Paddington Green Police Station

2 – 4 Harrow Road, London, W2 1XJ

Energy Statement – Part 1

WSP

01/04/2021

Berkeley
Designed for life

Berkeley Homes (Central London) Ltd.

Paddington Green Police Station

Energy Statement

PGPS-WSP-XX-XX-ST-ES-0001_P03

April 2021

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Berkeley Homes (Central London) Ltd.

Paddington Green Police Station, Westminster

Energy Statement

Project No: 70069424

April 2021

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1 EXECUTIVE SUMMARY

WSP has been commissioned by Berkeley Homes (Central London) Ltd. to develop and prepare an Energy Statement for Paddington Green Police Station (the Proposed Development) in the Westminster City Council (WCC) London. The development of the energy strategy has paid very close attention to the updated GLA Guidance (April 2020) and maximised performance for full compliance.

Multiple layers of statutory and policy requirements apply to PGPS at a national, regional and local level, each of which requires different energy efficiency and carbon emission targets to be met. The Proposed Development will be designed to address the relevant requirements applicable at each stage of development.

Westminster's approach to sustainable development is underpinned by policies from the London Plan and the Westminster City Plan. Together these documents provide spatial policies, development management policies and site allocations to guide and manage development in the borough.

1.1 ENERGY AND CARBON TARGETS

On that basis, the implications of the relevant targets for both the residential and non-residential components of the Proposed Development can be summarised as follows:

- All developments must meet the prevailing Building Regulations requirements. Specifically, with regards to energy and carbon compliance, all buildings must meet the Building Regulations Part L 'Target Emission Rate' (TER) requirements for the Part L revision which is current at the time of initial construction works for each particular developmental phase. The Proposed Development will be brought forward under Part L 2013 and this will be used as the basis of the energy strategy.
- The residential components of the Proposed Development will be assessed against Approved Document L1A (AD_L1A) which relates to new build residential buildings and all the non-residential components will be assessed against Approved Document L2A (AD_L2A) relating to new build non-residential buildings.
- In line with the London Plan, major developments are expected to be net zero-carbon by incorporating a series of measures as outlined in the energy hierarchy.
- Domestic developments should achieve at least a 10% improvement on Building Regulations from energy efficiency. Non-domestic developments should achieve at least a 15% improvement on Building Regulations from energy efficiency.
- Dynamic modelling for overheating risk analysis in line with the guidance and data sets in CIBSE TM52 and TM59 should be undertaken.
- Development will be required to connect or to demonstrate a potential connection to a decentralised energy system unless it can be demonstrated that it is not feasible or viable and evaluate the feasibility of communal heating system.
- Major developments should provide a reduction in expected CO_2 emissions using on-site renewable energy generation, where feasible to do so.
- Major developments should demonstrate how the net zero carbon target will be met, with at least a 35% on-site reduction beyond Part L 2013 and proposals for making up the shortfall to achieve net zero carbon, where required.
- The Energy Statement must include information of how the building's actual energy performance will be monitored post-construction and produce all relevant documentation as outlined in the "Be Seen – Energy Monitoring Guidance".
- All major developments are required to calculate and reduce the whole life-cycle carbon (WLC) emissions to fully capture the development's carbon impact.
- All new non-residential development and non-self-contained residential accommodation over 500 square metres floorspace (gross) are expected to meet or exceed BREEAM 'excellent' rating.

1.2 ENERGY STRATEGY

The energy strategy has been structured in accordance with GLA's energy hierarchy: Be Lean, Be Clean, Be Green. The proposals for the scheme have been developed in accordance with the desire to achieve an energy efficient and sustainable development.

The Proposed Development will be designed to achieve optimum energy performance, and will incorporate the following design features:

- During design development, significant consideration has been given to how the building fabric will respond to its environment in order that the energy consumption of the building is reduced as far as possible through passive means. The building fabric will be designed to significantly exceed the minimum fabric requirements of Part L1A and L2A (2013) of the Building Regulations.
- Passive design measures will be incorporated into the design to reduce energy demand and the risk of overheating.
- A high-performance building services solution is proposed for the Proposed Development.
- WSP has undertaken a desktop assessment of the WEG Energy Centre which suggested that there is sufficient capacity to serve the majority of PGPS. In line with the GLA heating hierarchy, main heating to the development will be provided through connection to the existing area-wide West End Gate network fed by no.1 CHP and no. 4No. highly efficient gas fired boilers.
- As part of the S106 agreements, the West End Gate (WEG) energy centre has been designed to facilitate connection to the Church Street district heating network and space has been provided for a plate heat exchanger for the connection. Furthermore, distribution pipework connecting the development to the DHN has been installed to allow for future connection to the network as soon as this becomes available. On the basis a future connection of PGPS to the DHN is proposed and will be provided through connection to the West End Gate energy centre.
- 2No. Air Source Heat Pumps located on the roof of Building I within screened area provide the heating and cooling load to CAT A non-residential areas.

- Hot water to the non-residential CAT A areas will be provided by the ASHP combined with 2No. Water Source Heat Pumps (WSHP) located at office floor level.
- Terminal units are designed to achieve a specific fan power in operation significantly lower than the Part L 2013 limiting SFP.
- All spaces will include 100% low energy lighting. Occupancy sensing will be specified throughout.
- 123 m^2 of PV are proposed on the roof of the three proposed buildings to contribute towards the on-site carbon reduction target of 35% and the overall Zero Carbon Target.

1.3 RESULTS

CARBON EMISSIONS

Accredited thermal simulation software IES<VE>2021 and SAP Elmhurst software were used to determine the regulated carbon emissions for the development. The GLA carbon emissions reporting spreadsheet version 1.2 has been utilised to calculate the site wide carbon emission savings. In line with the latest GLA conventions, SAP 2012 emission factors are used to calculate the carbon emission savings as the development is in a Heat Network Priority Area and will connect to an existing network using gas-engine CHP or a new network using low-emission CHP.

Table 1-1 Carbon emissions after providing renewable energy – Residential – SAP 2012 CF

TOTAL	REGULATED EMISSIONS (TONNES)	UNREGULATED EMISSIONS (TONNES)	% REDUCTION IN REGULATED CARBON EMISSIONS
Baseline emissions (Tonnes CO_2)	543.9	739.1	0.0%
Emissions after energy demand reduction (Tonnes CO_2)*	488.6	739.1	10%
Emissions after energy efficient supply (Tonnes CO_2)*	355.9	739.1	35%
Emissions after renewable energy (Tonnes CO_2)	355.9	739.1	35%

**The energy efficiency savings have been calculated on the basis that the buildings are served by a central heating system served by gas fired boilers only, with a seasonal efficiency of 96%. Cooling system for Be Lean stage has been assumed as air cooled chillers with SEER of 3.5.*

Table 1-2 Carbon emissions after providing renewable energy – Non-Residential – SAP 2012 CF

TOTAL	REGULATED EMISSIONS (TONNES)	UNREGULATED EMISSIONS (TONNES)	% REDUCTION IN REGULATED CARBON EMISSIONS
Baseline emissions (Tonnes CO_2)	184.3	287.7	0.0%
Emissions after energy demand reduction (Tonnes CO_2)*	143.2	287.7	22%
Emissions after energy efficient supply (Tonnes CO_2)*	140.8	287.7	23%
Emissions after renewable energy (Tonnes CO_2)	120.1	287.7	35%

**The energy efficiency savings have been calculated on the basis that the buildings are served by a central heating system served by gas fired boilers only, with a seasonal efficiency of 96%. Cooling system for Be Lean stage has been assumed as air cooled chillers with SEER of 4.5.*

Table 1-3 Carbon emissions after providing renewable energy – Whole Development – SAP 2012 CF

TOTAL	REGULATED EMISSIONS (TONNES)	UNREGULATED EMISSIONS (TONNES)	% REDUCTION IN REGULATED CARBON EMISSIONS
Baseline emissions (Tonnes CO_2)	728.2	1017.8	0.0%
Emissions after energy demand reduction (Tonnes CO_2)*	631.8	1017.8	13%
Emissions after energy efficient supply (Tonnes CO_2)*	496.7	1017.8	32%
Emissions after renewable energy (Tonnes CO_2)	476.3	1017.8	35%

**The energy efficiency savings have been calculated on the basis that the buildings are served by a central heating system served by gas fired boilers only, with a seasonal efficiency of 96%. Cooling system for Be Lean stage has been assumed as air cooled chillers with SEER of 3.5 for the residential area and 4.5 for the non-residential.*

Overall, the Proposed Development is shown to achieve the following carbon reductions after following the Energy Hierarchy of LEAN, CLEAN, GREEN when compared to Part L 2013 using SAP 2012 carbon factors:

- Residential Element – 35%
- Non-Residential Element – 35%
- Whole Development – 35%

The figures above are the reduction in carbon emission compared to each respective baseline.

1.4 FABRIC ENERGY EFFICIENCY (FEE)

Accredited Design SAP 2012 software was used to determine the FEE standards for all apartments. An analysis has been undertaken on the all the new build residential buildings to establish the performance of the fabric in relation to the TFEE. Results for TFEE and the Dwelling FEE (DFEE) for all residential buildings are as follows:

Table 1-4 Fabric energy efficiency and carbon emissions results by residential buildings

RESIDENTIAL BUILDINGS	BUILDING I	BUILDING J	BUILDING K
Average TFEE (kWh/m²)	34.1	32.70	33.30
Average FEE (kWh/m²)	32.95	29.63	32.31
Improvement	3%	9%	3%

All residential areas achieve compliance with the TFEE standard. Detailed façade design and thermal bridging calculations will be performed during detailed design stage once junction details will be specified. The final strategy for compliance with TFEE will be defined as design develops. The project will ensure compliance with the TFEE is achieved.

2 PROJECT BACKGROUND

2.1 DEVELOPMENT DESCRIPTION

WSP has been commissioned by Berkeley Homes (Central London) Ltd. to develop and prepare an Energy Statement for Paddington Green Police Station (the Proposed Development) in the Westminster City Council (WCC) London. The development of the energy strategy has paid very close attention to the updated GLA Guidance (April 2020) and maximised performance for full compliance.

The Applicant is submitting a full detailed planning application for "*demolition and redevelopment of the site to provide three buildings, providing private and affordable residential units (Class C3), commercial uses (Class E), flexible community/affordable workspace (Class E/F.1), provision of private and public amenity space, landscaping, tree and other planting, public realm improvements throughout the site including new pedestrian and cycle links, provision of public art and play space, basement level excavation to provide associated plant, servicing and disabled car and cycle parking, connecting through to the basement of the neighbouring West End Gate development*."

The client's ambition for the site is to deliver a high quality residential led mixed-use development that will complete the West End Gate masterplan. The scheme will complement and enhance the local environment including the Paddington Green and the wider Church Street area, improve the quality of life for local people and provide a sustainable development for new residents. The proposals will regenerate this part of the Edgware Road providing active frontages on Edgware Road and Harrow Road, in hand with an improved public realm and townscape.

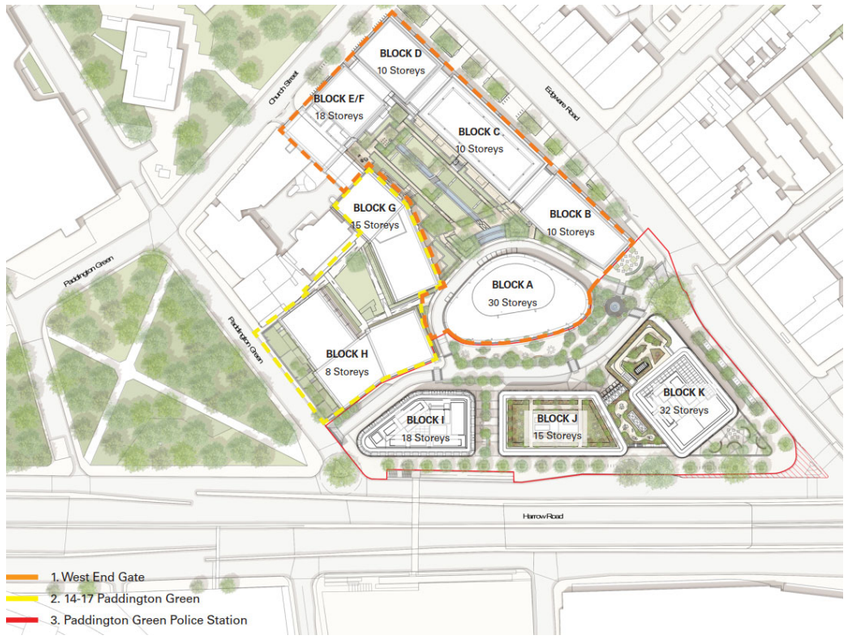

Figure 2-1 Top view showing the West End Gate Masterplan with the Proposed Development identified with the red line.

Figure 2-2 Perspective view of the Proposed Development.

Figure 2-3 Perspective view of the Proposed Development.

3 POLICY CONTEXT

Westminster's approach to sustainable development is underpinned by policies from the London Plan and the Westminster City Plan. Together these documents provide spatial policies, development management policies and site allocations to guide and manage development in the borough.

3.1 NATIONAL PLANNING POLICY

The National Planning Policy Framework (NPPF) was updated initially in July 2018 with minor amendments in February 2019 and replaces the 2012 NPPF. Plans and decisions should apply a presumption in favour of sustainable development.

The National Planning Policy Framework (NPPF) sets the planning context for sustainable design and construction. It is this that Local Planning Policies are based on and adapted to account for regionally specific requirements.

The NPPF identifies three dimensions to sustainable development - economic, social and environmental – which should be applied jointly and simultaneously:

- **Economic objective** – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure;
- **Social objective** – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering a well-designed and safe built environment, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and
- **Environmental objective** – to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

The NPPF promotes the pursuit of sustainable development by seeking positive improvements to the built and natural environment, and to people's quality of life. This will include:

- Delivering a sufficient supply of homes
- Building a strong, competitive economy
- Ensuring the vitality of town centres
- Promoting healthy and safe communities
- Promoting sustainable transport
- Supporting high quality communications
- Making effective use of land
- Achieving well-designed places
- Protecting green belt land
- Meeting the challenge of climate change, flooding and coastal change
- Conserving and enhancing the natural environment
- Conserving and enhancing the historic environment
- Facilitating the sustainable use of materials.

3.2 REGIONAL POLICY - THE LONDON PLAN MARCH 2021

The London Plan was adopted in March 2021 and is the Spatial Development Strategy for Greater London. It sets out a plan for how London will be developed over the next 20-25 years.

An overview of the energy policy is provided in Table 3-1:

Table 3-1 – Summary of key policies in the New London Plan

POLICY TITLE	SUMMARY OF POLICY
Policy SI1: Improving Air Quality	Development should not lead to further deterioration of existing poor air quality, create any new areas that exceed air quality limits and create unacceptable risk of high levels of exposure to poor air quality. Major development must be at least air quality neutral and should use design solutions to prevent or minimise increased exposure to existing air pollution and make provision to address local problems of air quality in preference to post-design or retrofitted mitigation measures. Major development must be submitted with an Air Quality Assessment. To reduce the impact on air quality during the construction and demolition phase development proposals must demonstrate how they plan to comply with the Non-Road Mobile Machinery Low Emission Zone and reduce emissions from the demolition and construction of buildings following best practice guidance.

POLICY TITLE	SUMMARY OF POLICY
Policy SI2: Minimising Greenhouse Gas Emissions	Major development should be net zero-carbon. Reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the energy hierarchy: Be Lean – Be Clean – Be Green – Be Seen. Major development proposal should include a detailed energy strategy to demonstrate how the zero-carbon target will be met and achieve a minimum on-site reduction of at least 35% beyond Building Regulations. Residential development should achieve 10% and non-residential should achieve 15% through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either: 1) through a cash in lieu contribution to the borough's carbon offset fund, or 2) off-site provided that an alternative proposal is identified and delivery is certain. Major development should calculate and minimise carbon emissions from any other part of the development, including plant or equipment (Unregulated emissions). Development (referable to the Mayor) should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.

3.3 REGIONAL POLICY – SUPPLEMENTARY PLANNING GUIDANCE

ENERGY ASSESSMENT GUIDANCE (DRAFT APRIL 2020)

The Mayor Energy Assessment Guidance sets out guidance on preparing energy assessments as part of planning applications. The document sets out the requirements to minimise CO_2 emissions through the application of the energy hierarchy:

1. **Be lean**: use less energy
2. **Be clean**: supply energy efficiently
3. **Be green**: use renewable energy
4. **Be seen**: monitor performance

Over the last 2 to 3 years, the quantum of coal in the electricity mix in the UK has substantially decreased and the quantum of low and zero carbon technologies (including PV, wind and nuclear energy) has increased; as a result, the carbon content of grid supplied electricity has reduced. This decarbonisation will accelerate; suggesting a push towards an increasingly electric future rather than the gas fuelled MEP solutions that we see today.

The Mayor strives to improve the air quality in London and a movement towards an all-electric solution also provides air quality benefits both local to the development and across the city.

Since January 2019, applicants submitting GLA referable applications have been encouraged to use the SAP 10.0 emission factors in areas where there are no opportunities to connect to existing or planned district heating networks. Applicants should continue to use the current Building Regulations methodology for estimating energy performance against Part L 2013 requirements, but with the outputs manually converted to the SAP 10.0 carbon emission factors.

SAP 2012 emission factors can still be used if the development is in a Heat Network Priority Area, there is a potential to connect to an existing network using gas-engine CHP or a new network using low-emission CHP; and the network operator has or is in the process of developing or has a strategy to decarbonise the network and has shared it with the GLA.

Table 2 Part L Carbon Factors – Part L 2013 (SAP 2012) and SAP 10.0

FUEL TYPE	PART L 2013 (SAP 2012) ($kg.CO_2/kWh$)	SAP 10.0 ($kg.CO_2/kWh$)
Grid Supplied Electricity	0.519	0.233
Natural Gas	0.216	0.210

3.1 LOCAL POLICY – WESTMINISTER CITY PLAN

CITY OF WESTMINSTER PLANNING POLICY (NOVEMBER 2016)

Westminster's City Plan 2016 is the local plan for Westminster. It sets out the vision for the City of Westminster up to and beyond 2026/27 and puts in place a policy framework to deliver that vision. It balances the requirements and demands to deliver against economic, social and environmental objectives. In its section on SUSTAINABLE AND INCLUSIVE DESIGN it addresses in Policy S28:

- Development must incorporate exemplary standards of sustainable and inclusive urban design and architecture. In the correct context, imaginative modern architecture is encouraged provided that it respects Westminster's heritage and local distinctiveness and enriches its world-class city environment.
- Development will:
  - reduce energy use and emissions that contribute to climate change during the lifecycle of the development; and
  - ensure the reduction, reuse or recycling of resources and materials, including water, waste and aggregates.
- Development must provide for an extended lifetime of the building itself through excellence in design quality, high quality durable materials, efficient operation, and the provision of high-quality floor space that can adapt to changing circumstances over time.

Furthermore, the saved sections of the Unitary Development Plan (UDP) Chapter 9 relevant to sustainability are:

- ENV 4 Planting around and on buildings
- ENV 5 Air pollution
- ENV 6 Noise pollution
- ENV 7 Controlling noise from plant, machinery and internal activity
- ENV 10 Light pollution
- ENV 12 Waste and recycling storage
- ENV 13 Protecting amenities, daylight, sunlight and environmental quality
- ENV 16 Trees and shrub cover
- ENV 17 Nature conservation and biodiversity

EMERGING CITY PLAN 2019 – 2040

The Examination in Public took place in late summer 2020, following which the City Council consulted on main modifications to the Plan in line with the Inspector's post-EIP comments. Following completion of the consultation exercise, Westminster have received the final Examiner's Report on 19th March 2021 which has found the Plan to be sound, meaning it now has weight in decision making. Westminster intend to adopt the new Plan at a full Council meeting, likely to be in April 2021.

Table 3-3 – Summary of key Draft New City of Westminster Plan 2019 - 2040

POLICY TITLE	SUMMARY OF POLICY
Policy 32: Air Quality	The council is committed to improving air quality in the city and expects development to reduce exposure to poor air quality and maximise opportunities to improve it locally without detriment of air quality in other areas. **AIR QUALITY NEUTRAL AND POSITIVE** Major developments and any developments incorporating Combined Heat and Power (CHP) should be at least Air Quality Neutral. Major developments in Opportunity Areas and Housing Renewal Areas and those subject to an Environmental Impact Assessment must additionally demonstrate how local air quality can be improved across the proposed development as part of an air quality positive approach. **AIR QUALITY ASSESSMENTS** Air Quality Assessments will be required for: ■ Major developments; ■ Proposals that include potentially air pollution generating uses or combustion-based technologies; ■ Proposals incorporating sensitive uses; and ■ All residential developments within Air Quality Focus Areas.
Policy 36: Energy	The council will promote zero carbon development and expects all development to reduce on-site energy demand and maximise the use of low carbon energy sources to minimise the effects of climate change **CARBON REDUCTION** All development proposals should follow the principles of the Mayor of London's energy hierarchy. Major development should be net zero carbon and demonstrate through an energy strategy how this target can be achieved Where it is clearly demonstrated that it is not financially or technically viable to achieve zero-carbon on-site, any shortfall in carbon reduction targets should be addressed via off-site measures or through the provision of a carbon offset payment secured by legal agreement. **HEAT NETWORKS** Developments should be designed in accordance with the Mayor of London's heating hierarchy. Major developments must connect to existing or planned local heat networks, or establish a new network, wherever feasible **OVERHEATING** All developments should be designed and operated to minimise the risk of internal overheating. Major development proposals will include a cooling strategy in line with the Mayor of London's cooling hierarchy.

3.2 BUILDING REGULATIONS (PART L)

All new buildings constructed in the UK must meet the minimum requirements of the UK Building Regulations. Specifically, with regards to energy and carbon compliance, all buildings must meet the Building Regulations Part L 'Target Emission Rate' (TER) requirements for the Part L revision which is current at the time of initial construction works for each particular developmental phase.

This is illustrated by the production of a BRUKL (Building Regulations United Kingdom Part L) document which lists details of the Part L calculation and proposed fabric and building services.

The requirements of Part L 2013 will apply to the Proposed Development. The residential component of the Proposed Development will be assessed against Approved Document L1A (AD_L1A) which relates to new build residential buildings and the non-residential component will be assessed against Approved Document L2A (AD_L2A) relating to new build non-residential buildings.

Emerging policy, with respect to the Future Homes Standard (FHS) and changes to the Building Regulation Part L and F is expected to be enforced by June 2022. The 'Draft Approved' document is available for review with the consultation period now concluded 8in February 2020. The below commentary is subject to the final version's release.
The new Part L and Part F regulations are set to come into effect in June 2022.
Transitional arrangements will apply to individual buildings, rather than site wide as they have in the past. Therefore, the Part L 2013 compliance targets will be applicable only to those plots within the Paddington Green Development submitting notice to Building Control prior to the publication of the new Building Regulations. For transitional arrangements to apply, the developer will need to both:

a. Submit a building / initial notice or deposited plans by June 2022; and
b. Commence work on site by June 2023.

Based on the current design programme, it is assumed that the current regulation will apply, and the development can be locked into the current regulation when a meaningful start on site is made.

4 BASELINE CARBON EMISSIONS

The first stage of the energy assessment is to establish the baseline site energy demand and CO_2 emissions based on dynamic energy modelling software for the whole Proposed Development.

Detailed energy modelling was undertaken based on the methodology from Part L1A and L2A of the Building Regulations in order to establish the baseline carbon emissions for the Proposed Development.

WSP utilised a dynamic simulation software package, the Virtual Environment (VE) suite from Integrated Environmental Solutions (IES). A render of the model can be seen in Figure 4-1 and Figure 4-2.

The carbon emissions for the residential elements of the Proposed Development were calculated utilising Accredited Design Standard Assessment Procedure (SAP) 2012 software, Elmhurst Design. The carbon emission and fabric performance of a relevant selection of units covering 82% of the total units proposed within the development were assessed under SAP methodology. The selection is representative of the worst-case scenario and includes the great majority of interim floors within the development with the highest multipliers. The carbon dioxide emission for the whole development have been calculated as a pro-rata from the tested selection and are reported in this document.

The GLA carbon emissions reporting spreadsheet version 1.2 has been utilised to calculate the site wide carbon emission savings. In line with the latest GLA conventions, SAP 2012 emission factors are used to calculate the carbon emission savings as the development is in a Heat Network Priority Area and will connect to an existing network using gas-engine CHP or a new network using low-emission CHP.

In line with the latest GLA Energy Assessment Guidance a plan showing how the network operator intent to decarbonise the network has been prepared and is attached to this document in Appendix E. The options available for the decarbonisation, timelines and actions taken to date are outlined in the Decarbonisation Strategy document submitted as part of the planning application.

This process enabled the identification of optimum fabric and building services specification required to meet Westminster's and the GLA's planning targets.

Table 4-1 and Table 4-2 summarise the baseline carbon emissions split by type and for the whole Proposed Development.

Table 4-1 Baseline regulated and unregulated carbon emissions split by type – SAP 2012 CF

TOTAL	BASELINE REGULATED EMISSIONS (TONNES CO_2)	BASELINE UNREGULATED EMISSIONS (TONNES CO_2)
New Build Residential – Part L 2013 Baseline	543.9	739.1
Non-Residential – Part L 2013 Baseline	184.3	287.7

Table 4-2 Overall baseline regulated and unregulated carbon emissions of the scheme - SAP 2012 CF

TOTAL	REGULATED EMISSIONS (TONNES CO_2)	UNREGULATED EMISSIONS (TONNES CO_2)
Baseline emissions	728.2	1017.8

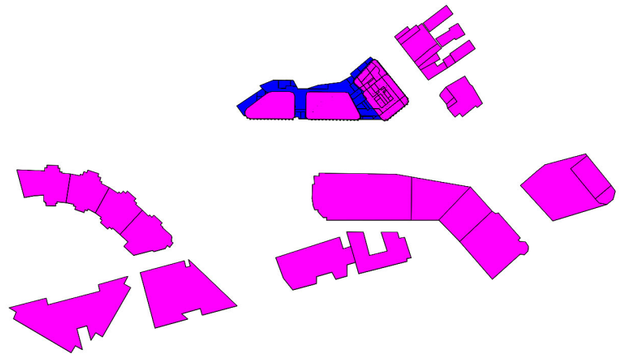

Figure 4-1 Render of the IES model of the development and the surrounding buildings – top view

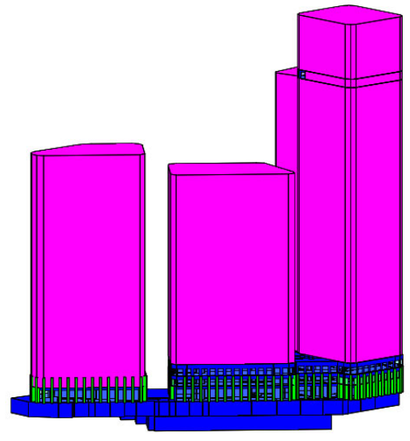

Figure 4-2 Render of the IES model of the development – perspective view

5 BE LEAN: DEMAND REDUCTION

The first step to achieving Building Regulations compliance and the targets outlined previously is to reduce energy demand. The measures associated with reducing demand can be termed as 'Energy Efficiency Measures'.

5.1 BUILDING FABRIC

During design development, significant consideration has been given to how the building fabric will respond to its environment in order that the energy consumption of the building is reduced as far as possible through passive means.

A façade optimisation exercise was performed which included detailed g-value, U-value and shading analysis and their impact on the cooling and heating requirements of the building as well as the impact on carbon emissions. The analysis also considered the incident solar radiation and the different requirements of the various façade orientations.

The architectural geometry, glazing area and shading elements provided in the façade are designed to maximise the passive measures, to mitigate overheating issues and maximise daylight and sunlight access within the proposed apartments. To meet the above requirements the glazing percentage has been optimised to be as follows:

- Block I = 47%
- Block J = 46%
- Block K = 50%

The building fabric consists of a unitised curtain walling system with high performance glazing and insulated metal panel. The facade is optimised to reduce heat loss in winter months and minimise heat gains in summer months. This will reduce the energy required to heat and cool the Proposed Development. An assessment of the building façade for each Building has been undertaken to establish the effect of differing U-values and g-values on carbon emissions and Target Fabric Energy Efficiency (TFEE) values.

An average U-value of 0.9 W/m^{2}k is currently targeted for the unitised façade to provide compliance with the TFEE and minimum requirements for domestic developments at Be Lean stage. A thermal bridging analysis was undertaken using SAP 2012 software calculating the length of all junctions in line with the conventions for curtain walling systems set out in the SAP conventions v8.2. Detailed façade design and thermal bridging calculations will be performed during detailed design stage when junction details will be specified. These will inform final U-values required for each building fabric element. The final strategy for compliance with TFEE will be defined as design develops.

This analysis is based on a party wall conditions between apartments and communal corridors in line with agreements with Building Control.

The building fabric will be designed to exceed the limiting fabric requirements of Part L1A (2016) and Part L2A (2016) of the Building Regulations as applicable.

Table 5-1 Fabric performance targets – Residential

FABRIC ASSUMPTIONS	TARGET PERFORMANCE	PART L1A LIMITING FABRIC PARAMETERS
Curtain wall average U-value (W/m^{2}K)	0.9	-
Glazing G-value (all glazing areas)	0.5	-
Internal walls adjacent to commercial premises/amenity U-value (W/m^{2}K)	0.2	0.3
Exposed floors and ground floors adjacent to commercial premises U-value (W/m^{2}K)	0.13	0.25
Roof U-Value (W/m^2. K)	0.13	0.20
Party Wall	0.0	0.2
Air permeability (m^3/hr.m^2@50pa)	3.0	10.0
Thermal Bridging Y-value (W/m^{2}K)*	0 (already included in the curtain wall U-value);	-

Table 5-2 Fabric performance targets – Non-Residential

FABRIC ASSUMPTIONS	TARGET PERFORMANCE	PART L2A LIMITING FABRIC PARAMETERS
Curtain Wall average U-value (W/m^2. K)	0.9	-
Glazing G-value (all glazing areas)	0.3	-
Basement Wall adjacent to unheated areas U-Value (W/m^{2}K)	0.13	0.35
Internal Walls to unheated spaces U-Value (W/m^{2}K)	0.20	-
Ground/Basement Floor connected to conditioned areas U-Value (W/m^{2}K) (varies)	0.13	0.25
Air permeability (m^3/hr.m^2@50pa)	3	10.0
Thermal Bridging Y-value (W/m^2.K)	0 (already included in the curtain wall U-value); 10% for the remaining areas.	-

5.2 THE BUILDING SERVICES

In line with the GLA heating hierarchy that prioritises the connection to an existing area-wide heat network the Proposed Development will connect to the West End Gate energy centre. Heating and hot water for the residential areas and non-residential landlord areas of the development will be served by 4 no. gas-fired condensing boilers & 1 no. Combined Heat and Power (CHP) in the West End Gate energy centre. Further details are provided in the 'Be Clean' section of this document.

Heating and cooling in the CAT A non-residential areas will be provided by an all-electric solution using 2 no. Air Source Heat Pumps (ASHPs) located on the roof of Building I. Domestic hot water in these areas will be served by the ASHP and 1 no. Water Source Heat Pump (WSHP) at each office floor level.

Low Temperature Hot Water (LTHW) pipework will be distributed via the basement to the heat interface unit within each block. From the Heat Interface Unit (HIU), all areas within these building will be provided with Fan Coil Units (FCU).

Residential Units (Use Class C3)

- Residential units will be connected to the site wide energy centre for provision of space heating and Domestic Hot Water (DHW). This will be via a HIU within each apartment to transfer heat from the network to the apartment and will include heat metering.
- Each apartment will be provided with a Mechanical Utility Cupboard (MUC), where the majority of the apartment plant and equipment will be located.
- Each apartment will be provided with a Mechanical Ventilation Heat Recovery (MVHR) unit. This will be located in the MUC and ducted at ceiling level.
- To mitigate the risk of overheating cooling the private apartments will be provided Air Cooled Chillers (ACC) located on the roof of Block I. Distributed chilled water (CHW) will serve Cooling Interface Units (CIU) within each apartment which will then serve high-efficient FCU located in each apartment
- An in-line Direct Expansion (DX) cooling module will be integrated into the MVHR to mitigate the risk of overheating in the summer months within the affordable apartments.
- 100% low energy LED/fluorescent lighting.

Non-residential

- The commercial and retail spaces will be developed to CAT A standard only.
- All non-residential spaces will be served by high efficiency FCUs.
- The tenants will be responsible for provision of services to suit their particular requirements. However, heating and cooling will be provided for the tenants' use with a capped services connection for the site wide LTHW.
- Mechanical ventilation will be provided in the office floors and the landlord areas to ensure sufficient ventilation can be provided at all times. Low specific fan power air handling units with heat recovery will be specified to reduce the energy demand associated with the mechanical ventilation systems.
- For the purposes of the energy analysis, reasonable assumptions have been made for the fit-out design typical of offices and retail units. This includes heating and ventilation via FCUs, mechanical ventilation via Air Handling Units (AHU) and low energy shop and display lighting with efficient controls.
- Whereas the base build is to be completed to a CAT A standard only, agreements with the landlord will be used to ensure that the tenants' services meet the specifications required to achieve the overall carbon emission reductions outlined within this document.
- Low energy LED/fluorescent lighting incorporating daylight and motion controls will be specified throughout.
- Automatic monitoring and targeting of energy consumption for HVAC systems specified from the HVAC plant.

Performance Specification

Table 5-3 lists the general design rationale and proposed specification for the MEP building services.

Table 5-3 Proposed energy conservation measures

ELEMENT	DESIGN RATIONALE
Air Handling Plant	Ventilation to the non-residential spaces is proposed to be through local mechanical ventilation units complete with heat recovery. The AHU providing mechanical ventilation to the basement will be provided to achieve a specific fan power (SFP) of **1.6 W/l/s** or lower. The AHU serving the offices will have a specific fan power (SFP) of **1.9 W/l/s** or lower. Extract SFP of **0.4 W/l/s** with **10ACH** in toilets/changing. Supply and exhaust ventilation to non-residential areas will be designed to exceed the minimum performance criteria outlined in the Non-Domestic Building Services Compliance Guide.
Energy Recovery	Where appropriate, air handling systems will incorporate heat recovery systems. These transfer waste heat from the exhaust air stream to the supply air stream via a honeycomb matrix of heat absorbing material, which is slowly rotated within the supply and exhaust air streams. The AHUs will incorporate thermal wheels with a minimum heat recovery efficiency of **80%**.
MVHR in Residential	Each apartment will be provided with a Mechanical Ventilation Heat Recovery (MVHR) unit. This will be designed to achieve a minimum efficiency of **88%** and an SFP of **0.56 W/l/s** or lower.
Space Heating	Space heating in the CAT A areas will be served by a LTHW network with an ASHP as the primary heat generator. The Seasonal Coefficient of Performance (SCOP) of the ASHP to be **3.75** or higher.
Domestic Hot Water	Hot water in the CAT A areas will be served by ASHP with WSHP. The seasonal Coefficient of Performance (SCOP) of the ASHP+WSHP to be **2.2** or higher.
Cooling Plant	Chilled water (CHW) in the CAT A will be provided by the ASHP. The system will have a SEER (Seasonal Energy Efficiency Ratio) of at least **7.00**. Cooling within the apartments will be served by the ACC with an energy efficiency ratio of **3.5** of higher.
Terminal Units	Heating and cooling to non-residential units to be provided by FCUs with an SFP of **0.17 W/l/s** or lower.
Lighting Technology	Detailed lighting proposals will be developed during the subsequent design phases. High efficiency lighting will be provided throughout to significantly exceed the minimum requirements of the Non-Domestic Building Services Compliance Guide. This includes the use of high efficiency fluorescent and/or LED luminaries throughout. Lighting to achieve a lighting power density of **1 W/m^2/(100 lux)** in the offices and **2 W/m^2/(100 lux)** in the remaining non-residential areas.
Display Lighting	Display lighting can be a significant source of energy consumption in retail, cultural/leisure and reception areas. High efficiency display lighting will be specified throughout to reduce the carbon emissions and cooling loads associated with display lighting provision. This will exceed Part L limiting values and the limits within the Part L notional building calculation. Display lighting lamp efficacy to target **80 lm/W**

ELEMENT	DESIGN RATIONALE
Lighting Control	Occupancy and daylight sensing will be specified to an appropriate level throughout the different areas of the Proposed Development. This assists in reducing the use of artificial lighting when areas are not occupied. Light dimming and Passive Infrared Sensors (PIR) are specified where applicable. Time switch on lighting controls is specified to avoid night time parasitic power.

5.3 CARBON EMISSION REDUCTION

Based upon the energy efficiency measures outlined, and excluding the contribution of the CHP, ASHP, WSHP and PV systems the following total carbon emissions are calculated in Table 5-6. The SAP 2012 carbon factors have been used for all further calculations using version 1.2 of the GLA Carbon Emission Reporting Spreadsheet.

The carbon emissions from the development are shown to be lower than the minimum requirements of the Building Regulations by energy efficiency measures alone. This is achieved via the use of the energy efficiency measures proposed (including a highly efficient building fabric, 100% low energy lighting and centralised ventilation with heat recovery systems) which far exceed the minimum requirements of the Regulations.

The residential element meets the target of 10% reduction in regulated carbon emission from energy efficiency for domestic development (Table 5-4).

- The non-residential element exceeds the target of 15% improvement on Building Regulations from energy efficiency (Table 5-5).

Table 5-4 Be Lean: Carbon emissions after the application of energy efficiency measures – Residential – SAP 2012 CF

TOTAL	REGULATED EMISSIONS (TONNES)	UNREGULATED EMISSIONS (TONNES)	% REDUCTION IN REGULATED CARBON EMISSIONS
Baseline emissions (Tonnes CO_2)	543.9	739.1	0.0%
Emissions after energy demand reduction (Tonnes CO_2)*	488.6	739.1	10%

**The energy efficiency savings have been calculated on the basis that the buildings are served by a central heating system served by gas fired boilers only, with a seasonal efficiency of 96%. Cooling system for Be Lean stage has been assumed as air cooled chillers with SEER of 3.5.*

Table 5-5 Be Lean: Carbon emissions after the application of energy efficiency measures – Non-Residential – SAP 2012 CF

TOTAL	REGULATED EMISSIONS (TONNES)	UNREGULATED EMISSIONS (TONNES)	% REDUCTION IN REGULATED CARBON EMISSIONS
Baseline emissions (Tonnes CO_2)	184.3	287.7	0.0%
Emissions after energy demand reduction (Tonnes CO_2)*	143.2	287.7	22%

**The energy efficiency savings have been calculated on the basis that the buildings are served by a central heating system served by gas fired boilers only, with a seasonal efficiency of 96%. Cooling system for Be Lean stage has been assumed as air cooled chillers with SEER of 4.5.*

Table 5-6 Be Lean: Carbon emissions after the application of energy efficiency measures – Whole Development – SAP 2012 CF

TOTAL	REGULATED EMISSIONS (TONNES)	UNREGULATED EMISSIONS (TONNES)	% REDUCTION IN REGULATED CARBON EMISSIONS
Baseline emissions (Tonnes CO_2)	728.2	1017.8	0.0%
Emissions after energy demand reduction (Tonnes CO_2)*	631.8	1017.8	13%

**The energy efficiency savings have been calculated on the basis that the buildings are served by a central heating system served by gas fired boilers only, with a seasonal efficiency of 96%. Cooling system for Be Lean stage has been assumed as air cooled chillers with SEER of 3.5 for the residential area and 4.5 for the non-residential.*

5.4 PART L FABRIC ENERGY EFFICIENCY

The TFEE (Target Fabric Energy Efficiency) standard is the maximum amount of energy which can be used to heat and cool a new dwelling. The TFEE standard is calculated by using a building of the same size and shape as the actual dwelling, but with the fabric and building services performance stipulated within Appendix R of SAP 2012. This is assessed for each new residential building.

The thermal performance of the façade has been considered in detail early on in the design process and close consideration has been given to the thermal performance of the façade based on the emerging design.

Accredited Design SAP2012 software was used to determine the FEE standards for all apartments. An analysis has been undertaken on the all the new build residential buildings to establish the performance of the fabric in relation to the TFEE. Results for TFEE and the Dwelling FEE (DFEE) for all residential buildings are as follows:

Table 5-7 Fabric energy efficiency and carbon emissions results by residential buildings

RESIDENTIAL BUILDINGS	BUILDING I	BUILDING J	BUILDING K
Average TFEE (kWh/m²)	34.1	32.70	33.30
Average FEE (kWh/m²)	32.95	29.63	32.31
Improvement	3%	9%	3%

All residential areas achieve compliance with the TFEE standard. Detailed façade design and thermal bridging calculations will be performed during detailed design stage once junction details will be specified. The final strategy for compliance with TFEE will be defined as design develops. The project will ensure compliance with the TFEE is achieved.

5.5 ENERGY DEMAND AFTER EFFICIENCY MEASURES

Table 5-8 Energy demand following energy efficiency measures

BUILDING USE	ENERGY DEMAND FOLLOWING ENERGY EFFICIENCY MEASURES (MWH/YEAR)						
	Space Heating	Hot Water	Lighting	Auxiliary	Cooling	Unregulated electricity	Unregulated gas
Domestic	691	1421	226	127	28	1902	-
Non-domestic	83	17	90	95	38	537	-

Table 5-9 Total cooling demand for the actual and notional buildings.

BUILDING USE	TOTAL ANNUAL COOLING DEMAND (MJ/YEAR)		
	Notional	Actual	Savings
Domestic	-	100,800	-
Non-domestic	170,212	135,597	20%

Table 5-10 Area weighted cooling demand for the actual and notional buildings.

BUILDING USE	AREA WEIGHTED AVERAGE COOLING DEMAND (MJ/M2)		
	Notional	Actual	Savings
Domestic	-	2.0	-
Non-domestic	14.4	11.5	20%

5.6 COSTS TO OCCUPANTS

Heating and hot water in the apartments will be provided by highly efficient centralised heating system served by the West End Gate energy centre.

The communal heating system is designed in line with the quality standard defined in the CIBSE Guidance CP1: Heat networks: Code of Practice for the UK (2020) and to minimise buildings' energy consumptions and heating and hot water costs.

The cost per unit of electricity and main gas has been estimated based on the information from a report produced in 2015 by Which?. The cost per heat from a heat network is 11.04p/kWh (6.85p/kWh as a variable charge or "direct to tenant" and 4.19p/kWh "via landlord"). This price is a direct cost per delivered kWh heat and includes the cost for plant maintenance and overheads.

The following consumptions have been calculated based on the relative efficiencies of each system:

Table 5-11 Total heating and hot water consumption

BUILDING USE	ENERGY CONSUMPTION (KWH/M²/YEAR)	
	Space Heating	Hot Water
Domestic	22.3	45.5

Base on the above the combined heating and hot water requirements per apartment is approximately 748 p/m^2/year. This equates to approx. £374 per year for a 50m^2 flat.

The use of SAP for annual cost predictions is not the most accurate means of demonstrating annual energy consumption and operating costs. The cost per unit heat will be determined by the network provider and is yet to be defined.

6 OVERHEATING ANALYSIS

Policy SI4 of the London Plan requires *major development* proposals to reduce potential overheating and reliance on air conditioning systems and demonstrate this is in accordance with the following cooling hierarchy.

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

Dynamic thermal models were built in IES VE to verify the internal conditions of the residential and non-residential elements of the development. All occupied spaces have been analysed against the criteria within TM52 and TM59. A stepped approach was utilised following the cooling hierarchy. Measures were incorporated into the models and building design until internal conditions became acceptable.

The following weather files have been used in the analysis following the GLA guidance for overheating assessments:

- London_LWC_DSY1_2020High50 (a moderately warm summer);
- London_LWC_DSY2_2020High50 (a year with a very intense single warm spell);
- London_LWC_DSY3_2020High50 (a year with a prolonged period of sustained warmth).

6.1 CIBSE TM52 OVERHEATING CRITERIA

CIBSE TM52 sets out criteria based on an adaptive approach to thermal comfort. The ‘adaptive’ approach to thermal comfort shows that the temperature at which the majority of people are comfortable ‘tracks’ the mean indoor temperature because of the correlation between indoor and outdoor temperature in naturally ventilated (free running) buildings.

The following three criteria, taken together, provide a robust yet balanced assessment of the risk of overheating of buildings in the UK and Europe. A room or building that fails any two of the three criteria is classed as overheating.

- The first criterion states the number of hours (He) during which ΔT (the difference between the actual operative temperature in a room and the limiting maximum acceptable air temperature) is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3% of occupied hours.
- The second criterion deals with the severity of overheating within any one day, which can be as important as its frequency, the level of which is a function of both temperature rise and its duration. This criterion sets a daily limit for acceptability. To allow for the severity of overheating the weighted exceedance (We) shall be less than or equal to 6.
- The third criterion sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable. The value of ΔT shall not exceed 4K.

For the residential apartments, in line with TM59 requirements, the analysis is conducted to ensure a sufficient comfort level during the night. The following criteria is specified for bedrooms in TM59:

- To guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26 °C for more than 1% of annual hours.

There are four assessment categories within TM52 which is dependent on the acceptable temperature range of free-running buildings. The CIBSE suggestion is that designers should aim to remain within the Category II limits.

Table 6-1 Categories of building types within CIBSE TM52

Category	Explanation	Suggested acceptable range (K)
I	High level of expectation only used for spaces occupied by very sensitive and fragile persons	± 2
II	Normal expectation (for all new buildings and renovations)	± 3
III	A moderate expectation (used for existing buildings)	± 4
IV	Values outside the criteria for the above categories (only acceptable for a limited period)	> 4

The GLA acknowledges that meeting the TM52 criteria is challenging for DSY2 & 3 weather files but expects the criteria is met for the DSY1 weather scenario.

6.2 OVERHEATING ANALYSIS - RESIDENTIAL

The passive design of the units has been considered in great detail, and the orientation and massing has considered its position on the application site relative to other buildings which will provide an element of shading but also to maximise daylight opportunities. Internal layouts have also been refined to allow the daylighting requirements to be achieved without reliance on excessive amounts of glazing. Façade options have been studied to minimise heat loss and solar gains, and to investigate the introduction of external shading measures.

A relevant selection of 20 no. apartments at level 12 were modelled in IES-VE software and tested for overheating according to TM59 methodology. Shading from adjacent building of relevant heights were considered in the analysis.

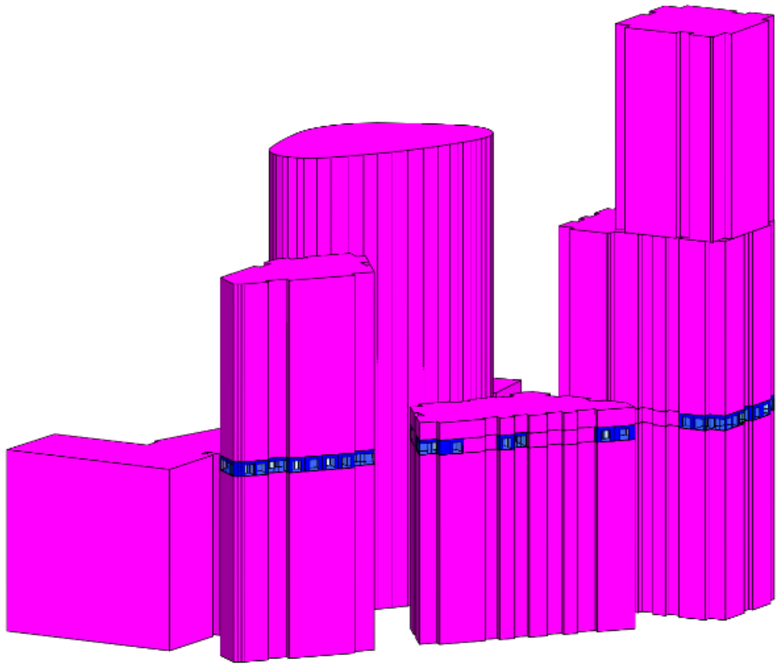

Figure 6-1 Render of the IES model of the overheating model – perspective view.

MODELLING ASSUMPTIONS

For the purposes of this analysis the following key assumptions have been made based on CIBSE TM59 guidance:

Occupancy and equipment gains

- Maximum sensible heat gain of 75 W/person and a maximum latent heat gain of 55 W/person are assumed in living spaces.
- Lighting energy is assumed at 2 W/m^2 from 6pm to 11pm.
- Gain profiles are as described on the table below:

Table 6-2 Occupancy and equipment load assumptions

UNIT/ROOM TYPE	OCCUPANCY	EQUIPMENT LOAD
Studio	2 people at all times	Peak load of 450W from 6pm to 8pm 200W from 8pm to 10pm 110W from 9am to 6pm and from 10pm to 12pm Base load of 85W for the rest of the day
1 bedroom apartment Kitchen/Living/Dining	1 person from 9am to 10pm; room is unoccupied for the rest of the day	Peak load of 450W from 6pm to 8pm 200W from 8pm to 10pm 110W from 9am to 6pm and from 10pm to 12pm Base load of 85W for the rest of the day
2 bedroom apartment Kitchen/Living/Dining	2 people from 9am to 10pm; room is unoccupied for the rest of the day	Peak load of 450W from 6pm to 8pm 200W from 8pm to 10pm 110W from 9am to 6pm and from 10pm to 12pm Base load of 85W for the rest of the day
3 bedroom apartment Kitchen/Living/Dining	3 people from 9am to 10pm; room is unoccupied for the rest of the day	Peak load of 450W from 6pm to 8pm 200W from 8pm to 10pm 110W from 9am to 6pm and from 10pm to 12pm Base load of 85W for the rest of the day
3 bedroom apartment Kitchen	3 people at 25% gains from 9am to 10pm; room is unoccupied for the rest of the day	Peak load of 300W from 6pm to 8pm Base load of 50W for the rest of the day
3 bedroom apartment Living Room	3 people at 75% gains from 9am to 10pm; room is unoccupied for the rest of the day	Peak load of 150W from 6pm to 8pm 60W from 9am to 6pm and from 10pm to 12pm Base load of 35W for the rest of the day
Double bedroom	2 people at 70% gains from 11pm to 8am 2 people at full gains from 8am to 9am and from 10pm to 11pm 1 person at full gains from 9am to 10pm	Peak load of 80W from 8am to 11pm Base load of 10W during sleeping hours
Single bedroom (too small to accommodate double bed)	1 person at 70% gains from 11pm to 8am 1 person at full gains from 8 am to 11pm	Peak load of 80W from 8am to 11pm Base load of 10W during sleeping hours

The TM59 assumptions above are stringent and worst-case scenario and assume full occupation during the day in all apartments. This is to account for vulnerable people such as children and the elderly and for people on shift work who may remain in their residences during the day.

Ventilation

- The primary means of reducing overheating risk is to open windows. Occupants are considered to open windows when the internal temperature exceeds 22°C and the room is occupied.
- All full height doors with access to the balcony have been assessed as inward opening side hung windows and an opening angle of 90 degrees. Occupants are

considered to open windows when the internal temperature exceeds 22°C and the room is occupied in line with TM59 guidance.

- Fresh air and free cooling in the remaining windows on the facades are provided by top-hung windows with an opening angle of 30°.
- In line with TM59 guidance internal doors have been modelled and assumed to be left open in the daytime and closed when the occupants are sleeping.
- MVHR is assumed to operate continuously within the affordable apartments providing 0.3 l/s/m^2 of fresh air.
- Infiltration is assumed at 0.25 AC/H continuously.
- No MVHR boost has been considered for the purposes of assessing overheating risk but this could be used in extreme weather situations.

Shading

- An effective g-value of 0.5 has been assumed without the incorporation of blinds, subject to design development.
- Balconies will significantly reduce the solar gains within the main living spaces and bedroom located behind.
- External fins have been incorporated throughout the façade to reduce the risk of overheating.

RESULTS

The overheating analysis was carried out to CIBSE TM59 requirements. A relevant selection of units within the Proposed Development, were assessed against Category II criteria. Overheating analysis was carried out using the three weather files as described in previously. A summary of the results is provided below.

Table 6-3 Cooling Hierarchy, project measures and project performance/simulation results for occupied zones – Residential

DESCRIPTION	PROJECT MEASURES	THERMAL COMFORT PERFORMANCE DSY 1	THERMAL COMFORT PERFORMANCE DSY 2	THERMAL COMFORT PERFORMANCE DSY 3
1.Minimise internal heat generation through energy efficient design	100% low energy LED lighting will be provided to reduce internal heat gains within the apartments.	0 of 51 zones pass	0 of 51 zones pass	0 of 51 zones pass
2.Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls	The proposal for the façades includes solar control glass and high thermal performance specification; helping to reduce solar gain and consequently reduce cooling loads. The proposed balconies and shading devices on top floors apartments will significantly reduce solar gains within the rooms behind.	0 of 51 zones pass	0 of 51 zones pass	0 of 51 zones pass
3.Manage the heat within the building through exposed internal thermal mass and high ceilings	Exposed ceilings were considered not suitable for the aesthetic of the residential spaces. Therefore, a passive strategy with exposed internal ceiling was not implemented for the Proposed Development.	Not Applicable		
4.Passive ventilation	Occupants of the apartments are considered to open windows when the internal temperature exceeds 22°C and the room is occupied.	41 of 51zones pass	1 of 51 zones pass	0 of 51 zones pass
5.Mechanical ventilation	Increased levels of mechanical ventilation compared to the minimum Building Regulations requirements will be provided to minimise the build-up of internal gains.	51 of 51 zones pass	1 of 51 zones pass	0 of 51 zones pass

The full TM59 assessments have demonstrated that passive design measures have been maximised and all rooms achieve compliance with guidance when free cooling via openable windows is viable during occupied hours.

NOISE AND AIR QUALITY SITE CONSTRAINTS

In line with TM59 guidance, the impact on overheating of potential air quality and acoustic issues that limit opening area have been considered in the assessments.

The internal ambient noise assessment carried out by Ramboll has reported that "*Based on the risk categories given in the Level 1 assessment from AVO (Figure 2) the site is in a 'high' risk category, meaning that there is a significant risk of adverse effects on residents if overheating is relieved with open windows or other façade openings.' And 'On this basis, control of overheating through open windows (or other simple façade openings) is not likely to be possible on any façade or floor level of the building'.*[1]

In line with the findings of the acoustic report, WSP has assessed the compliance with TM59 criteria in the event that overheating cannot be mitigated through natural ventilation via openable windows.

[1] Environmental Statement_Chapter 8_Technical Appendix 8 5_Site Suitability for Residential_Ramboll_March 2021.

Table 6-4 TM59 overheating assessment considering findings of acoustic and air quality report – Residential

DESCRIPTION	PROJECT MEASURES	THERMAL COMFORT PERFORMANCE DSY 1	THERMAL COMFORT PERFORMANCE DSY 2	THERMAL COMFORT PERFORMANCE DSY 3
Passive Measures maximised as per scenario 1+2+4+5 in Table 6-3 and windows closed.	-100% low energy LED lighting; - solar control glass and external shading in form of balconies and fins on the façade; - Increased levels of mechanical ventilation	0 of 51 zones pass	0 of 51 zones pass	0 of 51 zones pass
6.Active cooling systems (ensuring they are the lowest carbon options)*	Active cooling within the private units is being provided by Air Cooled Chillers (ACC) located on the roof of Block I. An in-line DX cooling module will be integrated into the MVHR to mitigate the risk of overheating in the summer months within the affordable apartments.	51 of 51 zones pass	51 of 51 zones pass	51 of 51 zones pass

*Rooms compliance for simulations when windows cannot be open is assessed against TM59 minimum criteria for predominantly mechanically ventilated buildings.

In all rooms when free cooling via openable windows cannot be provided during occupied hours due to noise constraints, the results show a significant number of occupied hours throughout the year when the internal operative temperature is considered outside acceptable conditions. The use of mechanical ventilation has demonstrated to help increasing occupant's thermal comfort. However, the proposed ventilation rate cannot be increased due to size and noise limitations of the MVHR system.

To provide levels of thermal comfort in line with guidance and future proof the development for future weather scenarios it is proposed that all MVHR within Block J are provided through direct expansion cooling coil. A MVHR unit equipped with a compression cooling system with a maximum cooling capacity of 1.5 kW has been assumed for the analysis.

Space cooling within the private apartments is proposed to cover peaks and provide comfort when considering future weather conditions. Minimum levels of intermittent purge ventilation in line with Part F of the Building regulations will be provided via passive ventilation to aid removal of high concentrations of pollutants and water vapour and improve thermal comfort.

Cooling usage is anticipated to be low due to the high efficiencies of the system. Furthermore, the carbon emissions associated to it will continually decrease with the decarbonisation of the grid.

Overheating in Corridors

In addition, it is recognised that market feedback on internal heat networks (particularly within multi storey residential buildings) in recent years has highlighted a common, significant failing; the overheating of internal corridor spaces particularly in summer. Solutions adopted to mitigate this problem include:

- 100% low energy lighting to reduce heat gains within the corridors.
- Corridor pipe heat losses are assumed at 6 W/m at all times.
- It is assumed that the smoke vent system will be utilised for environmental control to mitigate corridor overheating when the temperature is equal or greater than 25^{O}C.

The results have shown that temperatures within the corridors are above 28^{O}C for only 1% of the annual hours, when 3% is the maximum target defined by TM59. Therefore, cooling is not required in communal corridors.

RESIDENTIAL OVERHEATING ANALYSIS CONCLUSIONS

A range of overheating studies have been undertaken in line with guidance in industry documents such as CIBSE TM52, CIBSE TM59 and CIBSE Guide A, and a dynamic simulation model has been developed in order to test the influence of various parameters and ensure that overheating will not be an issue.

On the basis of the above, apartments are considered to comply with Policy 5.9 of the London Plan and Part L Criterion 3 of the Building Regulations and with CIBSE TM59 and TM52.

The strategy for minimising cooling demand in accordance with Policy 5.9 for the Proposed Development is as follows:

- Buildings orientation and massing have been optimised to reduce overheating. This study has considered its position on the application site relative to other buildings which will provide an element of shading but also to maximise daylight opportunities.
- Passive solar shading in the form of in-set balconies and fins on the façade are proposed to reduce the solar heat gains within all apartments.
- Internal layouts have also been refined to allow the daylighting requirements to be achieved and minimise the risk of overheating.
- 100% low energy lighting will be provided to reduce internal heat gains within the apartments.
- A highly efficient fabric and glazing is proposed incorporating glazing with low-e solar shield glass to protect the interior from solar gain.
- Within the apartments, mechanical ventilation will be provided via MVHR to cover peaks.

The results of the assessments showed that all apartments are compliant with the TM52 and TM59 overheating criteria for the DSY1 weather scenario when free cooling via openable windows is provided.

A significant number of apartments do not achieve compliance with TM52 and TM59 criteria for the DSY2 and DSY3 weather file.

In line with the findings of the acoustic and air quality reports WSP has assessed the compliance with TM59 criteria in the event that overheating cannot be mitigated through natural ventilation via openable windows.

Ventilation and glazing specification sensitivity analysis has been conducted and it has been determined that boosted mechanical ventilation and improved control glazing specifications will not be sufficient to achieve compliance with TM59 criteria when free cooling from openable windows cannot be provided.

To reduce the peak temperatures to acceptable levels and provide comfort when future weather conditions are considered the following additional mitigating measures have been considered:

- Space cooling in the private apartments will be provided Air Cooled Chillers (ACC) located on the roof of Block I. Distributed chilled water (CHW) will serve cooling interface units (CIU) within each apartment which will then serve high-efficient FCU located in each apartment
- An in-line DX cooling module will be integrated into the MVHR to mitigate the risk of overheating in the summer months within the affordable apartments.

The assumptions used focus on the worst-case scenario when rooms are occupied all day to take into account vulnerable people, the risk reduces when apartments are occupied only in the evening. As per TM59 guidance, the aim of this test is to encourage good design that is comfortable within sensible limits, without being so stringent that it over-promotes the use of mechanical cooling. During design development the team will look at additional opportunities to reduce the risk of overheating even further in extreme hot weather and heat wave events.

6.3 OVERHEATING ANALYSIS - NON-RESIDENTIAL

MODELLING ASSUMPTIONS

For the purposes of this analysis the following key assumptions have been made based on CIBSE TM52 guidance:

Internal gains

- The use of high efficiency fluorescent and/or LED luminaries is specified throughout. 25W/m^2 is specified in all retail spaces. Lighting is set to achieve a lighting power density of 2W/m^2/(100 lux) or less in all remaining spaces.
- An infiltration rate of 0.25 ACH in all spaces where it is applicable.

The following gains were used in the analysis:

Table 6-5 Occupancy gains

AREA	MAXIMUM SENSIBLE GAIN	MAXIMUM LATENT GAIN	OCCUPANCY DENSITY
Cupboards	-	-	-
Circulation	-	-	-
Commercial	90 W	60 W	8 m^2/person
Retail/Reception	85 W	55 W	5 m^2/person
Gym/Wellness	102 W	198 W	6 m^2/person
Resident's Amenity	90 W	60 W	8 m^2/person

Table 6-6 Internal equipment gains for conditioned areas

AREA	EQUIPMENT
Cupboards	-
Circulation	-
Commercial	25 W/m^2
Retail/Reception	5 W/m^2
Gym/Wellness	15 W/m^2
Resident's Amenity	25 W/m^2

The following gain profiles were considered for the retail and commercial spaces:

Table 6-7 Retail-Commercial gains profiles

AREA	LIGHTING PROFILE	OCCUPANCY PROFILE	EQUIPMENT PROFILE
Retail/Commercial	Monday to Friday 00:00-09:00 – 0% 09:00-17:00 – 100% 17:00:24:00 – 0%	Monday to Friday 00:00-09:00 – 0% 09:00-17:00 – 100% 17:00:24:00 – 0%	Monday to Friday 00:00-09:00 – 0% 09:00-17:00 – 100% 17:00:24:00 – 0%

NCM gains profiles were used for all remaining non-residential spaces.

Ventilation

The following auxiliary ventilation rates have been specified in the analysis:

Table 6-8 Ventilation rates

AREA	VENTILATION RATES
Cupboards	0.25 l/s-m^2
Circulation	1.173 l/s-m^2
Commercial	12 l/s-p
Retail/Reception	12 l/s-p
Gym/Wellness	30 l/s-p
Resident's Amenity	12 l/s-p

Shading

- An effective g-value of 0.3 has been assumed for the non-residential areas.
- External fins have been incorporated throughout the façade to reduce the risk of overheating.

6.4 RESULTS

The table below summarises the performance of the project during occupied hours after each step of the cooling hierarchy is introduced.

Table 6-9 Cooling Hierarchy, project measures and project performance/simulation results for occupied zones – Non-residential spaces

DESCRIPTION	PROJECT MEASURES	THERMAL COMFORT PERFORMANCE DSY 1	THERMAL COMFORT PERFORMANCE DSY 2	THERMAL COMFORT PERFORMANCE DSY 3
1.Minimise internal heat generation through energy efficient design	100% low energy LED lighting will be provided to reduce internal heat gains within the rooms.	0 of 73 zones pass	0 of 73 zones pass	0 of 73 zones pass
2.Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls	The proposal for the façades includes solar control glass with a g-value of 0.3 and high thermal performance specification on the south elevations; helping to reduce solar gain and consequently reduce cooling loads.	0 of 73 zones pass	0 of 73 zones pass	0 of 73 zones pass
3.Manage the heat within the building through exposed internal thermal mass and high ceilings	Provision of an exposed concrete ceiling has been tested to reduce cooling loads during occupied hours. No auxiliary ventilation.	0 of 73 zones pass	0 of 73 zones pass	0 of 73 zones pass
4.Passive ventilation	A passive design ventilation strategy is not proposed for the non-residential spaces.		Not Applicable	
5.Mechanical ventilation (windows closed)	Increased levels of mechanical ventilation compared to the minimum Building Regulations requirements will be provided to minimise the build-up of internal gains.	0 of 73 zones pass	0 of 73 zones pass	0 of 73 zones pass
6.Active cooling systems (ensuring they are the lowest carbon options)*	The active cooling of the development is being provided by an air source heat pump. As this strategy is electrically based it is the most carbon efficient solution. This is due to high efficiencies and the carbon emissions associated to it will continually decrease with the decarbonisation of the grid.	73 of 73 zones pass	73 of 73 zones pass	73 of 73 zones pass

*Rooms compliance for simulation when active cooling system is incorporated are assessed against TM52 minimum criteria for mechanically cooled buildings.

We have taken a stepped approach in the evaluation of the thermal comfort conditions within the development, following the London Plan energy hierarchy. As demonstrated in the table above, the various passive measures incorporated were not sufficient for full compliance with TM52, however they have reduced cooling loads by 20% compared to the notional building, as can be seen in the table below.

Table 6-10 Total cooling demand for the actual and notional buildings.

BUILDING USE	TOTAL ANNUAL COOLING DEMAND (MJ/YEAR)		
	Notional	Actual	Savings
Non-domestic	170,212	135,597	20%

Our analysis demonstrates that active cooling is necessary to be included within the proposal to comply with the requirements of TM52 and with maximum internal temperatures within the thermal comfort thresholds defined for the project.
The cooling capacities for the development are designed to accommodate increased temperatures associated with future climate change scenarios.

7 BE CLEAN: HEATING INFRASTRUCTURE

After consumption has been reduced through the application of energy efficiency measures, the next step is to consider low carbon technologies in order to provide further reduction in carbon dioxide emissions.

An appraisal of 'efficient supply' technologies was undertaken. This included an assessment of the use of CHP, Combined Cooling Heat and Power (CCHP) and district heating systems.

7.1 CONNECTION TO AN AREA WIDE HEAT NETWORK

Figure 7-1 Excerpt from the London Heat Map showing existing/proposed district heating networks

The development is located within the Heat Network Priority Areas (HNPAs). In line with the GLA heating hierarchy a low-temperature communal system is proposed for the Proposed Development.

Figure 7-1 shows the location of any existing and proposed district heating systems within the vicinity of the Proposed Development. Existing networks are shown in yellow and potential networks are shown in red. The Proposed Church Street district heating network located to the North of the application site.

As part of the S106 agreements, the West End Gate (WEG) energy centre has been designed to facilitate connection to the Church Street district heating network and space has been provided for a plate heat exchanger for the connection. Furthermore, distribution pipework connecting the development to the DHN has been installed to allow for future connection to the network as soon as this becomes available.

On the basis a future connection of PGPS to the DHN is proposed and will be provided through connection to the West End Gate energy centre. This has been future proofed for connection to the network. Westminster's energy officer has confirmed that the DHN, which forms part of the Church Street regeneration plan, is currently under review, but no infrastructure has been completed yet.

7.2 COMMUNAL HEATING SYSTEM

CHP

In line with the GLA heating hierarchy that prioritises the connection to an existing area-wide heat network the Proposed Development will connect to the West End Gate energy centre. This will provide heating and hot water to the residential and landlord areas of the Proposed Development until a connection to the Church Street network becomes available.

WSP has undertaken a desktop assessment of the WEG Energy Centre which suggested that there is sufficient capacity to serve the majority of PGPS. West End Gate's Energy Centre comprises 4 no. gas-fired condensing boilers & 1No. CHP.

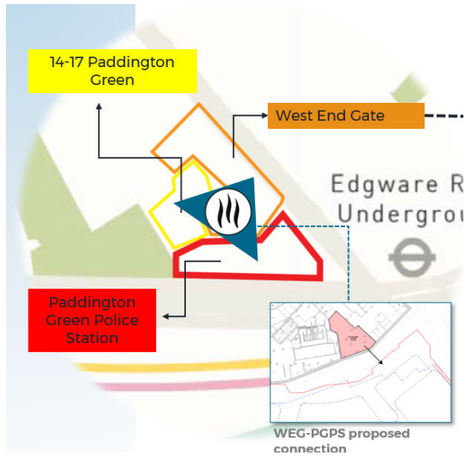

Figure 7-2 Schematics of the proposed area wide WEG heating network

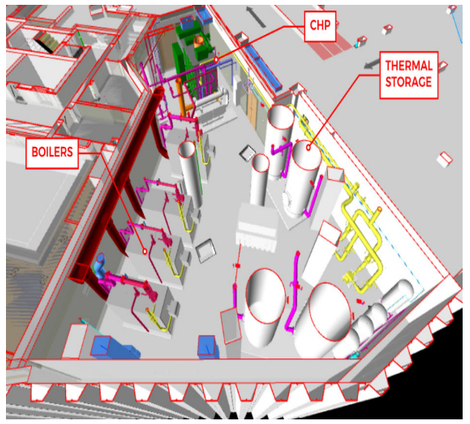

Figure 7-3 Schematics WEG energy centre

As a dedicated energy centre and associated services can be omitted, embodied carbon related to the MEP plant would be minimised as well as the associated embodied carbon and capital and operational expenditure.

The air quality impact of the CHP of WEG will be minimised through the installation of the Selective Catalytic Reduction (SCR) on the flue emissions.

The energy centre incorporates 1 No. CHP, 4 No. gas fired boilers and 60,000 litres of thermal storage to maximise the operational hours of the CHP unit.

The CHP unit as designed for the WEG energy centre would be 1 No. 426 kWe unit with gross efficiencies of: thermal efficiency 42% and electrical efficiency 39%. A side wide load analysis has been undertaken to consider the percentage of heating supplied by the CHP considering all residential and non-residential areas of the WEG masterplan served by the energy centre.

The load analysis has shown that the CHP would be able to meet approximately 45% of the annual space heating and domestic hot water loads of the residential areas within PGPS connected to the energy centre. The remainder of the heat requirement will be met by high efficiency gas fired boilers with an efficiency of 96%. The CHP unit will run for over 7,500 hours annually This provides a 32% improvement in Part L 2013 for the CLEAN stage of the GLAs Energy Hierarchy for the Proposed Development. A graph showing the estimated annual heating profile and CHP provision is shown in Figure 7-4.

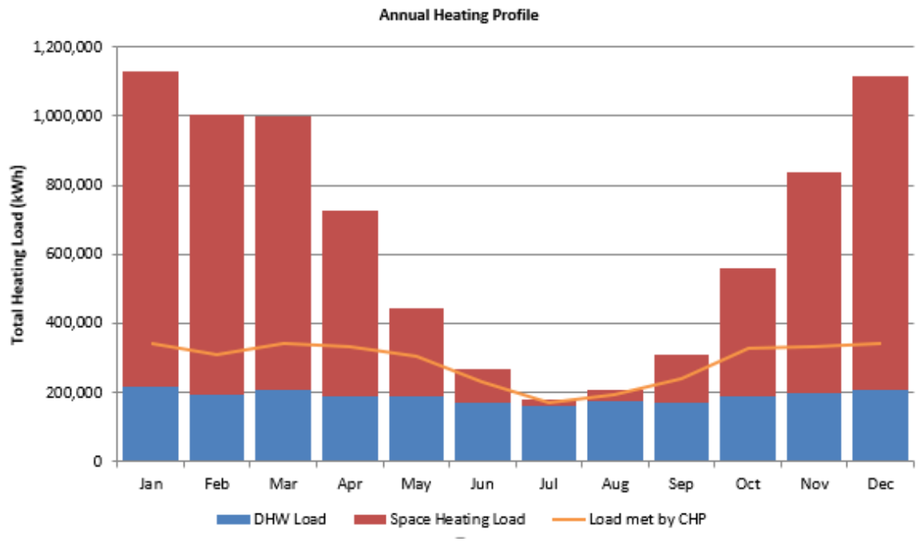

Figure 7-4 Estimated annual heating profile showing provision from a CHP led heating system for the WEG masterplan.

A communal heating scheme schematic showing the connection of the Proposed Development to the WEG energy centre is provided in Figure 7-5.

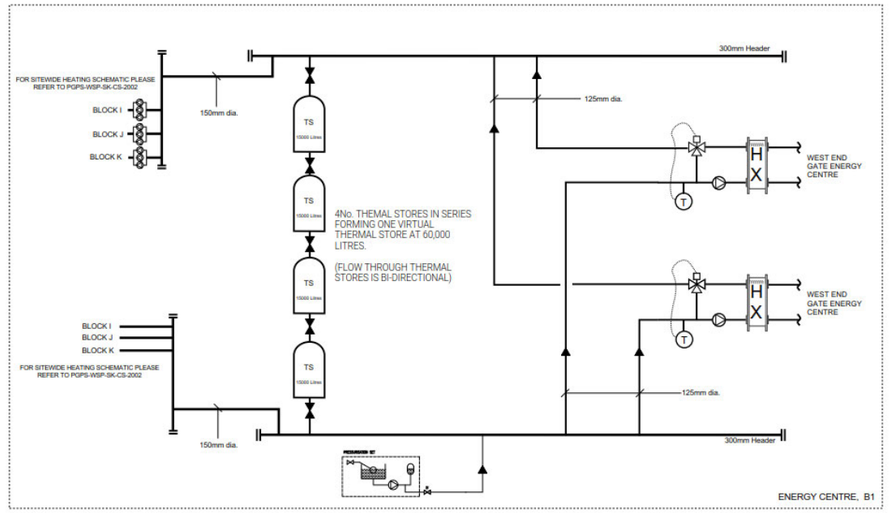

Figure 7-5 Communal Heating System Schematic.

HEAT PUMPS

Heating and cooling in the CAT A non-residential areas will be provided by an all-electric communal system fed by 2 no. Air Source Heat Pumps (ASHPs) located on the roof of Building I. Domestic hot water in these areas will be served by the ASHP and 1 no. Water Source Heat Pump (WSHP) at each office floor level.

Once the preliminary strategy was defined the site's annual heating and cooling loads were calculated in order to design the most efficient way of supplying heat to the development and establish the level of heat provision from each element of the overall system and resultant efficiencies. As the heating and cooling system are connected and interdependent, with the heating systems benefitting from the heat rejection from the cooling systems these have been looked at in conjunction.

Space heating and space cooling loads have been calculated using energy data based on experience on past projects of similar size and typology. Hourly external temperatures for the London test reference year weather file have been used for calculations.

Calculated annual heating and cooling loads can be found in Table 7-1, Figure 7-6, Figure 7-7.

Following the analysis of the site loads the concept design stage communal heating system schematics were produced and can be seen in Figure 7-8.

Table 7-1 Annual heating, cooling and electrical demand calculated for the Proposed Non-residential areas of the Development.

	ANNUAL HEAT DEMAND (KWH/YR)	ANNUAL COOLING DEMAND (KWH/YR)	ANNUAL ELECTRICAL DEMAND (KWH/YR)
Commercial CAT A	419,804	222,726	359,836

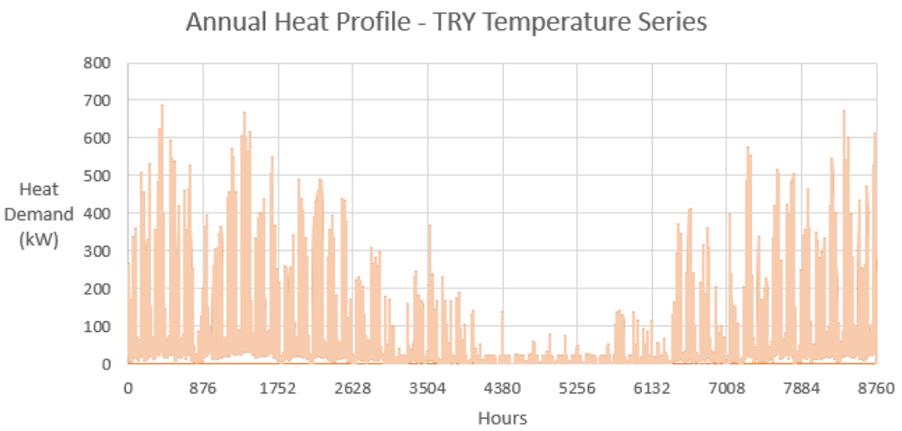

Figure 7-6 Estimated annual heating profile

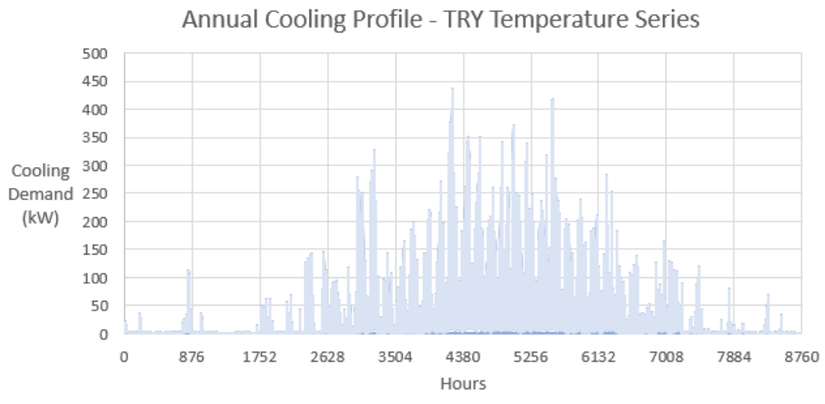

Figure 7-7 Estimated annual cooling profile

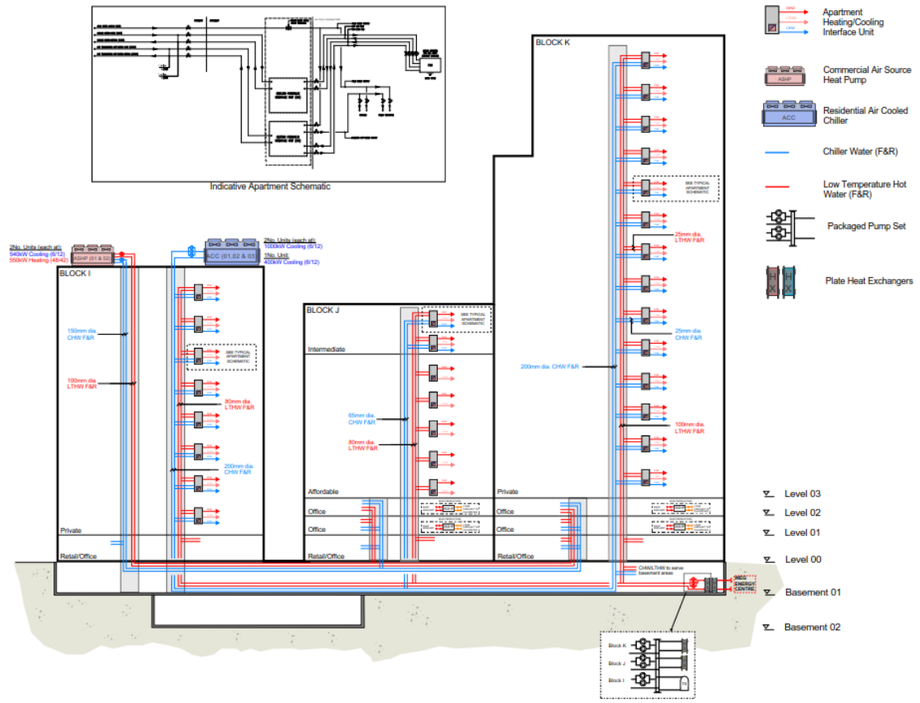

Figure 7-8 Communal Heating System Schematic

7.3 CENTRALISED COOLING SYSTEM

The communal cooling and heating systems in the CAT A areas of the development are interconnected and loads and strategy have been evaluated in tandem.

- Cooling within the CAT A areas within the Proposed Development's CHW network will be via the 2no. roof mounted ASHPs on Building I.
- To mitigate the risk of overheating cooling in the private apartments will be provided Air Cooled Chillers (ACC) located on the roof of Block I. Distributed chilled water (CHW) will serve cooling interface units (CIU) within each apartment which will then serve high-efficient FCU located in each apartment

Centralised cooling network schematics can be seen in Figure 7-8.

7.4 ENERGY CENTRE

Detailed energy centre layouts will be developed as part of the schematic design stage post planning; however sufficient space has been allowed for all plant to be accommodated as the design develops. Refer to Figure 7-5 and Figure 7-8 for the site wide mechanical servicing strategy. Proposed plant spaces are subject to further optimisation as design develops.

Due to limited space the energy centres will only serve the Proposed Development and is unable to accommodate capacity to serve any neighbouring developments. Detailed MEP drawings showing the plant space provision are provided in Appendix C of this document.

7.5 LOCAL PLANNING CRITERIA, INCLUDING LAND USE AND NOISE

The connection to a site wide heating network is preferred by the GLA and Westminster and satisfies the planning policies of the London Plan and Westminster City Plan, including provision to enable connection to a future energy network. The CHP equipment would be located at within the existing Energy Centre therefore no additional land take beyond the building footprint applies.

Modern CHP units are typically supplied with a proprietary acoustic enclosure which mitigates problematic noise egression. Noise levels will comply with local planning requirements.

The reversible ASHPs will be located on the roof of Block I and WSHPs will be located at floor level and will not use additional land adjacent to the Proposed Development.

The location of the units on the roof and on floor has been selected to minimise impact on adjacent properties. Noise levels will comply with local planning requirements.

7.6 FEASIBILITY OF EXPORTING HEAT/ELECTRICITY FROM THE SYSTEM

It is anticipated that the energy centre equipment will be sized to serve only the requirements of the Proposed Development as there is not a heat network in place to facilitate the exportation to other buildings in the local area.

7.7 INDIVIDUAL HEATING SYSTEM

There are no individual heating systems provided throughout the development.

7.8 SYSTEM MONITOR OF PERFORMANCE

The Proposed Development will be provided with Building Management System. This will control and monitor the building systems and services throughout the development, provide feedback of plant, system performance and energy usage of the system. The BMS will analyse this data to enable optimum use of the engineering facilities within the development with minimum of human intervention, and maximum energy efficiency.

The system will generally consist of distributed outstations, connected by a data network to enable central control and monitoring of each outstation. Each outstation will be capable of running independently.

The landlord services fall under the category of sub metering as the main supplies will be bulk metered as part of the building switch rooms. Both small power and lighting are to be sub metered in distribution boards in compliance with TM39:2009. This is achieved via in line meters in the distribution boards. All metering information can be collected and distributed to the BMS via the landlords unified network.

Apartments will be provided with small metering to minimise apartment access.

7.9 PIPEWORK LOSSES

All LTHW pipework will be provided with enhanced insulation and be thermally broken from pipework hangers to mitigate overheating.

The primary network has been estimated to be as follows:

Table 7-2 Distribution length

TYPE	TOTAL PIPE LENGTH (M)
Primary	7,200
In flat distribution	31,200

Corridor pipe heat losses are assumed at 6 W/m at all times and the primary distribution loss factor has been calculated to be 11.7%. Further analysis will be undertaken at detailed design stage to define accurate distribution heat losses.

7.10 CARBON EMISSION REDUCTION

On the basis that a connection to the Church Street district heating network is still under review and the associated carbon emission factors are not available, the use of CHP within the WEG energy centre is proposed to serve the Site. This provides savings for a 32% improvement in Part L 2013 as shown in Table 7-3, Table 7-4 and Table 7-5. The SAP 2012 carbon factors have been used for all further calculations using version 1.2 of the GLA Carbon Emission Reporting Spreadsheet.

Table 7-3 Be Clean: Carbon emissions after the application of energy efficiency measures – Residential – SAP 2012 CF

TOTAL	REGULATED EMISSIONS (TONNES)	UNREGULATED EMISSIONS (TONNES)	% REDUCTION IN REGULATED CARBON EMISSIONS
Baseline emissions (Tonnes CO_2)	543.9	739.1	0.0%
Emissions after energy demand reduction (Tonnes CO_2)*	488.6	739.1	10%
Emissions after energy efficient supply (Tonnes CO_2)*	355.9	739.1	35%

**The energy efficiency savings have been calculated on the basis that the buildings are served by a central heating system served by gas fired boilers only, with a seasonal efficiency of 96%. Cooling system for Be Lean stage has been assumed as air cooled chillers with SEER of 3.5.*

Table 7-4 Be Clean: Carbon emissions after the application of energy efficiency measures – Non-Residential – SAP 2012 CF

TOTAL	REGULATED EMISSIONS (TONNES)	UNREGULATED EMISSIONS (TONNES)	% REDUCTION IN REGULATED CARBON EMISSIONS
Baseline emissions (Tonnes CO_2)	184.3	287.7	0.0%
Emissions after energy demand reduction (Tonnes CO_2)*	143.2	287.7	22%
Emissions after energy efficient supply (Tonnes CO_2)*	140.8	287.7	23%

**The energy efficiency savings have been calculated on the basis that the buildings are served by a central heating system served by gas fired boilers only, with a seasonal efficiency of 96%. Cooling system for Be Lean stage has been assumed as air cooled chillers with SEER of 4.5.*

Table 7-5 Be Clean: Carbon emissions after the application of energy efficiency measures – Whole Development – SAP 2012 CF

TOTAL	REGULATED EMISSIONS (TONNES)	UNREGULATED EMISSIONS (TONNES)	% REDUCTION IN REGULATED CARBON EMISSIONS
Baseline emissions (Tonnes CO_2)	728.2	1017.8	0.0%
Emissions after energy demand reduction (Tonnes CO_2)*	631.8	1017.8	13%
Emissions after energy efficient supply (Tonnes CO_2)*	476.3	1017.8	32%

**The energy efficiency savings have been calculated on the basis that the buildings are served by a central heating system served by gas fired boilers only, with a seasonal efficiency of 96%. Cooling system for Be Lean stage has been assumed as air cooled chillers with SEER of 3.5 for the residential and 4.5 for the non-residential.*

8 BE GREEN: RENEWABLE ENERGY

Renewable energy technologies can provide a source of energy on-site that is not primarily based on the consumption of fossil fuels or grid electricity and/or utilises a heat source that is renewable such as ground source and solar thermal systems.

In accordance with the requirements of the London Plan and Westminster policy, we have evaluated a number of renewable energy technologies and outlined how they may be applied to the Proposed Development.

8.1 WIND POWER

Harnessing the kinetic energy of wind can provide a renewable source of onsite electricity generation. Wind turbines need to be positioned where a frequent and steady source of wind is available that is not too turbulent or uneven in direction. Typically, wind turbines are positioned on the roof of buildings that are significantly higher than their surroundings and or located in open areas where there is minimum disruption to prevailing winds.

The Proposed Development is located within an urban environment with near-by buildings providing turbulent wind conditions unsuitable for wind power generation. In addition, it is not considered appropriate in townscape, architectural and aviation safeguarding terms to provide wind turbines on top of buildings. On that basis they are not proposed for the Proposed Development.

8.2 BIOMASS HEATING

Biomass heating has embodied environmental impacts from transport and fuel combustion which makes it less desirable in Air Quality Management Areas (AQMAs), such as where the application site of the Proposed Development is located. A review of the potential impact on air quality from increased wood fuelled biomass use in London has been carried out by AEA Energy & Environment and was published in December 2007. The assessment indicates that potentially increasing the contribution from small-scale wood fuelled biomass combustion may lead to a substantial increase in nitrogen dioxide and particulate matter concentrations.

Further to this, solid biomass relies on a reliable fuel supply which must be delivered and stored on site. The application Site therefore requires good access routes and space for fuel storage and plant, which could not feasibly be incorporated within the proposed scheme. It also has relatively high maintenance requirements and fuel costs.

This technology is therefore deemed to be unsuitable for the Proposed Development.

8.3 GROUND SOURCE HEATING AND/OR COOLING

Ground source heating and/or cooling may be incorporated to make use of the thermal storage and ground temperature to provide heating and/or cooling to a building. Ground source heating is an effective renewable energy source when used to provide space heating via low grade heating system such as underfloor heating. Furthermore, a ground source heating system is not complementary to Westminster's and the GLA's requirement to support and develop district heating networks; therefore, it is not considered feasible for the Proposed Development.

8.4 SOLAR THERMAL HOT WATER HEATING

Solar thermal hot water (STHW) generation involves capturing solar radiant heat to preheat or heat domestic hot water. Correctly located and orientated, solar thermal systems can meet a proportion of a building's domestic hot water dependent on the expected demand profile and available space for locating STHW panels. Due to the limited amount of available space which will be used for solar photovoltaic panels a STHW system is not proposed for the development.

8.5 AIR SOURCE HEAT PUMPS

Air source heat pumps (ASHPs) are capable of providing heating and/or cooling utilising air temperatures. The use of ASHPs are an effective LZC technology as they have high efficiencies for both heating and cooling.

Air source heat pumps are proposed for the CAT A non-residential areas of Proposed Development as described in the previous section.

The disadvantage of ASHPs is that they are unable to deliver peak heating loads under extremely cold temperatures. However, if they are supplemented by additional Water Source Heat Pumps, they can be a very efficient solution and therefore are proposed to utilise in the Proposed Development.

8.6 WATER SOURCE HEATING AND OR COOLING

The development is not adjacent to bodies of water that can be used to extract or reject heat.

WSHPs have a significantly higher coefficient of performance (COP) than ASHPs due to the higher temperature of the heat source which is constant throughout the year. Low flow temperatures from the WSHPs further reduce the energy consumption and carbon emissions for the provision of hot water within the CAT A non-residential areas of the Proposed Development.

WSHPs are powered by grid supplied electricity. As mentioned in the ASHP section above, the National Grid is increasingly decarbonising due to an increase in renewable energy generation and a reduction in coal power generation. This leads to a long-term low carbon solution for the Proposed Development.

WSHPs are proposed to be connected to the low-grade LTHW networks as described in Section 5.2 providing high grade heat and further carbon reductions.

8.7 PHOTOVOLTAIC PANELS

The feasibility of providing PV panels has been assessed based upon estimated energy production (kWh) from the installed location along with manufacturers cost data to enable a life cycle cost analysis to be undertaken. Panels correctly oriented, maintained and not obscured by shading can be expected to provide in the region of 120kWh/m^2/year in London.

Roof space is at a premium due to the small ratio of roof to development area, and the requirement for the roofs to house various items of plant and amenity space. A roof mounted PV array is proposed on the roof of Building I and K within the Proposed

Development to provide a reduction in carbon emissions from renewable sources. The photovoltaic area has been maximised on all available areas not occupied by plant amenity spaces and other services. This would accommodate approximately 123 m^2 of PV laying at 5 degrees on the roof as shown in blue in Figure 8-1. This would equate to approximately 8.1 tonnes CO_2 per annum. This is subject to further design development as roof plant and other functions, e.g. roof access, Building Maintenance Unit (BMU), etc. are determined.

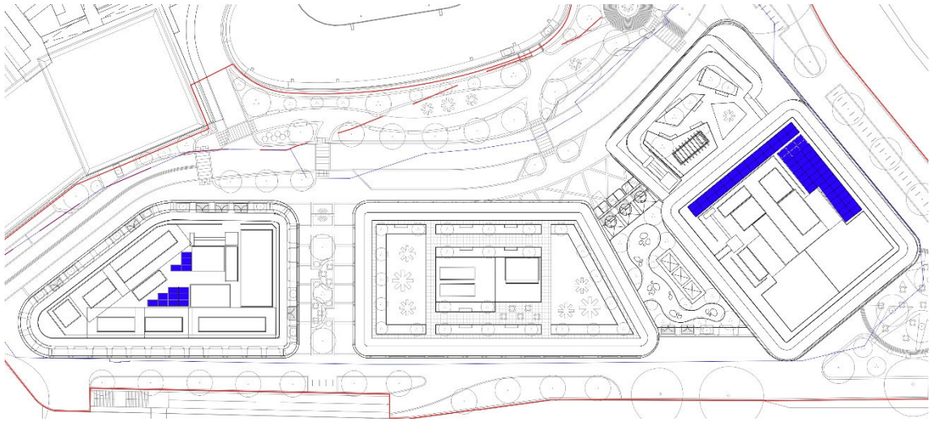

Figure 8-1 Proposed location of PV panels

8.8 LOCAL PLANNING CRITERIA, INCLUDING LAND USE AND NOISE

There are no known issues regarding the installation of roof mounted PVs. They will be located on the roof of the buildings therefore require no additional land and there are no acoustic issues to consider with PVs.

8.9 FEASIBILITY OF EXPORTING HEAT/ELECTRICITY FROM THE SYSTEM

The heat/electricity generated by the heat pumps/PVs is likely to be used primarily by the Proposed Development, with the option to export to the local distribution network should it prove feasible and the generation exceed the local heat/electricity demand. This will ensure energy is not waster through over generation.

8.10 CARBON EMISSIONS REDUCTION

All renewable energy technologies which may be considered feasible for the Proposed Development have been assessed, the outcomes of which are summarised above. From that exercise, it was concluded that only roof mounted PV panels and heat pumps would be suitable for inclusion in the Proposed Development. Savings from renewable energy are shown in the below tables.

Table 8-1 Be Green: Carbon emissions after providing renewable energy – Residential – SAP 2012 CF

TOTAL	REGULATED EMISSIONS (TONNES)	UNREGULATED EMISSIONS (TONNES)	% REDUCTION IN REGULATED CARBON EMISSIONS
Baseline emissions (Tonnes CO_2)	543.9	739.1	0.0%
Emissions after energy demand reduction (Tonnes CO_2)*	488.6	739.1	10%
Emissions after energy efficient supply (Tonnes CO_2)*	355.9	739.1	35%
Emissions after renewable energy (Tonnes CO_2)	355.9	739.1	35%

**The energy efficiency savings have been calculated on the basis that the buildings are served by a central heating system served by gas fired boilers only, with a seasonal efficiency of 96%. Cooling system for Be Lean stage has been assumed as air cooled chillers with SEER of 3.5.*

Table 8-2 Be Green: Carbon emissions after providing renewable energy – Non-Residential – SAP 2012 CF

TOTAL	REGULATED EMISSIONS (TONNES)	UNREGULATED EMISSIONS (TONNES)	% REDUCTION IN REGULATED CARBON EMISSIONS
Baseline emissions (Tonnes CO_2)	184.3	287.7	0.0%
Emissions after energy demand reduction (Tonnes CO_2)*	143.2	287.7	22%
Emissions after energy efficient supply (Tonnes CO_2)*	140.8	287.7	23%
Emissions after renewable energy (Tonnes CO_2)	120.1	287.7	35%

**The energy efficiency savings have been calculated on the basis that the buildings are served by a central heating system served by gas fired boilers only, with a seasonal efficiency of 96%. Cooling system for Be Lean stage has been assumed as air cooled chillers with SEER of 4.5.*

Table 8-3 Be Green: Carbon emissions after providing renewable energy – Whole Development – SAP 2012 CF

TOTAL	REGULATED EMISSIONS (TONNES)	UNREGULATED EMISSIONS (TONNES)	% REDUCTION IN REGULATED CARBON EMISSIONS
Baseline emissions (Tonnes CO_2)	728.2	1017.8	0.0%
Emissions after energy demand reduction (Tonnes CO_2)*	631.8	1017.8	13%
Emissions after energy efficient supply (Tonnes CO_2)*	496.7	1017.8	32%
Emissions after renewable energy (Tonnes CO_2)	476.3	1017.8	35%

**The energy efficiency savings have been calculated on the basis that the buildings are served by a central heating system served by gas fired boilers only, with a seasonal efficiency of 96%. Cooling system for Be Lean stage has been assumed as air cooled chillers with SEER of 3.5 for the residential and 4.5 for the non-residential.*

9 RESULTS

The three principal steps taken; Be Lean (Use Less Energy), Be Clean (Supply Energy Efficiently) and finally Be Green (Renewable Technology Measures) are summarised below. The target (Building Regulations compliant) carbon emissions for the Proposed Development are calculated to be 709.6 tonnes CO_2 per annum.

9.1 DEMAND REDUCTION (BE LEAN)

The application of the measures identified in Section 5 provides an overall reduction of 13% in carbon emissions from the Proposed Development and a total carbon reduction of 96.4 tonnes CO_2 per annum from the baseline carbon emissions. After this stage of the energy hierarchy the total regulated carbon emissions from the Proposed Development is shown to be 631.8 tonnes CO_2 per annum.

9.2 HEATING INFRASTRUCTURE (BE CLEAN)

A connection to the Church Street district heating network is proposed when this becomes available. The Proposed Development will be served by the West End Gate (WEG) energy centre which has been designed to facilitate connection to the Church Street district heating network and space has been provided for a plate heat exchanger for the connection.

The development proposes a communal heating and cooling system for the residential and landlord's areas through connection to the existing area-wide West End Gate network fed by 1no. CHP and 4no. highly efficient gas fired boilers.

The application of the measures identified in Section 7 provides an overall reduction of 19% in carbon emissions from the Proposed Development and a total carbon reduction of 135.1 tonnes CO_2 per annum from the baseline carbon emissions. After this stage of the energy hierarchy the total regulated carbon emissions from the Proposed Development is shown to be 496.7 tonnes CO_2 per annum.

9.3 RENEWABLE ENERGY (BE GREEN)

The feasibility of a range of renewable technologies has been assessed in the context of the London Plan. It was concluded that a combination of ASHP, WSHPs and PV could be suitable for inclusion in the energy strategy proposal for the CAT A non-residential areas.

The renewable technologies provide together an overall reduction of 3% in carbon emissions from the Proposed Development and a total carbon reduction of 20.4 tonnes CO_2 per annum from the baseline carbon emissions compliant development. After this stage of the energy hierarchy the total regulated carbon emissions from the Proposed Development is shown to be 476.3 tonnes CO_2 per annum.

9.4 GLA GUIDANCE ON PREPARING ENERGY ASSESSMENTS

In direct response to the information outlined within the Greater London Authority (GLA) Guidance on Preparing Energy Assessments (Draft, April 2020), the results outlined previously are summarised in the tables below, with the results presented against the overall carbon reduction target. As per the guidance, these have been separated into summaries for new build Residential and Non-Residential.

The proposals for the Proposed Development outlined within this energy strategy are considered to maximise the potential carbon savings which can be achieved on the application site through the provision of:

- A highly efficient building fabric;
- Efficient building services plant, including providing high efficiency air handling plant with heat recovery and low specific fan power;
- 100% low energy lighting and maximised use of LED and low energy fixtures;
- Main heating to the development will be provided through connection to the existing area-wide West End Gate network fed by 1no. CHP and 4no. highly efficient gas fired boilers.
- The West End Gate (WEG) energy centre serving the Proposed Development has been future proofed for future connection to the Church Street district heating network.
- Heat and cooling within the shell and core areas provided by all electric ASHPs, WSHPs.
- Roof mounted PV panels.

The residential element of the Proposed Development meets the GLA "Be Lean" target achieving a minimum 10% improvement on Part L 2013 from energy efficiency measures.

The non-residential element of the Proposed Development exceeds the GLA "Be Lean" minimum target of 15% improvements over Building Regulation, achieving an overall reduction of 22% in carbon emissions from energy efficiency measures.

Overall, the Proposed Development is shown to meet the carbon reduction target of 35% set by GLA achieving a 35% reduction in carbon emissions compared to the baseline utilising SAP 2012 carbon factors.

9.5 PART L 2013 FABRIC ENERGY EFFICIENCY (FEE)

Accredited Design SAP2012 software was used to determine the FEE standards for all apartments. Results for the target fabric energy efficiency (TFEE) and for the actual building FEE are as follows:

Table 9-1 Fabric energy efficiency and carbon emissions results by residential buildings

RESIDENTIAL BUILDINGS	BUILDING I	BUILDING J	BUILDING K
Average TFEE (kWh/m²)	34.1	32.70	33.30
Average FEE (kWh/m²)	32.95	29.63	32.31
Improvement	3%	9%	3%

All residential areas achieve compliance with the TFEE standard. Detailed façade design and thermal bridging calculations will be performed during detailed design stage once junction details will be specified. The final strategy for compliance with TFEE will be defined as design develops. The project will ensure compliance with the TFEE is achieved.

9.6 PART L 2013 CARBON DIOXIDE EMISSIONS

The following tables provide a summary of the performance of the Proposed Development. The performance of residential and non-residential elements is provided separately in Table 9-2, Table 9-3, and Table 9-2 summarises the overall site performance.

In line with the latest GLA Energy Assessment Guidance (April 2020) and the Westminster Carbon Offset Fund Guidance (January 2020), the carbon offset fund is calculated considering the cumulative shortfall of achieving the net zero-carbon target multiplied by the assumed lifetime of the development's service. In line with guidance the carbon offset price has been set at £95 per tonne CO_2 over 30 years.

Table 9-2 Regulated carbon dioxide savings from each stage of the energy hierarchy (SAP 2012 carbon factors) –Residential

	REGULATED CARBON DIOXIDE EMISSIONS SAVINGS (TONNES CO_2 PER ANNUM)	REGULATED CARBON DIOXIDE EMISSIONS SAVINGS (%)
Be Lean: Savings from energy demand reduction	55.3	10%
Be Clean: Savings from heat network	132.7	24%
Be Green: Savings from renewable energy	0	0%
Cumulative on-site savings	188.0	35%
Annual savings from off-set payment	355.9	-
Cumulative shortfall for offset payment	10,676 tonnes CO_2	
Total Site cash-in-lieu contribution	£1,014,254	

Table 9-3 Regulated carbon dioxide savings from each stage of the energy hierarchy (SAP 2012 carbon factors) – Non- Residential

	REGULATED CARBON DIOXIDE EMISSIONS SAVINGS (TONNES CO_2 PER ANNUM)	REGULATED CARBON DIOXIDE EMISSIONS SAVINGS (%)
Be Lean: Savings from energy demand reduction	41.2	22%
Be Clean: Savings from heat network	2.3	1%
Be Green: Savings from renewable energy	20.8	11%
Cumulative on-site savings	63.9	35%
Annual savings from off-set payment	120.4	-
Cumulative shortfall for offset payment	3,613 tonnes CO_2	
Total Site cash-in-lieu contribution	£343,269	

Table 9-4 Regulated carbon dioxide savings from each stage of the energy hierarchy (SAP 2012 carbon factors) – Site total (domestic + non-domestic)

	TOTAL REGULATED EMISSIONS (TONNES CO_2 PER ANNUM)	REGULATED CO_2 SAVINGS (TONNES CO_2 PER ANNUM)	PERCENTAGE SAVING (%)
Part L 2013 baseline	728.2		
Be Lean	631.8	96.4	13%
Be Clean	496.7	135.1	19%
Be Green	476.3	20.4	3%
Total Savings		251.9	35%
Total Site Carbon Shortfall	14,290 tonnes CO_2		
Total Site cash-in-lieu contribution	£1,357,525		

10 FLEXIBILITY AND PEAK DEMAND

In line with Policy SI 2 and SI3 of the London Plan, the possibility for including measures for reducing peak energy loadings has been considered in great details.

Load and peak demand calculations have been undertaken for the whole development and appropriate system capacity has been provided.

HEATING DEMAND

The following heating loads have been estimated for the Proposed Development:

	HEAT
Base Heating Load (MW)	2.12
Peak Load (MW)	2.33

WSP has undertaken a desktop assessment of the WEG Energy Centre which suggested that there is sufficient capacity to serve the majority of PGPS. West End Gate's Energy Centre comprises 4 no. gas-fired condensing boilers & 1 no. CHP. The WEG energy centre capacity has been calculated to be 6.16 MW. Additional 0.9 MW will be provided by the ASHP for the CAT A non-residential areas.

A side wide load analysis has been undertaken to consider the percentage of heating supplied by the CHP considering all residential and non-residential areas of the WEG masterplan served by the energy centre. The load analysis has shown that the CHP would be able to meet approximately 45% of the annual space heating and domestic hot water loads of the residential areas within PGPS connected to the energy centre. The remainder of the heat requirement will be met by high efficiency gas fired boilers with an efficiency of 96%. The analysis has demonstrated that the WEG Energy Centre has sufficient capacity to serve the Proposed Development.

HEAT ENERGY STORAGE

60,000 litres thermal storage will be provided at B1 level. Thermal stores shall be utilised to provide system resilience in case of downtime of the WEG Energy Centre.

A connection from the primary heating circuit will be made to the thermal stores to capture any lag in heat rejection profile for residential use.

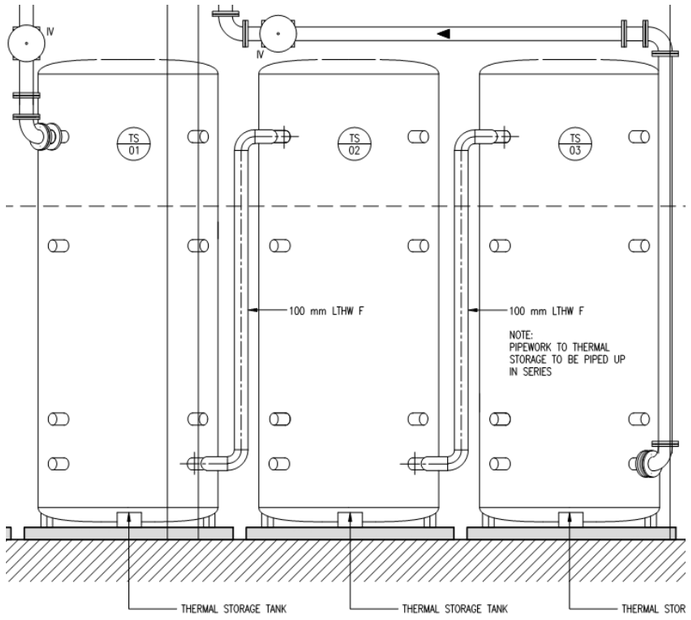

Figure 10-1Thermal Storage schematic

The detailed load analysis for assessing the percentage contribution of CHP including thermal storage has demonstrated that the proposed thermal storage provision will increase the contribution of CHP from approximately 26% to 45%.

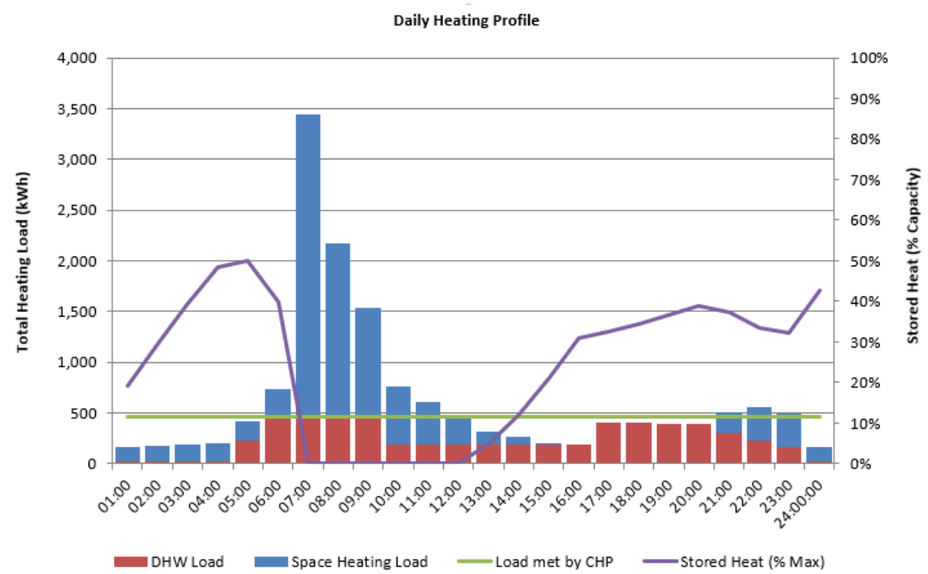

Figure 10-2Daily Heating Profile showing the contribution of thermal storage.

ELECTRICAL DEMAND

WSP has undertaken and electrical load demand for the Proposed Development as summarised in Figure 10-3.

Revision: 100321

Paddington Green Police Station Electrical Loading

Site Loading Summaries								
	Retail Power (kW)	Retail Power (A)	Residential Power (kW)	Residential Power (A)	Office Power (kW)	Office Power (A)	Landlords Power (kW)	Landlords Power (A)
Total	173.7	263.9	1113.0	1691.0	370.9	563.5	2056.1	3123.9
	182.8 kVA		1171.6 kVA		390.4 kVA		2164.3 kVA	

Total Site Wide Load (Not Including secondary Life Safety)					
kW	kW w/ 20% Spare Capacity	A	A w/ 20% Spare Capacity	kVA	kVA w/ 20% Spare Capacity
3714	4456	5642	6771	3909	4691

	kVA w/ 20% SC
Residential (kVA)	1406
Retail (kVA)	219
Office Areas (kVA)	468
Landlords (kVA)	2597
Total (kVA)	4691

Substation/Switchgear Arrangement

Description	Ref	Capacity (MVA)	Notes	m2	Preferred Location	Plant Height (m)
Residential Transformer	R1 TX	1.0	IDNO.	25	G	3.5
Residential Transformer	R2 TX	1.0	IDNO.	25	G	3.5
Landlord Transformer	LL1 TX	1.6	Private Sub.	25	B1	3.5
Landlord Transformer	LL2 TX	1.6	Private Sub.	25	B1	3.5
Life Safety Transformer	LS TX	1.0	IDNO.	25	G	3.5
UK Power Networks intake	UKPN Intake	3.75	IDNO.	27	G	3.5

Note: All frame sets subject to further design development

	kVA w/ 0.8 Diversity
R1 kVA (Residentail + Retail / 2)	650
R2 kVA (Residentail + Retail / 2)	650
LL1 kVA (Landlord & Offices Full Load / 2)	1226
LL2 kVA (Landlord & Offices Full Load / 2)	1226
LS TX kVA (Life Safety Full Load - No Diversity)	423.16

Figure 10-3 Electrical Load Assessment

WSP has engaged with UKPN, the local Distribution Network Operator (DNO) for Paddington Green Police Station to ascertain whether they would be capacity to serve the Proposed Development. They have provided a provisional quotation based on a capacity of 4.2MVA plus 1MVA diverse supply on the existing network.

The quotation provided is based on installing 2 x high voltage ring main units on site along with associated cabling from the high voltage point of connection at Amberly Road substation (approximately high voltage circuit length 3660m.) Two new feeders will be terminated on to the existing 2 breakers within the 11kV Amberly Road substation, and any existing services will need to be disconnected prior to the energisation of the proposed new high voltage services. The proposed total load of 4200kVA for site will be evenly split over 2 high voltage services.

ELECTRICAL ENERGY STORAGE

Battery storage has not been included due to a lack of spare renewable energy generation and space considerations.

RENEWABLE ENERGY GENERATION

The development will incorporate on-site electricity generation in the form of photovoltaic panels located at roof level. 77 no. photovoltaic panels are proposed on the roof with an approximate output of 21.2 kWp.

The solar panels are to be connected into the correct string arrangement to suit the specified inverter and wired via 4mm^2 double insulated DC cabling back to a local electrical switch room.

The DC cabling will be connected to a TPN inverter via DC isolation and then back to the electrical infrastructure via an AC isolator and generation meter. No RCD protection is to be used for the PV system to avoid nuisance tripping.

The generation meter is to be connected to the main building wide metering system via either a Pulse or MBUS gateway.

The relevant applications are to be submitted by the nominated installer / contractor.

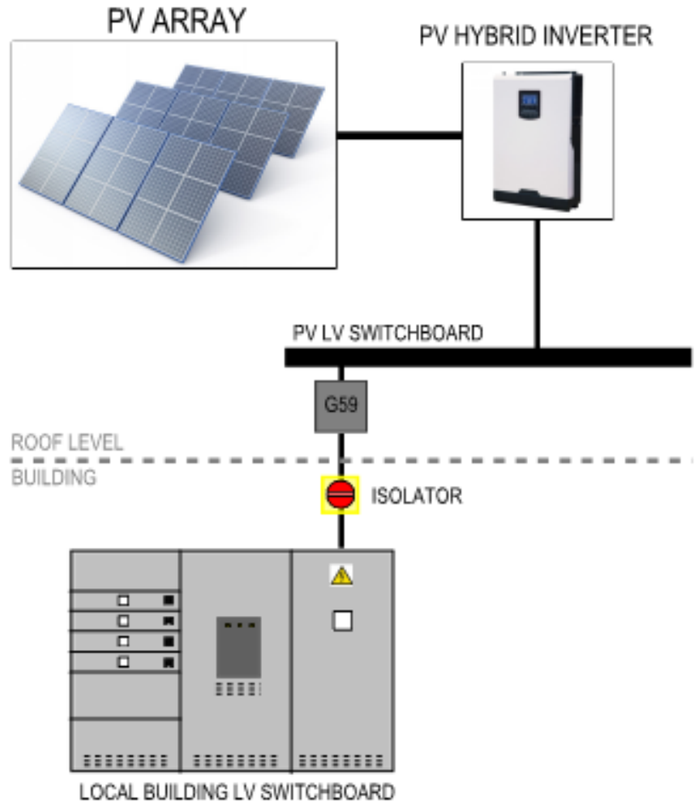

Figure 10-4PV Infrastructure Schematic

Further potential measure for reducing the peak demands than those identified above will be investigated at detailed design stage.

11 CONCLUSIONS

The proposals for the Proposed Development outlined within this energy strategy are considered to maximise the potential carbon savings which can be achieved on the application site through the provision of:

- A highly efficient building fabric;
- Efficient building services plant, including providing high efficiency air handling plant with heat recovery and low specific fan power;
- 100% low energy lighting and maximised use of LED and low energy fixtures;
- Main heating to the development will be provided through connection to the existing area-wide West End Gate network fed by 1No.CHP and 4No. highly efficient gas fired boilers.
- The West End Gate (WEG) energy centre serving the Proposed Development has been future proofed for future connection to the Church Street district heating network.
- Heat and cooling within the CAT A non-residential areas provided by all electric ASHPs, WSHPs.
- Roof mounted PV panels.

Overall, the Proposed Development is shown to achieve the following carbon reductions after following the Energy Hierarchy of LEAN, CLEAN, GREEN when compared to Part L 2013 using SAP 2012 carbon factors:

- Residential Element – 35%
- Non-Residential Element – 35%
- Whole Proposed Development – 35%

The figures above are the reduction in carbon emissions compared to each respective baseline.

The residential element of the Proposed Development meets the GLA “Be Lean” target achieving a minimum 10% improvement on Part L 2013 from energy efficiency measures.

The non-residential element of the Proposed Development exceeds the GLA “Be Lean” minimum target of 15% improvements over Building Regulation, achieving an overall reduction of 22% in carbon emissions from energy efficiency measures.

Overall, the Proposed Development is shown to meet the carbon reduction target of 35% set by GLA achieving a 35% reduction in carbon emissions compared to the baseline utilising SAP 2012 carbon factors.

12 BE SEEN AND WHOLE LIFE-CYCLE CARBON

The 'Be Seen' – Energy Monitoring Guidance' and 'Whole Life-Cycle Carbon Assessments Guidance' is under consultation. During this time the GLA may request that the development is compliant with the new guidance. In light of this, the project has sought to comply with the requirements described in the guidance as follows:

PLANNING STAGE

- Upload the necessary contextual and performance data to the 'be seen' portal;
- Confirm target dates for all subsequent 'be seen' stages';
- Confirm that metering plans that will enable the in-use energy performance reporting are in place.

AS-BUILT

- Update the contextual data and upload energy performance predictions for each reportable unit onto the 'be seen portal;
- Confirm the metering installation is complete and correctly calibrated.

IN-USE

- Submit energy performance data annually for each reportable unit for at least 5 years;
- Where actual performance differs from estimated performance, identify the causes and the potential mitigation measures, as necessary.

The proposed development is committed to comply with the 'be seen' requirements at each stage as mentioned above. For each post planning stages as-built and in-use requirements will be completed. For compliance with planning stage requirements, the following has been completed for the proposed development:

- Production of a TM54 analysis in line with the minimum requirements of the 'Be seen' energy monitoring guidance (Pre-consultation DRAFT April 2020),
- Completion of the GLA's 'be seen' spreadsheet with performance indicators including contextual data, building energy use and carbon emissions for the entire development as a whole.
- Contribution of operational carbon performance for Module B6 of the separate Whole Life-Cycle Carbon assessment using the findings of the TM54 analysis.
- Provide information on how the building's actual energy performance will be monitored post-construction.

A copy of the 'be seen' spreadsheet and TM54 analysis is provided in Appendix D of this report. Below is a summary of the planning stage performance indicators:

Residential Element of the development (Part L calculation)

- Annual Electricity Use: 2,336,881 kWh/yr
- Annual District Htg Use: 3,484,552 kWh/yr
- Predicted Annual Carbon Emissions: 1,095 tCO2/yr

Non-Residential Elements of the development (Part L Calculation)

- Annual Electricity Use: 783,890 kWh/yr
- Annual District Htg Use: 23,181 kWh/yr
- Elec Generation, Gross: 15,661 kWh/yr
- Predicted Annual Carbon Emissions: 399 tCO2/yr

Non-Residential Elements of the development (TM54 Calculation)

- Annual Electricity Use: 1,060,000 kWh/yr
- Annual District Htg Use: 29,000 kWh/yr
- Elec Generation, Gross: 15,661 kWh/yr
- Predicted Annual Carbon Emissions: 550 tCO_2/yr

The building's actual energy performance will be monitored post-construction. The Proposed Development will be provided with Building Management System. This will control and monitor the building systems and services throughout the development, provide feedback of plant, system performance and energy usage of the system. The BMS will analyse this data to enable optimum use of the engineering facilities within the development with minimum of human intervention, and maximum energy efficiency.

The system will generally consist of distributed outstations, connected by a data network to enable central control and monitoring of each outstation. Each outstation will be capable of running independently.

The landlord services fall under the category of sub metering as the main supplies will be bulk metered as part of the building switch rooms. Both small power and lighting are to be sub metered in distribution boards in compliance with TM39:2009. This is achieved via in line meters in the distribution boards. All metering information can be collected and distributed to the BMS via the landlords unified network.

Apartments will be provided with small metering to minimise apartment access.

13 APPENDIX A

13.1 SAP CALCULATIONS –– “BE LEAN” BLOCK COMPLIANCE

BLOCK COMPLIANCE
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Block Reference	Block I	**Issued on Date**	08/02/2021
Block Name	Block I		
Assessor Details	Miss Michela Martini, Michela Martini, Tel: 07756715427, michela.martini2@gmail.com	**Assessor ID**	Y294-0001
Client			

Block Compliance Report - DER

Block Reference: Block I		Block Name: Block I			
Property-Assessment Reference	**Multiplier**	**Floor Area (m^2)**	**DER ($kgCO_2/m^2$)**	**TER ($kgCO_2/m^2$)**	**% DER/TER**
I.02.04 EF-I.02.04 LEAN	1	50	16.14	18.38	12.17 %
I.02.05 EF-I.02.05 LEAN	1	50	13.68	16.27	15.91 %
I.02.06 EF-I.02.06 LEAN	1	50	13.37	16.12	17.04 %
I.03.01-I.03.01 LEAN	11	50	14.88	16.98	12.37 %
I.03.02-I.03.02 LEAN	11	50	18.77	18.17	-3.31 %
I.03.03-I.03.03 LEAN	11	54	12.94	15.43	16.12 %
I.03.07-I.03.07 LEAN	11	50	12.95	14.61	11.36 %
I.03.08-I.03.08 LEAN	11	77	13.79	14.74	6.42 %
I.03.09-I.03.09 LEAN	11	64	13.54	15.15	10.63 %
I.03.10-I.03.10 LEAN	11	51	15.91	17.07	6.80 %
I.03.04-I.03.04 LEAN	12	50	15.42	16.16	4.56 %
I.03.05-I.03.05 LEAN	12	50	12.85	14.49	11.35 %
I.03.06-I.03.06 LEAN	12	50	12.51	14.40	13.10 %
Totals:	116	6306	186.75	207.95	
Average DER = 14.29 $kgCO_2/m^2$		**% DER/TER**	PASS		
Average TER = 15.67 $kgCO_2/m^2$		8.81 %			

BLOCK COMPLIANCE
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Block Compliance Report - DFEE

Block Reference: Block I		Block Name: Block I			
Property-Assessment Reference	**Multiplier**	**Floor Area (m^2)**	**DFEE ($kWh/m^2/yr$)**	**TFEE ($kWh/m^2/yr$)**	**% DFEE/TFEE**
I.02.04 EF-I.02.04 LEAN	1	50	38.71	45.87	15.61 %
I.02.05 EF-I.02.05 LEAN	1	50	27.05	34.66	21.97 %
I.02.06 EF-I.02.06 LEAN	1	50	27.21	33.24	18.15 %
I.03.01-I.03.01 LEAN	11	50	34.90	38.24	8.74 %
I.03.02-I.03.02 LEAN	11	50	51.21	44.64	-14.72 %
I.03.03-I.03.03 LEAN	11	54	28.55	33.42	14.56 %
I.03.07-I.03.07 LEAN	11	50	24.17	26.06	7.28 %
I.03.08-I.03.08 LEAN	11	77	36.15	37.74	4.20 %
I.03.09-I.03.09 LEAN	11	64	33.69	35.11	4.06 %
I.03.10-I.03.10 LEAN	11	51	39.06	39.68	1.55 %
I.03.04-I.03.04 LEAN	12	50	35.29	34.59	-2.03 %
I.03.05-I.03.05 LEAN	12	50	23.53	25.48	7.65 %
I.03.06-I.03.06 LEAN	12	50	23.27	24.28	4.18 %
Totals:	116	6306	422.78	453.01	
Average DFEE = 32.95 kWh/m^2/yr		**% DFEE/TFEE**	PASS		
Average TFEE = 34.10 kWh/m^2/yr		3.37 %			

BLOCK COMPLIANCE
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Block Reference	Block J	**Issued on Date**	
Block Name	Block J		

Assessor Details	Miss Michela Martini, Michela Martini, Tel: 07756715427, michela.martini2@gmail.com	**Assessor ID**	V814-0001
Client			

Block Compliance Report - DER

Block Reference: Block J		Block Name: Block J			
Property-Assessment Reference	**Multiplier**	**Floor Area (m^2)**	**DER ($kgCO_2/m^2$)**	**TER ($kgCO_2/m^2$)**	**% DER/TER**
J.04.02-J.04.02 LEAN	9	70	13.78	14.74	6.54 %
J.04.03-J.04.03 LEAN	9	70	12.78	14.84	13.88 %
J.04.04-J.04.04 LEAN	9	75	13.96	15.58	10.39 %
J.04.05-J.04.05 LEAN	9	51	15.25	16.84	9.45 %
J.04.06-J.04.06 LEAN	9	91	10.57	12.56	15.85 %
J.04.07-J.04.07 LEAN	9	77	10.83	12.36	12.38 %
J.04.08-J.04.08 LEAN	9	70	10.90	12.41	12.18 %
J.04.01-J.04.01 LEAN	9	97	11.84	13.07	9.38 %
J.04.09-J.04.09 LEAN	9	94	11.27	12.82	12.12 %
Totals:	81	6255	111.18	125.22	
Average DER = 12.16 $kgCO_2/m^2$		**% DER/TER**	PASS		
Average TER = 13.72 $kgCO_2/m^2$		11.37 %			

Block Compliance Report - DFEE

Block Reference: Block J		Block Name: Block J			
Property-Assessment Reference	**Multiplier**	**Floor Area (m^2)**	**DFEE ($kWh/m^2/yr$)**	**TFEE ($kWh/m^2/yr$)**	**% DFEE/TFEE**
J.04.02-J.04.02 LEAN	9	70	34.81	34.28	-1.53 %
J.04.03-J.04.03 LEAN	9	70	31.27	35.34	11.51 %
J.04.04-J.04.04 LEAN	9	75	37.66	41.15	8.48 %
J.04.05-J.04.05 LEAN	9	51	36.65	38.65	5.16 %
J.04.06-J.04.06 LEAN	9	91	25.25	30.57	17.38 %
J.04.07-J.04.07 LEAN	9	77	22.30	25.11	11.22 %
J.04.08-J.04.08 LEAN	9	70	20.87	22.42	6.90 %
J.04.01-J.04.01 LEAN	9	97	31.66	35.20	10.07 %
J.04.09-J.04.09 LEAN	9	94	29.03	32.96	11.93 %
Totals:	81	6255	269.50	295.68	
Average DFEE = 29.63 $kWh/m^2/yr$		**% DFEE/TFEE**	PASS		
Average TFEE = 32.70 $kWh/m^2/yr$		9.39 %			

BLOCK COMPLIANCE
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Block Reference	Block K	**Issued on Date**	
Block Name	Block K		

Assessor Details	Miss Michela Martini, Michela Martini, Tel: 07756715427, michela.martini2@gmail.com	**Assessor ID**	Y294-0001
Client			

BLOCK COMPLIANCE
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Block Compliance Report - DER

Block Reference: Block K		Block Name: Block K			
Property-Assessment Reference	Multiplier	Floor Area (m^2)	DER ($kgCO_2/m^2$)	TER ($kgCO_2/m^2$)	% DER/TER
K.09.01-K.09.01 LEAN	12	56	16.96	17.10	0.79 %
K.09.02-K.09.02 LEAN	12	50	16.27	17.39	6.45 %
K.09.03-K.09.03 LEAN	12	81	14.74	15.14	2.64 %
K.09.04-K.09.04 LEAN	12	90	12.17	13.14	7.41 %
K.09.05-K.09.05 LEAN	12	51	13.03	15.05	13.41 %
K.09.06-K.09.06 LEAN	12	70	12.21	13.69	10.79 %
K.09.07-K.09.07 LEAN	12	70	12.46	13.91	10.44 %
K.09.08-K.09.08 LEAN	7	41	14.49	17.32	16.36 %
K.09.09-K.09.09 LEAN	7	42	14.43	17.13	15.76 %
K.09.10-K.09.10 LEAN	7	50	15.60	16.23	3.90 %
K.09.11-K.09.11 LEAN	7	44	13.83	17.67	21.75 %
K.09.12-K.09.12 LEAN	7	47	13.32	17.09	22.07 %
K.09.13-K.09.13 LEAN	12	54	13.19	14.79	10.80 %
K.09.14-K.09.14 LEAN	12	68	11.08	13.10	15.41 %
K.12.08-K.12.08 LEAN	14	70	11.26	12.49	9.87 %
K.16.01-K.16.01 LEAN	9	97	14.01	14.40	2.74 %
K.16.02-K.16.02 LEAN	9	101	12.99	13.99	7.13 %
K.16.03-K.16.03 LEAN	9	96	11.66	12.77	8.70 %
K.16.04-K.16.04 LEAN	9	73	11.70	13.54	13.60 %
K.16.05-K.16.05 LEAN	9	119	10.82	12.16	11.02 %
K.16.07-K.16.07 LEAN	9	100	13.09	13.04	-0.40 %
K.16.08-K.16.08 LEAN	9	103	10.41	12.27	15.16 %
K.16.09-K.16.09 LEAN	9	109	9.21	11.61	20.69 %
K.03.01 EF-K.03.01 LEAN	1	56	17.85	19.59	8.89 %
K.03.02 EF-K.03.02 LEAN	1	50	17.25	19.64	12.15 %
K.03.03 EF-K.03.03 LEAN	1	81	15.62	17.49	10.68 %
K.03.04 EF-K.03.04 LEAN	1	90	13.26	15.26	13.11 %
K.03.05 EF-K.03.05 LEAN	1	51	14.01	16.90	17.09 %
K.03.06 EF-K.03.06 LEAN	1	70	13.07	15.68	16.65 %
K.03.07 EF-K.03.07 LEAN	1	70	13.67	15.90	14.05 %
K.03.08 EF-K.03.08 LEAN	1	41	15.60	19.50	19.99 %
K.03.09 EF-K.03.09 LEAN	1	42	15.54	19.30	19.47 %
K.03.10 EF-K.03.10 LEAN	1	50	16.33	18.47	11.58 %
K.03.11 EF-K.03.11 LEAN	1	44	14.82	19.85	25.34 %
K.03.12 EF-K.03.12 LEAN	1	47	14.32	19.28	25.73 %
K.03.13 EF-K.03.13 LEAN	1	54	14.07	16.71	15.78 %
K.03.14 EF-K.03.14 LEAN	1	68	12.04	14.95	19.46 %
Totals:	243	17624	506.38	583.55	
Average DER = 12.72 $kgCO_2/m^2$		% DER/TER	PASS		
Average TER = 14.15 $kgCO_2/m^2$		10.11 %			

BLOCK COMPLIANCE
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Block Compliance Report - DFEE

Block Reference: Block K		Block Name: Block K			
Property-Assessment Reference	Multiplier	Floor Area (m^2)	DFEE ($kWh/m^2/yr$)	TFEE ($kWh/m^2/yr$)	% DFEE/TFEE
K.09.01-K.09.01 LEAN	12	56	45.46	42.27	-7.55 %
K.09.02-K.09.02 LEAN	12	50	40.41	40.30	-0.28 %
K.09.03-K.09.03 LEAN	12	81	41.39	40.96	-1.05 %
K.09.04-K.09.04 LEAN	12	90	32.67	31.46	-3.84 %
K.09.05-K.09.05 LEAN	12	51	27.31	28.59	4.48 %
K.09.06-K.09.06 LEAN	12	70	28.29	29.77	4.97 %
K.09.07-K.09.07 LEAN	12	70	29.46	31.56	6.68 %
K.09.08-K.09.08 LEAN	7	41	27.26	26.02	-4.74 %
K.09.09-K.09.09 LEAN	7	42	27.69	25.85	-7.11 %
K.09.10-K.09.10 LEAN	7	50	36.25	35.16	-3.12 %
K.09.11-K.09.11 LEAN	7	44	28.24	30.67	7.92 %
K.09.12-K.09.12 LEAN	7	47	27.33	29.80	8.27 %
K.09.13-K.09.13 LEAN	12	54	28.62	28.49	-0.44 %
K.09.14-K.09.14 LEAN	12	68	22.64	22.33	-1.38 %
K.12.08-K.12.08 LEAN	14	70	22.07	22.87	3.52 %
K.16.01-K.16.01 LEAN	9	97	41.11	41.17	0.15 %
K.16.02-K.16.02 LEAN	9	101	37.78	40.37	6.42 %
K.16.03-K.16.03 LEAN	9	96	31.98	30.76	-3.95 %
K.16.04-K.16.04 LEAN	9	73	27.83	29.83	6.72 %
K.16.05-K.16.05 LEAN	9	119	31.48	35.13	10.38 %
K.16.07-K.16.07 LEAN	9	100	37.30	35.23	-5.89 %
K.16.08-K.16.08 LEAN	9	103	28.50	31.11	8.40 %
K.16.09-K.16.09 LEAN	9	109	23.84	28.36	15.96 %
K.03.01 EF-K.03.01 LEAN	1	56	49.27	54.79	10.07 %
K.03.02 EF-K.03.02 LEAN	1	50	44.69	51.60	13.40 %
K.03.03 EF-K.03.03 LEAN	1	81	45.23	52.76	14.26 %
K.03.04 EF-K.03.04 LEAN	1	90	36.97	42.15	12.30 %
K.03.05 EF-K.03.05 LEAN	1	51	31.39	38.09	17.61 %
K.03.06 EF-K.03.06 LEAN	1	70	32.32	39.85	18.89 %
K.03.07 EF-K.03.07 LEAN	1	70	32.78	41.69	21.36 %
K.03.08 EF-K.03.08 LEAN	1	41	31.26	35.73	12.52 %
K.03.09 EF-K.03.09 LEAN	1	42	31.72	35.51	10.67 %
K.03.10 EF-K.03.10 LEAN	1	50	39.65	46.56	14.84 %
K.03.11 EF-K.03.11 LEAN	1	44	32.37	40.20	19.47 %
K.03.12 EF-K.03.12 LEAN	1	47	31.54	39.42	20.00 %
K.03.13 EF-K.03.13 LEAN	1	54	32.78	38.32	14.46 %
K.03.14 EF-K.03.14 LEAN	1	68	27.01	32.80	17.65 %
Totals:	243	17624	1,223.86	1,327.54	
Average DFEE = 31.94 kWh/m^2/yr		% DFEE/TFEE	PASS		
Average TFEE = 32.94 kWh/m^2/yr		3.04 %			

13.2 SAP CALCULATIONS – “BE CLEAN” – BLOCK COMPLIANCE

BLOCK COMPLIANCE
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Block Reference	Block I	**Issued on Date**	12/02/2021
Block Name	Block I		
Assessor Details	Miss Michela Martini, Michela Martini, Tel: 07756715427, michela.martini2@gmail.com	**Assessor ID**	V814-0001
Client			

Block Compliance Report - DER

Block Reference: Block I		Block Name: Block I			
Property-Assessment Reference	**Multiplier**	**Floor Area (m^2)**	**DER ($kgCO_2/m^2$)**	**TER ($kgCO_2/m^2$)**	**% DER/TER**
I.02.04 EF-I.02.04 CLEAN	1	50	11.68	18.38	36.44 %
I.02.05 EF-I.02.05 CLEAN	1	50	9.97	16.27	38.72 %
I.02.06 EF-I.02.06 CLEAN	1	50	9.69	16.12	39.87 %
I.03.01-I.03.01 CLEAN	11	50	10.67	16.98	37.17 %
I.03.02-I.03.02 CLEAN	11	50	13.24	18.17	27.13 %
I.03.03-I.03.03 CLEAN	11	54	9.35	15.43	39.39 %
I.03.07-I.03.07 CLEAN	11	50	9.44	14.61	35.39 %
I.03.08-I.03.08 CLEAN	11	77	10.20	14.74	30.79 %
I.03.09-I.03.09 CLEAN	11	64	9.76	15.15	35.58 %
I.03.10-I.03.10 CLEAN	11	51	11.37	17.07	33.40 %
I.03.04-I.03.04 CLEAN	12	50	11.24	16.16	30.43 %
I.03.05-I.03.05 CLEAN	12	50	9.37	14.49	35.36 %
I.03.06-I.03.06 CLEAN	12	50	9.09	14.40	36.85 %
Totals:	116	6306	135.07	207.95	
Average DER = 10.33 $kgCO_2/m^2$		**% DER/TER**	PASS		
Average TER = 15.67 $kgCO_2/m^2$		34.08 %			

BLOCK COMPLIANCE
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Block Compliance Report - DFEE

Block Reference: Block I		Block Name: Block I			
Property-Assessment Reference	**Multiplier**	**Floor Area (m^2)**	**DFEE ($kWh/m^2/yr$)**	**TFEE ($kWh/m^2/yr$)**	**% DFEE/TFEE**
I.02.04 EF-I.02.04 CLEAN	1	50	38.71	45.87	15.61 %
I.02.05 EF-I.02.05 CLEAN	1	50	27.05	34.66	21.97 %
I.02.06 EF-I.02.06 CLEAN	1	50	27.21	33.24	18.15 %
I.03.01-I.03.01 CLEAN	11	50	34.90	38.24	8.74 %
I.03.02-I.03.02 CLEAN	11	50	51.21	44.64	-14.72 %
I.03.03-I.03.03 CLEAN	11	54	28.55	33.42	14.56 %
I.03.07-I.03.07 CLEAN	11	50	24.17	26.06	7.28 %
I.03.08-I.03.08 CLEAN	11	77	36.15	37.74	4.20 %
I.03.09-I.03.09 CLEAN	11	64	33.69	35.11	4.06 %
I.03.10-I.03.10 CLEAN	11	51	39.06	39.68	1.55 %
I.03.04-I.03.04 CLEAN	12	50	35.29	34.59	-2.03 %
I.03.05-I.03.05 CLEAN	12	50	23.53	25.48	7.65 %
I.03.06-I.03.06 CLEAN	12	50	23.27	24.28	4.18 %
Totals:	116	6306	422.78	453.01	
Average DFEE = 32.95 kWh/m^2/yr		**% DFEE/TFEE**	PASS		
Average TFEE = 34.10 kWh/m^2/yr		3.37 %			

BLOCK COMPLIANCE
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Block Reference	Block J	**Issued on Date**	
Block Name	Block J		

Assessor Details	Miss Michela Martini, Michela Martini, Tel: 07756715427, michela.martini2@gmail.com	**Assessor ID**	V814-0001
Client			

Block Compliance Report - DER

Block Reference: Block J		Block Name: Block J			
Property-Assessment Reference	**Multiplier**	**Floor Area (m^2)**	**DER ($kgCO_2/m^2$)**	**TER ($kgCO_2/m^2$)**	**% DER/TER**
J.04.01-J.04.01 CLEAN	9	97	8.79	13.07	32.73 %
J.04.02-J.04.02 CLEAN	9	70	9.99	14.74	32.24 %
J.04.03-J.04.03 CLEAN	9	70	9.30	14.84	37.33 %
J.04.04-J.04.04 CLEAN	9	75	10.08	15.58	35.30 %
J.04.05-J.04.05 CLEAN	9	51	10.94	16.84	35.04 %
J.04.06-J.04.06 CLEAN	9	91	7.91	12.56	37.03 %
J.04.07-J.04.07 CLEAN	9	77	8.08	12.36	34.63 %
J.04.08-J.04.08 CLEAN	9	70	8.08	12.41	34.90 %
J.04.09-J.04.09 CLEAN	9	94	8.36	12.82	34.81 %
Totals:	81	6255	81.53	125.22	
Average DER = 8.94 $kgCO_2/m^2$		**% DER/TER**	PASS		
Average TER = 13.72 $kgCO_2/m^2$		34.84 %			

Block Compliance Report - DFEE

Block Reference: Block J		Block Name: Block J			
Property-Assessment Reference	**Multiplier**	**Floor Area (m^2)**	**DFEE ($kWh/m^2/yr$)**	**TFEE ($kWh/m^2/yr$)**	**% DFEE/TFEE**
J.04.01-J.04.01 CLEAN	9	97	31.66	35.20	10.07 %
J.04.02-J.04.02 CLEAN	9	70	34.81	34.28	-1.53 %
J.04.03-J.04.03 CLEAN	9	70	31.27	35.34	11.51 %
J.04.04-J.04.04 CLEAN	9	75	37.66	41.15	8.48 %
J.04.05-J.04.05 CLEAN	9	51	36.65	38.65	5.16 %
J.04.06-J.04.06 CLEAN	9	91	25.25	30.57	17.38 %
J.04.07-J.04.07 CLEAN	9	77	22.30	25.11	11.22 %
J.04.08-J.04.08 CLEAN	9	70	20.87	22.42	6.90 %
J.04.09-J.04.09 CLEAN	9	94	29.03	32.96	11.93 %
Totals:	81	6255	269.50	295.68	
Average DFEE = 29.63 $kWh/m^2/yr$		**% DFEE/TFEE**	PASS		
Average TFEE = 32.70 $kWh/m^2/yr$		9.39 %			

BLOCK COMPLIANCE
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Block Reference	Block K	**Issued on Date**	
Block Name	Block K		

Assessor Details	Miss Michela Martini, Michela Martini, Tel: 07756715427, michela.martini2@gmail.com	**Assessor ID**	V814-0001
Client			

BLOCK COMPLIANCE
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Block Compliance Report - DER

Block Reference: Block K		Block Name: Block K			
Property-Assessment Reference	Multiplier	Floor Area (m^2)	DER ($kgCO_2/m^2$)	TER ($kgCO_2/m^2$)	% DER/TER
K.09.01-K.09.01 CLEAN	12	56	12.13	17.10	29.04 %
K.09.02-K.09.02 CLEAN	12	50	11.58	17.39	33.42 %
K.09.03-K.09.03 CLEAN	12	81	10.66	15.14	29.59 %
K.09.04-K.09.04 CLEAN	12	90	8.89	13.14	32.37 %
K.09.05-K.09.05 CLEAN	12	51	9.42	15.05	37.40 %
K.09.06-K.09.06 CLEAN	12	70	8.95	13.69	34.61 %
K.09.07-K.09.07 CLEAN	12	70	9.15	13.91	34.23 %
K.09.08-K.09.08 CLEAN	7	41	10.41	17.32	39.91 %
K.09.09-K.09.09 CLEAN	7	42	10.37	17.13	39.46 %
K.09.10-K.09.10 CLEAN	7	50	11.36	16.23	30.02 %
K.09.11-K.09.11 CLEAN	7	44	9.93	17.67	43.82 %
K.09.12-K.09.12 CLEAN	7	47	9.60	17.09	43.83 %
K.09.13-K.09.13 CLEAN	12	54	9.56	14.79	35.35 %
K.09.14-K.09.14 CLEAN	12	68	8.21	13.10	37.32 %
K.12.08-K.12.08 CLEAN	14	70	8.36	12.49	33.09 %
K.16.01-K.16.01 CLEAN	9	97	10.09	14.40	29.95 %
K.16.02-K.16.02 CLEAR	9	101	9.50	13.99	32.08 %
K.16.03-K.16.03 CLEAN	9	96	8.53	12.77	33.21 %
K.16.04-K.16.04 CLEAN	9	73	8.57	13.54	36.71 %
K.16.05-K.16.05 CLEAN	9	119	8.04	12.16	33.88 %
K.16.07-K.16.07 CLEAN	9	100	9.52	13.04	26.98 %
K.16.08-K.16.08 CLEAN	9	103	7.69	12.27	37.33 %
K.16.09-K.16.01 CLEAN	9	109	6.92	11.61	40.41 %
K.03.01 EF-K.03.01 CLEAN	1	56	12.67	19.59	35.33 %
K.03.02 EF-K.03.02 CLEAN	1	50	12.19	19.64	37.92 %
K.03.03 EF-K.03.03 CLEAN	1	81	11.20	17.49	35.95 %
K.03.04 EF-K.03.04 CLEAN	1	90	9.60	15.26	37.09 %
K.03.05 EF-K.03.05 CLEAN	1	51	10.08	16.90	40.35 %
K.03.06 EF-K.03.06 CLEAN	1	70	9.49	15.68	39.48 %
K.03.07 EF-K.03.07 CLEAN	1	70	10.09	15.90	36.56 %
K.03.08 EF-K.03.08 CLEAN	1	41	11.23	19.50	42.40 %
K.03.09 EF-K.03.09 CLEAN	1	42	11.18	19.30	42.06 %
K.03.10 EF-K.03.10 CLEAN	1	50	11.80	18.47	36.11 %
K.03.11 EF-K.03.11 CLEAN	1	44	10.60	19.85	46.60 %
K.03.12 EF-K.03.12 CLEAN	1	47	10.29	19.28	46.63 %
K.03.13 EF-K.03.13 CLEAN	1	54	10.11	16.71	39.48 %
K.03.14 EF-K.03.14 CLEAN	1	68	8.84	14.95	40.87 %
Totals:	243	17624	366.81	583.55	
Average DER = 9.28 $kgCO_2/m^2$		% DER/TER	PASS		
Average TER = 14.15 $kgCO_2/m^2$		34.42 %			

BLOCK COMPLIANCE
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Block Compliance Report - DFEE

Block Reference: Block K		Block Name: Block K			
Property-Assessment Reference	**Multiplier**	**Floor Area (m^2)**	**DFEE ($kWh/m^2/yr$)**	**TFEE ($kWh/m^2/yr$)**	**% DFEE/TFEE**
K.09.01-K.09.01 CLEAN	12	56	45.46	42.27	-7.55 %
K.09.02-K.09.02 CLEAN	12	50	40.41	40.30	-0.28 %
K.09.03-K.09.03 CLEAN	12	81	41.39	40.96	-1.05 %
K.09.04-K.09.04 CLEAN	12	90	32.67	31.46	-3.84 %
K.09.05-K.09.05 CLEAN	12	51	27.31	28.59	4.48 %
K.09.06-K.09.06 CLEAN	12	70	28.29	29.77	4.97 %
K.09.07-K.09.07 CLEAN	12	70	29.46	31.56	6.68 %
K.09.08-K.09.08 CLEAN	7	41	27.26	26.02	-4.74 %
K.09.09-K.09.09 CLEAN	7	42	27.69	25.85	-7.11 %
K.09.10-K.09.10 CLEAN	7	50	36.25	35.16	-3.12 %
K.09.11-K.09.11 CLEAN	7	44	28.24	30.67	7.92 %
K.09.12-K.09.12 CLEAN	7	47	27.33	29.80	8.27 %
K.09.13-K.09.13 CLEAN	12	54	28.62	28.49	-0.44 %
K.09.14-K.09.14 CLEAN	12	68	22.64	22.33	-1.38 %
K.12.08-K.12.08 CLEAN	14	70	22.07	22.87	3.52 %
K.16.01-K.16.01 CLEAN	9	97	41.11	41.17	0.15 %
K.16.02-K.16.02 CLEAR	9	101	37.78	40.37	6.42 %
K.16.03-K.16.03 CLEAN	9	96	31.98	30.76	-3.95 %
K.16.04-K.16.04 CLEAN	9	73	27.83	29.83	6.72 %
K.16.05-K.16.05 CLEAN	9	119	31.48	35.13	10.38 %
K.16.07-K.16.07 CLEAN	9	100	37.30	35.23	-5.89 %
K.16.08-K.16.08 CLEAN	9	103	28.50	31.11	8.40 %
K.16.09-K.16.01 CLEAN	9	109	23.84	28.36	15.96 %
K.03.01 EF-K.03.01 CLEAN	1	56	49.27	54.79	10.07 %
K.03.02 EF-K.03.02 CLEAN	1	50	44.69	51.60	13.40 %
K.03.03 EF-K.03.03 CLEAN	1	81	45.23	52.76	14.26 %
K.03.04 EF-K.03.04 CLEAN	1	90	36.97	42.15	12.30 %
K.03.05 EF-K.03.05 CLEAN	1	51	31.39	38.09	17.61 %
K.03.06 EF-K.03.06 CLEAN	1	70	32.32	39.85	18.89 %
K.03.07 EF-K.03.07 CLEAN	1	70	32.78	41.69	21.36 %
K.03.08 EF-K.03.08 CLEAN	1	41	31.26	35.73	12.52 %
K.03.09 EF-K.03.09 CLEAN	1	42	31.72	35.51	10.67 %
K.03.10 EF-K.03.10 CLEAN	1	50	39.65	46.56	14.84 %
K.03.11 EF-K.03.11 CLEAN	1	44	32.37	40.20	19.47 %
K.03.12 EF-K.03.12 CLEAN	1	47	31.54	39.42	20.00 %
K.03.13 EF-K.03.13 CLEAN	1	54	32.78	38.32	14.46 %
K.03.14 EF-K.03.14 CLEAN	1	68	27.01	32.80	17.65 %
Totals:	243	17624	1,223.86	1,327.54	
Average DFEE = 31.94 $kWh/m^2/yr$		**% DFEE/TFEE**	PASS		
Average TFEE = 32.94 $kWh/m^2/yr$		3.04 %			

13.3 SAP CALCULATIONS – “BE LEAN” – FLAT TYPES

BASIC COMPLIANCE REPORT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	I.03.01	**Issued on Date**	24/02/2021
Assessment Reference	I.03.01 LEAN	**Prop Type Ref**	PGPS Block I
Property	PGPS, Westminster, London, London		

SAP Rating	84 B	**DER**	14.88	**TER**	16.98
Environmental	91 B	**% DER<TER**	12.37		
CO_2 Emissions (t/year)	0.63	**DFEE**	34.90	**TFEE**	38.24
General Requirements Compliance	Pass	**% DFEE<TFEE**	8.74		

Assessor Details	Miss Michela Martini, Michela Martini, Tel: 07756715427, michela.martini2@gmail.com	**Assessor ID**	Y294-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Mains gas (c)		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	16.98	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	14.88	$kgCO_2/m^2$	Pass
	-2.10 (-12.4%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	38.24	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	34.90	$kWh/m^2/yr$	
	-3.3 (-8.6%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
Openings and curtain wall	0.90 (max. 2.00)	0.90 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	3.00 (design value)	
Maximum	10.0	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Community heating scheme	-
Secondary heating system	None	

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 0.46 kWh/day Permitted by DBSCG 0.46	Pass
Primary pipework insulated	No primary pipework	

6 Controls

Space heating controls	Charging system linked to use of community heating, programmer and at least two room stats		Pass
Hot water controls	No cylinderstat		

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100	%	
Minimum	75	%	Pass

8 Mechanical ventilation

Continuous supply and extract system			
Specific fan power	0.52		
Maximum	1.5		Pass
MVHR efficiency	88	%	
Minimum	70	%	Pass

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Thames Valley)	Medium	Pass

Based on:

Overshading	Average
Windows facing North	13.51 m², No overhang
Air change rate	4.00 ach
Blinds/curtains	None

Criterion 4 – Building performance consistent with DER and DFEE rate

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	3.00 (design value)		
Maximum	10.0		Pass

10 Key features

Window U-value	0.90	W/m²K
Thermal bridging y-value	0.000	W/m²K
Air permeability	3.0	m³/m²h

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

BASIC COMPLIANCE REPORT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	J.04.03	**Issued on Date**	24/03/2021
Assessment Reference	J.04.03 LEAN	**Prop Type Ref**	
Property	Westminster, London, London		

SAP Rating	86 B	**DER**	12.78	**TER**	14.84
Environmental	91 B	**% DER<TER**	13.88		
CO_2 Emissions (t/year)	0.75	**DFEE**	31.27	**TFEE**	35.34
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.51		

Assessor Details	Miss Michela Martini, Michela Martini, Tel: 07756715427, michela.martini2@gmail.com	**Assessor ID**	Y294-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Mains gas (c)		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	14.84	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	12.78	$kgCO_2/m^2$	Pass
	-2.06 (-13.9%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	35.34	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	31.27	$kWh/m^2/yr$	
	-4.0 (-11.3%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
Openings and curtain wall	0.90 (max. 2.00)	0.90 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	3.00 (design value)	
Maximum	10.0	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Community heating scheme	-
Secondary heating system	None	

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 0.46 kWh/day Permitted by DBSCG 0.46	Pass
Primary pipework insulated	No primary pipework	

6 Controls

Space heating controls	Charging system linked to use of community heating, programmer and at least two room stats		Pass
Hot water controls	No cylinderstat		

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100	%	
Minimum	75	%	Pass

8 Mechanical ventilation

Continuous supply and extract system			
Specific fan power	0.56		
Maximum	1.5		Pass
MVHR efficiency	88	%	
Minimum	70	%	Pass

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Thames Valley)	Medium		Pass

Based on:

Overshading	Average		
Windows facing North Windows facing West	13.51 m², No overhang 2.25 m², No overhang		
Air change rate	4.00 ach		
Blinds/curtains	None		

Criterion 4 – Building performance consistent with DER and DFEE rate

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	3.00 (design value)		
Maximum	10.0		Pass

10 Key features

Window U-value	0.90	W/m²K
Thermal bridging y-value	0.000	W/m²K
Air permeability	3.0	m³/m²h

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

BASIC COMPLIANCE REPORT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	K.16.05	**Issued on Date**	19/03/2021
Assessment Reference	K.16.05 LEAN	**Prop Type Ref**	
Property	Westminster, London, London		

SAP Rating	87 B	**DER**	10.82	**TER**	12.16
Environmental	90 B	**% DER<TER**	11.02		
CO_2 Emissions (t/year)	1.05	**DFEE**	31.48	**TFEE**	35.13
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.38		

Assessor Details	Miss Michela Martini, Michela Martini, Tel: 07756715427, michela.martini2@gmail.com	**Assessor ID**	Y294-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Mains gas (c)		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	12.16	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	10.82	$kgCO_2/m^2$	Pass
	-1.34 (-11.0%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	35.13	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	31.48	$kWh/m^2/yr$	
	-3.6 (-10.3%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
Openings and curtain wall	0.90 (max. 2.00)	0.90 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	3.00 (design value)	
Maximum	10.0	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Community heating scheme	-
Secondary heating system	None	

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 0.46 kWh/day Permitted by DBSCG 0.46	Pass
Primary pipework insulated	No primary pipework	

6 Controls

Space heating controls	Charging system linked to use of community heating, programmer and at least two room stats		Pass
Hot water controls	No cylinderstat		

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100	%	
Minimum	75	%	Pass

8 Mechanical ventilation

Continuous supply and extract system			
Specific fan power	0.56		
Maximum	1.5		Pass
MVHR efficiency	88	%	
Minimum	70	%	Pass

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Thames Valley)	Slight	Pass

Based on:

Overshading	Average
Windows facing East	17.93 m², No overhang
Windows facing South East	8.97 m², No overhang
Windows facing South	9.08 m², No overhang
Air change rate	6.00 ach
Blinds/curtains	None

Criterion 4 – Building performance consistent with DER and DFEE rate

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	3.00 (design value)		
Maximum	10.0		Pass

10 Key features

Window U-value	0.90	W/m²K
Thermal bridging y-value	0.000	W/m²K
Air permeability	3.0	m³/m²h

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

13.4 SAP CALCULATIONS – “BE CLEAN” – FLAT TYPES

BASIC COMPLIANCE REPORT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	I.03.01	**Issued on Date**	16/03/2021
Assessment Reference	I.03.01 CLEAN	**Prop Type Ref**	PGPS Block I
Property	PGPS, Westminster, London, London		

SAP Rating	85 B	**DER**	10.67	**TER**	16.98
Environmental	93 A	**% DER<TER**	37.17		
CO_2 Emissions (t/year)	0.46	**DFEE**	34.90	**TFEE**	38.24
General Requirements Compliance	Pass	**% DFEE<TFEE**	8.74		

Assessor Details	Miss Michela Martini, Michela Martini, Tel: 07756715427, michela.martini2@gmail.com	**Assessor ID**	V814-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Mains gas (c)		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	16.98	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	10.67	$kgCO_2/m^2$	Pass
	-6.31 (-37.2%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	38.24	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	34.90	$kWh/m^2/yr$	
	-3.3 (-8.6%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
Openings and curtain wall	0.90 (max. 2.00)	0.90 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	3.00 (design value)	
Maximum	10.0	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Community heating scheme	-
Secondary heating system	None	

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 0.46 kWh/day Permitted by DBSCG 0.46	Pass
Primary pipework insulated	No primary pipework	

6 Controls

Space heating controls	Charging system linked to use of community heating, programmer and at least two room stats		Pass
Hot water controls	No cylinderstat		

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100	%	
Minimum	75	%	Pass

8 Mechanical ventilation

Continuous supply and extract system			
Specific fan power	0.52		
Maximum	1.5		Pass
MVHR efficiency	88	%	
Minimum	70	%	Pass

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Thames Valley)	Medium	Pass

Based on:

Overshading	Average
Windows facing North	13.51 m², No overhang
Air change rate	4.00 ach
Blinds/curtains	None

Criterion 4 – Building performance consistent with DER and DFEE rate

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	3.00 (design value)		
Maximum	10.0		Pass

10 Key features

Window U-value	0.90	W/m²K
Thermal bridging y-value	0.000	W/m²K
Air permeability	3.0	m³/m²h
Community CHP, Mains gas	N/A	

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

BASIC COMPLIANCE REPORT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	J.04.03	**Issued on Date**	24/03/2021
Assessment Reference	J.04.03 CLEAN	**Prop Type Ref**	
Property	Westminster, London, London		

SAP Rating	86 B	**DER**	9.30	**TER**	14.84
Environmental	93 A	**% DER<TER**	37.33		
CO_2 Emissions (t/year)	0.56	**DFEE**	31.27	**TFEE**	35.34
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.51		

Assessor Details	Miss Michela Martini, Michela Martini, Tel: 07756715427, michela.martini2@gmail.com	**Assessor ID**	V814-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Mains gas (c)		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	14.84	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	9.30	$kgCO_2/m^2$	Pass
	-5.54 (-37.3%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	35.34	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	31.27	$kWh/m^2/yr$	
	-4.0 (-11.3%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
Openings and curtain wall	0.90 (max. 2.00)	0.90 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	3.00 (design value)	
Maximum	10.0	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Community heating scheme	-
Secondary heating system	None	

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 0.46 kWh/day Permitted by DBSCG 0.46	Pass
Primary pipework insulated	No primary pipework	

6 Controls

Space heating controls	Charging system linked to use of community heating, programmer and at least two room stats		Pass
Hot water controls	No cylinderstat		

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100	%	
Minimum	75	%	Pass

8 Mechanical ventilation

Continuous supply and extract system			
Specific fan power	0.56		
Maximum	1.5		Pass
MVHR efficiency	88	%	
Minimum	70	%	Pass

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Thames Valley)	Medium		Pass

Based on:

Overshading	Average		
Windows facing North Windows facing West	13.51 m², No overhang 2.25 m², No overhang		
Air change rate	4.00 ach		
Blinds/curtains	None		

Criterion 4 – Building performance consistent with DER and DFEE rate

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	3.00 (design value)		
Maximum	10.0		Pass

10 Key features

Window U-value	0.90	W/m²K
Thermal bridging y-value	0.000	W/m²K
Air permeability	3.0	m³/m²h
Community CHP, Mains gas	N/A	

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

BASIC COMPLIANCE REPORT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	K.16.05	**Issued on Date**	19/03/2021
Assessment Reference	K.16.05 CLEAN	**Prop Type Ref**	
Property	Westminster, London, London		

SAP Rating	88 B	**DER**	8.04	**TER**	12.16
Environmental	93 A	**% DER<TER**	33.88		
CO_2 Emissions (t/year)	0.79	**DFEE**	31.48	**TFEE**	35.13
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.38		

Assessor Details	Miss Michela Martini, Michela Martini, Tel: 07756715427, michela.martini2@gmail.com	**Assessor ID**	V814-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Mains gas (c)		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	12.16	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	8.04	$kgCO_2/m^2$	Pass
	-4.12 (-33.9%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	35.13	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	31.48	$kWh/m^2/yr$	
	-3.6 (-10.3%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
Openings and curtain wall	0.90 (max. 2.00)	0.90 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	3.00 (design value)	
Maximum	10.0	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Community heating scheme	-
Secondary heating system	None	

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 0.46 kWh/day Permitted by DBSCG 0.46	Pass
Primary pipework insulated	No primary pipework	

6 Controls

Space heating controls	Charging system linked to use of community heating, programmer and at least two room stats		Pass
Hot water controls	No cylinderstat		

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100	%	
Minimum	75	%	Pass

8 Mechanical ventilation

Continuous supply and extract system			
Specific fan power	0.56		
Maximum	1.5		Pass
MVHR efficiency	88	%	
Minimum	70	%	Pass

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Thames Valley)	Slight	Pass

Based on:

Overshading	Average
Windows facing East	17.93 m², No overhang
Windows facing South East	8.97 m², No overhang
Windows facing South	9.08 m², No overhang
Air change rate	6.00 ach
Blinds/curtains	None

Criterion 4 – Building performance consistent with DER and DFEE rate

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	3.00 (design value)	
Maximum	10.0	Pass

10 Key features

Window U-value	0.90	W/m²K
Thermal bridging y-value	0.000	W/m²K
Air permeability	3.0	m³/m²h
Community CHP, Mains gas	N/A	

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

14 APPENDIX B

14.1 BRUKL SHEETS “BE LEAN”

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Paddington Green PS Part L LEAN

As designed

Date: Wed Mar 31 15:08:46 2021

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	15.6
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	15.6
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	12.1
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 fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the 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	0.17	0.22	B1000027:Surf[0]
Floor	0.25	0.13	0.13	B1000079:Surf[0]
Roof	0.25	0.13	0.13	0_000009:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.2	1.2	B1000079:Surf[1]
Personnel doors	2.2	1.2	1.2	B1000079:Surf[28]
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	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- L00 ASHP/MVHR+FCU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	4.5	0	1.6	0.8
Standard value	0.91*	3.2	N/A	1.6^	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.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

2- B01/02 CHP/AHU Heating Only

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.2	0	0.8
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- L01/02 ASHP/AHU Heating only

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.2	0	0.8
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.

4- L01/02 ASHP/AHU+FCU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	4.5	0	1.9	0.8
Standard value	0.91*	3.2	N/A	1.6^	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.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

5- L25 CHP+Chiller/MVHR+FCU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	3.27	0	1.6	0.8
Standard value	0.91*	2.55	N/A	1.6^	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.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

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

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
0-Affordable Workspace	-	-	-	-	-	-	-	0.2	-	-	N/A
0-BOH	-	-	-	-	-	-	-	0.2	-	-	N/A
0-BOH	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Cycle entrance	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Cycle entrance	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Cycle entrance	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Flexible commercial	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial-P	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial-P E	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial-P N	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial-P NE	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial-P SE	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial-P SW	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial-P W	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Int resi entrance	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Office entrance	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Office entrance-P N	-	-	-	-	-	-	-	0.2	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
0-Office entrance-P S	-	-	-	-	-	-	-	0.2	-	-	N/A
0-PD Resi Entrance	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Resi Amenity	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Residential entrance	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Residential entrance	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Residential entrance	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Residential entrance-P	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Stairs	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Store	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Virtual Golf	-	-	-	-	-	-	-	0.2	-	-	N/A
0-WC	-	-	0.4	-	-	-	-	-	-	-	N/A
0-Welfare area	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
1-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
1-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
1-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
1-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
1-Meeting room	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Meeting Room	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Meeting Room	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Meeting room	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Stairs	-	-	-	1.9	-	-	-	-	-	-	N/A
1-Stairs	-	-	-	1.9	-	-	-	-	-	-	N/A
1-WC	-	-	0.4	-	-	-	-	-	-	-	N/A
1-WC	-	-	0.4	-	-	-	-	-	-	-	N/A
1-WC	-	-	0.4	-	-	-	-	-	-	-	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
2-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
2-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
2-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
2-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
2-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
2-Meeting Room	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Meeting Room	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Meeting room	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Meeting room	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Stairs	-	-	-	1.9	-	-	-	-	-	-	N/A
2-Stairs	-	-	-	1.9	-	-	-	-	-	-	N/A
2-WC	-	-	0.4	-	-	-	-	-	-	-	N/A
2-WC	-	-	0.4	-	-	-	-	-	-	-	N/A
2-WC	-	-	0.4	-	-	-	-	-	-	-	N/A
25-Meeting Room	-	-	-	-	-	-	-	0.2	-	-	N/A
25-Residents Lounge-P N	-	-	-	-	-	-	-	0.2	-	-	N/A
25-Residents Lounge-P NW	-	-	-	-	-	-	-	0.2	-	-	N/A
25-Residents Lounge-P W	-	-	-	-	-	-	-	0.2	-	-	N/A
25-WC	-	-	0.4	-	-	-	-	-	-	-	N/A
B1-Basement fan room E	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Basement fan room N	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Basement fan room S	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Basement fan room W	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Car park fan room 1	-	-	-	1.6	-	-	-	-	-	-	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
B1-Car park fan room 2	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Car parking	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Comms In	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Comms service room	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Cycle store	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Cycle store 10	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Cycle store 100	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Cycle store 24	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Cycle store 36	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-LL TX1	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-LS TX	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-LTHW plant room	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-New cycle store	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Plant?	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Resi switch room	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Retail & DWS plant	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Retail DWS plant	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Sprinkler plant	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Switchgear	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Switchgear	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-TX	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-TX1 Cooling	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Wet riser	-	-	-	1.6	-	-	-	-	-	-	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	
0-Affordable Workspace	163	-	-	1149
0-BOH	241	-	-	113
0-BOH	242	-	-	125
0-Circulation	-	147	-	38
0-Circulation	-	103	-	164
0-Circulation	-	127	-	56
0-Circulation	-	185	-	23
0-Circulation	-	132	-	47
0-Circulation	-	144	-	38
0-Circulation	-	152	-	145
0-Circulation	-	117	-	114
0-Circulation	-	226	-	15
0-Cycle entrance	143	-	-	32
0-Cycle entrance	115	-	-	57
0-Cycle entrance	-	158	-	45
0-Flexible commercial	161	-	-	406

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
0-Flexible commercial	214	-	-	72
0-Flexible commercial	171	-	-	443
0-Flexible commercial	179	-	-	386
0-Flexible commercial	160	-	-	212
0-Flexible commercial	166	-	-	482
0-Flexible commercial-P	159	-	-	288
0-Flexible commercial-P E	160	-	-	143
0-Flexible commercial-P N	159	-	-	150
0-Flexible commercial-P NE	160	-	-	536
0-Flexible commercial-P SE	169	-	-	108
0-Flexible commercial-P SW	175	-	-	192
0-Flexible commercial-P W	168	-	-	246
0-Int resi entrance	-	149	-	112
0-Office entrance	-	81	80	237
0-Office entrance-P N	-	83	80	235
0-Office entrance-P S	-	92	80	233
0-PD Resi Entrance	-	116	-	81
0-Plant	87	-	-	431
0-Plant	105	-	-	169
0-Resi Amenity	188	-	-	235
0-Residential entrance	-	132	-	51
0-Residential entrance	-	89	80	327
0-Residential entrance	-	87	80	374
0-Residential entrance-P	-	85	80	222
0-Stairs	-	204	-	40
0-Store	226	-	-	11
0-Virtual Golf	-	89	-	540
0-WC	-	226	-	29
0-Welfare area	-	138	-	115
1-AHU Plant	94	-	-	125
1-AHU Plant	92	-	-	133
1-Circulation	-	96	-	121
1-Circulation	-	91	-	66
1-Circulation	-	111	-	86
1-Circulation	-	108	-	38
1-Circulation	-	104	-	45
1-Meeting room	212	-	-	74
1-Meeting Room	246	-	-	50
1-Meeting Room	246	-	-	50
1-Meeting room	244	-	-	53
1-Office	153	-	-	142
1-Office	147	-	-	377
1-Office	148	-	-	599

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
1-Office	153	-	-	126
1-Office	147	-	-	447
1-Office	154	-	-	220
1-Office	152	-	-	180
1-Office	149	-	-	1666
1-Office	153	-	-	132
1-Office	150	-	-	218
1-Office	153	-	-	988
1-Office	147	-	-	403
1-Office	214	-	-	76
1-Office	188	-	-	81
1-Office	147	-	-	816
1-Office	151	-	-	1041
1-Office	147	-	-	237
1-Stairs	-	110	-	38
1-Stairs	-	104	-	43
1-WC	-	96	-	115
1-WC	-	94	-	138
1-WC	-	89	-	189
2-AHU Plant	95	-	-	133
2-AHU Plant	97	-	-	125
2-Circulation	-	96	-	66
2-Circulation	-	108	-	45
2-Circulation	-	117	-	86
2-Circulation	-	114	-	38
2-Circulation	-	100	-	121
2-Meeting Room	261	-	-	50
2-Meeting Room	261	-	-	50
2-Meeting room	223	-	-	74
2-Meeting room	260	-	-	53
2-Office	151	-	-	1329
2-Office	148	-	-	599
2-Office	152	-	-	162
2-Office	154	-	-	988
2-Office	147	-	-	277
2-Office	151	-	-	266
2-Office	148	-	-	275
2-Office	154	-	-	142
2-Office	156	-	-	218
2-Office	151	-	-	106
2-Office	149	-	-	555
2-Office	153	-	-	1041
2-Office	155	-	-	220

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
2-Office	150	-	-	179
2-Office	195	-	-	81
2-Office	153	-	-	180
2-Office	155	-	-	132
2-Office	148	-	-	447
2-Office	225	-	-	76
2-Stairs	-	108	-	43
2-Stairs	-	115	-	38
2-WC	-	99	-	115
2-WC	-	97	-	138
2-WC	-	91	-	189
25-Meeting Room	175	-	-	107
25-Residents Lounge-P N	155	-	-	181
25-Residents Lounge-P NW	153	-	-	349
25-Residents Lounge-P W	157	-	-	139
25-WC	-	97	-	67
B1-Basement fan room E	117	-	-	123
B1-Basement fan room N	128	-	-	185
B1-Basement fan room S	114	-	-	112
B1-Basement fan room W	113	-	-	117
B1-Bin store 1	92	-	-	127
B1-Bin store 2	88	-	-	217
B1-Bin store 3	103	-	-	81
B1-Bin store 4	85	-	-	239
B1-Car park fan room 1	110	-	-	138
B1-Car park fan room 2	113	-	-	117
B1-Car parking	-	75	-	2252
B1-Circulation	-	154	-	97
B1-Circulation	-	146	-	50
B1-Circulation	-	164	-	94
B1-Circulation	-	115	-	105
B1-Circulation	-	125	-	341
B1-Circulation	-	153	-	42
B1-Circulation	-	143	-	114
B1-Circulation	-	147	-	74
B1-Circulation	-	145	-	102
B1-Circulation	-	134	-	92
B1-Circulation	-	197	-	20
B1-Circulation	-	138	-	70
B1-Circulation	-	163	-	37
B1-Comms In	182	-	-	52
B1-Comms service room	99	-	-	182
B1-Cycle store	79	-	-	361

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
B1-Cycle store 10	131	-	-	39
B1-Cycle store 100	82	-	-	307
B1-Cycle store 24	110	-	-	53
B1-Cycle store 36	113	-	-	45
B1-LL TX1	114	-	-	112
B1-Lobby	-	226	-	11
B1-Lobby	-	179	-	22
B1-LS TX	114	-	-	148
B1-LTHW plant room	80	-	-	870
B1-New cycle store	72	-	-	226
B1-Office cycle store 16	110	-	-	67
B1-Plant?	106	-	-	163
B1-Resi switch room	182	-	-	52
B1-Retail & DWS plant	100	-	-	182
B1-Retail bin store 3	132	-	-	46
B1-Retail DWS plant	86	-	-	354
B1-Sprinkler plant	84	-	-	441
B1-Stairs	-	145	-	36
B1-Stairs	-	132	-	48
B1-Stairs	-	112	-	67
B1-Stairs	-	119	-	69
B1-Stairs	-	125	-	55
B1-Switchgear	108	-	-	141
B1-Switchgear	98	-	-	220
B1-TX	128	-	-	87
B1-TX1 Cooling	175	-	-	54
B1-Wet riser	85	-	-	396
B2-Circulation	-	137	-	50
B2-Circulation	-	137	-	81
B2-Circulation	-	172	-	24
B2-Refuse waiting area	79	-	-	437
B2-Stairs	-	132	-	48
B2-Stairs	-	129	-	49

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?
0-Affordable Workspace	NO (-38.5%)	YES
0-BOH	N/A	N/A
0-BOH	NO (-99%)	NO
0-Flexible commercial	YES (+26.2%)	NO
0-Flexible commercial	NO (-22.2%)	NO
0-Flexible commercial	NO (-62.7%)	YES
0-Flexible commercial	NO (-39%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
0-Flexible commercial	YES (+3.4%)	NO
0-Flexible commercial	NO (-96.6%)	NO
0-Flexible commercial-P	NO (-63.1%)	YES
0-Flexible commercial-P E	NO (-45.7%)	YES
0-Flexible commercial-P N	NO (-18.6%)	NO
0-Flexible commercial-P NE	NO (-1.5%)	NO
0-Flexible commercial-P SE	NO (-25.2%)	YES
0-Flexible commercial-P SW	NO (-45.6%)	YES
0-Flexible commercial-P W	NO (-53.8%)	NO
0-Office entrance	NO (-74.7%)	NO
0-Office entrance-P N	NO (-35.3%)	NO
0-Office entrance-P S	NO (-58.8%)	YES
0-Resi Amenity	NO (-44.9%)	NO
0-Residential entrance	YES (+5.2%)	NO
0-Residential entrance	YES (+11%)	YES
0-Residential entrance-P	NO (-37.6%)	YES
0-Virtual Golf	N/A	N/A
0-Welfare area	NO (-98%)	NO
1-Meeting room	N/A	N/A
1-Meeting Room	N/A	N/A
1-Meeting Room	N/A	N/A
1-Meeting room	N/A	N/A
1-Office	NO (-48%)	YES
1-Office	NO (-55.8%)	NO
1-Office	NO (-62.1%)	YES
1-Office	NO (-38.1%)	NO
1-Office	NO (-71.5%)	YES
1-Office	NO (-58.7%)	NO
1-Office	NO (-64.9%)	YES
1-Office	NO (-82.4%)	NO
1-Office	NO (-66.5%)	YES
1-Office	NO (-94.2%)	NO
1-Office	NO (-49.6%)	NO
1-Office	NO (-41.3%)	NO
1-Office	NO (-71%)	NO
1-Office	NO (-84.8%)	NO
1-Office	NO (-39.1%)	NO
1-Office	NO (-73.6%)	YES
1-Office	NO (-91.7%)	NO
2-Meeting Room	N/A	N/A
2-Meeting Room	N/A	N/A
2-Meeting room	N/A	N/A
2-Meeting room	N/A	N/A
2-Office	YES (+48.5%)	NO
2-Office	NO (-51.4%)	YES
2-Office	NO (-48%)	NO
2-Office	NO (-53.5%)	NO
2-Office	NO (-40.9%)	NO
2-Office	NO (-56.7%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
2-Office	NO (-73%)	NO
2-Office	NO (-32.4%)	YES
2-Office	NO (-91.4%)	NO
2-Office	NO (-88.9%)	NO
2-Office	NO (-45.5%)	NO
2-Office	NO (-65.7%)	YES
2-Office	NO (-57.9%)	NO
2-Office	NO (-61.6%)	NO
2-Office	NO (-84%)	NO
2-Office	NO (-63.9%)	YES
2-Office	NO (-64%)	YES
2-Office	NO (-63.5%)	YES
2-Office	NO (-69.2%)	NO
25-Meeting Room	NO (-12%)	NO
25-Residents Lounge-P N	NO (-32%)	NO
25-Residents Lounge-P NW	NO (-33.5%)	NO
25-Residents Lounge-P W	NO (-27.9%)	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?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	11790.8	11790.8
External area [m^2]	13755.4	13755.4
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	4068.14	5009.22
Average U-value [W/m^2K]	0.3	0.36
Alpha value* [%]	10.21	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
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	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	8	7.36
Cooling	3.2	4.01
Auxiliary	7.88	7.47
Lighting	7.6	15.65
Hot water	4.09	1.46
Equipment*	45.54	45.54
TOTAL**	**30.77**	**35.95**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	65.73	77.56
Primary energy* [kWh/m^2]	70.65	91.98
Total emissions [kg/m^2]	12.1	15.6

* 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: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	20.6	0	6.3	0	1.6	0.9	0	0.96	0
	Notional	23.4	0	7.5	0	0.9	0.86	0	----	----
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	28.1	73	8.7	5.8	12.9	0.9	3.51	0.96	4.5
	Notional	24.6	112.1	7.9	8.2	12.9	0.86	3.79	----	----
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	37.7	115.2	11.9	12.3	13.1	0.88	2.6	0.96	3.27
	Notional	31.4	119.6	10.1	8.8	14	0.86	3.79	----	----
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	58.4	91	18.4	7.1	14.2	0.88	3.58	0.96	4.5
	Notional	43.4	102.7	14	7.5	13.9	0.86	3.79	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	13.4	0	4.1	0	11.2	0.9	0	0.96	0
	Notional	11	0	3.5	0	10.3	0.86	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

Key Features

The Building Control Body is advised to give particular attention to items whose specifications 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	0.06	B1000000:Surf[1]
Floor	0.2	0.13	B1000079:Surf[0]
Roof	0.15	0.13	0_000009:Surf[1]
Windows, roof windows, and rooflights	1.5	1.2	B1000079:Surf[1]
Personnel doors	1.5	1.2	B1000079:Surf[28]
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
m³/(h.m²) at 50 Pa	5	3

14.2 BRUKL SHEETS “BE CLEAN”

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Paddington Green PS Part L CLEAN

As designed

Date: Wed Mar 31 15:26:45 2021

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	15.5
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	15.5
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	11.9
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 fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the 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	0.17	0.22	B1000027:Surf[0]
Floor	0.25	0.13	0.13	B1000079:Surf[0]
Roof	0.25	0.13	0.13	0_000009:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.2	1.2	B1000079:Surf[1]
Personnel doors	2.2	1.2	1.2	B1000079:Surf[28]
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	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- L00 ASHP/MVHR+FCU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	4.5	0	1.6	0.8
Standard value	0.91*	3.2	N/A	1.6^	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.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

2- B01/02 CHP/AHU Heating Only

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	0	0.8
Standard value	N/A	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

3- L01/02 ASHP/AHU Heating only

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.2	0	0.8
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.

4- L01/02 ASHP/AHU+FCU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	4.5	0	1.9	0.8
Standard value	0.91*	3.2	N/A	1.6^	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.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

5- L25 CHP+Chiller/MVHR+FCU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	3.27	0	1.6	0.8
Standard value	N/A	2.55	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

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

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
0-Affordable Workspace	-	-	-	-	-	-	-	0.2	-	-	N/A
0-BOH	-	-	-	-	-	-	-	0.2	-	-	N/A
0-BOH	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Cycle entrance	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Cycle entrance	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Cycle entrance	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Flexible commercial	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial-P	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial-P E	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial-P N	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial-P NE	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial-P SE	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial-P SW	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial-P W	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Int resi entrance	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Office entrance	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Office entrance-P N	-	-	-	-	-	-	-	0.2	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
0-Office entrance-P S	-	-	-	-	-	-	-	0.2	-	-	N/A
0-PD Resi Entrance	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Resi Amenity	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Residential entrance	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Residential entrance	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Residential entrance	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Residential entrance-P	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Stairs	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Store	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Virtual Golf	-	-	-	-	-	-	-	0.2	-	-	N/A
0-WC	-	-	0.4	-	-	-	-	-	-	-	N/A
0-Welfare area	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
1-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
1-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
1-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
1-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
1-Meeting room	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Meeting Room	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Meeting Room	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Meeting room	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Stairs	-	-	-	1.9	-	-	-	-	-	-	N/A
1-Stairs	-	-	-	1.9	-	-	-	-	-	-	N/A
1-WC	-	-	0.4	-	-	-	-	-	-	-	N/A
1-WC	-	-	0.4	-	-	-	-	-	-	-	N/A
1-WC	-	-	0.4	-	-	-	-	-	-	-	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
2-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
2-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
2-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
2-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
2-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
2-Meeting Room	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Meeting Room	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Meeting room	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Meeting room	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Stairs	-	-	-	1.9	-	-	-	-	-	-	N/A
2-Stairs	-	-	-	1.9	-	-	-	-	-	-	N/A
2-WC	-	-	0.4	-	-	-	-	-	-	-	N/A
2-WC	-	-	0.4	-	-	-	-	-	-	-	N/A
2-WC	-	-	0.4	-	-	-	-	-	-	-	N/A
25-Meeting Room	-	-	-	-	-	-	-	0.2	-	-	N/A
25-Residents Lounge-P N	-	-	-	-	-	-	-	0.2	-	-	N/A
25-Residents Lounge-P NW	-	-	-	-	-	-	-	0.2	-	-	N/A
25-Residents Lounge-P W	-	-	-	-	-	-	-	0.2	-	-	N/A
25-WC	-	-	0.4	-	-	-	-	-	-	-	N/A
B1-Basement fan room E	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Basement fan room N	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Basement fan room S	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Basement fan room W	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Car park fan room 1	-	-	-	1.6	-	-	-	-	-	-	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
B1-Car park fan room 2	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Car parking	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Comms In	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Comms service room	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Cycle store	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Cycle store 10	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Cycle store 100	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Cycle store 24	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Cycle store 36	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-LL TX1	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-LS TX	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-LTHW plant room	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-New cycle store	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Plant?	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Resi switch room	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Retail & DWS plant	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Retail DWS plant	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Sprinkler plant	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Switchgear	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Switchgear	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-TX	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-TX1 Cooling	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Wet riser	-	-	-	1.6	-	-	-	-	-	-	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	
0-Affordable Workspace	163	-	-	1149
0-BOH	241	-	-	113
0-BOH	242	-	-	125
0-Circulation	-	147	-	38
0-Circulation	-	103	-	164
0-Circulation	-	127	-	56
0-Circulation	-	185	-	23
0-Circulation	-	132	-	47
0-Circulation	-	144	-	38
0-Circulation	-	152	-	145
0-Circulation	-	117	-	114
0-Circulation	-	226	-	15
0-Cycle entrance	143	-	-	32
0-Cycle entrance	115	-	-	57
0-Cycle entrance	-	158	-	45
0-Flexible commercial	161	-	-	406

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
0-Flexible commercial	214	-	-	72
0-Flexible commercial	171	-	-	443
0-Flexible commercial	179	-	-	386
0-Flexible commercial	160	-	-	212
0-Flexible commercial	166	-	-	482
0-Flexible commercial-P	159	-	-	288
0-Flexible commercial-P E	160	-	-	143
0-Flexible commercial-P N	159	-	-	150
0-Flexible commercial-P NE	160	-	-	536
0-Flexible commercial-P SE	169	-	-	108
0-Flexible commercial-P SW	175	-	-	192
0-Flexible commercial-P W	168	-	-	246
0-Int resi entrance	-	149	-	112
0-Office entrance	-	81	80	237
0-Office entrance-P N	-	83	80	235
0-Office entrance-P S	-	92	80	233
0-PD Resi Entrance	-	116	-	81
0-Plant	87	-	-	431
0-Plant	105	-	-	169
0-Resi Amenity	188	-	-	235
0-Residential entrance	-	132	-	51
0-Residential entrance	-	89	80	327
0-Residential entrance	-	87	80	374
0-Residential entrance-P	-	85	80	222
0-Stairs	-	204	-	40
0-Store	226	-	-	11
0-Virtual Golf	-	89	-	540
0-WC	-	226	-	29
0-Welfare area	-	138	-	115
1-AHU Plant	94	-	-	125
1-AHU Plant	92	-	-	133
1-Circulation	-	96	-	121
1-Circulation	-	91	-	66
1-Circulation	-	111	-	86
1-Circulation	-	108	-	38
1-Circulation	-	104	-	45
1-Meeting room	212	-	-	74
1-Meeting Room	246	-	-	50
1-Meeting Room	246	-	-	50
1-Meeting room	244	-	-	53
1-Office	153	-	-	142
1-Office	147	-	-	377
1-Office	148	-	-	599

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
1-Office	153	-	-	126
1-Office	147	-	-	447
1-Office	154	-	-	220
1-Office	152	-	-	180
1-Office	149	-	-	1666
1-Office	153	-	-	132
1-Office	150	-	-	218
1-Office	153	-	-	988
1-Office	147	-	-	403
1-Office	214	-	-	76
1-Office	188	-	-	81
1-Office	147	-	-	816
1-Office	151	-	-	1041
1-Office	147	-	-	237
1-Stairs	-	110	-	38
1-Stairs	-	104	-	43
1-WC	-	96	-	115
1-WC	-	94	-	138
1-WC	-	89	-	189
2-AHU Plant	95	-	-	133
2-AHU Plant	97	-	-	125
2-Circulation	-	96	-	66
2-Circulation	-	108	-	45
2-Circulation	-	117	-	86
2-Circulation	-	114	-	38
2-Circulation	-	100	-	121
2-Meeting Room	261	-	-	50
2-Meeting Room	261	-	-	50
2-Meeting room	223	-	-	74
2-Meeting room	260	-	-	53
2-Office	151	-	-	1329
2-Office	148	-	-	599
2-Office	152	-	-	162
2-Office	154	-	-	988
2-Office	147	-	-	277
2-Office	151	-	-	266
2-Office	148	-	-	275
2-Office	154	-	-	142
2-Office	156	-	-	218
2-Office	151	-	-	106
2-Office	149	-	-	555
2-Office	153	-	-	1041
2-Office	155	-	-	220

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
2-Office	150	-	-	179
2-Office	195	-	-	81
2-Office	153	-	-	180
2-Office	155	-	-	132
2-Office	148	-	-	447
2-Office	225	-	-	76
2-Stairs	-	108	-	43
2-Stairs	-	115	-	38
2-WC	-	99	-	115
2-WC	-	97	-	138
2-WC	-	91	-	189
25-Meeting Room	175	-	-	107
25-Residents Lounge-P N	155	-	-	181
25-Residents Lounge-P NW	153	-	-	349
25-Residents Lounge-P W	157	-	-	139
25-WC	-	97	-	67
B1-Basement fan room E	117	-	-	123
B1-Basement fan room N	128	-	-	185
B1-Basement fan room S	114	-	-	112
B1-Basement fan room W	113	-	-	117
B1-Bin store 1	92	-	-	127
B1-Bin store 2	88	-	-	217
B1-Bin store 3	103	-	-	81
B1-Bin store 4	85	-	-	239
B1-Car park fan room 1	110	-	-	138
B1-Car park fan room 2	113	-	-	117
B1-Car parking	-	75	-	2252
B1-Circulation	-	154	-	97
B1-Circulation	-	146	-	50
B1-Circulation	-	164	-	94
B1-Circulation	-	115	-	105
B1-Circulation	-	125	-	341
B1-Circulation	-	153	-	42
B1-Circulation	-	143	-	114
B1-Circulation	-	147	-	74
B1-Circulation	-	145	-	102
B1-Circulation	-	134	-	92
B1-Circulation	-	197	-	20
B1-Circulation	-	138	-	70
B1-Circulation	-	163	-	37
B1-Comms In	182	-	-	52
B1-Comms service room	99	-	-	182
B1-Cycle store	79	-	-	361

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
B1-Cycle store 10	131	-	-	39
B1-Cycle store 100	82	-	-	307
B1-Cycle store 24	110	-	-	53
B1-Cycle store 36	113	-	-	45
B1-LL TX1	114	-	-	112
B1-Lobby	-	226	-	11
B1-Lobby	-	179	-	22
B1-LS TX	114	-	-	148
B1-LTHW plant room	80	-	-	870
B1-New cycle store	72	-	-	226
B1-Office cycle store 16	110	-	-	67
B1-Plant?	106	-	-	163
B1-Resi switch room	182	-	-	52
B1-Retail & DWS plant	100	-	-	182
B1-Retail bin store 3	132	-	-	46
B1-Retail DWS plant	86	-	-	354
B1-Sprinkler plant	84	-	-	441
B1-Stairs	-	145	-	36
B1-Stairs	-	132	-	48
B1-Stairs	-	112	-	67
B1-Stairs	-	119	-	69
B1-Stairs	-	125	-	55
B1-Switchgear	108	-	-	141
B1-Switchgear	98	-	-	220
B1-TX	128	-	-	87
B1-TX1 Cooling	175	-	-	54
B1-Wet riser	85	-	-	396
B2-Circulation	-	137	-	50
B2-Circulation	-	137	-	81
B2-Circulation	-	172	-	24
B2-Refuse waiting area	79	-	-	437
B2-Stairs	-	132	-	48
B2-Stairs	-	129	-	49

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?
0-Affordable Workspace	NO (-38.5%)	YES
0-BOH	N/A	N/A
0-BOH	NO (-99%)	NO
0-Flexible commercial	YES (+26.2%)	NO
0-Flexible commercial	NO (-22.2%)	NO
0-Flexible commercial	NO (-62.7%)	YES
0-Flexible commercial	NO (-39%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
0-Flexible commercial	YES (+3.4%)	NO
0-Flexible commercial	NO (-96.6%)	NO
0-Flexible commercial-P	NO (-63.1%)	YES
0-Flexible commercial-P E	NO (-45.7%)	YES
0-Flexible commercial-P N	NO (-18.6%)	NO
0-Flexible commercial-P NE	NO (-1.5%)	NO
0-Flexible commercial-P SE	NO (-25.2%)	YES
0-Flexible commercial-P SW	NO (-45.6%)	YES
0-Flexible commercial-P W	NO (-53.8%)	NO
0-Office entrance	NO (-74.7%)	NO
0-Office entrance-P N	NO (-35.3%)	NO
0-Office entrance-P S	NO (-58.8%)	YES
0-Resi Amenity	NO (-44.9%)	NO
0-Residential entrance	YES (+5.2%)	NO
0-Residential entrance	YES (+11%)	YES
0-Residential entrance-P	NO (-37.6%)	YES
0-Virtual Golf	N/A	N/A
0-Welfare area	NO (-98%)	NO
1-Meeting room	N/A	N/A
1-Meeting Room	N/A	N/A
1-Meeting Room	N/A	N/A
1-Meeting room	N/A	N/A
1-Office	NO (-48%)	YES
1-Office	NO (-55.8%)	NO
1-Office	NO (-62.1%)	YES
1-Office	NO (-38.1%)	NO
1-Office	NO (-71.5%)	YES
1-Office	NO (-58.7%)	NO
1-Office	NO (-64.9%)	YES
1-Office	NO (-82.4%)	NO
1-Office	NO (-66.5%)	YES
1-Office	NO (-94.2%)	NO
1-Office	NO (-49.6%)	NO
1-Office	NO (-41.3%)	NO
1-Office	NO (-71%)	NO
1-Office	NO (-84.8%)	NO
1-Office	NO (-39.1%)	NO
1-Office	NO (-73.6%)	YES
1-Office	NO (-91.7%)	NO
2-Meeting Room	N/A	N/A
2-Meeting Room	N/A	N/A
2-Meeting room	N/A	N/A
2-Meeting room	N/A	N/A
2-Office	YES (+48.5%)	NO
2-Office	NO (-51.4%)	YES
2-Office	NO (-48%)	NO
2-Office	NO (-53.5%)	NO
2-Office	NO (-40.9%)	NO
2-Office	NO (-56.7%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
2-Office	NO (-73%)	NO
2-Office	NO (-32.4%)	YES
2-Office	NO (-91.4%)	NO
2-Office	NO (-88.9%)	NO
2-Office	NO (-45.5%)	NO
2-Office	NO (-65.7%)	YES
2-Office	NO (-57.9%)	NO
2-Office	NO (-61.6%)	NO
2-Office	NO (-84%)	NO
2-Office	NO (-63.9%)	YES
2-Office	NO (-64%)	YES
2-Office	NO (-63.5%)	YES
2-Office	NO (-69.2%)	NO
25-Meeting Room	NO (-12%)	NO
25-Residents Lounge-P N	NO (-32%)	NO
25-Residents Lounge-P NW	NO (-33.5%)	NO
25-Residents Lounge-P W	NO (-27.9%)	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?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	11790.8	11790.8
External area [m^2]	13755.4	13755.4
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	4068.14	5009.22
Average U-value [W/m^2K]	0.3	0.36
Alpha value* [%]	10.21	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
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	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	7.92	7.03
Cooling	3.2	4.01
Auxiliary	7.88	7.47
Lighting	7.6	15.65
Hot water	4.09	1.46
Equipment*	45.54	45.54
TOTAL**	**30.68**	**35.62**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	65.73	77.56
Primary energy* [kWh/m^2]	70.52	90.82
Total emissions [kg/m^2]	11.9	15.5

* 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: radiators, [HS] District heating, [HFT] District Heating, [CFT] Electricity										
	Actual	20.6	0	6.1	0	1.6	0.94	0	1	0
	Notional	23.4	0	6.5	0	0.9	1	0	----	----
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	28.1	73	8.7	5.8	12.9	0.9	3.51	0.96	4.5
	Notional	24.6	112.1	7.9	8.2	12.9	0.86	3.79	----	----
[ST] Fan coil systems, [HS] District heating, [HFT] District Heating, [CFT] Electricity										
	Actual	37.7	115.2	11.4	12.3	13.1	0.92	2.6	1	3.27
	Notional	31.4	119.6	8.7	8.8	14	1	3.79	----	----
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	58.4	91	18.4	7.1	14.2	0.88	3.58	0.96	4.5
	Notional	43.4	102.7	14	7.5	13.9	0.86	3.79	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	13.4	0	4.1	0	11.2	0.9	0	0.96	0
	Notional	11	0	3.5	0	10.3	0.86	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

Key Features

The Building Control Body is advised to give particular attention to items whose specifications 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	0.06	B1000000:Surf[1]
Floor	0.2	0.13	B1000079:Surf[0]
Roof	0.15	0.13	0_000009:Surf[1]
Windows, roof windows, and rooflights	1.5	1.2	B1000079:Surf[1]
Personnel doors	1.5	1.2	B1000079:Surf[28]
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
m³/(h.m²) at 50 Pa	5	3

14.3 BRUKL SHEETS “BE GREEN”

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Paddington Green PS Part L GREEN

As designed

Date: Wed Mar 31 16:16:22 2021

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	15.2
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	15.2
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	10.1
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 fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the 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	0.17	0.22	B1000027:Surf[0]
Floor	0.25	0.13	0.13	B1000079:Surf[0]
Roof	0.25	0.13	0.13	0_000009:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.2	1.2	B1000079:Surf[1]
Personnel doors	2.2	1.2	1.2	B1000079:Surf[28]
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	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- L00 ASHP/MVHR+FCU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.8	7	0	1.6	0.8
Standard value	2.5*	3.2	N/A	1.6^	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.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

2- B01/02 CHP/AHU Heating Only

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	0	0.8
Standard value	N/A	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

3- L01/02 ASHP/AHU Heating only

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.8	-	0.2	0	0.8
Standard value	2.5*	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 all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

4- L01/02 ASHP/AHU+FCU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.8	7	0	1.9	0.8
Standard value	2.5*	3.2	N/A	1.6^	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.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

5- L25 CHP+Chiller/MVHR+FCU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	3.27	0	1.6	0.8
Standard value	N/A	2.55	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

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

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
0-Affordable Workspace	-	-	-	-	-	-	-	0.2	-	-	N/A
0-BOH	-	-	-	-	-	-	-	0.2	-	-	N/A
0-BOH	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Circulation	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Cycle entrance	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Cycle entrance	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Cycle entrance	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Flexible commercial	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial-P	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial-P E	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial-P N	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial-P NE	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial-P SE	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial-P SW	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Flexible commercial-P W	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Int resi entrance	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Office entrance	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Office entrance-P N	-	-	-	-	-	-	-	0.2	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
0-Office entrance-P S	-	-	-	-	-	-	-	0.2	-	-	N/A
0-PD Resi Entrance	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Resi Amenity	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Residential entrance	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Residential entrance	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Residential entrance	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Residential entrance-P	-	-	-	-	-	-	-	0.2	-	-	N/A
0-Stairs	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Store	-	-	-	1.6	-	-	-	-	-	-	N/A
0-Virtual Golf	-	-	-	-	-	-	-	0.2	-	-	N/A
0-WC	-	-	0.4	-	-	-	-	-	-	-	N/A
0-Welfare area	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
1-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
1-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
1-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
1-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
1-Meeting room	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Meeting Room	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Meeting Room	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Meeting room	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
1-Stairs	-	-	-	1.9	-	-	-	-	-	-	N/A
1-Stairs	-	-	-	1.9	-	-	-	-	-	-	N/A
1-WC	-	-	0.4	-	-	-	-	-	-	-	N/A
1-WC	-	-	0.4	-	-	-	-	-	-	-	N/A
1-WC	-	-	0.4	-	-	-	-	-	-	-	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
2-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
2-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
2-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
2-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
2-Circulation	-	-	-	1.9	-	-	-	-	-	-	N/A
2-Meeting Room	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Meeting Room	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Meeting room	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Meeting room	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Office	-	-	-	-	-	-	-	0.2	-	-	N/A
2-Stairs	-	-	-	1.9	-	-	-	-	-	-	N/A
2-Stairs	-	-	-	1.9	-	-	-	-	-	-	N/A
2-WC	-	-	0.4	-	-	-	-	-	-	-	N/A
2-WC	-	-	0.4	-	-	-	-	-	-	-	N/A
2-WC	-	-	0.4	-	-	-	-	-	-	-	N/A
25-Meeting Room	-	-	-	-	-	-	-	0.2	-	-	N/A
25-Residents Lounge-P N	-	-	-	-	-	-	-	0.2	-	-	N/A
25-Residents Lounge-P NW	-	-	-	-	-	-	-	0.2	-	-	N/A
25-Residents Lounge-P W	-	-	-	-	-	-	-	0.2	-	-	N/A
25-WC	-	-	0.4	-	-	-	-	-	-	-	N/A
B1-Basement fan room E	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Basement fan room N	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Basement fan room S	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Basement fan room W	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Car park fan room 1	-	-	-	1.6	-	-	-	-	-	-	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
B1-Car park fan room 2	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Car parking	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Comms In	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Comms service room	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Cycle store	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Cycle store 10	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Cycle store 100	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Cycle store 24	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Cycle store 36	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-LL TX1	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-LS TX	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-LTHW plant room	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-New cycle store	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Plant?	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Resi switch room	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Retail & DWS plant	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Retail DWS plant	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Sprinkler plant	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Switchgear	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Switchgear	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-TX	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-TX1 Cooling	-	-	-	1.6	-	-	-	-	-	-	N/A
B1-Wet riser	-	-	-	1.6	-	-	-	-	-	-	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	
0-Affordable Workspace	163	-	-	1149
0-BOH	241	-	-	113
0-BOH	242	-	-	125
0-Circulation	-	147	-	38
0-Circulation	-	103	-	164
0-Circulation	-	127	-	56
0-Circulation	-	185	-	23
0-Circulation	-	132	-	47
0-Circulation	-	144	-	38
0-Circulation	-	152	-	145
0-Circulation	-	117	-	114
0-Circulation	-	226	-	15
0-Cycle entrance	143	-	-	32
0-Cycle entrance	115	-	-	57
0-Cycle entrance	-	158	-	45
0-Flexible commercial	161	-	-	406

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
0-Flexible commercial	214	-	-	72
0-Flexible commercial	171	-	-	443
0-Flexible commercial	179	-	-	386
0-Flexible commercial	160	-	-	212
0-Flexible commercial	166	-	-	482
0-Flexible commercial-P	159	-	-	288
0-Flexible commercial-P E	160	-	-	143
0-Flexible commercial-P N	159	-	-	150
0-Flexible commercial-P NE	160	-	-	536
0-Flexible commercial-P SE	169	-	-	108
0-Flexible commercial-P SW	175	-	-	192
0-Flexible commercial-P W	168	-	-	246
0-Int resi entrance	-	149	-	112
0-Office entrance	-	81	80	237
0-Office entrance-P N	-	83	80	235
0-Office entrance-P S	-	92	80	233
0-PD Resi Entrance	-	116	-	81
0-Plant	87	-	-	431
0-Plant	105	-	-	169
0-Resi Amenity	188	-	-	235
0-Residential entrance	-	132	-	51
0-Residential entrance	-	89	80	327
0-Residential entrance	-	87	80	374
0-Residential entrance-P	-	85	80	222
0-Stairs	-	204	-	40
0-Store	226	-	-	11
0-Virtual Golf	-	89	-	540
0-WC	-	226	-	29
0-Welfare area	-	138	-	115
1-AHU Plant	94	-	-	125
1-AHU Plant	92	-	-	133
1-Circulation	-	96	-	121
1-Circulation	-	91	-	66
1-Circulation	-	111	-	86
1-Circulation	-	108	-	38
1-Circulation	-	104	-	45
1-Meeting room	212	-	-	74
1-Meeting Room	246	-	-	50
1-Meeting Room	246	-	-	50
1-Meeting room	244	-	-	53
1-Office	153	-	-	142
1-Office	147	-	-	377
1-Office	148	-	-	599

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
1-Office	153	-	-	126
1-Office	147	-	-	447
1-Office	154	-	-	220
1-Office	152	-	-	180
1-Office	149	-	-	1666
1-Office	153	-	-	132
1-Office	150	-	-	218
1-Office	153	-	-	988
1-Office	147	-	-	403
1-Office	214	-	-	76
1-Office	188	-	-	81
1-Office	147	-	-	816
1-Office	151	-	-	1041
1-Office	147	-	-	237
1-Stairs	-	110	-	38
1-Stairs	-	104	-	43
1-WC	-	96	-	115
1-WC	-	94	-	138
1-WC	-	89	-	189
2-AHU Plant	95	-	-	133
2-AHU Plant	97	-	-	125
2-Circulation	-	96	-	66
2-Circulation	-	108	-	45
2-Circulation	-	117	-	86
2-Circulation	-	114	-	38
2-Circulation	-	100	-	121
2-Meeting Room	261	-	-	50
2-Meeting Room	261	-	-	50
2-Meeting room	223	-	-	74
2-Meeting room	260	-	-	53
2-Office	151	-	-	1329
2-Office	148	-	-	599
2-Office	152	-	-	162
2-Office	154	-	-	988
2-Office	147	-	-	277
2-Office	151	-	-	266
2-Office	148	-	-	275
2-Office	154	-	-	142
2-Office	156	-	-	218
2-Office	151	-	-	106
2-Office	149	-	-	555
2-Office	153	-	-	1041
2-Office	155	-	-	220

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
2-Office	150	-	-	179
2-Office	195	-	-	81
2-Office	153	-	-	180
2-Office	155	-	-	132
2-Office	148	-	-	447
2-Office	225	-	-	76
2-Stairs	-	108	-	43
2-Stairs	-	115	-	38
2-WC	-	99	-	115
2-WC	-	97	-	138
2-WC	-	91	-	189
25-Meeting Room	175	-	-	107
25-Residents Lounge-P N	155	-	-	181
25-Residents Lounge-P NW	153	-	-	349
25-Residents Lounge-P W	157	-	-	139
25-WC	-	97	-	67
B1-Basement fan room E	117	-	-	123
B1-Basement fan room N	128	-	-	185
B1-Basement fan room S	114	-	-	112
B1-Basement fan room W	113	-	-	117
B1-Bin store 1	92	-	-	127
B1-Bin store 2	88	-	-	217
B1-Bin store 3	103	-	-	81
B1-Bin store 4	85	-	-	239
B1-Car park fan room 1	110	-	-	138
B1-Car park fan room 2	113	-	-	117
B1-Car parking	-	75	-	2252
B1-Circulation	-	154	-	97
B1-Circulation	-	146	-	50
B1-Circulation	-	164	-	94
B1-Circulation	-	115	-	105
B1-Circulation	-	125	-	341
B1-Circulation	-	153	-	42
B1-Circulation	-	143	-	114
B1-Circulation	-	147	-	74
B1-Circulation	-	145	-	102
B1-Circulation	-	134	-	92
B1-Circulation	-	197	-	20
B1-Circulation	-	138	-	70
B1-Circulation	-	163	-	37
B1-Comms In	182	-	-	52
B1-Comms service room	99	-	-	182
B1-Cycle store	79	-	-	361

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
B1-Cycle store 10	131	-	-	39
B1-Cycle store 100	82	-	-	307
B1-Cycle store 24	110	-	-	53
B1-Cycle store 36	113	-	-	45
B1-LL TX1	114	-	-	112
B1-Lobby	-	226	-	11
B1-Lobby	-	179	-	22
B1-LS TX	114	-	-	148
B1-LTHW plant room	80	-	-	870
B1-New cycle store	72	-	-	226
B1-Office cycle store 16	110	-	-	67
B1-Plant?	106	-	-	163
B1-Resi switch room	182	-	-	52
B1-Retail & DWS plant	100	-	-	182
B1-Retail bin store 3	132	-	-	46
B1-Retail DWS plant	86	-	-	354
B1-Sprinkler plant	84	-	-	441
B1-Stairs	-	145	-	36
B1-Stairs	-	132	-	48
B1-Stairs	-	112	-	67
B1-Stairs	-	119	-	69
B1-Stairs	-	125	-	55
B1-Switchgear	108	-	-	141
B1-Switchgear	98	-	-	220
B1-TX	128	-	-	87
B1-TX1 Cooling	175	-	-	54
B1-Wet riser	85	-	-	396
B2-Circulation	-	137	-	50
B2-Circulation	-	137	-	81
B2-Circulation	-	172	-	24
B2-Refuse waiting area	79	-	-	437
B2-Stairs	-	132	-	48
B2-Stairs	-	129	-	49

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?
0-Affordable Workspace	NO (-38.5%)	YES
0-BOH	N/A	N/A
0-BOH	NO (-99%)	NO
0-Flexible commercial	YES (+26.2%)	NO
0-Flexible commercial	NO (-22.2%)	NO
0-Flexible commercial	NO (-62.7%)	YES
0-Flexible commercial	NO (-39%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
0-Flexible commercial	YES (+3.4%)	NO
0-Flexible commercial	NO (-96.6%)	NO
0-Flexible commercial-P	NO (-63.1%)	YES
0-Flexible commercial-P E	NO (-45.7%)	YES
0-Flexible commercial-P N	NO (-18.6%)	NO
0-Flexible commercial-P NE	NO (-1.5%)	NO
0-Flexible commercial-P SE	NO (-25.2%)	YES
0-Flexible commercial-P SW	NO (-45.6%)	YES
0-Flexible commercial-P W	NO (-53.8%)	NO
0-Office entrance	NO (-74.7%)	NO
0-Office entrance-P N	NO (-35.3%)	NO
0-Office entrance-P S	NO (-58.8%)	YES
0-Resi Amenity	NO (-44.9%)	NO
0-Residential entrance	YES (+5.2%)	NO
0-Residential entrance	YES (+11%)	YES
0-Residential entrance-P	NO (-37.6%)	YES
0-Virtual Golf	N/A	N/A
0-Welfare area	NO (-98%)	NO
1-Meeting room	N/A	N/A
1-Meeting Room	N/A	N/A
1-Meeting Room	N/A	N/A
1-Meeting room	N/A	N/A
1-Office	NO (-48%)	YES
1-Office	NO (-55.8%)	NO
1-Office	NO (-62.1%)	YES
1-Office	NO (-38.1%)	NO
1-Office	NO (-71.5%)	YES
1-Office	NO (-58.7%)	NO
1-Office	NO (-64.9%)	YES
1-Office	NO (-82.4%)	NO
1-Office	NO (-66.5%)	YES
1-Office	NO (-94.2%)	NO
1-Office	NO (-49.6%)	NO
1-Office	NO (-41.3%)	NO
1-Office	NO (-71%)	NO
1-Office	NO (-84.8%)	NO
1-Office	NO (-39.1%)	NO
1-Office	NO (-73.6%)	YES
1-Office	NO (-91.7%)	NO
2-Meeting Room	N/A	N/A
2-Meeting Room	N/A	N/A
2-Meeting room	N/A	N/A
2-Meeting room	N/A	N/A
2-Office	YES (+48.5%)	NO
2-Office	NO (-51.4%)	YES
2-Office	NO (-48%)	NO
2-Office	NO (-53.5%)	NO
2-Office	NO (-40.9%)	NO
2-Office	NO (-56.7%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
2-Office	NO (-73%)	NO
2-Office	NO (-32.4%)	YES
2-Office	NO (-91.4%)	NO
2-Office	NO (-88.9%)	NO
2-Office	NO (-45.5%)	NO
2-Office	NO (-65.7%)	YES
2-Office	NO (-57.9%)	NO
2-Office	NO (-61.6%)	NO
2-Office	NO (-84%)	NO
2-Office	NO (-63.9%)	YES
2-Office	NO (-64%)	YES
2-Office	NO (-63.5%)	YES
2-Office	NO (-69.2%)	NO
25-Meeting Room	NO (-12%)	NO
25-Residents Lounge-P N	NO (-32%)	NO
25-Residents Lounge-P NW	NO (-33.5%)	NO
25-Residents Lounge-P W	NO (-27.9%)	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?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	11790.8	11790.8
External area [m^2]	13755.4	13755.4
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	4068.14	5009.22
Average U-value [W/m^2K]	0.3	0.36
Alpha value* [%]	10.21	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
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	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	3.49	3.73
Cooling	2.02	4.01
Auxiliary	7.88	7.47
Lighting	7.6	15.65
Hot water	1.77	0.49
Equipment*	45.54	45.54
TOTAL**	**22.76**	**31.35**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	1.33	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]	65.73	77.56
Primary energy* [kWh/m^2]	64.6	89.46
Total emissions [kg/m^2]	10.1	15.2

* 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: radiators, [HS] District heating, [HFT] District Heating, [CFT] Electricity										
	Actual	20.6	0	6.1	0	1.6	0.94	0	1	0
	Notional	23.4	0	6.5	0	0.9	1	0	----	----
[ST] Fan coil systems, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	28.1	73	2.2	3.5	12.9	3.49	5.78	3.8	7
	Notional	24.6	112.1	2.7	8.2	12.9	2.56	3.79	----	----
[ST] Fan coil systems, [HS] District heating, [HFT] District Heating, [CFT] Electricity										
	Actual	37.7	115.2	11.4	12.3	13.1	0.92	2.6	1	3.27
	Notional	31.4	119.6	8.7	8.8	14	1	3.79	----	----
[ST] Fan coil systems, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	58.4	91	4.7	4.3	14.2	3.43	5.91	3.8	7
	Notional	43.4	102.7	4.7	7.5	13.9	2.56	3.79	----	----
[ST] Central heating using water: radiators, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	13.4	0	1.1	0	11.2	3.51	0	3.8	0
	Notional	11	0	1.2	0	10.3	2.56	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

Key Features

The Building Control Body is advised to give particular attention to items whose specifications 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	0.06	B1000000:Surf[1]
Floor	0.2	0.13	B1000079:Surf[0]
Roof	0.15	0.13	0_000009:Surf[1]
Windows, roof windows, and rooflights	1.5	1.2	B1000079:Surf[1]
Personnel doors	1.5	1.2	B1000079:Surf[28]
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
m³/(h.m²) at 50 Pa	5	3