	-
FF-Galley	150	-	-
FF-Female WC	150	-	-
FF-Male WC	150	-	-
FF-ACC. WC	150	-	-
FF-Emg Staircase	150	-	-
Staircase	150	-	-
Lift well	150	-	-
Multipurpose activity room	150	-	-
GF-Change 2	150	-	-
GF-Shower 3	150	-	-
GF-Machinery Room 1	150	-	-
GF-Machinery Room 2	150	-	-

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
GF-Cleaners Locker	150	-	-
Multipurpose activity room	150	-	-
Staircase	150	-	-
FF-Circulation 2	150	-	-
FF-Circulation 3	150	-	-
Social area	150	-	-
Multipurpose room	150	-	-
Staircase	150	-	-
FF-Circulation 4	150	-	-
FF-Cabin 7	150	-	-
FF-Cabin 8	150	-	-
FF-Cabin 9	150	-	-
FF-Cabin10	150	-	-
FF-Cabin11	150	-	-
FF-Cabin12	150	-	-
FF-Cabin 1	150	-	-
FF-Cabin 2	150	-	-
FF-Cabin 3	150	-	-
FF-Cabin 4	150	-	-
FF-Cabin 5	150	-	-
FF-Cabin 6	150	-	-

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?
GF-Office	NO (-77.1%)	NO
GF-Emg Staircase	N/A	N/A
GF-Tea Station	N/A	N/A
GF-First Aid	N/A	N/A
GF-Operations	NO (-62.3%)	NO
GF-WC	N/A	N/A
GF-Staff Change 1	N/A	N/A
GF-Staff Change 2	N/A	N/A
GF-Shower 2	N/A	N/A
GF-Female Change	N/A	N/A
GF-Plant Boil Room	N/A	N/A
GF-Female WC	N/A	N/A
GF-Male WC	N/A	N/A
GF-Lobby 1	N/A	N/A
GF-Lobby 2	N/A	N/A
GF-Change	N/A	N/A
GF-Meter Room	N/A	N/A
GF-Cleaners St.	N/A	N/A
GF-Shower 1	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
GF-Male Change	N/A	N/A
GF-Change 1	N/A	N/A
GF-Shower 3	N/A	N/A
GF- Lobby	N/A	N/A
GF- Lobby 3	N/A	N/A
GF-ACC Shower Change	N/A	N/A
GF-WC 2	N/A	N/A
GF-WC 1	N/A	N/A
FF-Training Room	NO (-76.2%)	NO
FF-Cabin13	NO (-81.7%)	NO
FF-Cabin14	NO (-80.5%)	NO
FF-Lounge	NO (-69.6%)	NO
FF-Laundry	N/A	N/A
FF-Emg Staircase	NO (-92.8%)	NO
FF-Galley	NO (-66.1%)	NO
FF-Cleaners Locker	N/A	N/A
FF-Toilet 1	N/A	N/A
FF-Toilet 2	N/A	N/A
FF-Toilet 3	N/A	N/A
FF-Toilet 4	N/A	N/A
FF-Toilet 5	N/A	N/A
FF-Toilet 6	N/A	N/A
FF-Toilet 7	N/A	N/A
FF-Toilet 8	N/A	N/A
FF-Toilet 9	N/A	N/A
FF-Circulation 1	N/A	N/A
FF-cleaners & gen. Locker	N/A	N/A
FF-Galley	N/A	N/A
FF-Female WC	N/A	N/A
FF-Male WC	N/A	N/A
FF-ACC. WC	N/A	N/A
FF-Emg Staircase	NO (-93.8%)	NO
Staircase	NO (-90.1%)	NO
Lift well	N/A	N/A
Multipurpose activity room	NO (-36.9%)	NO
GF-Change 2	N/A	N/A
GF-Shower 3	N/A	N/A
GF-Machinery Room 1	N/A	N/A
GF-Machinery Room 2	N/A	N/A
GF-Cleaners Locker	NO (-65.8%)	NO
Multipurpose activity room	NO (-81.6%)	NO
Staircase	NO (-94.2%)	NO
FF-Circulation 2	N/A	N/A
FF-Circulation 3	N/A	N/A
Social area	NO (-37.4%)	NO
Multipurpose room	NO (-24.5%)	NO
Staircase	NO (-95.1%)	NO
FF-Circulation 4	N/A	N/A
FF-Cabin 7	NO (-77.1%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
FF-Cabin 8	NO (-77.1%)	NO
FF-Cabin 9	NO (-77.1%)	NO
FF-Cabin10	NO (-77.1%)	NO
FF-Cabin11	NO (-77.1%)	NO
FF-Cabin12	NO (-77.1%)	NO
FF-Cabin 1	NO (-86.1%)	NO
FF-Cabin 2	NO (-86.1%)	NO
FF-Cabin 3	NO (-86.1%)	NO
FF-Cabin 4	NO (-86.1%)	NO
FF-Cabin 5	NO (-86.1%)	NO
FF-Cabin 6	NO (-86.1%)	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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	2225.5	2225.5
External area [m^2]	4353.6	4353.6
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	838.06	1314.88
Average U-value [W/m^2K]	0.19	0.3
Alpha value* [%]	12.08	10

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

Building Use

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

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

	Actual	Notional
Heating	1.66	3.61
Cooling	0.71	1.76
Auxiliary	19.88	17.47
Lighting	11.38	9.05
Hot water	68.16	76.11
Equipment*	28.73	28.73
TOTAL**	**101.78**	**107.98**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	66.27	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*66.27*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	26.08	54.03
Primary energy [kWh/m^2]	56.93	159.43
Total emissions [kg/m^2]	5.74	14.65

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] GSHP/WSHP, [HFT] Electricity, [CFT] Electricity										
	Actual	17.1	9	1.7	0.7	19.9	2.86	3.52	3.5	4.5
	Notional	36.1	18	3.6	1.8	17	2.78	2.84	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Hillingdon Workshop Baseline2

As designed

Date: Wed Jul 19 13:26:57 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.18

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.18

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

Foundation area [m²]: 31.57

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

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	7.59	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	13.28	
Target primary energy rate (TPER), $kWh/m^2.annum$	81.71	
Building primary energy rate (BPER), $kWh/m^2.annum$	141.15	
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	0.26	0.26	GF000001:Surf[2]
Floors	0.18	0.18	0.18	GF000001:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.18	0.18	GF000001:Surf[1]
Windows** and roof windows	1.6	-	-	No windows, galzed doors, or roof windows in building
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	1.59	1.59	GF000000:Surf[3]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

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

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

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- GSHP_Basecase

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	2.5	2	0	2	-
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					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.

"No HWS in project, or hot water is provided by HVAC system"

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

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

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
GF-Tea Station	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-WC	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Technical Manuals Room	-	-	-	-	-	-	-	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
GF-Tea Station	95	-	-
GF-WC	95	-	-
GF-Technical Manuals Room	95	-	-

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

Zone	**Solar gain limit exceeded? (%)**	**Internal blinds used?**
GF-Tea Station	N/A	N/A
GF-WC	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
GF-Technical Manuals Room	N/A	N/A

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	31.6	31.6
External area [m^2]	122.8	122.8
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	8	3
Average conductance [W/K]	29.37	43.08
Average U-value [W/m^{2}K]	0.24	0.35
Alpha value* [%]	25	10

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

Building Use

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

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

	Actual	Notional
Heating	39.36	13.66
Cooling	2.23	5.94
Auxiliary	18.46	15.43
Lighting	30.97	19.22
Hot water	1	0.79
Equipment*	37.46	37.46
TOTAL**	**92.02**	**55.04**

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

Energy Production by Technology [kWh/m^2]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	321.37	235.66
Primary energy [kWh/m^2]	141.15	81.71
Total emissions [kg/m^2]	13.28	7.59

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] GSHP/WSHP, [HFT] Electricity, [CFT] Electricity										
	Actual	309.7	11.7	39.4	2.2	18.5	2.19	1.45	2.5	2
	Notional	136.7	99	13.7	5.9	15.4	2.78	4.63	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Hillingdon Workshop Be Lean2

As designed

Date: Wed Jul 19 13:51:46 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.18

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.18

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

Foundation area [m²]: 31.57

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	7.41	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	6.9	
Target primary energy rate (TPER), $kWh/m^2.annum$	79.64	
Building primary energy rate (BPER), $kWh/m^2.annum$	74.18	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.16	0.16	GF000001:Surf[2]
Floors	0.18	0.11	0.11	GF000001:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.12	0.12	GF000001:Surf[1]
Windows** and roof windows	1.6	-	-	No windows, galzed doors, or roof windows in building
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	1.59	1.59	GF000000:Surf[3]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

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

** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position.

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

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

Air permeability	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	2.5

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- GSHP_Be lean

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.5	2	0	2	0.85
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					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.

1- GSHP_Be lean

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	2.5	-
Standard value	2*	N/A

* Standard shown is for all types except absorption and gas engine heat pumps.

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
GF-Tea Station	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-WC	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Technical Manuals Room	-	-	-	-	-	-	-	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
GF-Tea Station	150	-	-
GF-WC	150	-	-
GF-Technical Manuals Room	150	-	-

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?
GF-Tea Station	N/A	N/A
GF-WC	N/A	N/A
GF-Technical Manuals Room	N/A	N/A

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	31.6	31.6
External area [m^2]	122.8	122.8
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	19.32	43.08
Average U-value [W/m^{2}K]	0.16	0.35
Alpha value* [%]	12.86	10

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

Building Use

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

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

	Actual	Notional
Heating	10.19	13.46
Cooling	0.37	4.69
Auxiliary	17.3	15.43
Lighting	19.79	19.22
Hot water	1	0.79
Equipment*	37.46	37.46
TOTAL**	**48.65**	**53.59**

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

Energy Production by Technology [kWh/m^2]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	82.14	182.69
Primary energy [kWh/m^2]	74.18	79.64
Total emissions [kg/m^2]	6.9	7.41

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] GSHP/WSHP, [HFT] Electricity, [CFT] Electricity										
	Actual	80.2	1.9	10.2	0.4	17.3	2.19	1.45	2.5	2
	Notional	134.7	48	13.5	4.7	15.4	2.78	2.84	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Hillingdon Workshop Be Green_PV3

As designed

Date: Mon Jul 24 16:01:43 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.18

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.18

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

Foundation area [m²]: 31.57

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	7.41	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	-187.13	
Target primary energy rate (TPER), $kWh/m^2.annum$	79.64	
Building primary energy rate (BPER), $kWh/m^2.annum$	-2135	
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	0.16	0.16	GF000001:Surf[2]
Floors	0.18	0.11	0.11	GF000001:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.12	0.12	GF000001:Surf[1]
Windows** and roof windows	1.6	-	-	No windows, galzed doors, or roof windows in building
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	1.59	1.59	GF000000:Surf[3]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

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

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	2.5

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- WSHP_Be green

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	3.5	4.5	0	0.9	0.85
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					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.

1- WSHP_Be green

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	3.5	-
Standard value	2*	N/A

* Standard shown is for all types except absorption and gas engine heat pumps.

Zone-level mechanical ventilation, exhaust, and terminal units

ID	**System type in the Approved Documents**
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

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

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
GF-Tea Station	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-WC	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Technical Manuals Room	-	-	-	-	-	-	-	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
GF-Tea Station	150	-	-
GF-WC	150	-	-
GF-Technical Manuals Room	150	-	-

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?
GF-Tea Station	N/A	N/A
GF-WC	N/A	N/A
GF-Technical Manuals Room	N/A	N/A

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	31.6	31.6
External area [m^2]	122.8	122.8
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	19.32	43.08
Average U-value [W/m^2K]	0.16	0.35
Alpha value* [%]	12.86	10

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

Building Use

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

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

	Actual	Notional
Heating	7.8	13.46
Cooling	0.15	4.69
Auxiliary	12.82	15.43
Lighting	19.79	19.22
Hot water	0.71	0.79
Equipment*	37.46	37.46
TOTAL**	**41.27**	**53.59**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	1489.52	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*1489.52*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	82.14	182.69
Primary energy [kWh/m^2]	-2135.01	79.64
Total emissions [kg/m^2]	-187.13	7.41

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] GSHP/WSHP, [HFT] Electricity, [CFT] Electricity										
	Actual	80.2	1.9	7.8	0.2	12.8	2.86	3.52	3.5	4.5
	Notional	134.7	48	13.5	4.7	15.4	2.78	2.84	----	----

Key to terms

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

BRUKL Output Document

Compliance with England Building Regulations Part L 2021

HM Government

Project name

Hillingdon Boat Shed Baseline2

As designed

Date: Wed Jul 19 14:08:42 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.18

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.18

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

Foundation area [m²]: 33.28

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

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	5.23	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	10.17	
Target primary energy rate (TPER), $kWh/m^2.annum$	56.27	
Building primary energy rate (BPER), $kWh/m^2.annum$	107.96	
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	0.26	0.26	GF000006:Surf[1]
Floors	0.18	0.18	0.18	GF000005:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.18	0.18	VD000000:Surf[0]
Windows** and roof windows	1.6	-	-	No windows, galzed doors, or roof windows in building
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	1.59	1.59	GF000000:Surf[1]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

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

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

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- GSHP_Baseline

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	2.5	2	0	2	-
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					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.

1- GSHP_Baseline

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	2.5	-
Standard value	2*	N/A

* Standard shown is for all types except absorption and gas engine heat pumps.

Zone-level mechanical ventilation, exhaust, and terminal units

ID	**System type in the Approved Documents**
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

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

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
GF-WC	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Kitchenette	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Office	-	-	-	-	-	-	-	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
GF-WC	95	-	-
GF-Kitchenette	95	-	-
GF-Office	95	-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
GF-WC	N/A	N/A
GF-Kitchenette	N/A	N/A
GF-Office	N/A	N/A

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	33.3	33.3
External area [m^2]	122.8	122.8
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	8	3
Average conductance [W/K]	29.1	36.65
Average U-value [W/m^2K]	0.24	0.3
Alpha value* [%]	22.93	10

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

Building Use

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

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

	Actual	Notional
Heating	31.31	9.81
Cooling	1.9	3.56
Auxiliary	17.38	12.34
Lighting	18.75	11.38
Hot water	1	0.79
Equipment*	37.41	37.41
TOTAL**	**70.34**	**37.89**

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

Energy Production by Technology [kWh/m^2]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	256.32	157.57
Primary energy [kWh/m^2]	107.96	56.27
Total emissions [kg/m^2]	10.17	5.23

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] GSHP/WSHP, [HFT] Electricity, [CFT] Electricity										
	Actual	246.4	9.9	31.3	1.9	17.4	2.19	1.45	2.5	2
	Notional	98.2	59.4	9.8	3.6	12.3	2.78	4.63	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Hillingdon Boat Shed Be Lean2

As designed

Date: Wed Jul 19 14:12:06 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.18

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.18

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

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Foundation area [m²]: 33.28

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

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

Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	5.1	
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	5.4	
Target primary energy rate (TPER), kWh/m^2.annum	54.78	
Building primary energy rate (BPER), kWh/m^2.annum	58.02	
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	0.16	0.16	GF000006:Surf[1]
Floors	0.18	0.11	0.11	GF000005:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.12	0.12	VD000000:Surf[0]
Windows** and roof windows	1.6	-	-	No windows, galzed doors, or roof windows in building
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	1.59	1.59	GF000000:Surf[1]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

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

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

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

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

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

Air permeability	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	2.5

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- GSHP_Be Lean

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	2.5	2	0	2	0.85
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					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.

1- GSHP_Be Lean

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	2.5	-
Standard value	2*	N/A

* Standard shown is for all types except absorption and gas engine heat pumps.

Zone-level mechanical ventilation, exhaust, and terminal units

ID	**System type in the Approved Documents**
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

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

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
GF-WC	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Kitchenette	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Office	-	-	-	-	-	-	-	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
GF-WC	150	-	-
GF-Kitchenette	150	-	-
GF-Office	150	-	-

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?
GF-WC	N/A	N/A
GF-Kitchenette	N/A	N/A
GF-Office	N/A	N/A

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	33.3	33.3
External area [m^2]	122.8	122.8
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	19.18	36.65
Average U-value [W/m^{2}K]	0.16	0.3
Alpha value* [%]	12.93	10

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

Building Use

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

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

	Actual	Notional
Heating	7.81	9.74
Cooling	0.2	2.58
Auxiliary	17.02	12.34
Lighting	12.03	11.38
Hot water	1	0.79
Equipment*	37.41	37.41
TOTAL**	**38.06**	**36.83**

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

Energy Production by Technology [kWh/m^2]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	62.5	123.86
Primary energy [kWh/m^2]	58.02	54.78
Total emissions [kg/m^2]	5.4	5.1

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] GSHP/WSHP, [HFT] Electricity, [CFT] Electricity										
	Actual	61.4	1.1	7.8	0.2	17	2.19	1.45	2.5	2
	Notional	97.5	26.4	9.7	2.6	12.3	2.78	2.84	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Hillingdon Boat Shed Be Green_PV3 — As designed

Date: Mon Jul 24 16:16:21 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.18

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.18

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

Foundation area [m²]: 33.28

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	5.1	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	-153.7	
Target primary energy rate (TPER), $kWh/m^2.annum$	54.78	
Building primary energy rate (BPER), $kWh/m^2.annum$	-1767.28	
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	0.16	0.16	GF000006:Surf[1]
Floors	0.18	0.11	0.11	GF000005:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.12	0.12	VD000000:Surf[0]
Windows** and roof windows	1.6	-	-	No windows, galzed doors, or roof windows in building
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	1.59	1.59	GF000000:Surf[1]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

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

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	2.5

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- WSHP_Be Green

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	3.5	4.5	0	0.9	0.85
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					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.

1- WSHP_Be Green

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	3.5	-
Standard value	2*	N/A

* Standard shown is for all types except absorption and gas engine heat pumps.

Zone-level mechanical ventilation, exhaust, and terminal units

ID	**System type in the Approved Documents**
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

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

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
GF-WC	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Kitchenette	-	-	-	-	-	-	-	0.3	-	-	N/A
GF-Office	-	-	-	-	-	-	-	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
GF-WC	150	-	-
GF-Kitchenette	150	-	-
GF-Office	150	-	-

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?
GF-WC	N/A	N/A
GF-Kitchenette	N/A	N/A
GF-Office	N/A	N/A

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Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

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% Area	Building Type
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Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	5.97	9.74
Cooling	0.08	2.58
Auxiliary	12.53	12.34
Lighting	12.03	11.38
Hot water	0.71	0.79
Equipment*	37.41	37.41
TOTAL**	**31.33**	**36.83**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	1234.58	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*1234.58*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	62.5	123.86
Primary energy [kWh/m^2]	-1767.29	54.78
Total emissions [kg/m^2]	-153.7	5.1

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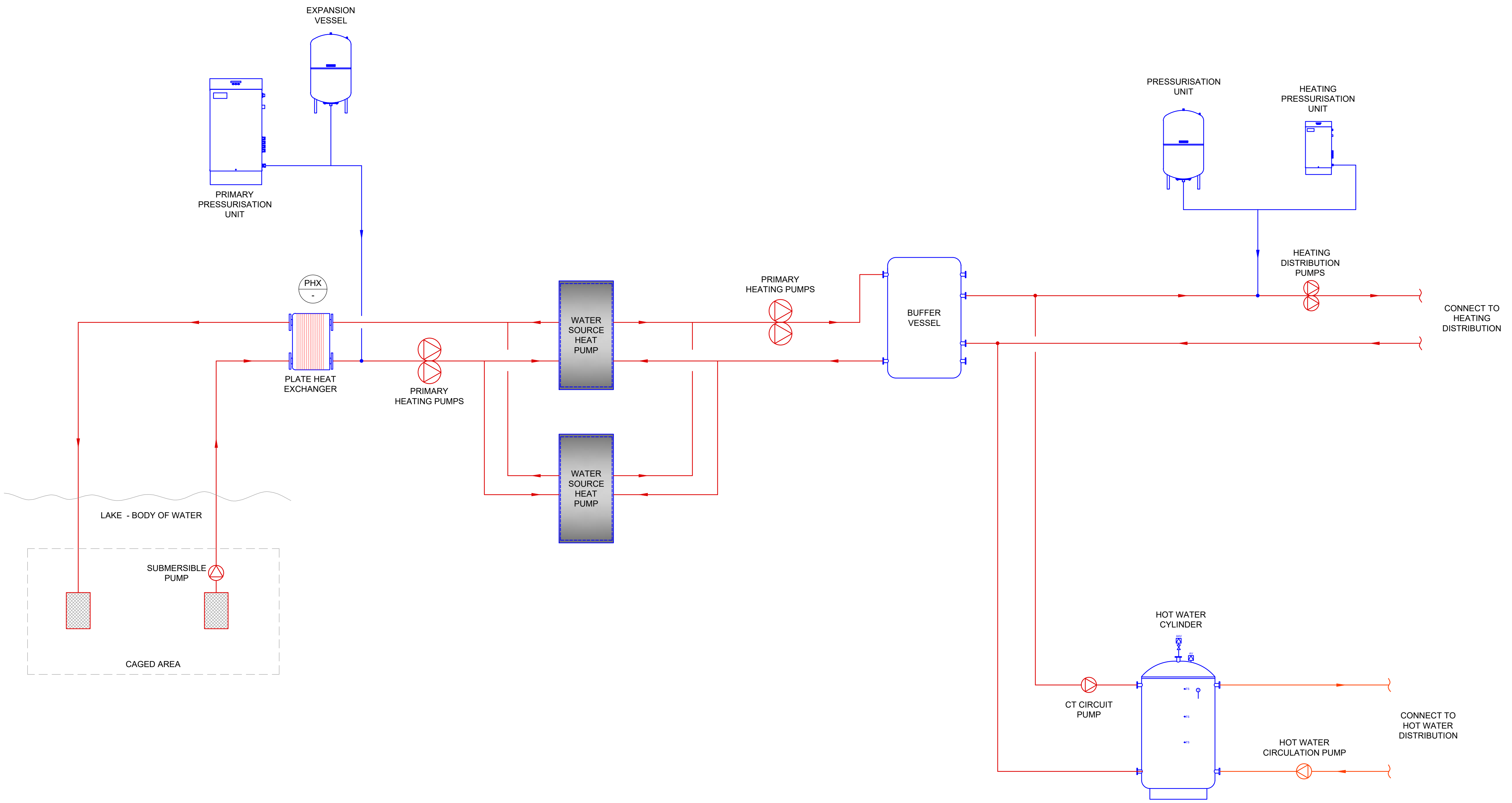
THIS IS NOT AN INSTALLATION / WORKING DRAWING!



DO NOT SCALE DRAWING - IF IN DOUBT, ASK

Notes:

1. THIS DRAWING IS INTENDED AS A SKETCH DIAGRAM OUTLINING THE OVERALL MAIN EQUIPMENT AND PHILOSOPHY.

Rev	Drawn	App'd	Date	Revision Description
A	SO	DG	25.07.23	FOR INFORMATION

Issue

FOR INFORMATION

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Client

LONDON BOROUGH OF HILLINGDON

Project

HILLINGDON WATER SPORTS FACILITY AND ACTIVITY CENTRE

Title

MAIN HEAT GENERATION PHILOSOPHY SCHEMATIC

Scale: NTS @ A1 | Drawn By: S.Osmond

Date: JULY '23 | Checked By: H.Eftekhary

Drg. No. 23-360/M/SK/01 | Rev. A

File name : C:\temp\23-360 HWSFAC\BSGMECH-HWSFAC.dwg User : SAMOSMOND Date Plotted : 25/07/2023 08:47:35