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Gunnersbury Park Sports Facility

Energy Strategy Report
29 October 2015

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Quality Management

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P03	19.10. 2015	Issue for planning	NI	AR	KM
P04	29.10. 2015	Issue for planning incorporating comments from design team	NI	AR	KM

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1. Executive Summary

This Energy Statement for planning has been prepared by Capita Property and Infrastructure to illustrate the concept energy strategy of the proposed development in terms of building fabric, and building services. These have been developed to assist with demonstrating solutions for compliance with the requirements of Part L 2013 of the Building Regulations, the Greater London Authority (GLA) London Plan 2015, the Ealing Council Energy Strategy Document 2013-2018, and the Hounslow Sustainability Guidance and draft proposed Local Plan 2015-2030.

Part L 2013 of the Building Regulations is a national policy which requires compliance in all instances. The London Plan 2015 is a regional policy that requires a more onerous CO_2 reduction target over and above that of the Part L 2013 and is applicable to all buildings within the jurisdiction of the GLA. The Ealing Council Energy Strategy Document, and the Hounslow Sustainability Guidance and draft proposed Local Plan 2015-2030 both reference the requirements to meet Part L 2013 and the London Plan 2015. The Gunnersbury Park Sports Facility development is designed to meet all of the aforementioned policy requirements by utilising highly effective insulation, high building airtightness, high efficiency building services, and low/zero carbon technologies in the form of waste water heat recovery and solar photovoltaics (PV).

The following figures and table present the proposed solutions to satisfying the relevant policies.

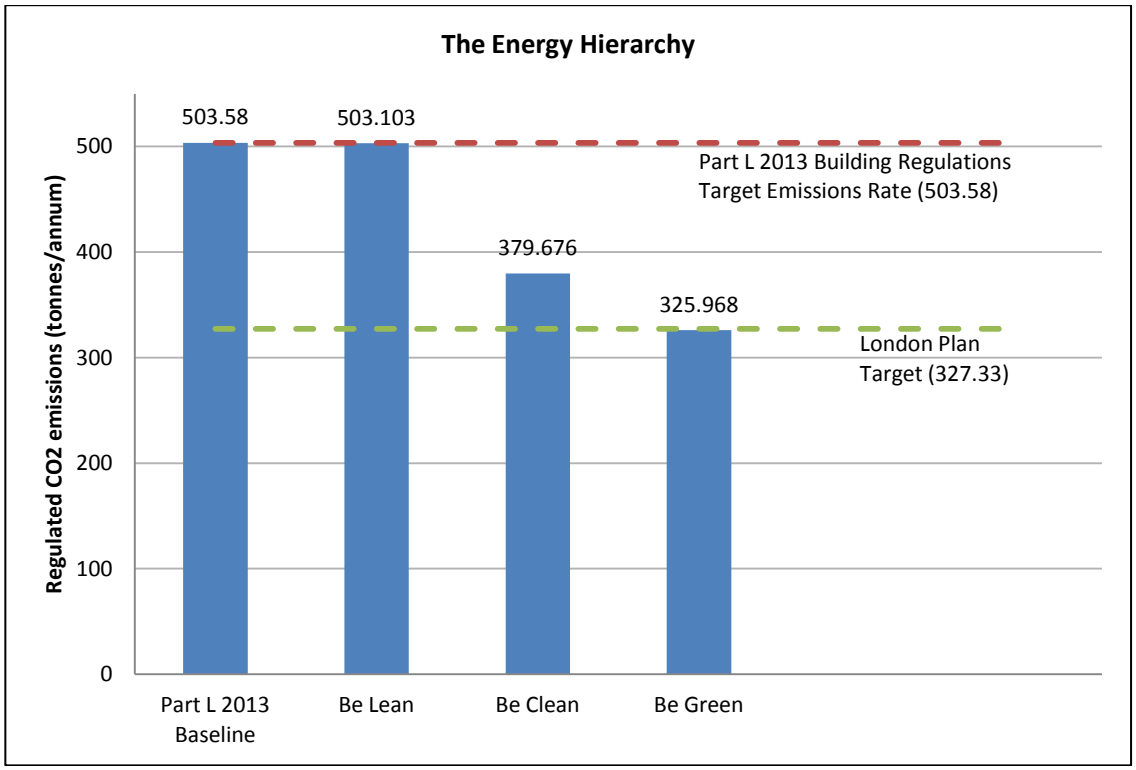


Figure 1.1: The Energy Hierarchy and Compliance with the London Plan

	Carbon dioxide emissions (Tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Part L 2013 Baseline	503.58	56.884
Be Lean	503.103	56.884
Be Clean	379.676	56.884
Be Green	325.968	56.884

Table 1.1: Carbon dioxide emissions after each stage of the Energy Hierarchy

	Regulated Carbon dioxide savings	
Energy Hierarchy	**Tonnes CO2 per annum**	**% reduction (on Part L 2013 baseline building)**
Be Lean	0.5	0.1
Be Clean	123.4	24.5
Be Green	53.7	10.7
Total Cumulative Savings	**177.6**	**35.3**
Total Target Savings	**176.3**	**35.0**
Annual Surplus	**1.4**	

Table 1.2: Regulated carbon dioxide savings from each stage of the Energy Hierarchy

Energy Hierarchy	**Building Regs Part L 2013 Compliant**	**London Plan 2015 Compliant**	**Ealing and Hounslow Council Compliant**	**Features of Compliance**	**% reduction CO_2**	**BER ($kgCO_2/m^2$/year)**	**Part L 2013 TER ($kgCO_2/m^2$/year)**
Be Lean	YES	NO	NO	Improved: • Reduced U-values • Reduced air permeability Rating • Reduced glazing solar heat gain properties • Use of vertical shading fins • Reduced heating and cooling demand via heat recovery ventilation	0.1	153.0	153.2
Be Clean	YES	NO	NO	As above plus the following: • Improved heating and cooling plant efficiencies • DHW - Waste water heat pump heat recovery system.	24.5	115.5	153.1
Be Green	YES	YES	YES	As above plus: • Solar PV approx providing 101,000kWh_e per annum (estimated as 92.0kWp ≈ 920m² assuming monocristalline with a 15% panel efficiency and 80% inverter/losses efficiency)	10.7	99.2	153.1
TOTAL					**35.3**		

Table 1.3: Summary of route to compliance

The route to compliance with Policy 5.2 of the London Plan 2015 is as per the above "Lean, Clean, and Green" hierarchy. It can be seen that with the utilisation of the Features of Compliance within each part of the Energy Hierarchy, compliance is achieved.

1.1 Compliance

As outlined in the Sustainable Design and Construction Supplementary Planning Guidance, since 6 April 2014 the Mayor of London has applied a 35% carbon reduction target beyond Part L 2013 of the Building Regulations. This is deemed to be broadly equivalent to the 40% target beyond Part L 2010 of the Building Regulations, as specified in Policy 5.2 of the London Plan 2015.

It can be seen that the improvements in the building fabric and services alone satisfy the requirements of Part L of the Building Regulations but do not satisfy the requirements of the London Plan and the requirements of Ealing and Hounslow Councils. To satisfy the requirements of the London Plan and requirements of both councils, the scheme will require the provision of a waste water heat recovery system utilising a waste water source heat pump (WSHP), and renewables in the form of a photovoltaic (PV) array with a maximum annual electrical energy provision to the building of 101,000kWh$_e$ (approximated to a rating of 92kWp which would be approx 920m^2 area required).

The following table presents a summary of the relevant planning policy requirements and the predicted NCM CO_2 emissions. These calculations are based on the current building form and early stage indicators of building services performance. These calculations shall be further refined during the next design stage to factor in refinements in the building fabric and building services design.

Policy Level	Planning Policy Document	Policy Requirements	Predicted Achievement
National	Building Regulations Part L 2013	Building Emission Rate (BER) must be less than the Target Emission Rate (TER). BER ≤ TER	BER ≤ TER 35.3% less than TER.
Regional	London Plan 2015, Non-domestic 2013 - 2016	35% reduction in CO_2 emissions on Building Regulations Part L 2013 requirements. This is the equivalent of a 40% Reduction in CO_2 emissions on Building Regulations Part L 2010 requirements.	35.3% reduction in CO_2 emissions on Building Regulations 2013 Part L requirements.
Local	Hounslow Sustainability Guidance Hounslow Local Plan (proposed submission) 2015-2030	Compliance with London Plan 2015 i.e. 40% reduction on Part L 2010 baseline (which the GLA has now approximated to a 35% reduction on the more onerous Part L 2013 baseline).	35.3% reduction in CO_2 emissions on Building Regulations 2013 Part L requirements.
Local	Ealing Council Energy Strategy Document 2013-2018	Compliance with London Plan 2015 and cut at least 20% of CO2 emissions by using renewable energy generation (lower level acceptable where CHP contribution is high).	Of the total 35.3% reduction in CO_2 emissions on the Part L 2013 baseline, 26.1% of the reduction uses a combination of low carbon waste water heat recovery (15.4%) and a PV array (10.7%).

Table 1.4: Planning Policies and Predicted Achievements

This initial appraisal has determined that to comply with the relevant policies, the following key elements will have to be adopted (subject to detailed design).

- Improved U-values well below the notional building and limiting requirements of Part L of the Building Regulations 2013
- Improved glazing properties
- Improved air permeability rating
- Installation of waste water heat recovery heat pump system for DHW for pre-heating water serving gas fired boilers
- Installation of a solar PV array sized to provide no more than approx 101,000kWh$_e$ into the building (assumed rating of 92kWp which would be approx 920m^2 area required)

2. Introduction

This report will focus on the whole of the development as this falls within the requirements of Part L (2013) of the Building Regulations, the London Plan, and Hounslow/Ealing Council sustainability strategies in terms of the CO2 emission targets.

National Calculation Methodology (NCM) based CO_2 modelling analysis using IES VE 2015 has been undertaken (which is a Department for Communities and Local Government (DCLG) approved software provider as at the date of this report. This calculation follows the requirements of the NCM building energy demand/consumption and CO_2 emissions per year for Part L (2013) of the Building Regulations.

Please note that the following calculations are preliminary, and therefore subject to further refinement during detailed design stages.

2.1 Part L CO_2 Modelling Limitations

The CO_2 model produced for this project utilises IES Virtual Environment which is a DCLG accredited modelling software, which has been tested and validated by the manufacturer with regard to the accuracy of results obtained.

The three dimensional modelling and complex data entry with regard to profiles, constructions and services etc has been input using the pre-set Government approved National Calculation Methodology (NCM) templates which are the same for all buildings of this type.

The approved weather data files used by the modelling software are based on recorded data for the nearest geographical location and these provide details on temperature, solar irradiation, wind speed, wind direction etc.

The CO2 emissions calculated are from Government and industry agreed NCM room templates.

These templates contain standard operating conditions for occupancy, equipment gains, lighting levels, room conditioning and minimum ventilation rates, and therefore may not necessarily match the actual usage of the building. Part L CO_2 modelling is a national bench marking tool and is not intended to provide estimates of actual energy consumption/CO_2 emissions, but instead is meant to provide a means of comparing the relative CO_2 emissions potential between buildings.

2.2 Description of Site

The site is located on an existing site in Gunnersbury Park which is located on Popes Lane, London W3 8LQ within the London Borough of Hounslow. Although the area as a whole is in an urban location due to the surrounding built-up environment, the extensive size of the park creates a “rural” microclimate within the vicinity of the proposed development. For the purposes of the calculations performed however, the building has been assumed to be placed within an urban location.

The proposed development comprises a two storey building with a net internal area (NIA) of 3,234.0m^2 as per the architect’s area schedule.

2.3 Scheme Aspiration

The principal aim of the construction of new buildings in energy and sustainability terms is to minimise their environmental impact. This report will focus on minimising NCM calculated carbon dioxide emissions of the development.

It is proposed to initially achieve this by minimising the energy demand of the building through passive means such as building fabric and building services equipment and thereafter maximising the efficiency of building services plant. The strategy will also review the potential for the utilisation of decentralised energy in the form of a district heating scheme and the installation of low and zero carbon technologies.

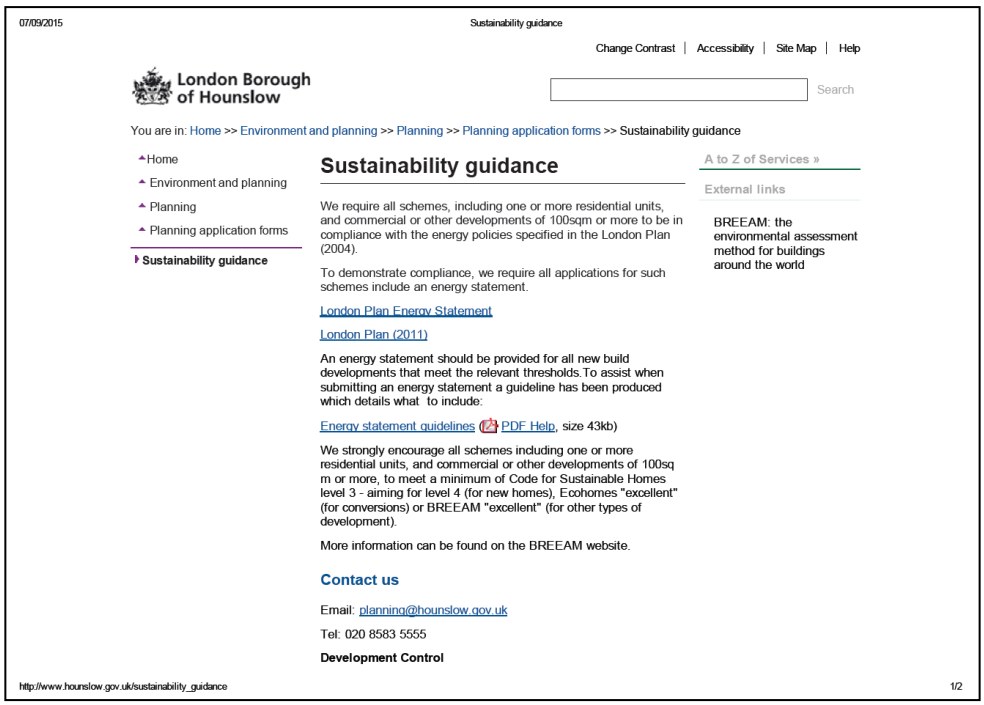
2.4 Planning Policy

The following planning policies related to minimising carbon dioxide (CO_2) emissions from the buildings would be applicable to this development:

- At a National Level – Building Regulations, National Planning Practice Guidance (NPPG) and National Planning Policy Framework (NPPF)
- At a Regional Level – London Plan
- At a Local Level – Hounslow Sustainability Guidance, Hounslow Local Plan (proposed) and Ealing Council Energy Strategy 2013-2018.

At a regional level the London Plan was adopted in 2011 with subsequent amendments amalgamated into an updated version in 2015. This document sets out an integrated economic, environmental, transport and social framework for the development of London to the year 2031. The principal target in terms of minimising carbon dioxide emissions is to achieve a ''40% reduction in CO_2 emissions on Building Regulations 2010 Part L Requirements'' which the GLA have confirmed corresponds with 35% reduction in CO_2 emissions on Building Regulations Part L 2013 requirements.

At a local level the principal aims of the Hounslow Sustainability Guidance and the draft proposed Hounslow Local Plan in terms of minimising carbon dioxide emissions is "reiterating established principles for sustainable design and construction set out in the London Plan".



07/09/2015 Sustainability guidance

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London Borough of Hounslow

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Sustainability guidance

We require all schemes, including one or more residential units, and commercial or other developments of 100sqm or more to be in compliance with the energy policies specified in the London Plan (2004).

To demonstrate compliance, we require all applications for such schemes include an energy statement.

London Plan Energy Statement

London Plan (2011)

An energy statement should be provided for all new build developments that meet the relevant thresholds.To assist when submitting an energy statement a guideline has been produced which details what to include:

Energy statement guidelines PDF Help, size 43kb)

We strongly encourage all schemes including one or more residential units, and commercial or other developments of 100sq m or more, to meet a minimum of Code for Sustainable Homes level 3 - aiming for level 4 (for new homes), Ecohomes "excellent" (for conversions) or BREEAM "excellent" (for other types of development).

More information can be found on the BREEAM website.

Contact us

Email: planning@hounslow.gov.uk

Tel: 020 8583 5555

Development Control

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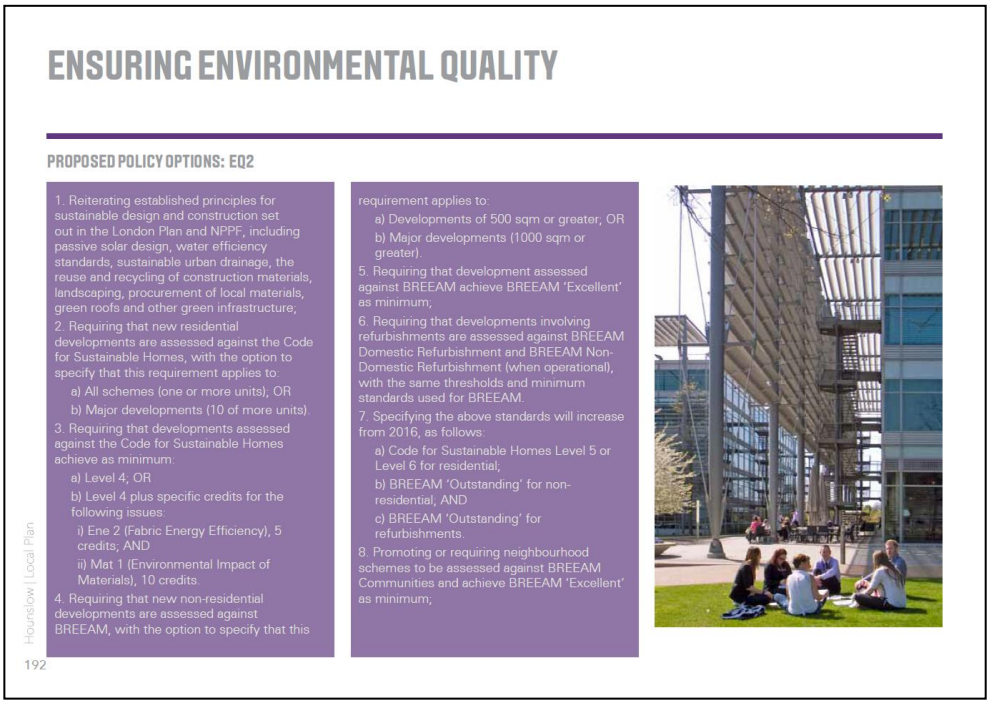
External links

BREEAM: the environmental assessment method for buildings around the world

http://www.hounslow.gov.uk/sustainability_guidance 1/2

Figure 2.1: London Borough of Hounslow Sustainability Guidance (taken 07.09.2015)



ENSURING ENVIRONMENTAL QUALITY

PROPOSED POLICY OPTIONS: EQ2

1. Reiterating established principles for sustainable design and construction set out in the London Plan and NPPF, including passive solar design, water efficiency standards, sustainable urban drainage, the reuse and recycling of construction materials, landscaping, procurement of local materials, green roofs and other green infrastructure;
2. Requiring that new residential developments are assessed against the Code for Sustainable Homes, with the option to specify that this requirement applies to:
   a) All schemes (one or more units); OR
   b) Major developments (10 of more units).
3. Requiring that developments assessed against the Code for Sustainable Homes achieve as minimum:
   a) Level 4; OR
   b) Level 4 plus specific credits for the following issues:
      i) Ene 2 (Fabric Energy Efficiency), 5 credits; AND
      ii) Mat 1 (Environmental Impact of Materials), 10 credits.
4. Requiring that new non-residential developments are assessed against BREEAM, with the option to specify that this requirement applies to:
   a) Developments of 500 sqm or greater, OR
   b) Major developments (1000 sqm or greater).
5. Requiring that development assessed against BREEAM achieve BREEAM 'Excellent' as minimum;
6. Requiring that developments involving refurbishments are assessed against BREEAM Domestic Refurbishment and BREEAM Non-Domestic Refurbishment (when operational), with the same thresholds and minimum standards used for BREEAM.
7. Specifying the above standards will increase from 2016, as follows:
   a) Code for Sustainable Homes Level 5 or Level 6 for residential;
   b) BREEAM 'Outstanding' for non-residential, AND
   c) BREEAM 'Outstanding' for refurbishments.
8. Promoting or requiring neighbourhood schemes to be assessed against BREEAM Communities and achieve BREEAM 'Excellent' as minimum;

Hounslow | Local Plan

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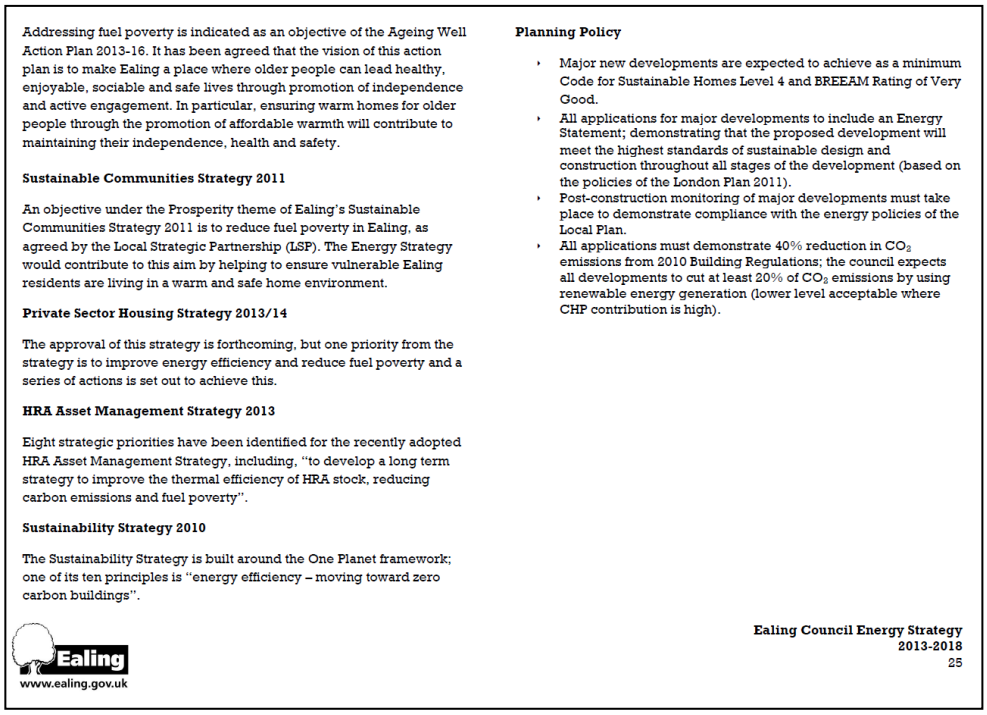
Figure 2.2: Extract from Hounslow Local Plan (Proposed) - Policy EQ2 - ensuring Environmental Quality

At a local level the Ealing Council Energy Strategy 2013-2018 has principal targets in terms of minimising carbon dioxide emissions "based on the policies of the London Plan 2011" to achieve a "40% reduction in CO2 emissions from 2010 Building Regulations; the council expects all developments to cut at least 20% of CO2 emissions by using renewable energy generation (lower level acceptable where CHP contribution is high)."



Addressing fuel poverty is indicated as an objective of the Ageing Well Action Plan 2013-16. It has been agreed that the vision of this action plan is to make Ealing a place where older people can lead healthy, enjoyable, sociable and safe lives through promotion of independence and active engagement. In particular, ensuring warm homes for older people through the promotion of affordable warmth will contribute to maintaining their independence, health and safety.

Sustainable Communities Strategy 2011

An objective under the Prosperity theme of Ealing's Sustainable Communities Strategy 2011 is to reduce fuel poverty in Ealing, as agreed by the Local Strategic Partnership (LSP). The Energy Strategy would contribute to this aim by helping to ensure vulnerable Ealing residents are living in a warm and safe home environment.

Private Sector Housing Strategy 2013/14

The approval of this strategy is forthcoming, but one priority from the strategy is to improve energy efficiency and reduce fuel poverty and a series of actions is set out to achieve this.

HRA Asset Management Strategy 2013

Eight strategic priorities have been identified for the recently adopted HRA Asset Management Strategy, including, "to develop a long term strategy to improve the thermal efficiency of HRA stock, reducing carbon emissions and fuel poverty".

Sustainability Strategy 2010

The Sustainability Strategy is built around the One Planet framework; one of its ten principles is "energy efficiency – moving toward zero carbon buildings".

Planning Policy

- Major new developments are expected to achieve as a minimum Code for Sustainable Homes Level 4 and BREEAM Rating of Very Good.
- All applications for major developments to include an Energy Statement; demonstrating that the proposed development will meet the highest standards of sustainable design and construction throughout all stages of the development (based on the policies of the London Plan 2011).
- Post-construction monitoring of major developments must take place to demonstrate compliance with the energy policies of the Local Plan.
- All applications must demonstrate 40% reduction in CO_2 emissions from 2010 Building Regulations; the council expects all developments to cut at least 20% of CO_2 emissions by using renewable energy generation (lower level acceptable where CHP contribution is high).

Ealing
www.ealing.gov.uk

Ealing Council Energy Strategy
2013-2018
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Figure 2.3: Extract from Ealing Council Energy Strategy

2.5 Policy Measures

The UK Government's aspiration to reduce carbon dioxide (CO_2) emissions from buildings has resulted in the implementation of a number of national policies for developments which have in turn been passed down to developers via regional and local policies.

The relevant national and local policies deemed applicable to this development are stated in this Section, and compliance with the relevant polices is presented in Sections 3 and 4.

2.5.1 National, Regional, and Local Policy Levels

At a National level the relevant policies and standards are the Building Regulations, National Planning Practice Guidance (NPPG) and National Planning Policy Framework (NPPF). At a Regional level the relevant policy is the London Plan and in particular the "Policy 5.2 – Minimising Carbon Dioxide Emissions". At a Local level the relevant policy is the Hounslow Sustainability Guidance (enshrined in the draft Local Plan (Proposed) 2015-2030) and the Ealing Council Energy Strategy 2013-2018.The requirements of these policies are outlined in the table below.

Policy Level	Planning Policy Document	Policy
National	Building Regulations Part L 2013	Building Emission Rate (BER) must be less than the Target Emission Rate (TER). BER ≤TER
Regional	London Plan 2015 *Non-domestic buildings 2013 - 2016*	35% reduction on CO_2 emissions on Building Regulations Part L 2013 requirements. This is the equivalent of a 40% Reduction in CO_2 emissions on Building Regulations Part L 2010 requirements.
Local	Hounslow Sustainability Guidance Hounslow Local Plan (proposed submission) 2015-2030	Compliance with London Plan 2015 i.e. 40% reduction on Part L 2010 baseline (which the GLA has now approximated to a 35% reduction on the more onerous Part L 2013 baseline).
Local	Ealing Council Energy Strategy Document 2013-2018	Compliance with London Plan 2015 and cut at least 20% of CO2 emissions by using renewable energy generation (lower level acceptable where CHP contribution is high).

Table 2.1: National, Regional, and Local Level Requirements

2.6 Methodology

The methodology used in this report to demonstrate the reduction of the development's energy consumption and the associated carbon dioxide (CO_2) emissions will be that of the London Plan.

The London Plan utilises the following Energy Hierarchy:

- Be Green: use renewable energy
- Be Clean: supply energy efficiently
- Be Lean: use less energy

Energy Hierarchy

This hierarchy aims to reduce the energy consumption of the building by means of passive design and active measures in the first instance (Lean). The passive approach reduces the energy consumption required to heat, cool or provide artificial lighting in the building. The active approach would be to implement active design measures such as efficient building services. Thereafter the provision of clean energy is considered such as combined heat and power (CHP) or heat pumps (Clean). Finally, the application of renewable technologies to further minimise CO_2 emissions is considered (Green).

2.7 Procedure

The proposed development has been modelled using IES VE 2015 (see Figure 2.5 and Figure 2.6) which is a DCLG approved software for NCM based simulations used in Part L analysis.

2.8 Site Overview

The Gunnersbury Park Sports Facility proposed development is located within the administrative boundary of Hounslow Council. The site is located within the vicinity of Gunnersbury Park.

Figure 2.4: Site layout plan (AFLS+P Architects)

2.9 Development Overview

The site is located on an existing site in Gunnersbury Park which is located on Popes Lane, London W3 8LQ within the London Borough of Hounslow. Although the area as a whole is in an urban location due to the surrounding built-up environment, the extensive size of the park creates a “rural” microclimate within the vicinity of the proposed development. For the purposes of the calculations performed however, the building has been assumed to be placed within an urban location.

The proposed development comprises a two storey building with a net internal area (NIA) of 3,234.0m^2 as per the architect’s area schedule.

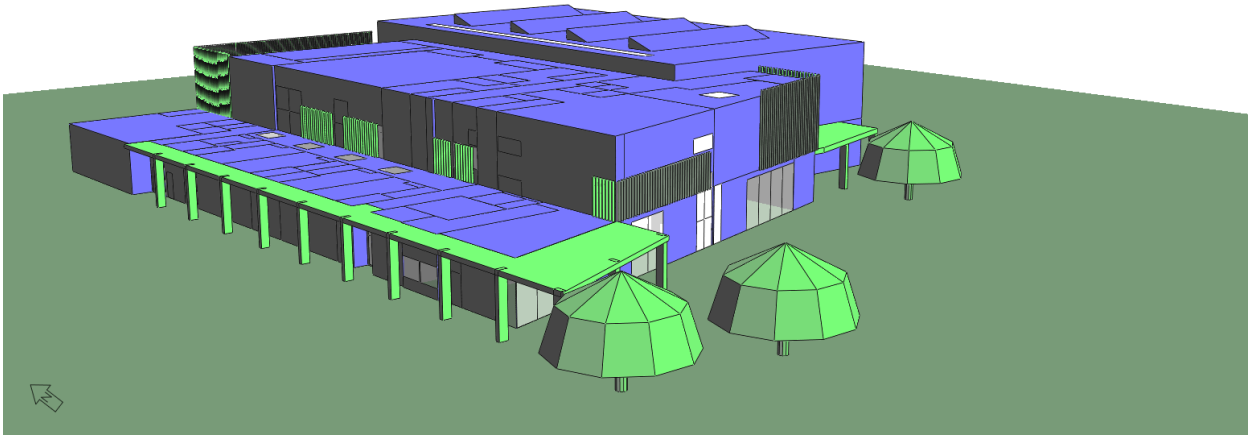


Figure 2.5: 3D view from the south-west

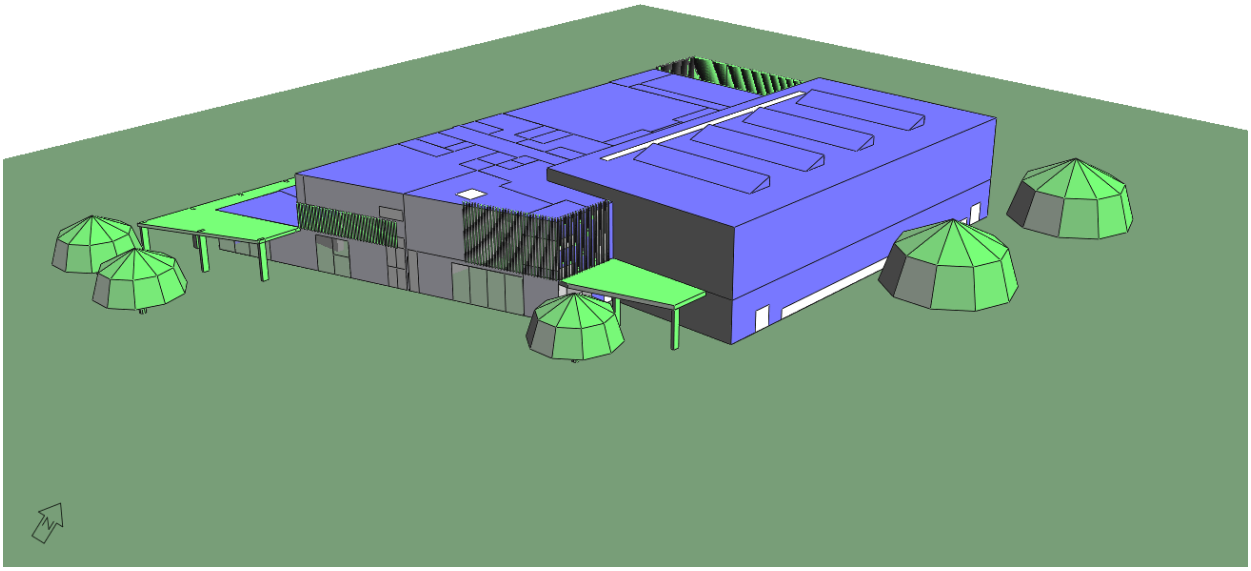


Figure 2.6: 3D view from the south-east

3. Energy Measures (Be Lean, Be Clean, Be Green)

This section of the report describes what improvements have been incorporated to help reduce the building energy demand, improve efficiency of energy supply, and maximise the generation of renewable energy.

3.1 Demand Reduction (Be Lean)

Demand reduction measures concern reducing energy demand by the building through passive means (by improving its fabric performance) and active means (by improving the performance of energy consuming services).

3.1.1 Building Fabric

The table below depicts the Notional and Limiting building fabric U-values/air permeability in Approved Documents L2A 2013 and the parameters proposed for this development.

Construction Element	Proposed U-values	ADL2A 2013 Notional Building U-Values	ADL2A 2013 Limiting U-Values	% improvement of proposed against Notional U-values	% improvement of proposed against limiting U-values
Roof	0.13	0.18	0.25	27.8	48.0
External Walls	0.15	0.26	0.35	42.3	57.1
Ground Floors	0.15	0.22	0.25	31.8	40.0
Openings (i.e. windows)	1.2	1.6	2.2	25.0	45.5
Air permeability Rate (m^3/m^2.hr @ 50Pa)	3	3	10	0.0	70.0

Table 3.1: Building fabric comparisons between proposed and ADL2A 2013 values

In addition to the above, the building services have been designed with the following features to reduce the building's energy demand.

3.1.2 Lighting

1. Utilisation of natural daylight: The building form has been devised so as to optimise the use of natural daylight and minimise dependency on artificial lighting during daylight hours.

2. Incorporation of Light Emitting Diode (LED) luminaires in all spaces. These types of luminaires consume far less electrical energy than traditional linear or compact fluorescent lumianires typically used in non-domestic buildings.

3. Daylight dimming control: The LED luminaires are linked to daylight sensors in spaces with windows and rooflights. These lumianries are designed to dim down when daylight provision is sufficient, and ramp up when daylight is insufficient. This feature allows for the constant provision of suitable illumination at all times with a preference for natural daylight.

4. Occupancy detection: LED luminaires shall be designed to be controlled based on occupancy in a space such that artificial lighting (in conjunction with daylight dimming, where applicable) is only activated when rooms are occupied.

3.1.3 Ventilation

5. Mixed mode and heat recovery: Mechanically ventilated spaces are controlled via a mixed mode system where natural ventilation (which includes free cooling) is utilised whenever conditions are favourable from an energy standpoint and at all other times, mechanical ventilation with heat recovery (with a dry efficiency no worse than 70%) is utilised. This control feature ensures that the building is always running using the least energy intensive heating/cooling and ventilation (and heating/cooling) strategy.

6. Reduced specific fan power: All mechanical systems shall be specified and selected such that the specific fan power is no worse than that required in the Non-domestic Building Services Compliance Guide 2013.

3.1.4 Cooling

7. Thermal mass: Thermal mass through internally exposed blockwork and phase change material shall be incorporated into the building fabric design. When used in conjunction with free night cooling via natural ventilation, this will reduce the cooling loads in high internal gain spaces that require active cooling (such as the fitness studios) and can completely remove altogether the need for active cooling in low internal gain spaces (such as the staffroom and offices). A preliminary CIBSE TM52 overheating calculation incorporating thermal mass has been carried out. The results are in Appendix B.

8. Cooling: Active cooling (with a contribution from thermal mass) will be required in the fitness studios and MPAS area due to the potentially large internal gains arising as a result of exercise activity taking place in those spaces. The museum archive spaces will also receive active cooling due to the very tight internal environment controls required in these spaces (i.e. temperature and humidity) which natural ventilation and thermal mass alone would not be able to provide.

3.1.5 Auxiliary Energy and Controls

9. Auxiliary Energy - pumps: All pumps shall be equipped with variable speed control to minimise electrical power consumption during periods of low load.

10. Auxiliary Energy – fans: All ventilation fans shall be equipped with variable speed control so as to minimise electrical power consumption during periods of low load.

11. Controls: All building services systems shall be controlled from a central Building Management System designed to optimise the performance of systems according to user need and prevailing conditions, as well as provide real-time smart metering of all building services performance metrics for future analysis.

3.2 Energy Supply Efficiency (Be Clean)

3.2.1 CHP review

The main goal of this approach is to generate and supply heating, cooling and electrical energy more efficiently. Typically this is achieved using (among other provisions) Combined Heat and Power (CHP) systems. In a non-domestic setting CHP is typically utilised where it can be guaranteed that an all year round heating demand

(including summer, which is referred to as the base load) would be required, such as in leisure centres with swimming pools, hotels and other multi-residential schemes, hospitals, and prisons.

Gunnersbury Park Sports Facility is not proposed to have a swimming pool, which means that the largest summer time heating load (i.e. base load) will be from the showers, which in themselves cannot be guaranteed to be high during building occupation due to the tendency of shower users to prefer cooler water in summer than in winter for comfort. Further to this the anticipated electrical demand (including non-regulated electrical power i.e. from plugged-in appliances) is unlikely to remain at or around a 1:1 ratio to the heating load throughout the year, due to the variation in heating load mentioned above. For this reason, CHP is not likely to be economic as stated in the Greater London Authority Guidance on Preparing Energy Assessments (April 2015):

Page 25 – "The following types of developments need not install on-site CHP:
Non-domestic developments with a simultaneous demand for heat and power for less than 5,000 hours per annum. Examples of such developments may include offices and schools. Developments falling under the two bullet points above would not be expected to install a site heat network (as there is no prospect of connecting to an area heat network). In these circumstances building/dwelling specific heating technologies, such as individual gas boilers or heat pumps, would be acceptable."

3.2.2 District Heating Review

On the London Heat Map there is no existing district heating network mains (yellow line) and no potential/proposed district heating network mains (red line) within one mile of the proposed building site. However there are decentralised energy potential areas (purple zone) showing where there is the opportunity for inclusion of a district heating network in the future. Based on this, the provision of a future district heating connection could be provided within the Gunnersbury Park Sports Facility.

Figure 3.1: London Heat Map around Gunnersbury Park

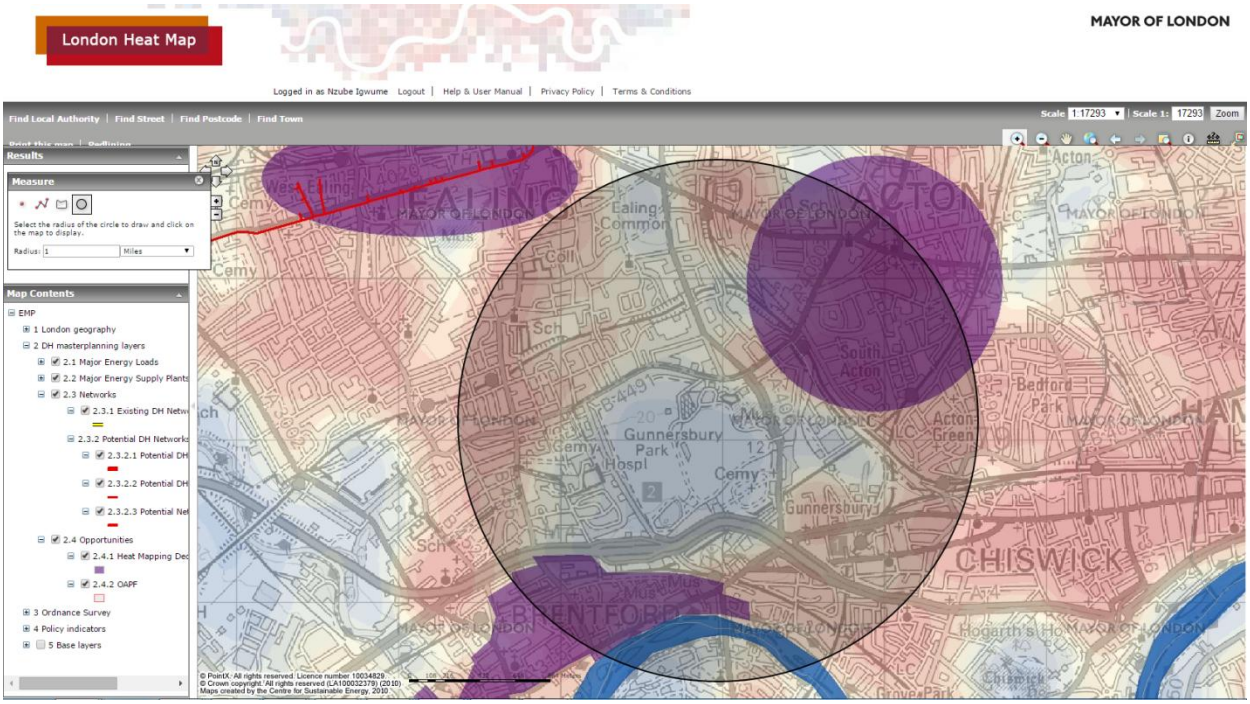


Figure 3.2: London Heat map showing one mile radius around the Sports Facility location in Gunnersbury Park

In general the following energy efficiency measures, deemed as feasible, have been proposed, and listed in the table below:

3.2.3 Be Clean – Energy Features

The following building services features have been provided so as to reduce the CO_2 intensity of heating and cooling energy provided.

3.2.3.1 Heating and cooling

1. Low NO_x gas fired condensing boilers rated at 95% gross efficiency providing space heating to most of site
2. Three-pipe VRF heating/cooling (with simultaneous heat recovery) provided to fitness studio, MPAS, and Museum Archive spaces. The three-pipe system will allow for excess heat generated one of the above zones to be distributed into other zones where there is a call for heat with a corresponding cooling of the source zone. This feature will greatly increase the seasonal coefficient of performance (SCOP) of the VRF system.

3.2.3.2 Domestic hot water

3. Waste water heat recovery system: This system would recover heat from the waste water from the showers and wash hand basins (but not toilets and urinals) which would be at approximately 35°C and use this to pre-heat the incoming cold water supply before it is fed into the gas fired condensing water heaters. This provision is ideal for this sports facility as it would reduce the requirement for gas fired hot water generation by up to approximately 50% on any given day. The system will utilise a water-source heat pump (WSHP) and due to the high wastewater supply temperatures provided, would provide a high

SCOP. Further to this there should be no issue of load mis-matching as heat shall only be recovered when there is a domestic hot water load from the showers and wash hand basins. In order to cope with the lag time between initial hot water generation from the condensing boilers and the recovered heat, a buried highly insulated attenuation tank shall be provided as part of the below ground drainage system. It is anticipated that this feature alone with reduce CO_2 emissions associated with DHW by approximately 15.4%.

3.3 Renewable Energy Measures – Be Green

We have reviewed potential renewable technologies that could be used on the site to assist with compliance with the CO2 emissions requirements set out for the development.

Biomass

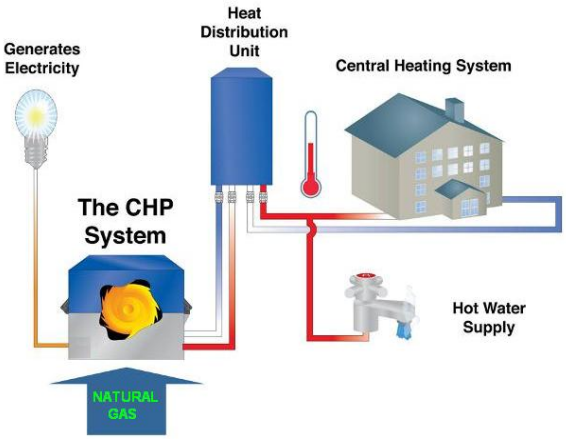
Technology Description – Biomass Boiler

Wood pellets are a type of wood fuel, generally made from compacted sawdust. They are usually produced as a by-product of sawmilling and other wood transformation activities. The pellets are extremely dense and can be produced with a low humidity content (below 10%) that allows them to be burned with a very high combustion efficiency. Further, their regular geometry and small size allow automatic feeding with very fine calibration. They can be fed to a burner by auger feeding or by pneumatic conveying. Their high density also permits compact storage and rational transport over long distance. They can be conveniently blown from a tanker to a storage bunker or silo on a customer's premises. With the surge in the price of fossil fuels, the demand for pellet heating has increased in UK, and when a sizable industry is emerging the cost per kWh is very similar (if not higher) than the equivalent of Natural Gas boilers.

Feasibility

The Mayor's Draft Air Quality Strategy was published for consultation in October 2009 and was fully adopted in December 2010. A policy was formulated based on a threshold of 500kWth for biomass plant in London. It is assumed that biomass installations of less than 500kWth would be too small to warrant the expensive pollution abatement equipment necessary to maintain air quality. With this Strategy, the Mayor aims to ensure that measures to improve air quality are embedded in the planning process. In line with the Mayor's approach, the use of biomass within proposed development site is discouraged as although the baseline heating demand is likely to be higher than 500kWth, the year-round heat utilisation of the facility is likely to be limited due to the lack of a swimming pool. Furthermore the sustainable sourcing of wood chips/pellets (and associated delivery cost) into an Inner London borough is likely to be limited and prohibitively expensive. **This technology is therefore not considered further.**

Biofuel



Technology Description - Biofuel

Biofuels are a wide range of fuels which are in some way derived from biomass. The term covers solid biomass, liquid fuels and various biogases. Bioethanol is an alcohol made by fermenting the sugar components of plant materials and it is made mostly from sugar and starch crops. Ethanol can be used as a fuel for CHP units in its pure form, but it is usually used as a gasoline additive to increase octane and improve vehicle emissions. Biodiesel is made from vegetable oils, animal fats or recycled greases. Biodiesel can be used as a fuel for vehicles in its pure form, but it is usually used as a diesel additive to reduce levels of particulates, carbon monoxide, and hydrocarbons from diesel-powered CHP units. Biodiesel is produced from oils or fats using transesterification and is the most common biofuel in UK.

Feasibility

By 2020, the demand for bio-fuels for cars will be substantially higher due to the targets agreed under the EU Biofuel Directive. Many environmental groups and studies indicate that the targets will not be achievable without reducing the amount of arable land. Resourcing of biofuels by sustainable sources in large quantities may not be a sustainable option in the near future. Bio-liquids, being a finite resource, may be better employed against targets for transport and domestic heating, and incentivized in these applications instead. **Their use therefore is not recommended.**

Wind Energy

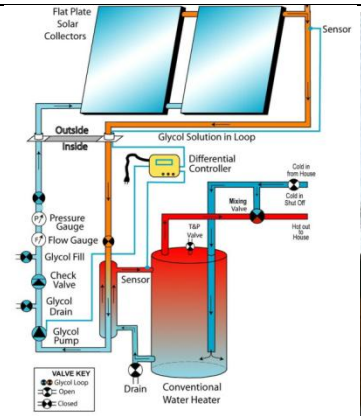

Technology Description – Wind Turbines

Wind power is the conversion of wind energy into a useful form of energy, such as using wind turbines to make electricity. Wind power is non-dispatchable, meaning that for economic operation, all of the available output must be taken when it is available. Good selection of a wind turbine site is critical to the economic development of wind power. Small-scale wind power is the name given to wind generation systems with the capacity to produce up to 50 kW of electrical power. In locations near or around a group of high-rise buildings, wind shear generates areas of intense turbulence, especially at street-level. The risks associated with mechanical or catastrophic failure have thus plagued urban wind development in densely populated areas, rendering the costs of insuring urban wind systems prohibitive. Moreover, quantifying the amount of wind in urban areas has been difficult, as little is known about the actual wind resources of towns and cities.

Feasibility

The site is surrounded by built up areas which would generate air turbulence reducing the maximum achievable air speed. In addition to noise and planning issues, this would limit the generation capacity of the unit making it **unfeasible for the site.**

Solar Thermal or Solar Hot Water



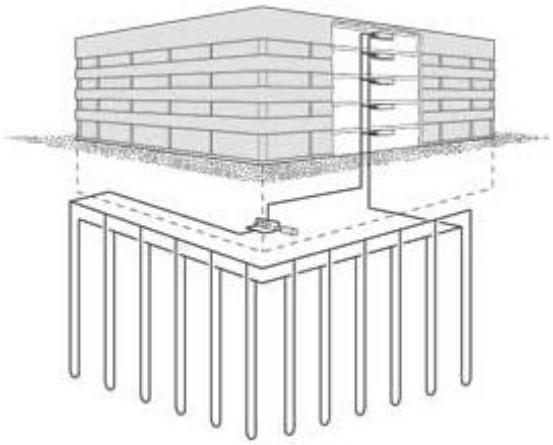
Technology Description – Solar Thermal

Solar thermal systems (also known as solar hot water (SHW)) absorb the sun's energy and generate heat for hot water. The system uses a solar collector in which a fluid is heated by the sun. After collecting and absorbing the available solar radiation, this solar heat is transferred directly to a domestic hot water storage system, from which the heat is distributed. If the system cannot provide adequate heat, an auxiliary or backup system (i.e. boiler) provides the additional heat. Utilising a storage system will generally improve the viability of solar thermal installations by matching the availability of solar domestic hot water to user demand. The schematic above details the components of a Solar Thermal system.

Feasibility

This technology would be in competition with the proposed waste heat recovery system for pre-heating the DHW boilers. Also the area of Solar Thermal panels required to provide compliance with the London Plan 2015 would be over 2000m^2 which the building roof area would not be able to provide. Finally, the peak solar thermal output would be available when there is least hot water demand i.e. in summer which would lead to load mis-matching even with hot water storage. **It has therefore been deemed unfeasible for the development.**

Ground Source Heat Pumps



Technology Description – Ground Source Heat Pump

Modern Ground Source Heat Pump (GSHP) systems reach fairly high Coefficient of Performances (COP), 3-4.5, on the coldest of winter nights, compared to 1.75-2.5 for air-source heat pumps on cool days. Ground source heat pumps are among the most energy efficient technologies for providing HVAC and water heating. Actual COP of a geothermal system which includes the power required to circulate the fluid through the underground tubes can be lower than 2.5. The setup costs are higher than for conventional systems. System life is estimated at 25 years for inside components and 50+ years for the ground loop.

GSHP technologies exploit seasonal temperature differences between ground and air temperatures. Pipework is placed either horizontally or vertically in the ground. Fluid pumped through the pipes takes up heat which is then extracted by the heat pump and released at a higher temperature to drive a space heating system. The same system can also cool occupied space and reject the extracted heat back into the ground.

Feasibility

Ground source heat pumps operate at best efficiency only when both heating (winter) and cooling (summer) profiles are balanced, maintaining fairly constant ground temperature. Gunnersbury Park Sports Facility would most likely have a very high heating demand (from the DHW and heating systems) in winter with a moderate to low cooling demand in summer. This profile mismatch could lead to a steady reduction in ground temperature over time thereby reducing the COP and SCOP of the GSHP system. A means of remedying this would be to utilise the solar thermal system in summer to “top up” the ground temperature or thermal storage medium in the summer and autumn seasons prior to winter. However the costs of having both systems (GSHP and SHW) combined would be uneconomical. **It has therefore been deemed unfeasible.**

Solar Energy

Technology Description – Solar PV

Photovoltaic systems use solar cells to convert sunlight into electricity. The PV consists of one or two layers of a semi-conducting material, usually silicon. When light shines on the cell it creates an electric field across the layers, causing electricity to flow. The greater the light intensity, the greater the flow of electricity. The electrical output from a single cell is small, so multiple cells are connected together and encapsulated (usually behind glass) to form an array with a greater output. PV technology is ideally suited for use on public and commercial buildings, providing pollution and noise-free electricity without requiring extra space, as they can be integrated into the fabric of a building with relative ease.

Energy generated from LZC energy source per year

The system will be sized to provide a proportion of the required 20% reduction of site carbon dioxide emissions via renewables.

Feasibility

There is a proportion of free area on the roof that could be utilised for the installation of solar PV panels. At this point it has been calculated that up to 920m^2 of PV area would be needed and the proposed roof space has enough area for the installation of solar PV. The roof space is also potentially free from shading which would have a detrimental effect on the performance of the panels. In addition the PV electrical output will be at its highest when there is a demand for electrically driven comfort cooling in the high heat gain spaces (studios and MPAS areas) and the museum archive area. **This is the most feasible technology for this site as it would not compete with other chosen technologies.**

To satisfactorily utilise renewable energy we have therefore proposed to adopt the roof space area for PV panels with the following performance requirement:

Total electrical output from all PV panels shall be **not more than 101MWh$_e$/year** and **92kW$_e$ (peak)**.

This can be achieved with approximately 920m^2 of PV panels located on the building roof, facing due south, with an inclination of 30° (final PV array sizing to be completed and confirmed by a specialist).

Date	PV generated electricity (MWh)
Jan 01-31	3.44
Feb 01-28	4.47
Mar 01-31	8.14
Apr 01-30	10.51
May 01-31	12.86
Jun 01-30	14.28
Jul 01-31	13.93
Aug 01-31	12.64
Sep 01-30	9.95
Oct 01-31	6.60
Nov 01-30	3.68
Dec 01-31	2.98
Total	103.48

Table 3.2: Estimated annual electricity generation via PV

The provision of Solar PV also assists with satisfying 10.7% out of the 20% reduction in CO_2 emissions via on-site Low to Zero carbon technologies, and additionally, it helps to achieve the London Plan and Hounslow/Ealing Council CO_2 reduction targets.

3.4 Results

It can be seen that the improvements in the building fabric and services alone satisfy the requirements of Part L of the Building Regulations but do not satisfy the requirements of the London Plan and the requirements of Ealing and Hounslow Councils. To satisfy the requirements of the London Plan and requirements of both councils, the scheme will require the provision of a waste water heat recovery system utilising a waste water source heat pump (WSHP), and renewables in the form of a photovoltaic (PV) array with a maximum annual electrical energy provision to the building of 101,000kWh$_e$ (approximated to a rating of 92kWp which would be approx 920m^2 area required).

	Carbon dioxide emissions (Tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Part L 2013 Baseline	503.58	56.884
Be Lean	503.103	56.884
Be Clean	379.676	56.884
Be Green	325.968	56.884

Table 3.3: Carbon dioxide emissions after each stage of the Energy Hierarchy

	Regulated Carbon dioxide savings	
Energy Hierarchy	**Tonnes CO2 per annum**	**% reduction (on Part L 2013 baseline building)**
Be Lean	0.5	0.1
Be Clean	123.4	24.5
Be Green	53.7	10.7
Total Cumulative Savings	**177.6**	**35.3**
Total Target Savings	**176.3**	**35.0**
Annual Surplus	**1.4**	

Table 3.4: Regulated carbon dioxide savings from each stage of the Energy Hierarchy

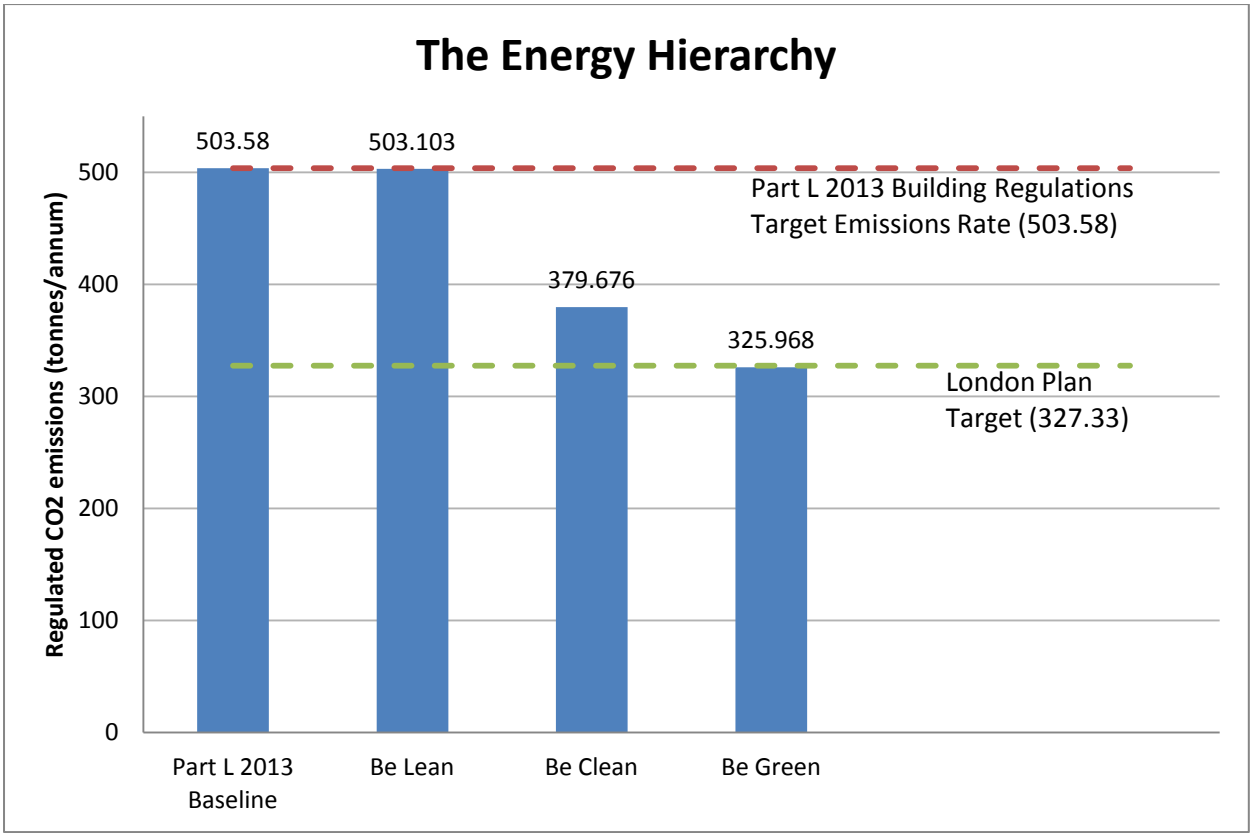


Figure 3.3: The Energy Hierarchy and Compliance with the London Plan

4. Conclusion

The following table presents a summary of the relevant planning policy requirements and the predicted achievements, confirming compliance with all the policy levels.

Policy Level	Planning Policy Document	Policy Requirements	Predicted Achievement
National	Building Regulations Part L 2013	Building Emission Rate (BER) must be less than the Target Emission Rate (TER). BER ≤ TER	BER ≤ TER 35.3% less than TER.
Regional	London Plan 2015, Non-domestic 2013 - 2016	35% reduction in CO_2 emissions on Building Regulations Part L 2013 requirements. This is the equivalent of a 40% Reduction in CO_2 emissions on Building Regulations Part L 2010 requirements.	35.3% reduction in CO_2 emissions on Building Regulations 2013 Part L requirements.
Local	Hounslow Sustainability Guidance Hounslow Local Plan (proposed submission) 2015-2030	Compliance with London Plan 2015 i.e. 40% reduction on Part L 2010 baseline (which the GLA has now approximated to a 35% reduction on the more onerous Part L 2013 baseline).	35.3% reduction in CO_2 emissions on Building Regulations 2013 Part L requirements.
Local	Ealing Council Energy Strategy Document 2013-2018	Compliance with London Plan 2015 and cut at least 20% of CO2 emissions by using renewable energy generation (lower level acceptable where CHP contribution is high).	Of the total 35.3% reduction in CO_2 emissions on the Part L 2013 baseline, 26.1% of the reduction uses a combination of low carbon waste water heat recovery (15.4%) and a PV array (10.7%).

Table 4.1: Planning policies and predicted achievements

This initial appraisal has determined that to comply with the relevant policies, the following key elements will have to be adopted (subject to detailed design).

- Improved U-values well below the notional building and limiting requirements of Part L of the Building Regulations 2013
- Improved glazing properties
- Improved air permeability rating
- Installation of waste water heat recovery heat pump system for DHW for pre-heating water serving gas fired boilers
- Installation of a solar PV array sized to provide no more than approx 101,000kWh$_e$ into the building (assumed rating of 92kWp which would be approx 920m^2 area required)

Appendix A – Preliminary Lean, Clean and Green BRUKL Output documents

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Gunnersbury LEAN

As designed

Date: Wed Sep 09 16:44:26 2015

Administrative information

Building Details

Address: Gunnersbury Park Sports Facility, London, W3 8LQ

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.4

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.4

BRUKL compliance check version: v5.2.d.2

Owner Details

Name: Ealing Council

Telephone number:

Address: , ,

Certifier details

Name: Nzube Igwume

Telephone number: 01923294800

Address: Capita Property and Infrastructure, 1st Floor Oak House, Reeds Crescent, Watford, WD24 4PH

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	153.2
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	153.2
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	153
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.24	1.64	GF000000:Surf[2]
Floor	0.25	0.15	0.15	RM000000:Surf[0]
Roof	0.25	0.15	1.64	VD000000:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.17	1.2	CR000000:Surf[2]
Personnel doors	2.2	2.2	2.2	RM000000:Surf[2]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

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

* There might be more than one surface where the maximum U-value occurs.
** 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.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	3

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- LEAN 3 VRF Mixmod Mass MVHR 70pc

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.91	2.6	0	0	0.7
Standard value	0.91*	3.2	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

2- LEAN 2 Radiator Mixmod Mass MVHR 70pc

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.91	-	0	0	0.7
Standard value	0.91*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

3- LEAN 5 Rad only

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.91	-	0	0	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

4- LEAN 1 Underfloor VRF temper AHU HR 70pc

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.91	-	0	0	0.7
Standard value	0.91*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

5- LEAN 3A VRF Mixmod NV Mass MVHR 70pc

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.91	2.6	0	0	0.7
Standard value	0.91*	3.2	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

6- LEAN 4 Rad panel VRF temper AHU HR 70pc

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.91	-	0	0	0.7
Standard value	0.91*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

1- LEAN DHW WSHP waste heat scop 4

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.91	-
Standard value	0.9*	N/A
* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.		

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
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 supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

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	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
GF 37 TOP OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 MIDDLE OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 LOBBY	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 BOTTOM OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 BOTTOM WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 TOP WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 KITCHENETTE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 33 ESCAPE STAIR	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 38 OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 51 ACC WC	-	-	-	1.5	-	-	-	-	-	-	N/A
CORRIDOR	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 MCCC OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 OFFICE RIGHT	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 21 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 21 SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 21 TEAM CHANGE 5	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 50 OFFICIAL CH SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 49 FIRST AID	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 19 TEAM CHANGE 4 SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 19 TEAM CHANGE 4 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 50 OFFICAIL CH	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 19 TEAM CHANGE 4	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 18 TEAM CHANGE 3 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 18 TEAM CHANGE 3 SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 18 TEAM CHANGE 3	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 43 TEAM CHANGE 2 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 43 TEAM CHANGE 2 SHOWER	-	-	-	1.5	-	-	-	-	-	-	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	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
GF 43 TEAM CHANGE 2	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 42 TEAM CHANGE 1 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 42 TEAM CHANGE 1 SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 42 TEAM CHANGE 1	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 15 ACC CHANGE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 09 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 10 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 08 CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 07 ACC WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 20 TEAM CHANGE 6 SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 20 TEAM CHANGE 6 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 20 TEAM CHANGE 6	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 14 DRY CHANGE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 14 DRY CHANGE SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 53 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 14 CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 34 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 13 DRY CHANGE SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 13 DRY CHANGE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 13 DRY CHANGE CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 36 OFFICIAL CH	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 22 TEAM CHANGE 7 SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 22 TEAM CHANGE 7 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 22 TEAM CHANGE 7	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 23 TEAM CHANGE 8 SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 23 TEAM CHANGE 8 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 23 TEAM CHANGE 8	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 30 CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 02 OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 29 CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 01-2 RECEPTION	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 01-3 CIRCLATION	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 01 FOYER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 12 ACC CHANGE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 03-1 SERVERY	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 03 CAFE	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 03 ACC CHANGE	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 09 ACC WC	-	-	-	1.5	-	-	-	-	-	-	N/A
VOID OVER HUB	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 07 CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 11 STAFF ROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 05 CHANGE SHOWER	-	-	-	1.5	-	-	-	-	-	-	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	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
FF 05 CHANGE	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 05 CHANGE WC	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 04 CHANGE SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 04 CHANGE WC	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 04 CHANGE	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 10 CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
STAIR WELL	-	-	-	1.5	-	-	-	-	-	-	N/A
CORRIDOR	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 13 OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 01-1 LOBBY	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 11 SPORTS HALL	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 11 SPORTS HALL VOID	-	-	-	1.5	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
ROLLER RACKING LOBBY	-	202	-	25
GF 37 TOP OFFICE	128	-	-	89
GF 37 MIDDLE OFFICE	127	-	-	92
GF 37 STORE	181	-	-	3
GF 37 LOBBY	-	263	-	17
GF 37 BOTTOM OFFICE	127	-	-	92
GF 37 PRINT STORE	90	-	-	17
GF 37 BOTTOM WC	-	567	-	14
GF 37 TOP WC	-	567	-	14
GF 37 KITCHENETTE	143	-	-	72
GF 28 PLANT	119	-	-	164
GF 33 ESCAPE STAIR	-	170	-	36
CL STORE	162	-	-	6
GF 38 QUARANTINE	119	-	-	9
GF 38 OFFICE	162	-	-	56
GF 37 PALLET STORAGE LOBBY	-	233	-	18
GF 51 ACC WC	-	549	-	15
GF 38 MUSEUM ARCHIVE	54	-	-	150
CORRIDOR	-	137	-	96
GF 37 MCCC OFFICE	80	-	-	717
GF 37 OFFICE RIGHT	130	-	-	86
GF 27 SPORTS HALL	63	-	-	123
GF 21 WC	-	394	-	19
GF 21 SHOWER	-	201	-	20
GF 21 TEAM CHANGE 5	-	123	-	79
GF 50 OFFICIAL CH SHOWER	-	301	-	6
GF 49 FIRST AID	114	-	-	79

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
GF 19 TEAM CHANGE 4 SHOWER	-	200	-	20
GF 19 TEAM CHANGE 4 WC	-	414	-	19
GF 50 OFFICAIL CH	-	161	-	30
GF 50 CUPBOARD	181	-	-	2
GF 19 TEAM CHANGE 4	-	123	-	85
GF 19 TEAM CHANGE 4 CUPBOARD	181	-	-	2
GF 18 TEAM CHANGE 3 WC	-	429	-	18
GF 18 TEAM CHANGE 3 SHOWER	-	206	-	19
GF 18 TEAM CHANGE 3 CUPBOARD	181	-	-	2
GF 18 TEAM CHANGE 3	-	123	-	85
GF 43 TEAM CHANGE 2 WC	-	413	-	19
GF 43 TEAM CHANGE 2 SHOWER	-	200	-	20
GF 43 TEAM CHANGE 2 CUPBOARD	181	-	-	1
GF 43 TEAM CHANGE 2	-	127	-	75
GF 42 TEAM CHANGE 1 WC	-	430	-	18
GF 42 TEAM CHANGE 1 SHOWER	-	206	-	19
GF 42 TEAM CHANGE 1	-	127	-	75
GF 42 TEAM CHANGE 1 CUPBOARD	181	-	-	2
GF 04.1 KITCHEN STORE	119	-	-	11
GF 04 KITCHEN	-	203	-	216
GF 15 ACC CHANGE	-	427	-	21
GF 05 BAR STORE	181	-	-	5
GF 09 WC	-	602	-	11
GF 10 WC	-	602	-	11
GF 08 CIRCULATION	-	251	-	20
GF 07 ACC WC	-	580	-	13
GF 06.1 STORE	181	-	-	5
GF 06 MULTIPURPOSE ROOM	-	69	-	264
GF 20 TEAM CHANGE 6 SHOWER	-	206	-	19
GF 20 TEAM CHANGE 6 WC	-	430	-	18
GF 20 TEAM CHANGE 6 CUPBOARD	181	-	-	1
GF 20 TEAM CHANGE 6	-	127	-	76
GF 14 DRY CHANGE	-	122	-	123
GF 14 DRY CHANGE SHOWER	-	180	-	28
GF 53 WC	-	353	-	33
GF 14 CIRCULATION	-	301	-	13
GF 34 WC	-	340	-	37
GF 13 DRY CHANGE SHOWER	-	180	-	30
GF 13 DRY CHANGE	-	119	-	122
GF 13 DRY CHANGE CIRCULATION	-	301	-	11
GF 36 OFFICIAL CH	-	183	-	32
GF 22 TEAM CHANGE 7 SHOWER	-	207	-	19
GF 22 TEAM CHANGE 7 WC	-	430	-	18

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
GF 22 TEAM CHANGE 7 CUPBOARD	181	-	-	1
GF 22 TEAM CHANGE 7	-	127	-	76
GF 23 TEAM CHANGE 8 SHOWER	-	201	-	20
GF 23 TEAM CHANGE 8 WC	-	414	-	19
GF 23 TEAM CHANGE 8	-	127	-	76
GF 23 TEAM CHANGE 8 CUPBOARD	181	-	-	1
GF 30 CIRCULATION	-	130	-	148
GF 02 OFFICE	149	-	-	66
GF 29 CIRCULATION	-	124	-	291
CIRCULATION	-	137	-	146
GF 01-2 RECEPTION	-	97	15	96
GF 01-3 CIRCLATION	-	109	-	97
GF 01 FOYER	-	77	15	628
GF 12 ACC CHANGE	-	399	-	24
GF 03-1 SERVERY	91	-	-	203
GF 03 CAFE	-	59	-	949
FF 01-1 STUDIO STORE	140	-	-	16
FF 03 ACC CHANGE	-	287	-	22
FF 09 ACC WC	-	602	-	17
VOID OVER HUB	-	226	15	0
FF 07 CIRCULATION	-	107	-	185
FF 08 CL ST	181	-	-	5
FF 11 STAFF ROOM	165	-	-	94
FF 01 STUDIO	-	63	-	1060
FF 05 CHANGE SHOWER	-	248	-	25
FF 05 CHANGE	-	163	-	92
FF 05 CHANGE WC	-	546	-	27
FF 04 CHANGE SHOWER	-	239	-	26
FF 04 CHANGE WC	-	546	-	27
FF 04 CHANGE	-	165	-	90
FF 10 CIRCULATION	-	248	-	69
FF 12 PLANT	119	-	-	233
STAIR WELL	-	177	-	64
CORRIDOR	-	142	-	312
FF 06 STUDIO	140	-	-	16
FF 06-2 STUDIO	-	58	-	1832
FF 06-1 STUDIO STORE	140	-	-	16
FF 13 OFFICE	142	-	-	127
GF 01-1 LOBBY	-	154	-	45
GF 11 SPORTS HALL	-	110	-	7040
GF 11 SPORTS HALL VOID	-	338	-	0

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
ROLLER RACKING LOBBY	N/A	N/A
GF 37 TOP OFFICE	N/A	N/A
GF 37 MIDDLE OFFICE	N/A	N/A
GF 37 BOTTOM OFFICE	N/A	N/A
GF 37 KITCHENETTE	N/A	N/A
GF 38 QUARANTINE	N/A	N/A
GF 38 OFFICE	N/A	N/A
GF 37 PALLET STORAGE LOBBY	N/A	N/A
GF 38 MUSEUM ARCHIVE	N/A	N/A
GF 37 MCCC OFFICE	N/A	N/A
GF 37 OFFICE RIGHT	N/A	N/A
GF 49 FIRST AID	N/A	N/A
GF 04 KITCHEN	N/A	N/A
GF 06 MULTIPURPOSE ROOM	N/A	N/A
GF 02 OFFICE	N/A	N/A
GF 01-2 RECEPTION	N/A	N/A
GF 01 FOYER	NO (-9.4%)	YES
GF 03-1 SERVERY	NO (-62.8%)	YES
GF 03 CAFE	NO (-64.6%)	YES
VOID OVER HUB	NO (-40.1%)	YES
FF 11 STAFF ROOM	NO (-48%)	YES
FF 01 STUDIO	NO (-71.9%)	YES
FF 06-2 STUDIO	NO (-61.1%)	YES
FF 13 OFFICE	NO (-69.9%)	YES
GF 11 SPORTS HALL	N/A	N/A
GF 11 SPORTS HALL VOID	NO (-95.2%)	YES

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	3287.4	3287.4
External area [m^2]	6952.3	6952.3
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	4
Average conductance [W/K]	1513.31	2158.31
Average U-value [W/m^2K]	0.22	0.31
Alpha value* [%]	10.01	10

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
100	**D2 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	11.87	14.26
Cooling	0.09	0.34
Auxiliary	22.23	20.4
Lighting	19.2	22.17
Hot water	599.37	594.38
Equipment*	34.19	34.19
TOTAL**	**652.77**	**651.55**

* Energy used by equipment does not count towards the total for 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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	37.33	47.72
Primary energy* [kWh/m^2]	870	871.01
Total emissions [kg/m^2]	153	153.2

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	56.9	0	18.5	0	24.7	0.85	0	0.91	0
	Notional	54.5	0	17.6	0	21.8	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	62.9	0	20.4	0	11.3	0.85	0	0.91	0
	Notional	58.4	0	18.8	0	6.7	0.86	0	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	24.2	2.3	7.5	0.3	17	0.89	2.24	0.91	3
	Notional	68.1	27.5	22	2.7	11.6	0.86	2.84	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	0.9	0	0.3	0	18.5	0.85	0	0.91	0
	Notional	22.5	0	7.2	0	20.4	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	76.6	0	24.9	0	1.5	0.85	0	0.91	0
	Notional	82	0	26.4	0	0.9	0.86	0	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	3.3	5.5	1	0.7	49.9	0.89	2.24	0.91	3
	Notional	6	18.1	1.9	1.8	45.4	0.86	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

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.15	RM000000:Surf[3]
Floor	0.2	0.15	RM000000:Surf[0]
Roof	0.15	0.13	RM000000:Surf[1]
Windows, roof windows, and rooflights	1.5	0.7	GF000039:Surf[1]
Personnel doors	1.5	2.2	RM000000:Surf[2]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	3

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Gunnersbury CLEAN

As designed

Date: Wed Sep 09 16:50:42 2015

Administrative information

Building Details

Address: Gunnersbury Park Sports Facility, London, W3 8LQ

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.4

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.4

BRUKL compliance check version: v5.2.d.2

Owner Details

Name: Ealing Council

Telephone number:

Address: , ,

Certifier details

Name: Nzube Igwume

Telephone number: 01923294800

Address: Capita Property and Infrastructure, 1st Floor Oak House, Reeds Crescent, Watford, WD24 4PH

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	153.1
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	153.1
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	115.5
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.24	1.64	GF000000:Surf[2]
Floor	0.25	0.15	0.15	RM000000:Surf[0]
Roof	0.25	0.15	1.64	VD000000:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.17	1.2	CR000000:Surf[2]
Personnel doors	2.2	2.2	2.2	RM000000:Surf[2]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

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

* There might be more than one surface where the maximum U-value occurs.
** 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.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	3

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- CLEAN 3 VRF Mixmod Mass MVHR 70pc

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	5.5	2.6	0	0	0.7
Standard value	2.5*	3.2	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

2- CLEAN 2 Radiator Mixmod Mass MVHR 70pc

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.95	-	0	0	0.7
Standard value	0.91*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

3- CLEAN 5 Rad only

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.95	-	0	0	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

4- CLEAN 1 Underfloor VRF temper AHU HR 70pc

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.95	-	0	0	0.7
Standard value	0.91*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

5- CLEAN 3A VRF Mixmod NV Mass MVHR 70pc

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	5.5	2.6	0	0	0.7
Standard value	2.5*	3.2	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

6- CLEAN 4 Rad panel VRF temper AHU HR 70pc

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.95	-	0	0	0.7
Standard value	0.91*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

1- CLEAN DHW WWHP GAS Hybrid SE 1-279

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1.28	-
Standard value	0.9*	N/A
* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.		

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
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 supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

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	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
GF 37 TOP OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 MIDDLE OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 LOBBY	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 BOTTOM OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 BOTTOM WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 TOP WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 KITCHENETTE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 33 ESCAPE STAIR	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 38 OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 51 ACC WC	-	-	-	1.5	-	-	-	-	-	-	N/A
CORRIDOR	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 MCCC OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 OFFICE RIGHT	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 21 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 21 SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 21 TEAM CHANGE 5	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 50 OFFICIAL CH SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 49 FIRST AID	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 19 TEAM CHANGE 4 SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 19 TEAM CHANGE 4 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 50 OFFICAIL CH	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 19 TEAM CHANGE 4	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 18 TEAM CHANGE 3 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 18 TEAM CHANGE 3 SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 18 TEAM CHANGE 3	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 43 TEAM CHANGE 2 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 43 TEAM CHANGE 2 SHOWER	-	-	-	1.5	-	-	-	-	-	-	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	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
GF 43 TEAM CHANGE 2	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 42 TEAM CHANGE 1 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 42 TEAM CHANGE 1 SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 42 TEAM CHANGE 1	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 15 ACC CHANGE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 09 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 10 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 08 CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 07 ACC WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 20 TEAM CHANGE 6 SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 20 TEAM CHANGE 6 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 20 TEAM CHANGE 6	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 14 DRY CHANGE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 14 DRY CHANGE SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 53 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 14 CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 34 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 13 DRY CHANGE SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 13 DRY CHANGE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 13 DRY CHANGE CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 36 OFFICIAL CH	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 22 TEAM CHANGE 7 SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 22 TEAM CHANGE 7 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 22 TEAM CHANGE 7	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 23 TEAM CHANGE 8 SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 23 TEAM CHANGE 8 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 23 TEAM CHANGE 8	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 30 CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 02 OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 29 CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 01-2 RECEPTION	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 01-3 CIRCLATION	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 01 FOYER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 12 ACC CHANGE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 03-1 SERVERY	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 03 CAFE	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 03 ACC CHANGE	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 09 ACC WC	-	-	-	1.5	-	-	-	-	-	-	N/A
VOID OVER HUB	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 07 CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 11 STAFF ROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 05 CHANGE SHOWER	-	-	-	1.5	-	-	-	-	-	-	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	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
FF 05 CHANGE	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 05 CHANGE WC	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 04 CHANGE SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 04 CHANGE WC	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 04 CHANGE	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 10 CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
STAIR WELL	-	-	-	1.5	-	-	-	-	-	-	N/A
CORRIDOR	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 13 OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 01-1 LOBBY	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 11 SPORTS HALL	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 11 SPORTS HALL VOID	-	-	-	1.5	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
ROLLER RACKING LOBBY	-	202	-	25
GF 37 TOP OFFICE	128	-	-	89
GF 37 MIDDLE OFFICE	127	-	-	92
GF 37 STORE	181	-	-	3
GF 37 LOBBY	-	263	-	17
GF 37 BOTTOM OFFICE	127	-	-	92
GF 37 PRINT STORE	90	-	-	17
GF 37 BOTTOM WC	-	567	-	14
GF 37 TOP WC	-	567	-	14
GF 37 KITCHENETTE	143	-	-	72
GF 28 PLANT	119	-	-	164
GF 33 ESCAPE STAIR	-	170	-	36
CL STORE	162	-	-	6
GF 38 QUARANTINE	119	-	-	9
GF 38 OFFICE	162	-	-	56
GF 37 PALLET STORAGE LOBBY	-	233	-	18
GF 51 ACC WC	-	549	-	15
GF 38 MUSEUM ARCHIVE	54	-	-	150
CORRIDOR	-	137	-	96
GF 37 MCCC OFFICE	80	-	-	717
GF 37 OFFICE RIGHT	130	-	-	86
GF 27 SPORTS HALL	63	-	-	123
GF 21 WC	-	394	-	19
GF 21 SHOWER	-	201	-	20
GF 21 TEAM CHANGE 5	-	123	-	79
GF 50 OFFICIAL CH SHOWER	-	301	-	6
GF 49 FIRST AID	114	-	-	79

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
GF 19 TEAM CHANGE 4 SHOWER	-	200	-	20
GF 19 TEAM CHANGE 4 WC	-	414	-	19
GF 50 OFFICAIL CH	-	161	-	30
GF 50 CUPBOARD	181	-	-	2
GF 19 TEAM CHANGE 4	-	123	-	85
GF 19 TEAM CHANGE 4 CUPBOARD	181	-	-	2
GF 18 TEAM CHANGE 3 WC	-	429	-	18
GF 18 TEAM CHANGE 3 SHOWER	-	206	-	19
GF 18 TEAM CHANGE 3 CUPBOARD	181	-	-	2
GF 18 TEAM CHANGE 3	-	123	-	85
GF 43 TEAM CHANGE 2 WC	-	413	-	19
GF 43 TEAM CHANGE 2 SHOWER	-	200	-	20
GF 43 TEAM CHANGE 2 CUPBOARD	181	-	-	1
GF 43 TEAM CHANGE 2	-	127	-	75
GF 42 TEAM CHANGE 1 WC	-	430	-	18
GF 42 TEAM CHANGE 1 SHOWER	-	206	-	19
GF 42 TEAM CHANGE 1	-	127	-	75
GF 42 TEAM CHANGE 1 CUPBOARD	181	-	-	2
GF 04.1 KITCHEN STORE	119	-	-	11
GF 04 KITCHEN	-	203	-	216
GF 15 ACC CHANGE	-	427	-	21
GF 05 BAR STORE	181	-	-	5
GF 09 WC	-	602	-	11
GF 10 WC	-	602	-	11
GF 08 CIRCULATION	-	251	-	20
GF 07 ACC WC	-	580	-	13
GF 06.1 STORE	181	-	-	5
GF 06 MULTIPURPOSE ROOM	-	69	-	264
GF 20 TEAM CHANGE 6 SHOWER	-	206	-	19
GF 20 TEAM CHANGE 6 WC	-	430	-	18
GF 20 TEAM CHANGE 6 CUPBOARD	181	-	-	1
GF 20 TEAM CHANGE 6	-	127	-	76
GF 14 DRY CHANGE	-	122	-	123
GF 14 DRY CHANGE SHOWER	-	180	-	28
GF 53 WC	-	353	-	33
GF 14 CIRCULATION	-	301	-	13
GF 34 WC	-	340	-	37
GF 13 DRY CHANGE SHOWER	-	180	-	30
GF 13 DRY CHANGE	-	119	-	122
GF 13 DRY CHANGE CIRCULATION	-	301	-	11
GF 36 OFFICIAL CH	-	183	-	32
GF 22 TEAM CHANGE 7 SHOWER	-	207	-	19
GF 22 TEAM CHANGE 7 WC	-	430	-	18

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
GF 22 TEAM CHANGE 7 CUPBOARD	181	-	-	1
GF 22 TEAM CHANGE 7	-	127	-	76
GF 23 TEAM CHANGE 8 SHOWER	-	201	-	20
GF 23 TEAM CHANGE 8 WC	-	414	-	19
GF 23 TEAM CHANGE 8	-	127	-	76
GF 23 TEAM CHANGE 8 CUPBOARD	181	-	-	1
GF 30 CIRCULATION	-	130	-	148
GF 02 OFFICE	149	-	-	66
GF 29 CIRCULATION	-	124	-	291
CIRCULATION	-	137	-	146
GF 01-2 RECEPTION	-	97	15	96
GF 01-3 CIRCLATION	-	109	-	97
GF 01 FOYER	-	77	15	628
GF 12 ACC CHANGE	-	399	-	24
GF 03-1 SERVERY	91	-	-	203
GF 03 CAFE	-	59	-	949
FF 01-1 STUDIO STORE	140	-	-	16
FF 03 ACC CHANGE	-	287	-	22
FF 09 ACC WC	-	602	-	17
VOID OVER HUB	-	226	15	0
FF 07 CIRCULATION	-	107	-	185
FF 08 CL ST	181	-	-	5
FF 11 STAFF ROOM	165	-	-	94
FF 01 STUDIO	-	63	-	1060
FF 05 CHANGE SHOWER	-	248	-	25
FF 05 CHANGE	-	163	-	92
FF 05 CHANGE WC	-	546	-	27
FF 04 CHANGE SHOWER	-	239	-	26
FF 04 CHANGE WC	-	546	-	27
FF 04 CHANGE	-	165	-	90
FF 10 CIRCULATION	-	248	-	69
FF 12 PLANT	119	-	-	233
STAIR WELL	-	177	-	64
CORRIDOR	-	142	-	312
FF 06 STUDIO	140	-	-	16
FF 06-2 STUDIO	-	58	-	1832
FF 06-1 STUDIO STORE	140	-	-	16
FF 13 OFFICE	142	-	-	127
GF 01-1 LOBBY	-	154	-	45
GF 11 SPORTS HALL	-	110	-	7040
GF 11 SPORTS HALL VOID	-	338	-	0

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
ROLLER RACKING LOBBY	N/A	N/A
GF 37 TOP OFFICE	N/A	N/A
GF 37 MIDDLE OFFICE	N/A	N/A
GF 37 BOTTOM OFFICE	N/A	N/A
GF 37 KITCHENETTE	N/A	N/A
GF 38 QUARANTINE	N/A	N/A
GF 38 OFFICE	N/A	N/A
GF 37 PALLET STORAGE LOBBY	N/A	N/A
GF 38 MUSEUM ARCHIVE	N/A	N/A
GF 37 MCCC OFFICE	N/A	N/A
GF 37 OFFICE RIGHT	N/A	N/A
GF 49 FIRST AID	N/A	N/A
GF 04 KITCHEN	N/A	N/A
GF 06 MULTIPURPOSE ROOM	N/A	N/A
GF 02 OFFICE	N/A	N/A
GF 01-2 RECEPTION	N/A	N/A
GF 01 FOYER	NO (-9.4%)	YES
GF 03-1 SERVERY	NO (-62.8%)	YES
GF 03 CAFE	NO (-64.6%)	YES
VOID OVER HUB	NO (-40.1%)	YES
FF 11 STAFF ROOM	NO (-48%)	YES
FF 01 STUDIO	NO (-71.9%)	YES
FF 06-2 STUDIO	NO (-61.1%)	YES
FF 13 OFFICE	NO (-69.9%)	YES
GF 11 SPORTS HALL	N/A	N/A
GF 11 SPORTS HALL VOID	NO (-95.2%)	YES

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	3287.4	3287.4
External area [m^2]	6952.3	6952.3
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	4
Average conductance [W/K]	1513.31	2158.31
Average U-value [W/m^2K]	0.22	0.31
Alpha value* [%]	10.01	10

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
100	**D2 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	10.97	13.35
Cooling	0.05	0.34
Auxiliary	22.23	20.4
Lighting	19.2	22.17
Hot water	426.45	594.38
Equipment*	34.19	34.19
TOTAL**	**478.89**	**650.64**

* Energy used by equipment does not count towards the total for 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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	37.33	47.72
Primary energy* [kWh/m^2]	658.19	872.11
Total emissions [kg/m^2]	115.5	153.1

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	56.9	0	17.7	0	24.7	0.89	0	0.95	0
	Notional	54.5	0	17.6	0	21.8	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	62.9	0	19.6	0	11.3	0.89	0	0.95	0
	Notional	58.4	0	18.8	0	6.7	0.86	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	24.2	2.3	1.2	0.1	17	5.39	4.48	5.5	6
	Notional	68.1	27.5	7.4	2.7	11.6	2.56	2.84	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	0.9	0	0.3	0	18.5	0.89	0	0.95	0
	Notional	22.5	0	7.2	0	20.4	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	76.6	0	23.8	0	1.5	0.89	0	0.95	0
	Notional	82	0	26.4	0	0.9	0.86	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	3.3	5.5	0.2	0.3	49.9	5.39	4.48	5.5	6
	Notional	6	18.1	0.6	1.8	45.4	2.56	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

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.15	RM000000:Surf[3]
Floor	0.2	0.15	RM000000:Surf[0]
Roof	0.15	0.13	RM000000:Surf[1]
Windows, roof windows, and rooflights	1.5	0.7	GF000039:Surf[1]
Personnel doors	1.5	2.2	RM000000:Surf[2]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	3

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Gunnersbury GREEN

As designed

Date: Wed Sep 09 16:52:47 2015

Administrative information

Building Details

Address: Gunnersbury Park Sports Facility, London, W3 8LQ

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.4

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.4

BRUKL compliance check version: v5.2.d.2

Owner Details

Name: Ealing Council

Telephone number:

Address: , ,

Certifier details

Name: Nzube Igwume

Telephone number: 01923294800

Address: 1st Floor Oak House, Reeds Crescent, Watford, WD24 4PH

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	153.1
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	153.1
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	99.2
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.24	1.64	GF000000:Surf[2]
Floor	0.25	0.15	0.15	RM000000:Surf[0]
Roof	0.25	0.15	1.64	VD000000:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.17	1.2	CR000000:Surf[2]
Personnel doors	2.2	2.2	2.2	RM000000:Surf[2]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

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

* There might be more than one surface where the maximum U-value occurs.
** 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.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	3

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- CLEAN 3 VRF Mixmod Mass MVHR 70pc

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	5.5	2.6	0	0	0.7
Standard value	2.5*	3.2	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

2- CLEAN 2 Radiator Mixmod Mass MVHR 70pc

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.95	-	0	0	0.7
Standard value	0.91*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

3- CLEAN 5 Rad only

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.95	-	0	0	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

4- CLEAN 1 Underfloor VRF temper AHU HR 70pc

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.95	-	0	0	0.7
Standard value	0.91*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

5- CLEAN 3A VRF Mixmod NV Mass MVHR 70pc

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	5.5	2.6	0	0	0.7
Standard value	2.5*	3.2	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

6- CLEAN 4 Rad panel VRF temper AHU HR 70pc

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.95	-	0	0	0.7
Standard value	0.91*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

1- CLEAN DHW WWHP GAS Hybrid SE 1-279

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1.28	-
Standard value	0.9*	N/A
* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.		

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
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 supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

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	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
GF 37 TOP OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 MIDDLE OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 LOBBY	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 BOTTOM OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 BOTTOM WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 TOP WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 KITCHENETTE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 33 ESCAPE STAIR	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 38 OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 51 ACC WC	-	-	-	1.5	-	-	-	-	-	-	N/A
CORRIDOR	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 MCCC OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 37 OFFICE RIGHT	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 21 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 21 SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 21 TEAM CHANGE 5	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 50 OFFICIAL CH SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 49 FIRST AID	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 19 TEAM CHANGE 4 SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 19 TEAM CHANGE 4 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 50 OFFICAIL CH	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 19 TEAM CHANGE 4	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 18 TEAM CHANGE 3 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 18 TEAM CHANGE 3 SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 18 TEAM CHANGE 3	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 43 TEAM CHANGE 2 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 43 TEAM CHANGE 2 SHOWER	-	-	-	1.5	-	-	-	-	-	-	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	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
GF 43 TEAM CHANGE 2	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 42 TEAM CHANGE 1 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 42 TEAM CHANGE 1 SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 42 TEAM CHANGE 1	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 15 ACC CHANGE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 09 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 10 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 08 CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 07 ACC WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 20 TEAM CHANGE 6 SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 20 TEAM CHANGE 6 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 20 TEAM CHANGE 6	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 14 DRY CHANGE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 14 DRY CHANGE SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 53 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 14 CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 34 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 13 DRY CHANGE SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 13 DRY CHANGE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 13 DRY CHANGE CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 36 OFFICIAL CH	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 22 TEAM CHANGE 7 SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 22 TEAM CHANGE 7 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 22 TEAM CHANGE 7	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 23 TEAM CHANGE 8 SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 23 TEAM CHANGE 8 WC	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 23 TEAM CHANGE 8	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 30 CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 02 OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 29 CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 01-2 RECEPTION	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 01-3 CIRCLATION	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 01 FOYER	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 12 ACC CHANGE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 03-1 SERVERY	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 03 CAFE	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 03 ACC CHANGE	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 09 ACC WC	-	-	-	1.5	-	-	-	-	-	-	N/A
VOID OVER HUB	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 07 CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 11 STAFF ROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 05 CHANGE SHOWER	-	-	-	1.5	-	-	-	-	-	-	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	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
FF 05 CHANGE	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 05 CHANGE WC	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 04 CHANGE SHOWER	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 04 CHANGE WC	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 04 CHANGE	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 10 CIRCULATION	-	-	-	1.5	-	-	-	-	-	-	N/A
STAIR WELL	-	-	-	1.5	-	-	-	-	-	-	N/A
CORRIDOR	-	-	-	1.5	-	-	-	-	-	-	N/A
FF 13 OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 01-1 LOBBY	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 11 SPORTS HALL	-	-	-	1.5	-	-	-	-	-	-	N/A
GF 11 SPORTS HALL VOID	-	-	-	1.5	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
ROLLER RACKING LOBBY	-	202	-	25
GF 37 TOP OFFICE	128	-	-	89
GF 37 MIDDLE OFFICE	127	-	-	92
GF 37 STORE	181	-	-	3
GF 37 LOBBY	-	263	-	17
GF 37 BOTTOM OFFICE	127	-	-	92
GF 37 PRINT STORE	90	-	-	17
GF 37 BOTTOM WC	-	567	-	14
GF 37 TOP WC	-	567	-	14
GF 37 KITCHENETTE	143	-	-	72
GF 28 PLANT	119	-	-	164
GF 33 ESCAPE STAIR	-	170	-	36
CL STORE	162	-	-	6
GF 38 QUARANTINE	119	-	-	9
GF 38 OFFICE	162	-	-	56
GF 37 PALLET STORAGE LOBBY	-	233	-	18
GF 51 ACC WC	-	549	-	15
GF 38 MUSEUM ARCHIVE	54	-	-	150
CORRIDOR	-	137	-	96
GF 37 MCCC OFFICE	80	-	-	717
GF 37 OFFICE RIGHT	130	-	-	86
GF 27 SPORTS HALL	63	-	-	123
GF 21 WC	-	394	-	19
GF 21 SHOWER	-	201	-	20
GF 21 TEAM CHANGE 5	-	123	-	79
GF 50 OFFICIAL CH SHOWER	-	301	-	6
GF 49 FIRST AID	114	-	-	79

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
GF 19 TEAM CHANGE 4 SHOWER	-	200	-	20
GF 19 TEAM CHANGE 4 WC	-	414	-	19
GF 50 OFFICAIL CH	-	161	-	30
GF 50 CUPBOARD	181	-	-	2
GF 19 TEAM CHANGE 4	-	123	-	85
GF 19 TEAM CHANGE 4 CUPBOARD	181	-	-	2
GF 18 TEAM CHANGE 3 WC	-	429	-	18
GF 18 TEAM CHANGE 3 SHOWER	-	206	-	19
GF 18 TEAM CHANGE 3 CUPBOARD	181	-	-	2
GF 18 TEAM CHANGE 3	-	123	-	85
GF 43 TEAM CHANGE 2 WC	-	413	-	19
GF 43 TEAM CHANGE 2 SHOWER	-	200	-	20
GF 43 TEAM CHANGE 2 CUPBOARD	181	-	-	1
GF 43 TEAM CHANGE 2	-	127	-	75
GF 42 TEAM CHANGE 1 WC	-	430	-	18
GF 42 TEAM CHANGE 1 SHOWER	-	206	-	19
GF 42 TEAM CHANGE 1	-	127	-	75
GF 42 TEAM CHANGE 1 CUPBOARD	181	-	-	2
GF 04.1 KITCHEN STORE	119	-	-	11
GF 04 KITCHEN	-	203	-	216
GF 15 ACC CHANGE	-	427	-	21
GF 05 BAR STORE	181	-	-	5
GF 09 WC	-	602	-	11
GF 10 WC	-	602	-	11
GF 08 CIRCULATION	-	251	-	20
GF 07 ACC WC	-	580	-	13
GF 06.1 STORE	181	-	-	5
GF 06 MULTIPURPOSE ROOM	-	69	-	264
GF 20 TEAM CHANGE 6 SHOWER	-	206	-	19
GF 20 TEAM CHANGE 6 WC	-	430	-	18
GF 20 TEAM CHANGE 6 CUPBOARD	181	-	-	1
GF 20 TEAM CHANGE 6	-	127	-	76
GF 14 DRY CHANGE	-	122	-	123
GF 14 DRY CHANGE SHOWER	-	180	-	28
GF 53 WC	-	353	-	33
GF 14 CIRCULATION	-	301	-	13
GF 34 WC	-	340	-	37
GF 13 DRY CHANGE SHOWER	-	180	-	30
GF 13 DRY CHANGE	-	119	-	122
GF 13 DRY CHANGE CIRCULATION	-	301	-	11
GF 36 OFFICIAL CH	-	183	-	32
GF 22 TEAM CHANGE 7 SHOWER	-	207	-	19
GF 22 TEAM CHANGE 7 WC	-	430	-	18

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
GF 22 TEAM CHANGE 7 CUPBOARD	181	-	-	1
GF 22 TEAM CHANGE 7	-	127	-	76
GF 23 TEAM CHANGE 8 SHOWER	-	201	-	20
GF 23 TEAM CHANGE 8 WC	-	414	-	19
GF 23 TEAM CHANGE 8	-	127	-	76
GF 23 TEAM CHANGE 8 CUPBOARD	181	-	-	1
GF 30 CIRCULATION	-	130	-	148
GF 02 OFFICE	149	-	-	66
GF 29 CIRCULATION	-	124	-	291
CIRCULATION	-	137	-	146
GF 01-2 RECEPTION	-	97	15	96
GF 01-3 CIRCLATION	-	109	-	97
GF 01 FOYER	-	77	15	628
GF 12 ACC CHANGE	-	399	-	24
GF 03-1 SERVERY	91	-	-	203
GF 03 CAFE	-	59	-	949
FF 01-1 STUDIO STORE	140	-	-	16
FF 03 ACC CHANGE	-	287	-	22
FF 09 ACC WC	-	602	-	17
VOID OVER HUB	-	226	15	0
FF 07 CIRCULATION	-	107	-	185
FF 08 CL ST	181	-	-	5
FF 11 STAFF ROOM	165	-	-	94
FF 01 STUDIO	-	63	-	1060
FF 05 CHANGE SHOWER	-	248	-	25
FF 05 CHANGE	-	163	-	92
FF 05 CHANGE WC	-	546	-	27
FF 04 CHANGE SHOWER	-	239	-	26
FF 04 CHANGE WC	-	546	-	27
FF 04 CHANGE	-	165	-	90
FF 10 CIRCULATION	-	248	-	69
FF 12 PLANT	119	-	-	233
STAIR WELL	-	177	-	64
CORRIDOR	-	142	-	312
FF 06 STUDIO	140	-	-	16
FF 06-2 STUDIO	-	58	-	1832
FF 06-1 STUDIO STORE	140	-	-	16
FF 13 OFFICE	142	-	-	127
GF 01-1 LOBBY	-	154	-	45
GF 11 SPORTS HALL	-	110	-	7040
GF 11 SPORTS HALL VOID	-	338	-	0

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
ROLLER RACKING LOBBY	N/A	N/A
GF 37 TOP OFFICE	N/A	N/A
GF 37 MIDDLE OFFICE	N/A	N/A
GF 37 BOTTOM OFFICE	N/A	N/A
GF 37 KITCHENETTE	N/A	N/A
GF 38 QUARANTINE	N/A	N/A
GF 38 OFFICE	N/A	N/A
GF 37 PALLET STORAGE LOBBY	N/A	N/A
GF 38 MUSEUM ARCHIVE	N/A	N/A
GF 37 MCCC OFFICE	N/A	N/A
GF 37 OFFICE RIGHT	N/A	N/A
GF 49 FIRST AID	N/A	N/A
GF 04 KITCHEN	N/A	N/A
GF 06 MULTIPURPOSE ROOM	N/A	N/A
GF 02 OFFICE	N/A	N/A
GF 01-2 RECEPTION	N/A	N/A
GF 01 FOYER	NO (-9.4%)	YES
GF 03-1 SERVERY	NO (-62.8%)	YES
GF 03 CAFE	NO (-64.6%)	YES
VOID OVER HUB	NO (-40.1%)	YES
FF 11 STAFF ROOM	NO (-48%)	YES
FF 01 STUDIO	NO (-71.9%)	YES
FF 06-2 STUDIO	NO (-61.1%)	YES
FF 13 OFFICE	NO (-69.9%)	YES
GF 11 SPORTS HALL	N/A	N/A
GF 11 SPORTS HALL VOID	NO (-95.2%)	YES

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	3287.4	3287.4
External area [m^2]	6952.3	6952.3
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	4
Average conductance [W/K]	1513.31	2158.31
Average U-value [W/m^2K]	0.22	0.31
Alpha value* [%]	10.01	10

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
100	**D2 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	10.97	13.35
Cooling	0.05	0.34
Auxiliary	22.23	20.4
Lighting	19.2	22.17
Hot water	426.45	594.38
Equipment*	34.19	34.19
TOTAL**	**478.89**	**650.64**

* Energy used by equipment does not count towards the total for 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	31.48	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	37.33	47.72
Primary energy* [kWh/m^2]	658.19	872.11
Total emissions [kg/m^2]	99.2	153.1

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	56.9	0	17.7	0	24.7	0.89	0	0.95	0
	Notional	54.5	0	17.6	0	21.8	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	62.9	0	19.6	0	11.3	0.89	0	0.95	0
	Notional	58.4	0	18.8	0	6.7	0.86	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	24.2	2.3	1.2	0.1	17	5.39	4.48	5.5	6
	Notional	68.1	27.5	7.4	2.7	11.6	2.56	2.84	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	0.9	0	0.3	0	18.5	0.89	0	0.95	0
	Notional	22.5	0	7.2	0	20.4	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	76.6	0	23.8	0	1.5	0.89	0	0.95	0
	Notional	82	0	26.4	0	0.9	0.86	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	3.3	5.5	0.2	0.3	49.9	5.39	4.48	5.5	6
	Notional	6	18.1	0.6	1.8	45.4	2.56	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

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.15	RM000000:Surf[3]
Floor	0.2	0.15	RM000000:Surf[0]
Roof	0.15	0.13	RM000000:Surf[1]
Windows, roof windows, and rooflights	1.5	0.7	GF000039:Surf[1]
Personnel doors	1.5	2.2	RM000000:Surf[2]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	3

Appendix B – Preliminary CIBSE TM52 Overheating Output

Overall
Passed: 16 rooms:
Failed: 0 rooms:
Unoccupied: 99 rooms:

Data:
Days data= 153 01-May 30-Sep
Days (summer)= 153 01-May 30-Sep
Data OK? OK Full summer

Occupancy:
Note: This report assesses occupied periods only. Please be aware that TM52 should be conducted for occupied and/or “available hours
Use of educational NCM profiles may be seen as inappropriate due to prolonged unoccupied periods during summer months.
See Section 6.1.2 (a) of TM52 for further information.

Passed: 16 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
GF 37 TOP OFFICE	RM000001	100	1.2	15	3	2
GF 37 MIDDLE OFFICE	RM000002	100	1.9	17	3	2
GF 37 BOTTOM OFFICE	RM000005	100	1.9	18	3	2
GF 38 OFFICE	RM000012	100	0	0	0	-
GF 37 MCCC OFFICE	GF000000	100	1.4	22	4	2
GF 37 OFFICE RIGHT	GF000001	100	1.2	17	3	2
GF 06 MULTIPURPOSE ROOM	GF000020	100	2.8	23	4	2
GF 02 OFFICE	GF000038	100	1.8	24.5	4	2
GF 01 FOYER	GF00003D	100	1.5	20	3	2
GF 03-1 SERVERY	GF00003F	100	1.2	17.5	3	2
GF 03 CAFE	GF000040	100	1.3	19	3	2
FF 11 STAFF ROOM	FF000006	100	2	22.5	4	2
FF 01 STUDIO	FF000007	100	2.7	28	4	2
FF 06-2 STUDIO	FF00000F	100	1.4	21.5	4	2
FF 13 OFFICE	FF000003	100	2.7	30	4	2
GF 11 SPORTS HALL	GF000003	100	0.9	14	3	2

Failed: 0 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing

Unoccupied: 99 rooms:

Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
ROLLER RACKING LOBBY	RM000000	0	0	0	0	-
GF 37 STORE	RM000003	0	0	0	0	-
GF 37 LOBBY	RM000004	0	0	0	0	-
GF 37 PRINT STORE	RM000006	0	0	0	0	-
GF 37 BOTTOM WC	RM000008	0	0	0	0	-
GF 37 TOP WC	RM000009	0	0	0	0	-
GF 37 KITCHENETTE	RM00000A	0	0	0	0	-
GF 28 PLANT	RM00000E	0	0	0	0	-
GF 33 ESCAPE STAIR	RM00000F	0	0	0	0	-
CL STORE	RM000010	0	0	0	0	-
GF 38 QUARANTINE	RM000011	0	0	0	0	-
GF 37 PALLET STORAGE LOBBY	RM000013	0	0	0	0	-
GF 51 ACC WC	RM000014	0	0	0	0	-
GF 38 MUSEUM ARCHIVE	RM000015	0	0	0	0	-
CORRIDOR	RM000016	0	0	0	0	-
GF 27 SPORTS HALL	GF000002	0	0	0	0	-
GF 21 WC	GF000004	0	0	0	0	-
GF 21 SHOWER	RM000019	0	0	0	0	-
GF 21 TEAM CHANGE 5	GF000005	0	0	0	0	-
GF 50 OFFICIAL CH SHOWER	GF000007	0	0	0	0	-
GF 49 FIRST AID	GF000006	0	0	0	0	-
GF 19 TEAM CHANGE 4 SHOWEF	RM000007	0	0	0	0	-
GF 19 TEAM CHANGE 4 WC	RM00000B	0	0	0	0	-
GF 50 OFFICAIL CH	GF000008	0	0	0	0	-
GF 50 CUPBOARD	GF000009	0	0	0	0	-
GF 19 TEAM CHANGE 4	RM00000C	0	0	0	0	-

GF 19 TEAM CHANGE 4 CUPBOA	GF00000A	0	0	0	0	-
GF 18 TEAM CHANGE 3 WC	GF00000C	0	0	0	0	-
GF 18 TEAM CHANGE 3 SHOWEI	GF00000D	0	0	0	0	-
GF 18 TEAM CHANGE 3 CUPBOA	GF00000B	0	0	0	0	-
GF 18 TEAM CHANGE 3	GF00000E	0	0	0	0	-
GF 43 TEAM CHANGE 2 WC	GF00000F	0	0	0	0	-
GF 43 TEAM CHANGE 2 SHOWEI	GF000010	0	0	0	0	-
GF 43 TEAM CHANGE 2 CUPBOA	GF000011	0	0	0	0	-
GF 43 TEAM CHANGE 2	GF000012	0	0	0	0	-
GF 42 TEAM CHANGE 1 WC	GF000014	0	0	0	0	-
GF 42 TEAM CHANGE 1 SHOWEI	GF000015	0	0	0	0	-
GF 42 TEAM CHANGE 1	GF000013	0	0	0	0	-
GF 42 TEAM CHANGE 1 CUPBOA	GF000016	0	0	0	0	-
GF 04.1 KITCHEN STORE	GF000017	0	0	0	0	-
GF 04 KITCHEN	GF000018	0	0	0	0	-
GF 15 ACC CHANGE	GF000019	0	0	0	0	-
GF 05 BAR STORE	GF00001A	0	0	0	0	-
GF 09 WC	GF00001B	0	0	0	0	-
GF 10 WC	GF00001C	0	0	0	0	-
GF 08 CIRCULATION	GF00001D	0	0	0	0	-
GF 07 ACC WC	GF00001E	0	0	0	0	-
GF 06.1 STORE	GF00001F	0	0	0	0	-
GF 20 TEAM CHANGE 6 SHOWEI	GF000022	0	0	0	0	-
GF 20 TEAM CHANGE 6 WC	GF000023	0	0	0	0	-
GF 20 TEAM CHANGE 6 CUPBOA	GF000021	0	0	0	0	-
GF 20 TEAM CHANGE 6	GF000024	0	0	0	0	-
GF 14 DRY CHANGE	GF000025	0	0	0	0	-
GF 14 DRY CHANGE SHOWER	GF000026	0	0	0	0	-
GF 53 WC	GF000027	0	0	0	0	-
GF 14 CIRCULATION	VN000000	0	0	0	0	-
GF 34 WC	GF000028	0	0	0	0	-
GF 13 DRY CHANGE SHOWER	GF00002A	0	0	0	0	-
GF 13 DRY CHANGE	GF000029	0	0	0	0	-
GF 13 DRY CHANGE CIRCULATIO	GF00002B	0	0	0	0	-
GF 36 OFFICIAL CH	GF00002C	0	0	0	0	-
GF 22 TEAM CHANGE 7 SHOWEI	GF00002E	0	0	0	0	-
GF 22 TEAM CHANGE 7 WC	GF00002F	0	0	0	0	-
GF 22 TEAM CHANGE 7 CUPBOA	GF00002D	0	0	0	0	-
GF 22 TEAM CHANGE 7	GF000030	0	0	0	0	-
GF 23 TEAM CHANGE 8 SHOWEI	GF000031	0	0	0	0	-
GF 23 TEAM CHANGE 8 WC	GF000032	0	0	0	0	-
GF 23 TEAM CHANGE 8	GF000033	0	0	0	0	-
GF 23 TEAM CHANGE 8 CUPBOA	GF000034	0	0	0	0	-
TOP LIFT	GF000035	0	0	0	0	-
BOTTOM LIFT	GF000036	0	0	0	0	-
GF 30 CIRCULATION	GF000037	0	0	0	0	-
GF 29 CIRCULATION	GF000039	0	0	0	0	-
CIRCULATION	CR000000	0	0	0	0	-
GF 01-2 RECEPTION	GF00003A	0	0	0	0	-
GF 01-3 CIRCLATION	GF00003C	0	0	0	0	-
GF 12 ACC CHANGE	GF00003E	0	0	0	0	-
FF 01-1 STUDIO STORE	FF000000	0	0	0	0	-
FF 03 ACC CHANGE	FF000001	0	0	0	0	-
FF 09 ACC WC	FF000002	0	0	0	0	-
TOP LIFT	TP000000	0	0	0	0	-
BOTTOM LIFT	BT000000	0	0	0	0	-
VOID OVER HUB	VD000000	0	0	0	0	-
FF 07 CIRCULATION	FF000004	0	0	0	0	-
FF 08 CL ST	FF000005	0	0	0	0	-
FF 05 CHANGE SHOWER	FF000008	0	0	0	0	-
FF 05 CHANGE	FF000009	0	0	0	0	-
FF 05 CHANGE WC	FF00000A	0	0	0	0	-
FF 04 CHANGE SHOWER	FF00000C	0	0	0	0	-
FF 04 CHANGE WC	FF00000B	0	0	0	0	-
FF 04 CHANGE	FF00000D	0	0	0	0	-
FF 10 CIRCULATION	FF000011	0	0	0	0	-
FF 12 PLANT	FF000012	0	0	0	0	-
STAIR WELL	ST000000	0	0	0	0	-
CORRIDOR	CR000001	0	0	0	0	-
FF 06 STUDIO	FF00000E	0	0	0	0	-
FF 06-1 STUDIO STORE	FF000010	0	0	0	0	-
GF 01-1 LOBBY	GF000041	0	0	0	0	-
GF 11 SPORTS HALL VOID	GF00003B	0	0	0	0	-

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