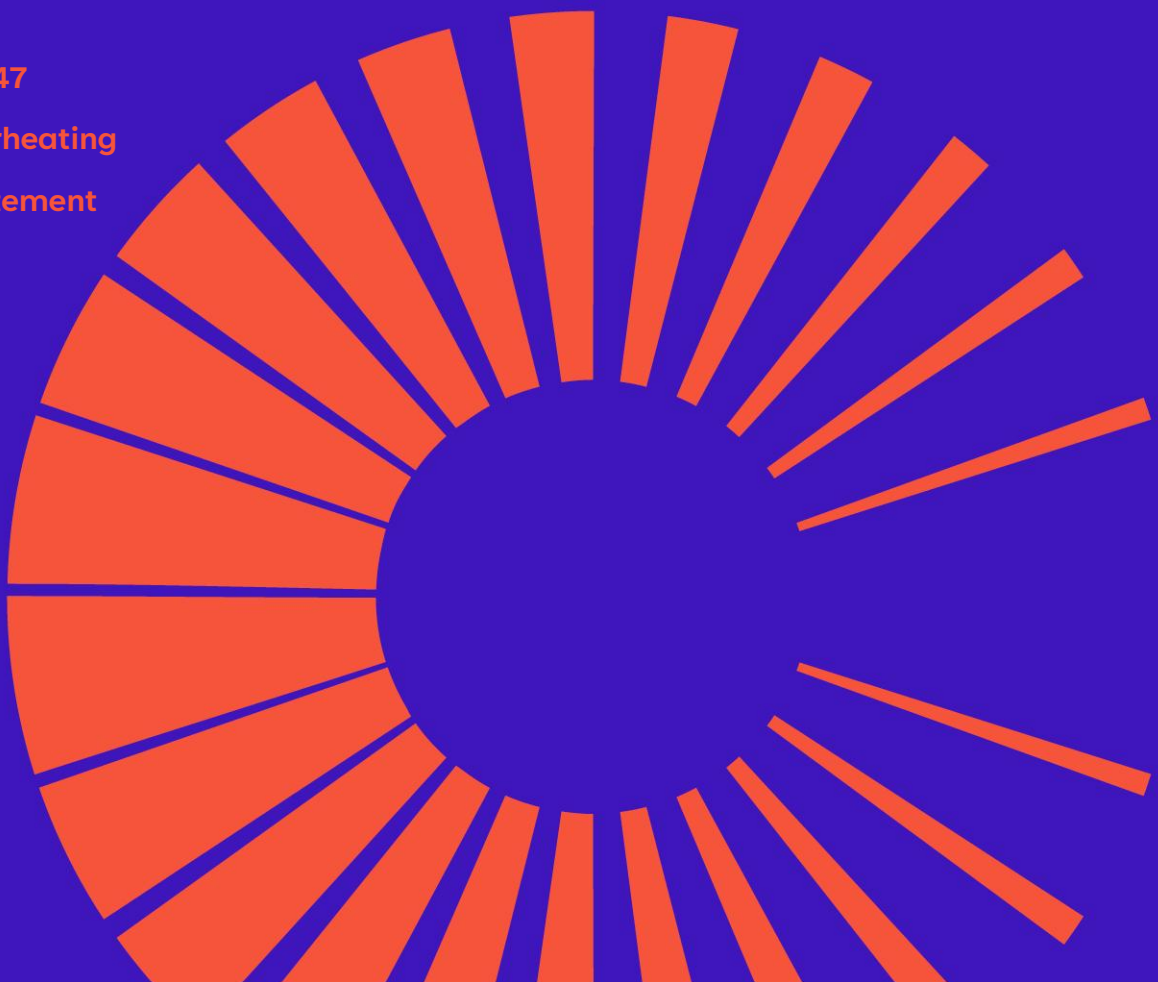
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Longwalk Road, Stockley Park, London

Project No.: 25047

Energy and Overheating Assessment Statement



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1.0 Executive Summary 2
1.1 Energy Assessment 2
1.2 Thermal Comfort and Overheating Assessment 6
2.0 Introduction 7
3.0 Methodology 11
4.0 Carbon Emissions 'Baseline' 12
5.0 'Be Lean' Stage 14
6.0 'Be Clean' Stage 17
7.0 Be Green – Low or Zero Carbon Energy Technology 20
7.1 Feasibility Assessment of Viable Technologies 22
7.1.1 Air Source Heat Pumps (ASHP) 22
7.1.2 Solar Photovoltaic (PV) Panels 25
8.0 Be Seen – Monitor, verify and report on energy performance 29
9.0 Flexibility and Peak Demand 30
10.0 Thermal Comfort and Climate Change 31
10.1 Predicted Mean Vote (PMV) & Percentage of People Dissatisfied (PPD) 32
10.2 TM52 – DSY1 2020 High 50th Percentile 32
11.0 Conclusion 34
Appendix 1 – BRUKL Outputs 38

1.0 Executive Summary

This Energy and overheating assessment Statement has been prepared on behalf of Zinc RE UK to summarise the energy assessment for the proposed commercial/employment development, comprising flexible industrial, storage and distribution uses (Use Classes B2, B8 and E(g)(iii)), together with ancillary office space, yard areas, servicing and vehicular and cycle parking. The assessment excludes consideration of the energy requirements associated with the shower block located to the north of Unit 100.

The proposed development consists of two non-residential units with a total Gross Internal Area (GIA) of 10,979m². The warehouse areas shall not be fitted out initially, while the office space shall be fitted out as part of the development. The assessment demonstrates compliance with the GLA Energy Assessment Guidance 2022 with policies SI 2, SI 3 and SI 4 of the London Plan 2021.

The proposed development consists of:

Unit 100	6,052 m²
Unit 200	4,927 m²
Non-Residential Use Total (GIA)	= **10,979 m²**

1.1 Energy Assessment

- The development is subject to the 'London Plan' and its associated energy hierarchy and implemented measures at the relevant stages as follows:
- 'Be Lean' – Passive design measures include improvements to fabric and measure to maximise daylighting requirements. Active design measures include high efficiency mechanical equipment such as mechanical ventilation heat recovery units, smart controls and high efficiency lighting.
- 'Be Clean' – No existing and proposed heat networks affect the proposed site and cannot be taken benefit from at this time or in the near future.
- 'Be Green' – High efficiency air source heat pumps and maximise Solar PV provision.

In accordance with the London Plan 2021 a contribution to the carbon offset fund is required to offset residual emissions remaining after the CO_2 emissions reductions realised within the energy hierarchy to achieve a net zero carbon contribution.

The London Plan requires developments to demonstrate a reduction in carbon emissions of at least 15% against the baseline through fabric and energy efficiency measures only, as part of the Be Lean stage. At this stage of assessment, we consider this approach to be an inequitable basis for determining the improvement in the development's carbon emissions. Accordingly, we have calculated the baseline building output using the Approved Document Part L minimum building construction performance criteria and utilised the Building Energy Rating (BER) to form the baseline building, in order to accurately assess the savings associated with each stage of the energy hierarchy. We consider this methodology to provide a more accurate representation of the carbon emission reductions attributable to improvements in building fabric and energy efficiency measures, given the inclusion of improved thermal fabric and PV within the Notional Building used for comparison. It should be noted that the required 35% reduction against Target Energy Building (TER) shall be achieved in the final solution, but baseline TER figures do not include for cooling loads and additional auxiliary loads associated with heat pumps etc., therefore it is not reasonable comparison for the hierarchy calculations to compare our energy efficiency measures against this reduced notional building performance.

The proposed energy efficiency measures achieve an energy demand reduction of approximately 22% for both Unit 100, Unit 200 and the overall development, exceeding the 15% reduction target set by London Plan 2021 under the 'Be Lean' stage. The reduction is based on comparison with the baseline building output using the Approved Document Part L Minimum Building construction performance criteria.

Both Unit 100 and Unit 200 achieve a 35% reduction and the overall development achieves 37% reduction in Building Emission Rate (BER) relative to the Target Emission Rate (TER) through the incorporation of solar photovoltaic (PV) panels. The combined Air Source Heat Pump (ASHP) and solar PV strategy therefore considered within the Be Green stage for the development.

The outcomes for the development, in CO_2 emissions terms, after following the prescribed energy hierarchy are set out in the tables below.

	Target Carbon Dioxide Emission Rate (TER) (Tonnes CO_2 per annum)	Building Carbon Dioxide Emission Rate (BER) (Tonnes CO_2 per annum)	Reduction from 'Baseline' BER %
Baseline	4.2	17.8	-
Be lean: savings from energy demand reduction	3.1	13.9	22.1
Be clean: savings from heat network	3.1	13.9	22.1
Be green: savings from renewable energy (ASHP)	9.6	11.5	35
Be green: savings from renewable energy (PV)	9.6	6.2	64.9
Net Zero	9.6	0	100
	Target Carbon Dioxide Emission Rate (TER) (Tonnes CO_2 per annum)	**Building Carbon Dioxide Emission Rate (BER) (Tonnes CO_2 per annum)**	**Carbon Emission Reduction (%) from Part L Compliant BER to TER at the 'Be Green' Stage**
Be green: savings from renewable energy (PV)	9.6	6.2	35

Table 1 - Regulated Carbon Dioxide Savings from 'Baseline' (Unit 100)

	Regulated carbon dioxide savings (Tonnes CO_2 per annum)
Annual savings from off-set payment	6.2
	(Tonnes CO_2)
Cumulative savings for off-set payment	187
	(£)
Cash in-lieu contribution	17,781

Table 2 – Saving on Off Set Payment (Unit 100)

	Target Carbon Dioxide Emission Rate (TER) (Tonnes CO_2 per annum)	Building Carbon Dioxide Emission Rate (BER) (Tonnes CO_2 per annum)	Reduction from 'Baseline' BER %
Baseline	6.6	18.0	-
Be lean: savings from energy demand reduction	5.6	13.9	22.9
Be clean: savings from heat network	5.6	13.9	22.9
Be green: savings from renewable energy (ASHP)	8.8	10.8	40.1
Be green: savings from renewable energy (PV)	8.8	5.7	68.2
Net Zero	8.8	0	100
	Target Carbon Dioxide Emission Rate (TER) (Tonnes CO_2 per annum)	**Building Carbon Dioxide Emission Rate (BER) (Tonnes CO_2 per annum)**	**Carbon Emission Reduction (%) from Part L Compliant BER to TER at the 'Be Green' Stage**
Be green: savings from renewable energy (PV)	8.8	5.7	35

Table 3 - Regulated Carbon Dioxide Savings from 'Baseline' (Unit 200)

	Regulated carbon dioxide savings (Tonnes CO_2 per annum)
Annual savings from off-set payment	5.7
	(Tonnes CO_2)
Cumulative savings for off-set payment	171
	(£)
Cash in-lieu contribution	16,290

Table 4 - Saving on Off Set Payment (Unit 200)

	Target Carbon Dioxide Emission Rate (TER) (Tonnes CO_2 per annum)	Building Carbon Dioxide Emission Rate (BER) (Tonnes CO_2 per annum)	Reduction from 'Baseline' BER %
Baseline	14.7	35.4	-
Be lean: savings from energy demand reduction	12.6	27.3	22.8
Be clean: savings from heat network	12.6	27.3	22.8

Be green: savings from renewable energy (ASHP)	18.4	22.0	38.0
Be green: savings from renewable energy (PV)	18.4	11.5	67.4
Net Zero	18.4	0	100
	Target Carbon Dioxide Emission Rate (TER) (Tonnes CO_2 per annum)	**Building Carbon Dioxide Emission Rate (BER) (Tonnes CO_2 per annum)**	**Carbon Emission Reduction (%) from Part L Compliant BER to TER at the 'Be Green' Stage**
Be green: savings from renewable energy (PV)	**18.4**	**11.5**	**37.2**

Table 5 - Regulated Carbon Dioxide Savings from 'Baseline' (Whole Site)

	Regulated carbon dioxide savings (Tonnes CO_2 per annum)
Annual savings from off-set payment	11.5
	(Tonnes CO_2)
Cumulative savings for off-set payment	346
	(£)
Cash in-lieu contribution	32,905

Table 6 - Saving on Off Set Payment (Whole Site)

A solar PV array will be provided on each building. The table below sets out the required PV capacity for each unit to achieve the required 35% improvement over the Building Regulations baseline and demonstrate compliance with the relevant London Plan 2021 energy targets.

	PV Area (m2)	**KWp**
Unit 100	222.6	44.52
Unit 200	213	42.6
Whole Site	435.6	87.12

Table 7 - Required PV Area to Achieve London Plan 2021

The tables below demonstrate that the required PV capacity for each unit complies with the minimum carbon emission reduction requirements set out under Building Regulations Part L 2021 and achieves the London Plan 2021 net zero carbon requirement through an appropriate carbon offset fund. The combined PV area requirements for Unit 100 and Unit 200 total 930 m², However, the IES assessment requires a total PV area of 915 m² for the site. 930 m² is proposed which is a betterment to IES.

	PV Area (m2)	**kWp**
Unit 100	480	96

Unit 200	450	90
Whole Site	930	186

Table 8 - Required PV Area to Achieve Net Zero

From the Low or Zero carbon assessment as detailed in section 7, it was determined that the building energy needs would be met utilising a combination of the following.

- Efficient VRF / VRV heating and cooling system
- Hot water delivered from local point of use electric water heaters.
- Low energy efficient LED lighting
- Roof top mounted PV array

1.2 Thermal Comfort and Overheating Assessment

An overheating and thermal comfort assessment has been caried out on the buildings to address the requirements of the London Plan SI4 and BREEAM HEA04.

A thermal comfort assessment has been undertaken to assess the Predicted Mean Vote (PMV) and Percentage of People Dissatisfied (PPD), and to identify the design considerations incorporated at this stage to demonstrate compliance with the relevant thermal comfort requirements.

It can be seen from section 9 that the overheating of the development is within parameters and methodology required as set out in TM52 and the London Plan SI4, which includes a TM52 overheating assessment. Measures for the development include passive systems including natural ventilation and consideration of solar gains from glazing areas on the building. Beyond this the office spaces have had cooling included on them from a VRF system to manage the cooling requirements on the hottest of days.

2.0 Introduction

Chord Consult has been appointed by Zinc to help steer and inform the energy credentials of a new commercial/employment development within flexible Use Class B2 / B8 development use with associated landscaping, parking and infrastructure. The warehouse space shall not be fitted out initially; however, the office space shall be fitted out as part of the development. Chord Consult has also prepared this Energy Statement to demonstrate how the development will comply with planning policies of the London Plan 2021 in accordance with 'Energy Assessment Guidance Greater London Authority guidance on preparing energy assessments as part of planning applications (June 2022)'.

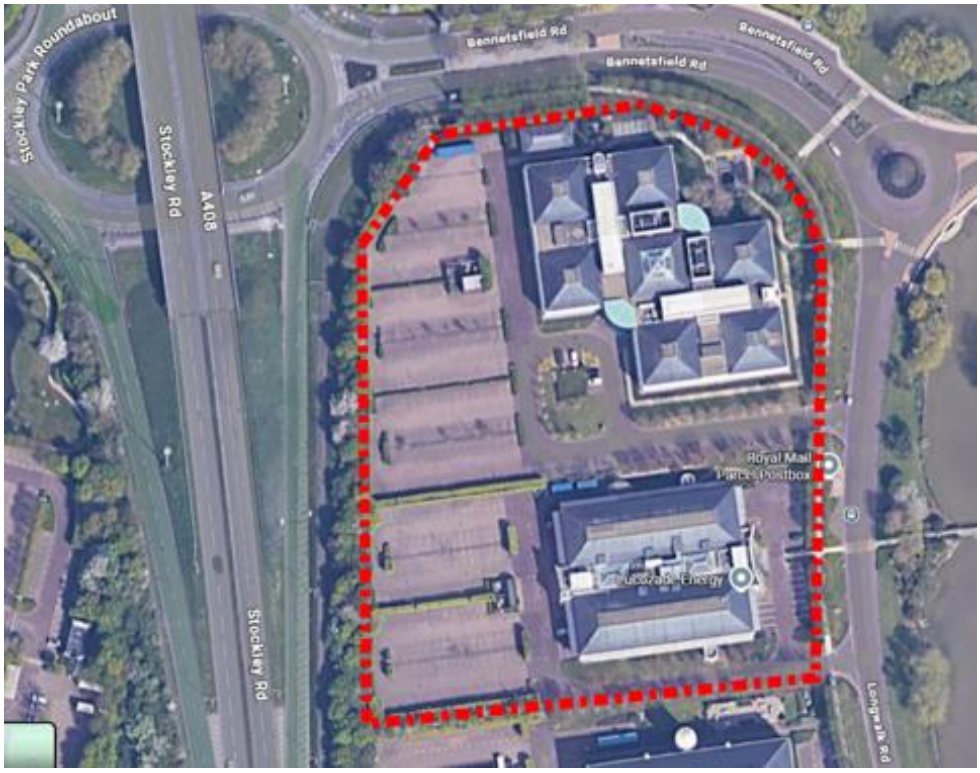


Figure 1 - Longwalk Road, UB11 1BA - Site Location

The proposed development is located at Longwalk – a business park development alongside the country park and golf course. The site currently consists of two office buildings just off Stockley Road (A408) to Longwalk where the site is accessed. The site is shown in the google maps image shown below.

The project consists of a 2No detached industrial units on site as shown in the image below.



Figure 2 - Longwalk Road, UB11 1BA - Proposed Site Plan

An area schedule for all the units in the development considered within the planning application are shown in the table below.

Unit Reference	Warehouse Area (m^2)	Office Area (m^2)	Total Area (m^2)
Unit 100	5,301	751	6,052
Unit 200	4,259	668	4,927

Table 9 - Make Up of Development by Floor Area

This statement is provided to demonstrate compliance with policies SI 2, SI 3 and SI 4 of the London Plan 2021. The specific requirements of the policies are as follows as well as providing detail to comply with the BREEAM requirements for HE04:

Policy SI 2

A Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

1) be Lean: use less energy and manage demand during operation

2) be Clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly

3) be Green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site

4) be Seen: monitor, verify and report on energy performance.

B Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.

C A minimum on-site reduction of at least 35 per cent beyond Building Regulations 152 is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:

1) through a cash in lieu contribution to the borough's carbon offset fund, or

2) off-site provided that an alternative proposal is identified and delivery is certain.

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

E Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.

F Development proposals referable to the mayor should calculate whole lifecycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.

Policy SI 3

A Boroughs and developers should engage at an early stage with relevant energy companies and bodies to establish the future energy and infrastructure requirements arising from large-scale development proposals such as Opportunity Areas, Town Centres, other growth areas or clusters of significant new development.

B Energy masterplans should be developed for large-scale development locations (such as those outlined in Part A and other opportunities) which establish the most effective energy supply options. Energy masterplans should identify:

1) major heat loads (including anchor heat loads, with particular reference to sites such as universities, hospitals and social housing)

2) heat loads from existing buildings that can be connected to future phases of a heat network

3) major heat supply plant including opportunities to utilise heat from energy from waste plants

4) secondary heat sources, including both environmental and waste heat

5) opportunities for low and ambient temperature heat networks

6) possible land for energy centres and/or energy storage

7) possible heating and cooling network routes

8) opportunities for futureproofing utility infrastructure networks to minimise the impact from road works

9) infrastructure and land requirements for electricity and gas supplies

10) implementation options for delivering feasible projects, considering issues of procurement, funding and risk, and the role of the public sector

11) opportunities to maximise renewable electricity generation and incorporate demand-side response measures.

C Development Plans should:

1) identify the need for, and suitable sites for, any necessary energy infrastructure requirements including energy centres, energy storage and upgrades to existing infrastructure 348 The London Plan 2021 - Chapter 9 Sustainable Infrastructure

2) identify existing heating and cooling networks, identify proposed locations for future heating and cooling networks and identify opportunities for expanding and inter-connecting existing networks as well as establishing new networks.

D Major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system:

1) the heat source for the communal heating system should be selected in accordance with the following heating hierarchy:

a) connect to local existing or planned heat networks

b) use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)

c) use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network)

d) use ultra-low NOx gas boilers

2) CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements in Part B of Policy SI 1 Improving air quality

3) where a heat network is planned but not yet in existence the development should be designed to allow for the cost-effective connection at a later date.

Heat networks should achieve good practice design and specification standards for primary, secondary and tertiary systems comparable to those set out in the CIBSE/ADE Code of Practice CP1 or equivalent.

Policy SI 4

A Development proposal should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.

B Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:

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

2) minimise internal heat generation through energy efficient design

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

4) provide passive ventilation

5) provide mechanical ventilation

6) provide active cooling systems.

3.0 Methodology

The Client should avoid, and the team would wish to avoid, a proposal coming forward, at the construction stage of the project, whereby poor energy efficiency is employed but renewable technologies included, only to satisfy regulatory and local authority requirements. Consideration should be given to potential increased inefficiency at part load conditions and at times when renewable energy generation is not available in this respect.

In accordance with GLA energy assessment guidance, the predicted energy demand for the entire development has been based upon a bespoke modelling generated specifically for the Longwalk Industrial Units development. 'Benchmark' Carbon Emissions data has been derived from this model to provide a basis for carrying out options analysis. Separately, a dynamic simulation model using National Calculation Methodology (NCM) software calculations have been undertaken.

The modelling has been carried out following the London Plans methodology where appropriate to demonstrate the reductions of carbon emissions at each defined stage.

It is not envisaged that the data represented in this initial energy and carbon analysis demonstrates the final solutions, as further design development shall be required by the relevant services designer. However, the figures provided within this report provide a suitable benchmark for comparisons to demonstrate compliance with the planning policy addressed within.

Summation of the building's predicted CO_2 emissions provides the annual CO_2 emissions for the development that is the basis of the analysis in this statement.

4.0 Carbon Emissions 'Baseline'

The 'Baseline' development for comparison is represented by the notional building as defined in Building Regulations and the NCM modelling guide for Longwalk Industrial Units. 'Benchmark' data has been derived from the calculations/model to provide the basis for a suitable 'Baseline' development in accordance with GLA guidance.

Due to allowances within the Notional Building used for comparison, when undertaking a "baseline" building, the Target Emissions Rate (TER) can not adequately be treated as the baseline figure, due to Notional Building in this scenario still accounting for improved construction details and PV array, whilst not accounting for any cooling/auxiliary loads associated with heat pumps in the final solution (where TER actually rises when heat pumps are introduced). As such, the Building Emissions Rate (BER) has been used to form the baseline model, to accurately assess the energy reductions associated with each stage of the hierarchy.

Carbon emissions for the 'Baseline' development are taken from the IES software modelling and shown in the tables below respectively:

The CO_2 emission and primary energy rates of the building must not exceed the targets		
The building does not comply with England Building Regulations Part L 2021		
Target CO_2 emission rate (TER), $kgCO_2/m^2annum$	0.67	
Building CO_2 emission rate (BER), $kgCO_2/m^2annum$	2.85	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	6.15	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	29.58	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

Figure 3 - Longwalk Industrial Units –Results Building CO_2 Emission 'Baseline' (Unit 100)

Energy Consumption by End Use [kWh/m^2]		
	Actual	**Notional**
Heating	10.3	3.47
Cooling	0	0
Auxiliary	0.19	0.1
Lighting	3.53	5.03
Hot water	5.52	3.96
Equipment*	31.69	31.69
TOTAL**	**19.54**	**12.56**

***Figure 4 - Longwalk Industrial Units – Results Energy Consumption 'Baseline'* (Unit 100)**

	Energy Consumption (kWh/year)	Carbon Emissions ($kgCO_2$/year)
Baseline: Part L 2021 of the Building Regulations Compliant Development	121,912	17,781

Table 10 - Regulated Energy Consumption and Carbon Dioxide Emission for the 'Baseline' (Unit 100)

The CO_2 emission and primary energy rates of the building must not exceed the targets		
The building does not comply with England Building Regulations Part L 2021		
Target CO_2 emission rate (TER), $kgCO_2/m^2annum$	1.32	
Building CO_2 emission rate (BER), $kgCO_2/m^2annum$	3.62	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	13.17	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	37.48	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

Figure 5 - Longwalk Industrial Units –Results Building CO_2 Emission 'Baseline' (Unit 200)

Energy Consumption by End Use [kWh/m^2]		
	Actual	**Notional**
Heating	15.28	5.22
Cooling	0	0
Auxiliary	0.27	0.18
Lighting	3.61	5.53
Hot water	5.54	3.92
Equipment*	31.41	31.41
TOTAL**	**24.69**	**14.86**

Figure 6 - Longwalk Industrial Units – Results Energy Consumption 'Baseline' (Unit 200)

	Energy Consumption (kWh/year)	Carbon Emissions ($kgCO_2$/year)
Baseline: Part L 2021 of the Building Regulations Compliant Development	122,714	17,992

Table 11 - Regulated Energy Consumption and Carbon Dioxide Emission for the 'Baseline' (Unit 200)

5.0 'Be Lean' Stage

Reducing energy usage is the priority in the energy hierarchy. It is often the measure with least cost implications, and any reduction will, in turn, reduce the requirement for on-site generation from renewable energy sources.

Achieving the optimum use of energy throughout a building's life requires the implementation of passive design to reduce the need for energy associated with controlling the environment and efficient controls to assist in the occupant's use of energy.

The calculated carbon emissions for the 'be lean' stage is based on a combination of passive and active energy efficiency measures to the following specification:

Passive Measures

- Maximising daylighting in all areas. The glazing specification will be carefully considered, aiming to provide an optimum balance between passive solar heating, limiting summertime overheating and maximising the potential for natural daylight transmission (Lt = 0.65 min. / g = 0.4 max.).
- An air permeability of 3m³/hr/m² @ 50Pa will be targeted.
- The following 'U' values are proposed for the building fabric of the new building:

Element	Part L 2021 Limiting 'U' value (W/m².K)	Proposed 'U' value (W/m².K)	% Betterment
External Wall	0.26	**0.16**	*38*
Ground / Exposed Floor	0.18	**0.14**	*22*
Roof	0.16	**0.14**	*12*
Glazing / Doors	1.6	**1.4**	*12*

Table 12 - Fabric Standards for the Entire Development

Active Measures

- HVAC and lighting systems to operate 'on demand' where practical.
- Practical zoning of HVAC systems.
- LED lighting to be adopted throughout with daylight-linked dimming and occupancy sensing as appropriate.
- All mechanical supply and extract ventilation will be delivered by high efficiency, low energy fans maximising heat recovery where possible through the ventilation units.
- Weather compensation for all heating systems.

Carbon emissions for the 'Be Lean' development and reduction against the baseline are taken from IES software modelling, and shown in the tables below respectively:

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

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

Target CO_2 emission rate (TER), $kgCO_2/m^2annum$	0.49	
Building CO_2 emission rate (BER), $kgCO_2/m^2annum$	2.22	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	4.4	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	23.34	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

Figure 7 - Longwalk Industrial Units – Results Target CO_2 Emission 'Be Lean' (Unit 100)

Energy Consumption by End Use [kWh/m²]		
	Actual	**Notional**
Heating	5.38	1.83
Cooling	0	0
Auxiliary	1.1	0.61
Lighting	3.53	5.03
Hot water	5.52	3.96
Equipment*	31.69	31.69
TOTAL**	**15.52**	**11.45**

Figure 8 - Longwalk Industrial Units – Results Energy Consumption *'Be Lean' (Unit 100)*

	Energy Consumption (kWh/year)	Carbon Emissions ($kgCO_2$/year)	Carbon Emissions saving from Baseline ($kgCO_2$/year)
Baseline: Part L 2021 of the Building Regulations Compliant Development	121,912	17,781	-
After energy demand reduction (be lean)	96,830	13,850	3,931

Table 5 - Regulated Energy Consumption and Carbon Dioxide Emission from 'Baseline' to 'Be Lean' (Unit 100)

The CO_2 emission and primary energy rates of the building must not exceed the targets		
The building does not comply with England Building Regulations Part L 2021		
Target CO_2 emission rate (TER), $kgCO_2/m^2$annum	1.12	
Building CO_2 emission rate (BER), $kgCO_2/m^2$annum	2.79	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	11.23	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	29.15	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

Figure 9 - Longwalk Industrial Units –Results Target CO_2 Emission *'Be Lean' (Unit 200)*

Energy Consumption by End Use [kWh/m²]		
	Actual	**Notional**
Heating	9.1	3.53
Cooling	0	0
Auxiliary	1.06	0.63
Lighting	3.61	5.53
Hot water	5.54	3.92
Equipment*	31.41	31.41
TOTAL**	**19.3**	**13.61**

Figure 10 - Longwalk Industrial Units – Results Energy Consumption *'Be Lean' (Unit 200)*

	Energy Consumption (kWh/year)	Carbon Emissions ($kgCO_2$/year)	Carbon Emissions saving from Baseline ($kgCO_2$/year)
Baseline: Part L 2021 of the Building Regulations Compliant Development	122,714	17,992	-
After energy demand reduction (be lean)	95,924	13,866	4,126

Table 6 - Regulated Energy Consumption and Carbon Dioxide Emission from 'Baseline' to 'Be Lean' (Unit 200)

6.0 ‘Be Clean’ Stage

The benefits of heat networks are widely known. In accordance with London Plan Policy SI 3, and as part of this energy assessment, the GLA’s ‘London Heat Map’ has been used to identify whether the development falls within an area of existing heat networks, planned heat networks or within a Heat Network Priority Area (HNPA).

The London Heat Map has been used for analysis of the development area to identify any of the above characteristics. Images taken from the map are provided below.

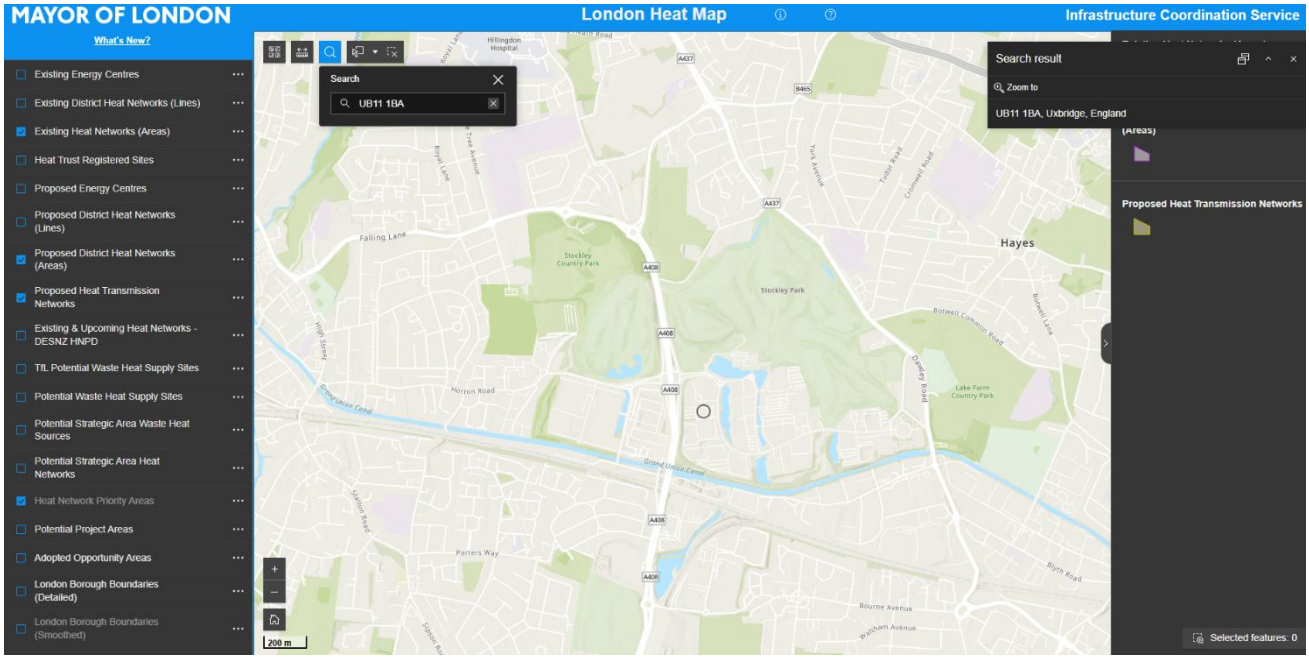


Figure 11 - London Heat Map for Heathrow

Figure 11 above shows the general search display when entering the area code for the UB11 postcode area. No existing and proposed heat networks and routes, according to the map key, have been highlighted within Heathrow generally. The UB11 postcode area is indicated by a circle on the map. One HNPA has been identified within Heathrow but does not border the proposed site. Closer analysis for the actual site can be seen in Figure 12.

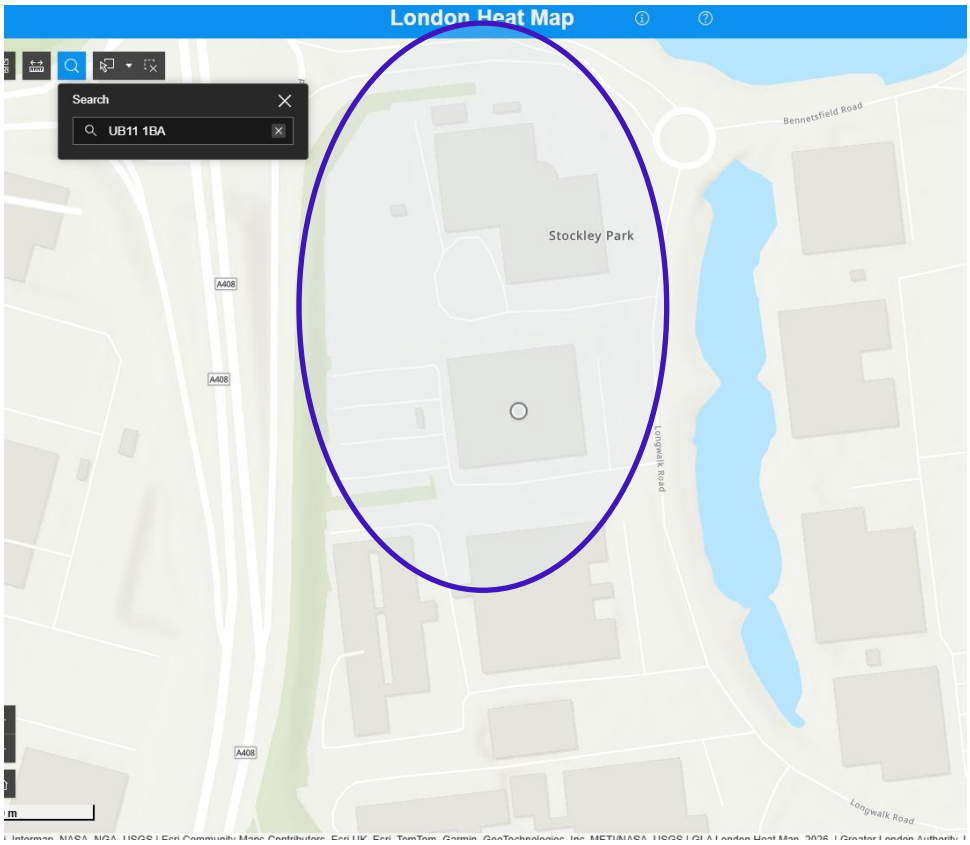


Figure 12 - London Heat Map for Longwalk

Figure 12 depicts the heat map for the development area. The proposed site is shown by the purple circle over the image. As described previously, this image provides further evidence that no existing and proposed heat networks affect the proposed site and cannot be taken benefit from at this time or in the near future.

On this basis, in accordance with GLA guidance, there is no proposal to utilise general heat networks to serve the building. Given the location of the site, limited available area and mixed use of the building, the use of an energy centre is not proposed. The mix of use within the development and requirement to respond to individual and different needs lend itself to a de-centralized solution, therefore individual heating systems, separate for usage areas, shall be provided. Given that there are no plans for future networks in the area, provision for the development to be served by a heat network is not incorporated at this stage. At the end of plant serviceable life, 10-15 years from construction, the potential to incorporate heat network provision could be re-evaluated.

GLA guidance regarding the provision of ‘clean’ heating and hot water solutions for development have been followed in full prior to the conclusion for the proposed solutions.

Carbon emissions for the ‘Be Clean’ development and reduction against the baseline are taken from the IES software model:

	Energy Consumption (kWh/year)	Carbon Emissions ($kgCO_2$/year)	Carbon Emissions saving from Baseline ($kgCO_2$/year)
Baseline: Part L 2021 of the Building Regulations Compliant Development	121,912	17,781	-
After energy demand reduction (be lean)	96,830	13,850	3,931
After heat network connection (be clean)	96,830	13,850	3,931

Table 15 - Regulated Energy Consumption and Carbon Dioxide Emission from 'Baseline' to 'Be Clean' (Unit 100)

	Energy Consumption (kWh/year)	Carbon Emissions ($kgCO_2$/year)	Carbon Emissions saving from Baseline ($kgCO_2$/year)
Baseline: Part L 2021 of the Building Regulations Compliant Development	122,714	17,992	-
After energy demand reduction (be lean)	95,924	13,866	4,126
After energy demand reduction (be clean)	95,924	13,866	4,126

Table 16 - Regulated Energy Consumption and Carbon Dioxide Emission from 'Baseline' to 'Be Lean' (Unit 200)

7.0 Be Green – Low or Zero Carbon Energy Technology

The third stage of the energy hierarchy refers to the production of renewable and low/zero carbon energy, relating to the reduction in carbon emissions from on-site renewables.

A range of approved renewable technologies have been appraised, considering the suitability, feasibility, size and capital cost of each system required to meet the target. This is summarised as below:

Renewable/LZC Technology	Pros / Benefits	Cons / Limitations	Considered for the Development (*)
Air Source Heat Pump (ASHP) ASHP systems utilise energy from the surrounding air within the refrigeration cycle. Air-to-Water technology uses water as the medium to provide wet heating and domestic hot water. Air-to-Air technology provides heating and cooling via refrigerant (VRF) to building/ fresh air.	• High efficiency heating/cooling with Coefficient of Performance (COP) typically between 250% and 450% depending on technology and system. • Single system for simultaneous heating and cooling (air-to-air) • Major proportion of plant able to be located externally not affecting GIA. • No need for gas or other fuels to development • Potential for continued Carbon Emission reduction of development following reduction in the electrical grid.	• Acoustic/aesthetic impact of external plant • GWP of refrigerants to be considered.	For space heating and hot water generation.
Ground Source Heat Pump (GSHP) GSHP systems utilise more stable temperatures of the earth (below ground) as an energy store. This technology can provide heating and cooling to building similar to air-to-air heat pumps. Installations can be horizontal via buried services in a trench or vertical via 'boreholes.'	• High efficiency technology • Minimal maintenance to below-ground system. • External plant requirement reduces effect on GIA. • No need for gas or other fuels to development • Potential for continued Carbon Emission reduction of development following reduction in the electrical grid.	• Increased costs compared with Air Source. • Integration with foundations/coordination with below-ground services required at an early stage. • Large external site area required for installation. • Full ground survey required to determine suitable geology	Site Constraints
Solar Photovoltaic (PV) Panels	• Simple integration to most developments	• Shading from nearby buildings, structures,	

Solar radiation converted into electrical energy through semi-conductor cells installed within a panel. Electrical Energy in AC form converted to DC electricity via an inverter and distributed to a building, electrical grid or stored in batteries.	• Low maintenance requirement • No ongoing costs aside from technology replacement (such as inverters) • Flexibility of installation on roofs, facades, standalone arrangements, etc.	landscape, etc. affects panel performance. • Inclination and orientation can also affect performance. • Installation in conservation/heritage areas not always permissible • High embodied carbon technology	
Solar Thermal Similar to PV using solar radiation to generate energy. In this technology the sun's energy is used to heat fluid for transfer into a development's domestic hot water (DHW) system.	• Low maintenance requirement limited predominantly to system pump and fluid pH. • Little on-going cost based on low maintenance requirement.	• As per PV above, plus; • To be sized for building DHW requirements which may not suit all development types with low hot water demand and reduced/no summer occupancy. • Temperature top-up often required from additional technology	PV and ASHP preferred as usable solutions
Wind Turbine Wind energy is used to turn a propeller, which in turn drives an alternator to generate electricity. Small scale can be roof-mounted (up to 2kW typically) or pole mounted for domestic use (up to 6kW typically). Commercially and standalone technologies can range typically from 10kW to 500kW (medium scale) and higher outputs.	• Little on-going cost based on low maintenance requirement. • Excess electricity can be exported to the grid.	• Potential planning issues with aesthetics/noise • Structural / vibration impact on building needs to be assessed. • Better suited to open sites to reduce potential for downstream turbulence caused by nearby buildings.	Noise and Aesthetics
Bio-Renewable Energy Sources Wood-fuel boilers relying on automated fuel feed to generate heat energy. Storage is provided for fuel (such as wood chip or pellet) with a dedicated mechanical system transporting the fuel to the boiler for combustion. Are highly efficient, clean and almost carbon neutral (the tree-growing process effectively absorbs the CO2 that is emitted during combustion). Automated systems require mechanical fuel handling and a large storage silo	• Can be considered almost carbon neutral on basis that growing trees for fuel absorbs CO_2 emitted in boiler use. • Uses fuels with lowest carbon emission factors. • Running costs	• Availability of fuel supply and delivery frequency requires investigation. • High maintenance requirement • Significant plant space for boiler, storage and automated feed system required	Area requirements not feasible for development

Fuel Cells Hydrogen and oxygen combined in a controlled chemical reaction. The resulting energy is converted to electricity by fuel cells.	• Highly efficient electrical generation • Clean process in terms of minimal pollution	• Prohibitively expensive • Technology risk associated with early stages of commercialisation for fuel cells.	Area requirements not feasible for development

Table 17 - Renewable Energy Technology Option Appraisal

* Key

Green indicates considered within the development's energy strategy.

Amber indicates possible feasibility following further design consideration.

Red indicates not feasible for the development.

7.1 Feasibility Assessment of Viable Technologies

This section explains each viable technology in more detail as well as quantifying the renewable energy generation, the associated CO2 emission reduction, capital costs, annual cost savings and simple payback periods in order to further investigate the feasibility of each technology.

7.1.1 Air Source Heat Pumps (ASHP)

ASHPs are classified as either air-to-air or air-to-water depending on whether the heat distribution system in the building uses air or water.

- An air-to-water system distributes heat via the wet central heating system. Heat pumps work much more efficiently at a lower temperature than a standard direct electric or gas boiler system. They are more suitable for lower temperature heating systems such as underfloor heating, which give out heat at lower temperatures over longer periods of time.
- An air-to-air system produces warm air which is circulated by fans to heat or cool. They typically do not provide hot water as well although hot water systems can be provided linking on to these systems. The heat or coolth can be distributed via refrigerant or water.

For the proposed heating and cooling system within the offices, an air-to-air heat pump would be used as part of the VRF system. Domestic hot water to the office spaces would be delivered into the space utilising local point of use direct electric water heaters.

Air source heat pumps are a scalable technology and therefore the external condensers size and appearance are dependent upon the size of the system. The images below show typical external condensers for a VRV system which would be required close to the office space within each industrial unit.

The figures outlined as suitable for Part L calculations appear far too optimistic within the below datasheets, therefore the more reasonable performance against best possible real world data has been used, taking some benefit of high performance equipment, without taking the highly optimistic figures, even though these have been proven through Part L compliant calculation methods.

R32 VRF Heat Recovery - High Efficiency

Seasonal Efficiency	Best Possible		Standard		Part L	
	SEER (C)	SCOP	SEER (C)	SCOP	SEER (C)	SCOP
PURY-EM200YNW-A1	7.74	4.39			13.11	7.40
PURY-EM250YNW-A1	7.37	4.29			13.90	7.51
PURY-EM300YNW-A1	6.97	4.15			10.78	7.63

Figure 13 – VRF Data Sheet



Figure 14 - VRV ASHP External Condensers

An air source heat pump uses an external condenser to extract low-grade heat from the surrounding air; it is therefore important to locate the condenser to avoid stagnation of air forming a micro-climate of cold air that would reduce the efficiency. The location of the external condenser should also consider the noise generated by the fan and potentially compressor, therefore a less noise sensitive location should be adopted whilst trying to minimise the distance to the building it is serving.

The total heat load calculated for the offices is 128 kW which shall be provided by the Air Source Heat Pump systems. The heat pumps will meet 90% of the space heating energy demand of occupied areas, significantly reducing the CO_2 emissions of the building and therefore contributing to an LZC strategy. The results from the feasibility assessment for Air Source Heat Pumps are shown below:

The CO_2 emission and primary energy rates of the building must not exceed the targets		
The building does not comply with England Building Regulations Part L 2021		
Target CO_2 emission rate (TER), $kgCO_2/m^2annum$	1.54	
Building CO_2 emission rate (BER), $kgCO_2/m^2annum$	1.85	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	16.47	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	19.9	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

Figure 15 - Longwalk Industrial Units – Results Target CO_2 Emission 'BE GREEN – ASHP' (Unit 100)

Energy Consumption by End Use [kWh/m^2]		
	Actual	**Notional**
Heating	2.18	1.19
Cooling	1.06	0.5
Auxiliary	1.1	1.64
Lighting	3.53	5.03
Hot water	5.52	3.96
Equipment*	31.69	31.69
TOTAL**	**13.38**	**12.33**

Figure 16 - Longwalk Industrial Units – Unit 100 Results Energy Consumption 'BE GREEN – ASHP' (Unit 100)

	Energy Consumption (kWh/year)	Carbon Emissions ($kgCO_2$/year)	Carbon Emissions saving from Baseline ($kgCO_2$/year)
Baseline: Part L 2021 of the Building Regulations Compliant Development	121,912	17,781	-
After energy demand reduction (be lean)	96,830	13,850	3,931
After heat network connection (be clean)	96,830	13,850	3,931
After ASHP (be green)	83,479	11,542	6,239

Table 18 - Regulated Energy Consumption and Carbon Dioxide Emission from 'Baseline' to 'Be Green – ASHP' (Unit 100)

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

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

Target CO_2 emission rate (TER), $kgCO_2/m^2$annum	1.77	
Building CO_2 emission rate (BER), $kgCO_2/m^2$annum	2.17	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	18.87	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	23.18	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

Figure 17 - Longwalk Industrial Units – Results Target CO_2 Emission 'Be Green – ASHP' (Unit 200)

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

	Actual	Notional
Heating	4.15	2.36
Cooling	1.17	0.54
Auxiliary	1.06	1.79
Lighting	3.61	5.53
Hot water	5.54	3.92
Equipment*	31.41	31.41
TOTAL**	**15.53**	**14.14**

Figure 18 - Longwalk Industrial Units – Results Energy Consumption 'Be Green – ASHP' (Unit 200)

	Energy Consumption (kWh/year)	Carbon Emissions ($kgCO_2$/year)	Carbon Emissions saving from Baseline ($kgCO_2$/year)
Baseline: Part L 2021 of the Building Regulations Compliant Development	122,714	17,992	-
After energy demand reduction (be lean)	95,924	13,866	4,126
After energy demand reduction (be lean)	95,924	13,866	4,126

After ASHP (be green)	77,187	10,785	7,207

Table 19 - Regulated Energy Consumption and Carbon Dioxide Emission from 'Baseline' to 'Be Green – ASHP' (Unit 200)

7.1.2 Solar Photovoltaic (PV) Panels

Photovoltaic (PV) Panels convert sunlight into electricity and therefore are most effective mounted on an unobstructed south facing roof area at an inclination of 34 degrees (in the UK). The image below shows a roof mounted PV installation when combined with pitched roof.



Figure 19 - PV Array Mounted on Pitched Warehouse Roof

The proposed development would benefit from further renewable installations. In accordance with the London Plan 2021 and the GLA Energy Assessment Guidance (June 2022), the potential for solar PV has therefore been considered as part of the Be Green stage of the London Plan Energy Hierarchy.

Photovoltaic panels are made up of a number of individual solar cells where photons within sunlight separate electrons from the silicon which in turn generates an electric charge. A PV solar array can be easily scaled up subject to available mounting area. PV solar cells are available in three distinct types:

- Monocrystalline – the most efficient type of panel with the longest lifespan achieving efficiencies of up to 24% but are the most expensive cell type.
- Polycrystalline – moderate efficiency and lifespan achieving efficiencies of up to 19% but more affordable than monocrystalline panels.
- Thin film – shorter lifespan but available in several different materials including flexible cells, efficiencies of up to 18% can be achieved with thin film technology.

The combined ASHP and PV strategy is therefore considered within the Be Green stage for the development. A solar PV array on each building would be required table below indicates the quantity of PV that would be required to achieve a 35% improvement over building regulation requirements meeting the London Plan targets.

	Area PV required	Approx PV output (20% efficient)	Number of Panels (1.9m² per panel)
Unit 100	222.6 m²	44.52 kWp	118
Unit 200	213 m²	42.6 kWp	113
Total	435.6 m²	87.12 kWp	231

Table 20 - Area PV Required to Achieve London Plan

An indicative PV panel area of approximately 222.6m² for Unit 100 and 213 m² for Unit 200 has been incorporated into the energy assessment. The assessment currently assumes 118 PV panels on the Unit 100 roof and 113 PV panels on the Unit 200 roof within the proposed development.

The indicative layout provided does not reflect a final design for the scheme and will need further dialogue with a PV specialist. At this stage, the plant requirements are not fully detailed and will need further development. Potential screening of the roof area to tailor the aesthetic is also not considered at this stage.

Based on the PV capacity and configuration assumed within the energy model, the proposed installation is estimated to generate approximately 41,240 kWh/year for Unit 100 and 39,463 kWh/year for Unit 200 of renewable electricity. This generation will contribute towards reducing the annual electricity demand and associated regulated CO_2 emissions of the development. In accordance with GLA requirements, the performance and output of the PV system shall be monitored by a centralised system.

Carbon emissions for the 'Be Green' development is taken from the IES software model, respectively, and shown in the tables below:

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

Target CO_2 emission rate (TER), $kgCO_2/m^2annum$	1.54	
Building CO_2 emission rate (BER), $kgCO_2/m^2annum$	1	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	16.47	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	10.14	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

Figure 20 - Longwalk Industrial Units – Results Target CO_2 Emission 'Be Green – PV' (Unit 100)

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	2.18	1.19
Cooling	1.06	0.5
Auxiliary	1.1	1.64
Lighting	3.53	5.03
Hot water	5.52	3.96
Equipment*	31.69	31.69
TOTAL**	**13.38**	**12.33**

Figure 20 - Longwalk Industrial Units – Results Energy Consumption 'Be Green – PV' (Unit 100)

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	6.61	1.25
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*6.61*	*1.25*

Figure 21 - PV Energy Production from BRUKL 'Be Green – PV' (Unit 100)

	Energy Consumption (kWh/year)	Carbon Emissions ($kgCO_2$/year)	Carbon Emissions saving from Baseline ($kgCO_2$/year)
Baseline: Part L 2021 of the Building Regulations Compliant Development	121,912	17,781	-
After energy demand reduction (be lean)	96,830	13,850	3,931
After heat network connection (be clean)	96,830	13,850	3,931
After ASHP (be green)	83,479	11,542	6,239
After PV (be green)	83,479	6,239	11,542

Table 21 - Regulated Energy Consumption and Carbon Dioxide Emission from 'Baseline' to 'Be Green – PV' (Unit 100)

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

Target CO_2 emission rate (TER), $kgCO_2/m^2annum$	1.77	
Building CO_2 emission rate (BER), $kgCO_2/m^2annum$	1.15	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	18.87	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	11.46	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

Figure 22 - Longwalk Industrial Units – Results Target CO_2 Emission 'Be Green – PV' (Unit 200)

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

	Actual	Notional
Heating	4.15	2.36
Cooling	1.17	0.54
Auxiliary	1.06	1.79
Lighting	3.61	5.53
Hot water	5.54	3.92
Equipment*	31.41	31.41
TOTAL**	**15.53**	**14.14**

Figure 23 - Longwalk Industrial Units – Results Energy Consumption 'Be Green – PV' (Unit 200)

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	7.94	1.48
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*7.94*	*1.48*

Figure 24 - PV Energy Production from BRUKL 'Be Green – PV' (Unit 200)

	Energy Consumption (kWh/year)	Carbon Emissions ($kgCO_2$/year)	Carbon Emissions saving from Baseline ($kgCO_2$/year)
Baseline: Part L 2021 of the Building Regulations Compliant Development	122,714	17,992	-
After energy demand reduction (be lean)	95,924	13,866	4,126
After energy demand reduction (be lean)	95,924	13,866	4,126
After ASHP (be green)	77,187	10,785	7,207
After PV (be green)	77,187	5,715	12,277

Table 7 - Regulated Energy Consumption and Carbon Dioxide Emission from 'Baseline' to 'Be Green – PV' (Unit 200)

8.0 Be Seen – Monitor, verify and report on energy performance

Energy collection facility will be provided in line with Approved document Part L. This will have an offsite monitoring capability with live readings exported as necessary for compliance with London Plan.

9.0 Flexibility and Peak Demand

In accordance with London Plan Policies SI 2 and SI 3, estimates of the peak energy demand, available capacity and potential for flexibility in demand within the development have been estimated in the table below.

	Electrical	Enabled Through...
Estimate Peak Demand (kWp)	44.52 (Unit 100) 42.6 (Unit 200)	Realistic estimates of demand profiles and peak demand
Available Capacity (MW)	1.22 MVA 700KVA for (Unit 100) 520 for (Unit 200) Budget application made to SSEN (IDNO engagement has been established)	Early engagement with the DNO or Independent Distribution Network Operator (IDNO) to establish available capacity

Table 8 - Site Wide Peak Energy Demand, Available Capacity and Flexibility Potential Appraisal

A summary table of the flexibility measures incorporated within the development is below.

Flexibility Achieved Through	Yes/No	Details
Electrical energy storage	No	
Heat energy storage	No	
Renewable energy generation (load matching)	Yes	Solar PV energy to be used within building
Gateway to enable automated demand response	No	
Smart systems integration (e.g. smart charge points for EV, gateway etc.)	No	Limited EV charging requirement but isolation will be provided to disable facility if required.
Other initiative	No	

Table 9 - Flexibility Options Appraisal

The electrical generation from the PV installation shall be export capable to provide additional capacity to the local electrical grid. Energy efficiency measures will be incorporated into the design for the lighting including automatic controls to reduce energy demand. In accordance with Part L of the building regulations all lighting circuits will be provided with metering allowing the users to monitor and adapt lighting usage where required.

10.0 Thermal Comfort and Climate Change

The development incorporates suitable passive measures within the building envelope and services design to mitigate overheating and reduce cooling demand, in line with London Plan Policy SI 4.

London Plan Policy SI 4 implements the following cooling hierarchy:

1. Reduce the amount of heat entering the building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure.
2. Minimise internal heat generation through energy efficient design.
3. Manage the heat within the building through exposed internal thermal mass and high ceilings.
4. Provide passive ventilation.
5. Provide mechanical ventilation.
6. Provide active cooling systems.

As part of the BREEAM credit targeted for HEA04 relating to thermal comfort, the below outlines how the proposed strategy has utilized passive, active and LZC technologies to mitigate overheating risk, noting while cooling has been proposed, the designs also consider means of reducing cooling loads through passive design strategies.

The fabric first approach and other passive design measures have been considered to reduce risks of overheating by reducing external solar gains. The design strategy has considered the below factors when looking to reduce excessive solar gains in peak temperatures:

- Northeast facing glazing to offices spaces to minimise excessive direct solar gain to occupied areas for extended periods of time, maintaining more autonomous indoor thermal control conditions.
- Balancing of light transmittance (LT) and Solar transmittance (G) values to maximise useful daylight but reduce solar gains in peak seasons where excessive heat gains can lead to thermal discomfort.
- Thermal mass shall be present within the construction, with concrete (and other materials with thermal mass properties) proposed as part of the building fabric which can absorb cooler air throughout unoccupied periods and discharge this as the space heats up, passively cooling the space without the need for mechanical services intervention.
- Beyond these passive measures, a number of active measures are also proposed to reduce heat gains and maintain more comfortable temperatures prior to any cooling being required, which include:
- Hybrid ventilation solutions with openable windows supplementing the mechanical ventilation system, allowing increased air changes per hour of fresh air, mitigating effects of internal heat gains from occupancy, equipment and lighting within peak periods with automatic controls on CO2 and temperature set points.
- Summer Bypass to MVHR systems can bypass the plate exchanger, or utilise beneficially, the unit's ability to pre-temper the incoming air, meaning that in a cooler internal environment, the mechanical ventilation system reduce incoming air temperatures in peak temperatures when there is sufficient temperature differentials.
- Nighttime purge functions of the proposed MVHR systems can be used to reduce space temperatures overnight by providing background ventilation on low fan speeds (for efficient function), where cooler nighttime temperatures may be introduced to offset heat gains of the space throughout the occupied day, providing a more natural solution to the temperature reduction strategies.

Having discussed all of the below, as part of the energy strategy, and mitigation of overheating risk associated with future climate change, cooling is proposed through the high efficiency VRF/VRV system to provide thermal comfort to all occupant in the offices areas and reduce overheating risks in the future where it is predicted external temperatures are likely to become more extreme. Whilst this is provided as part of the energy efficiency strategy, the passive and active measures proposed to minimise overheating risk will all contribute to a reduction in energy associated with cooling solutions by reducing the loads required to maintain thermal comfort of the space, reducing energy input to the cooling equipment during these periods.

It should also be noted that cooling systems may be managed at central controller, limiting the local control of occupants within the space, whereby risk of inefficient management of the system by unauthorised users is mitigated and energy reduction can further be improved through the shut off of cooling systems until peak periods where this is required.

A thermal comfort assessment has been completed to assess the Predicted Mean Vote (PMV) and Percentage of People Dissatisfied (PPD) has been undertaken to determine the design considerations made at this stage and demonstrate the thermal comfort requirements have been met.

10.1 Predicted Mean Vote (PMV) & Percentage of People Dissatisfied (PPD)

The table below is to demonstrate compliance with the requirements for PMV & PPD to ensure the heating and cooling strategy, along with building design, achieves suitable thermal comfort for all users within a given space.

Predicted mean vote is a scale to assess the average thermal sensation of occupants from -3 (cold) to +3 (hot) with an acceptable range being between +/-0.5 on this scale.

Percentage of People Dissatisfied is a measure calculated in line with the PMV to determine the percentage of people likely to feel thermal discomfort in the space, with an acceptable limit being 10%.

DSY 3	PMV occupied hours min / max	PPD occupied hours min / max	PMV / PPD Category pass / fail
UNIT 100_MEETING ROOM	-0.25 / 0.38	5.00 / 8.03	Pass
UNIT 100_OFFICE	-0.24 / 0.24	5.00 / 6.21	Pass
UNIT 100_RECEPTION	-0.25 / 0.35	5.00 / 7.50	Pass
UNIT 200_MEETING ROOM	-0.24 / 0.24	5.00 / 6.22	Pass
UNIT 200_OFFICE	-0.24 / 0.24	5.00 / 6.22	Pass
UNIT 200_OFFICE	-0.24 / 0.24	5.00 / 6.22	Pass
UNIT 200_RECEPTION	-0.24 / 0.37	5.00 / 7.90	Pass

DSY 2	PMV occupied hours min / max	PPD occupied hours min / max	PMV / PPD Category pass / fail
UNIT 100_MEETING ROOM	-0.24 / 0.40	5.00 / 8.40	Pass
UNIT 100_OFFICE	-0.24 / 0.24	5.00 / 6.23	Pass
UNIT 100_RECEPTION	-0.25 / 0.37	5.00 / 7.80	Pass
UNIT 200_MEETING ROOM	-0.24 / 0.24	5.00 / 6.19	Pass
UNIT 200_OFFICE	-0.24 / 0.24	5.00 / 6.23	Pass
UNIT 200_OFFICE	-0.24 / 0.24	5.00 / 6.23	Pass
UNIT 200_RECEPTION	-0.24 / 0.39	5.00 / 8.21	Pass

DSY 1	PMV occupied hours min / max	PPD occupied hours min / max	PMV / PPD Category pass / fail
UNIT 100_MEETING ROOM	-0.24 / 0.40	5.00 / 8.28	Pass
UNIT 100_OFFICE	-0.24 / 0.27	5.00 / 6.47	Pass
UNIT 100_RECEPTION	-0.25 / 0.38	5.00 / 7.94	Pass
UNIT 200_MEETING ROOM	-0.24 / 0.24	5.00 / 6.23	Pass
UNIT 200_OFFICE	-0.24 / 0.25	5.00 / 6.33	Pass
UNIT 200_OFFICE	-0.24 / 0.25	5.00 / 6.27	Pass
UNIT 200_RECEPTION	-0.24 / 0.39	5.00 / 8.14	Pass

Figure 25 - Thermal Comfort Results

As can be seen in the table above, the predicted mean vote and percentage of people dissatisfied are within the outlined requirements for compliance with minimum and maximum figure falling with the PMV scale and below 10% of PPD, against weather files DSY1, 2 & 3 against 2020 High 50th percentile.

10.2 TM52 – DSY1 2020 High 50th Percentile

Room Name	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)
UNIT 100_MEETING ROOM	0	0	0
UNIT 100_OFFICE	0	0	0
UNIT 100_RECEPTION	0	0	0
UNIT 200_MEETING ROOM	0	0	0
UNIT 200_OFFICE	0	0	0
UNIT 200_OFFICE	0	0	0
UNIT 200_RECEPTION	0	0	0

Figure 26 - TM52 Results

As can be seen in the results table above, the occupied rooms all meet requirements of TM52 through the measures outlined in this report with passive measures to minimise heat gains in peak periods, reducing cooling loads required from proposed VRF system contributing cooling to the spaces for the benefit of thermal comfort to end users. The assessment has been undertaken using the weather files DSY1 against 2020 High 50th percentile.

11.0 Conclusion

The results demonstrate the contribution of the proposed passive measure design, low carbon heating and renewable energy measures towards meeting the energy and carbon reduction meeting the requirements of approved document Part L and the London Plan 2021.

In the first stage of the energy hierarchy ('Be Lean'), a number of passive and high efficiency measures have been applied to reduce the energy consumption of the building, i.e., improving U-values, system efficiencies, etc. These approaches generally require very little ongoing maintenance and provide good value for money savings. The carbon reduction realised at this stage is 22% compared with the 'Baseline' development. The reduction is based on comparison with the baseline building output using the NCM Notional Building construction details.

In the second stage of the energy hierarchy ('Be Clean') it was determined that no local heat networks either existing, proposed are available to the site.

In the third stage of the energy hierarchy ('Be Green'), Carbon emissions reductions are achieved through the incorporation of low carbon technologies, including Air Source Heat Pumps (ASHPs) and Solar Photovoltaic (PV) panels with the passive design measures. It was demonstrated that additional carbon savings could be made, without affecting the proposed servicing strategy for the building, through the inclusion of a Solar Photovoltaic (PV) array. Initial calculations show the development would benefit from an installation of approximately 222.6 m² (44.52 kWp) array for Unit 100 and 213 m² (42.6 kWp) array for Unit 200. The carbon reduction realised at this stage is approximately 35% in Building Emission Rate (BER) relative to the Be Green Target Emission Rate (TER) through the incorporation of PV panels and ASHP.

To achieve the GLA net zero carbon target, calculations indicate that increasing the site total solar PV installation to approximately 480.8 m² (96kWp) array for Unit 100 and 450 m² (90 kWp) array for Unit 200 would be suitable as stated in the GLA London Plan 2021 guidance. If the Net zero targets are not to be achieved utilising additional PV installation, then a carbon offset payment can be provided to a total of £17,781.

The final summary table for development Carbon Emissions reductions are as follows:

	Target Carbon Dioxide Emission Rate (TER) (Tonnes CO_2 per annum)	Building Carbon Dioxide Emission Rate (BER) (Tonnes CO_2 per annum)	Reduction from 'Baseline' BER %
Baseline	4.2	17.8	-
Be lean: savings from energy demand reduction	3.1	13.9	22.1
Be clean: savings from heat network	3.1	13.9	22.1
Be green: savings from renewable energy (ASHP)	9.6	11.5	35
Be green: savings from renewable energy (PV)	9.6	6.2	64.9
Net Zero	9.6	0	100
	Target Carbon Dioxide Emission Rate (TER) (Tonnes CO_2 per annum)	**Building Carbon Dioxide Emission Rate (BER) (Tonnes CO_2 per annum)**	**Carbon Emission Reduction (%) from Part L Compliant BER to TER at the 'Be Green' Stage**

Be green: savings from renewable energy (PV)	9.6	6.2	35

Table 10 - Regulated Carbon Dioxide Savings from 'Baseline' (Unit 100)

	Regulated carbon dioxide savings (Tonnes CO_2 per annum)
Annual savings from off-set payment	6.2
	(Tonnes CO_2)
Cumulative savings for off-set payment	187
	(£)
Cash in-lieu contribution	17,781

Table 11 - Saving on Off Set Payment (Unit 100)

	Target Carbon Dioxide Emission Rate (TER) (Tonnes CO_2 per annum)	Building Carbon Dioxide Emission Rate (BER) (Tonnes CO_2 per annum)	Reduction from 'Baseline' BER %
Baseline	6.6	18.0	-
Be lean: savings from energy demand reduction	5.6	13.9	22.9
Be clean: savings from heat network	5.6	13.9	22.9
Be green: savings from renewable energy (ASHP)	8.8	10.8	40.1
Be green: savings from renewable energy (PV)	8.8	5.7	68.2
Net Zero	8.8	0	100
	Target Carbon Dioxide Emission Rate (TER) (Tonnes CO_2 per annum)	**Building Carbon Dioxide Emission Rate (BER) (Tonnes CO_2 per annum)**	**Carbon Emission Reduction (%) from Part L Compliant BER to TER at the 'Be Green' Stage**
Be green: savings from renewable energy (PV)	8.8	5.7	35

Table 12 - Regulated Carbon Dioxide Savings from 'Baseline' (Unit 200)

	Regulated carbon dioxide savings (Tonnes CO_2 per annum)

Annual savings from off-set payment	5.7
	(Tonnes CO_2)
Cumulative savings for off-set payment	171
	(£)
Cash in-lieu contribution	16,290

Table 13 - Saving on Off Set Payment (Unit 200)

	Target Carbon Dioxide Emission Rate (TER) (Tonnes CO_2 per annum)	Building Carbon Dioxide Emission Rate (BER) (Tonnes CO_2 per annum)	Reduction from 'Baseline' BER %
Baseline	14.7	35.4	-
Be lean: savings from energy demand reduction	12.6	27.3	22.8
Be clean: savings from heat network	12.6	27.3	22.8
Be green: savings from renewable energy (ASHP)	18.4	22.0	38.0
Be green: savings from renewable energy (PV)	18.4	11.5	67.4
Net Zero	18.4	0	100
	Target Carbon Dioxide Emission Rate (TER) (Tonnes CO_2 per annum)	**Building Carbon Dioxide Emission Rate (BER) (Tonnes CO_2 per annum)**	**Carbon Emission Reduction (%) from Part L Compliant BER to TER at the 'Be Green' Stage**
Be green: savings from renewable energy (PV)	18.4	11.5	37.2

Table 29 - Regulated Carbon Dioxide Savings from 'Baseline' (Whole Site)

	Regulated carbon dioxide savings (Tonnes CO_2 per annum)
Annual savings from off-set payment	11.5
	(Tonnes CO_2)
Cumulative savings for off-set payment	346
	(£)
Cash in-lieu contribution	32,905

Table 30 - Saving on Off Set Payment (Whole Site)

	PV Area (m2)	KWp
Unit 100	222.6	44.52
Unit 200	213	42.6
Whole Site	435.6	87.12

Table 31 - Required PV Area to Achieve London Plan 2021

	PV Area (m2)	kWp
Unit 100	480	96
Unit 200	450	90
Whole Site	930	186

Table 32 - Required PV Area to Achieve Net Zero

Appendix 1 – BRUKL Outputs

The below BRUKLs are the combined site total calculation sheets for the various calculated stages. The broken down BRULKs for each building Unit 100 and 200 are also available if required.

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name **Shell and Core**

d260826_LONGWALK_BE LEAN

As designed

Date: Wed Aug 26 10:40:04 2026

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.31

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.31

BRUKL compliance module version: v6.1.e.1

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Foundation area [m^2]: 888.91

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

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	1.12	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	2.44	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	11.48	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	25.56	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.16	0.16	NT000012:Surf[17]
Floors	0.18	0.14	0.14	NT000012:Surf[0]
Pitched roofs	0.16	0.14	0.14	NT000002:Surf[2]
Flat roofs	0.18	0.14	0.14	NT00004B:Surf[0]
Windows** and roof windows	1.6	1.4	1.4	NT000012:Surf[1]
Rooflights***	2.2	1.3	1.3	NT000000:Surf[14]
Personnel doors^	1.6	1.4	1.4	NT000012:Surf[13]
Vehicle access & similar large doors	1.3	1.3	1.3	NT000000:Surf[74]
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

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

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

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

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

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

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

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

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

1- ELECTRIC PANEL HEATER + MVHR (200 - RECEPTION)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1	-	0.2	-	0.8
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

2- ELECTRIC PANEL HEATER + DIRTY EXTRACT

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

3- ELECTRIC PANEL HEATER + NATURAL VENTILATION

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1	-	0.2	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

4- ELECTRIC PANEL HEATER + MVHR (100 - RECEPTION)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1	-	0.2	-	0.8
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

5- ELECTRIC PANEL HEATER + MVHR (200 - OFFICE 1)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1	-	0.2	-	0.8
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

6- ELECTRIC PANEL HEATER + MVHR (200 - OFFICE 2)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1	-	0.2	-	0.8
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

7- ELECTRIC PANEL HEATER + MVHR (200 - MEETING ROOM)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1	-	0.2	-	0.8
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

8- ELECTRIC PANEL HEATER + MVHR (100 - MEETING ROOM)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	-	0.8
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

9- ELECTRIC PANEL HEATER + MVHR (100 - OFFICE)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	-	0.8
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

1- INSTANTANEOUS POINT OF USE DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0.005
Standard value	1	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
UNIT 200_RECEPTION	-	-	-	1.5	-	-	-	-	-	-	N/A
UNIT 200_ACC WC	-	-	0.3	-	-	-	-	-	-	-	N/A
UNIT 100_ACC WC	-	-	0.3	-	-	-	-	-	-	-	N/A
UNIT 100_RECEPTION	-	-	-	1.5	-	-	-	-	-	-	N/A
UNIT 200_OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
UNIT 200_OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A
UNIT 200_MEETING ROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
UNIT 200_WC	-	-	0.3	-	-	-	-	-	-	-	N/A
UNIT 200_WC	-	-	0.3	-	-	-	-	-	-	-	N/A
UNIT 200_WC	-	-	0.3	-	-	-	-	-	-	-	N/A
UNIT 200_WC	-	-	0.3	-	-	-	-	-	-	-	N/A
UNIT 200_ACC WC	-	-	0.3	-	-	-	-	-	-	-	N/A
UNIT 100_WC	-	-	0.3	-	-	-	-	-	-	-	N/A
UNIT 100_WC	-	-	0.3	-	-	-	-	-	-	-	N/A
UNIT 100_WC	-	-	0.3	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
UNIT 100_WC	-	-	0.3	-	-	-	-	-	-	-	N/A
UNIT 100_ACC WC	-	-	0.3	-	-	-	-	-	-	-	N/A
UNIT 100_MEETING ROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
UNIT 100_OFFICE	-	-	-	1.5	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
UNIT 200_RECEPTION	NO
UNIT 200_STORE	NO
UNIT 200_ACC WC	NO
UNIT 200_MAIN STAIR	NO
UNIT 200_UNDERCROFT	NO
UNIT 100_CLEANER STORE	NO
UNIT 100_MAIN STAIR	NO
UNIT 100_ACC WC	NO
UNIT 100_RECEPTION	NO
UNIT 100_UNDERCROFT	NO
UNIT 200_OFFICE	NO
UNIT 200_RISER	NO
UNIT 200_RISER	NO
UNIT 200_OFFICE	NO
UNIT 200_MAIN STAIR	NO
UNIT 200_MEETING ROOM	NO
UNIT 200_CIRCULATION	NO
UNIT 200_CLEANER STORE	NO
UNIT 200_WC	NO
UNIT 200_WC	NO
UNIT 200_WC	NO
UNIT 200_WC	NO
UNIT 200_ROOF ACCESS	NO
UNIT 200_ACC WC	NO
UNIT 200_COMMS	NO
UNIT 100_CLEANER STORE	NO
UNIT 100_ROOF ACCESS	NO
UNIT 100_WC	NO
UNIT 100_WC	NO
UNIT 100_WC	NO
UNIT 100_WC	NO
UNIT 100_ACC WC	NO
UNIT 100_MEETING ROOM	NO
UNIT 100_MAIN STAIR	NO
UNIT 100_CIRCULATION	NO
UNIT 100_COMMS	NO
UNIT 100_ESACPE STAIR	NO
UNIT 200_ESCAPE STAIR	NO

Shell and core configuration

Zone	Assumed shell?
UNIT 200_ESCAPSE STAIR	NO
UNIT 100_WAREHOUSE	YES
UNIT 200_WAREHOUSE	YES
UNIT 100_OFFICE	NO

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
UNIT 200_RECEPTION	95	15	9
UNIT 200_STORE	95	-	-
UNIT 200_ACC WC	95	-	-
UNIT 200_MAIN STAIR	95	-	-
UNIT 200_UNDERCROFT	95	-	-
UNIT 100_CLEANER STORE	95	-	-
UNIT 100_MAIN STAIR	95	-	-
UNIT 100_ACC WC	95	-	-
UNIT 100_RECEPTION	95	15	9
UNIT 100_UNDERCROFT	95	-	-
UNIT 200_OFFICE	95	-	-
UNIT 200_RISER	95	-	-
UNIT 200_RISER	95	-	-
UNIT 200_OFFICE	95	-	-
UNIT 200_MAIN STAIR	95	-	-
UNIT 200_MEETING ROOM	95	-	-
UNIT 200_CIRCULATION	95	-	-
UNIT 200_CLEANER STORE	95	-	-
UNIT 200_WC	95	-	-
UNIT 200_WC	95	-	-
UNIT 200_WC	95	-	-
UNIT 200_WC	95	-	-
UNIT 200_ROOF ACCESS	95	-	-
UNIT 200_ACC WC	95	-	-
UNIT 200_COMMS	95	-	-
UNIT 100_CLEANER STORE	95	-	-
UNIT 100_ROOF ACCESS	95	-	-
UNIT 100_WC	95	-	-
UNIT 100_WC	95	-	-
UNIT 100_WC	95	-	-
UNIT 100_WC	95	-	-
UNIT 100_ACC WC	95	-	-
UNIT 100_MEETING ROOM	95	-	-
UNIT 100_MAIN STAIR	95	-	-
UNIT 100_CIRCULATION	95	-	-
UNIT 100_COMMS	95	-	-
UNIT 100_ESACPE STAIR	95	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
UNIT 200_ESCAPE STAIR	95	-	-
UNIT 200_ESCAPSE STAIR	95	-	-
UNIT 100_WAREHOUSE	95	-	-
UNIT 200_WAREHOUSE	95	-	-
UNIT 100_OFFICE	95	-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
UNIT 200_RECEPTION	YES (+254.7%)	NO
UNIT 200_UNDERCROFT	YES (+81.1%)	NO
UNIT 100_RECEPTION	YES (+124.3%)	NO
UNIT 100_UNDERCROFT	YES (+83%)	NO
UNIT 200_OFFICE	YES (+75.7%)	NO
UNIT 200_OFFICE	YES (+64.4%)	NO
UNIT 200_MEETING ROOM	YES (+84%)	NO
UNIT 100_MEETING ROOM	YES (+47.9%)	NO
UNIT 100_WAREHOUSE	YES (+53.2%)	NO
UNIT 200_WAREHOUSE	YES (+42.1%)	NO
UNIT 100_OFFICE	YES (+27.8%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	11209.2	11209.2
External area [m^2]	29835	29835
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	5
Average conductance [W/K]	7615.13	8364.03
Average U-value [W/m^2K]	0.26	0.28
Alpha value* [%]	24.91	10

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

Building Use

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

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

	Actual	Notional
Heating	7.03	2.59
Cooling	0	0
Auxiliary	1	0.62
Lighting	3.56	5.25
Hot water	5.36	3.95
Equipment*	31.56	31.56
TOTAL**	**16.95**	**12.42**

* 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	4.8
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*4.8*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	20.26	13.16
Primary energy [kWh_{PE}/m^2]	25.56	11.48
Total emissions [kg/m^2]	2.44	1.12

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] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	267.1	0	92.7	0	0	0.8	0	1	0
	Notional	174.6	0	34.4	0	0	1.41	0	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	144.4	0	50.1	0	6.3	0.8	0	1	0
	Notional	100.2	0	19.7	0	3.6	1.41	0	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	149.7	0	52	0	6.3	0.8	0	1	0
	Notional	100.2	0	19.7	0	3.6	1.41	0	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	236.3	0	82	0	6.3	0.8	0	1	0
	Notional	162.6	0	32	0	3.6	1.41	0	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	329	0	114.3	0	6.3	0.8	0	1	0
	Notional	169.1	0	33.3	0	3.6	1.41	0	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	58.2	0	20.2	0	6.3	0.8	0	1	0
	Notional	38.5	0	7.6	0	3.6	1.41	0	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	192.2	0	66.7	0	7.4	0.8	0	1	0
	Notional	84.7	0	16.7	0	4.2	1.41	0	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	86.5	0	30	0	7.4	0.8	0	1	0
	Notional	55.7	0	11	0	4.2	1.41	0	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	129.6	0	42.8	0	15.6	0.84	0	1	0
	Notional	119.7	0	23.6	0	31.3	1.41	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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name **Shell and Core**

d260903_LONGWALK_BE GREEN (PV)

As designed

Date: Thu Sep 03 15:09:59 2026

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.31

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.31

BRUKL compliance module version: v6.1.e.1

Foundation area [m^2]: 888.91

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

Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	1.64	
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	1.03	
Target primary energy rate (TPER), kWh_{PE}/m^2.annum	17.48	
Building primary energy rate (BPER), kWh_{PE}/m^2.annum	10.36	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.16	0.16	NT000012:Surf[17]
Floors	0.18	0.14	0.14	NT000012:Surf[0]
Pitched roofs	0.16	0.14	0.14	NT000001:Surf[2]
Flat roofs	0.18	0.14	0.14	NT00004B:Surf[0]
Windows** and roof windows	1.6	1.4	1.4	NT000012:Surf[1]
Rooflights***	2.2	1.3	1.3	NT000000:Surf[14]
Personnel doors^	1.6	1.4	1.4	NT000012:Surf[13]
Vehicle access & similar large doors	1.3	1.3	1.3	NT000000:Surf[74]
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

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

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

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

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

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

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

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

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

1- VRF + MVHR (200 - RECEPTION)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.39	7.74	0	1.5	0.8
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

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

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

2- ELECTRIC PANEL HEATER + DIRTY EXTRACT

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

3- ELECTRIC PANEL HEATER + NATURAL VENTILATION

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

4- VRF + MVHR (100 - MEETING ROOM)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.39	7.74	0	1.5	0.8
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

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

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

5- VRF + MVHR (200 - OFFICE 1)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.39	7.74	0	1.5	0.8
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

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

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

6- VRF + MVHR (200 - OFFICE 2)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.39	7.74	0	1.5	0.8
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

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

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

7- VRF + MVHR (200 - MEETING ROOM)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.39	7.74	0	1.5	0.8
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

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

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

8- VRF + MVHR (100 - OFFICE)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.39	7.74	0	1.5	0.8
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

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

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

1- INSTANTANEOUS POINT OF USE DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0.005
Standard value	1	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

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

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
UNIT 200_ACC WC	-	-	0.3	-	-	-	-	-	-	-	N/A
UNIT 100_ACC WC	-	-	0.3	-	-	-	-	-	-	-	N/A
UNIT 200_WC	-	-	0.3	-	-	-	-	-	-	-	N/A
UNIT 200_WC	-	-	0.3	-	-	-	-	-	-	-	N/A
UNIT 200_WC	-	-	0.3	-	-	-	-	-	-	-	N/A
UNIT 200_WC	-	-	0.3	-	-	-	-	-	-	-	N/A
UNIT 200_ACC WC	-	-	0.3	-	-	-	-	-	-	-	N/A
UNIT 100_WC	-	-	0.3	-	-	-	-	-	-	-	N/A
UNIT 100_WC	-	-	0.3	-	-	-	-	-	-	-	N/A
UNIT 100_WC	-	-	0.3	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
UNIT 100_WC	-	-	0.3	-	-	-	-	-	-	-	N/A
UNIT 100_ACC WC	-	-	0.3	-	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
UNIT 200_RECEPTION	NO
UNIT 200_STORE	NO
UNIT 200_ACC WC	NO
UNIT 200_MAIN STAIR	NO
UNIT 200_UNDERCROFT	NO
UNIT 100_CLEANER STORE	NO
UNIT 100_MAIN STAIR	NO
UNIT 100_ACC WC	NO
UNIT 100_RECEPTION	NO
UNIT 100_UNDERCROFT	NO
UNIT 200_OFFICE	NO
UNIT 200_RISER	NO
UNIT 200_RISER	NO
UNIT 200_OFFICE	NO
UNIT 200_MAIN STAIR	NO
UNIT 200_MEETING ROOM	NO
UNIT 200_CIRCULATION	NO
UNIT 200_CLEANER STORE	NO
UNIT 200_WC	NO
UNIT 200_WC	NO
UNIT 200_WC	NO
UNIT 200_WC	NO
UNIT 200_ROOF ACCESS	NO
UNIT 200_ACC WC	NO
UNIT 200_COMMS	NO
UNIT 100_CLEANER STORE	NO
UNIT 100_ROOF ACCESS	NO
UNIT 100_WC	NO
UNIT 100_WC	NO
UNIT 100_WC	NO
UNIT 100_WC	NO
UNIT 100_ACC WC	NO
UNIT 100_MEETING ROOM	NO
UNIT 100_MAIN STAIR	NO
UNIT 100_CIRCULATION	NO
UNIT 100_COMMS	NO
UNIT 100_ESACPE STAIR	NO
UNIT 200_ESCAPE STAIR	NO
UNIT 200_ESCAPSE STAIR	NO
UNIT 100_WAREHOUSE	YES

Shell and core configuration

Zone	Assumed shell?
UNIT 100_OFFICE	NO
UNIT 200_WAREHOUSE	YES

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
UNIT 200_RECEPTION	95	15	9
UNIT 200_STORE	95	-	-
UNIT 200_ACC WC	95	-	-
UNIT 200_MAIN STAIR	95	-	-
UNIT 200_UNDERCROFT	95	-	-
UNIT 100_CLEANER STORE	95	-	-
UNIT 100_MAIN STAIR	95	-	-
UNIT 100_ACC WC	95	-	-
UNIT 100_RECEPTION	95	15	9
UNIT 100_UNDERCROFT	95	-	-
UNIT 200_OFFICE	95	-	-
UNIT 200_RISER	95	-	-
UNIT 200_RISER	95	-	-
UNIT 200_OFFICE	95	-	-
UNIT 200_MAIN STAIR	95	-	-
UNIT 200_MEETING ROOM	95	-	-
UNIT 200_CIRCULATION	95	-	-
UNIT 200_CLEANER STORE	95	-	-
UNIT 200_WC	95	-	-
UNIT 200_WC	95	-	-
UNIT 200_WC	95	-	-
UNIT 200_WC	95	-	-
UNIT 200_ROOF ACCESS	95	-	-
UNIT 200_ACC WC	95	-	-
UNIT 200_COMMS	95	-	-
UNIT 100_CLEANER STORE	95	-	-
UNIT 100_ROOF ACCESS	95	-	-
UNIT 100_WC	95	-	-
UNIT 100_WC	95	-	-
UNIT 100_WC	95	-	-
UNIT 100_WC	95	-	-
UNIT 100_ACC WC	95	-	-
UNIT 100_MEETING ROOM	95	-	-
UNIT 100_MAIN STAIR	95	-	-
UNIT 100_CIRCULATION	95	-	-
UNIT 100_COMMS	95	-	-
UNIT 100_ESACPE STAIR	95	-	-
UNIT 200_ESCAPE STAIR	95	-	-
UNIT 200_ESCAPSE STAIR	95	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
UNIT 100_WAREHOUSE	95	-	-
UNIT 100_OFFICE	95	-	-
UNIT 200_WAREHOUSE	95	-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
UNIT 200_RECEPTION	YES (+254.7%)	NO
UNIT 200_UNDERCROFT	YES (+81.1%)	NO
UNIT 100_RECEPTION	YES (+124.3%)	NO
UNIT 100_UNDERCROFT	YES (+83%)	NO
UNIT 200_OFFICE	YES (+75.7%)	NO
UNIT 200_OFFICE	YES (+64.4%)	NO
UNIT 200_MEETING ROOM	YES (+84%)	NO
UNIT 100_MEETING ROOM	YES (+47.9%)	NO
UNIT 100_WAREHOUSE	YES (+53.2%)	NO
UNIT 100_OFFICE	YES (+27.8%)	NO
UNIT 200_WAREHOUSE	YES (+42.1%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	11209.2	11209.2
External area [m^2]	29835	29835
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	5
Average conductance [W/K]	7615.13	8364.02
Average U-value [W/m^2K]	0.26	0.28
Alpha value* [%]	24.91	10

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

Building Use

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

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

	Actual	Notional
Heating	3.05	1.72
Cooling	1.11	0.51
Auxiliary	1	1.7
Lighting	3.56	5.25
Hot water	5.36	3.95
Equipment*	31.56	31.56
TOTAL**	**14.09**	**13.14**

* 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	7.2	1.39
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*7.2*	*1.39*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	40.22	21.87
Primary energy [kWh_{PE}/m^2]	10.36	17.48
Total emissions [kg/m^2]	1.03	1.64

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] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	268.5	0	93.2	0	0	0.8	0	1	0
	Notional	174.9	0	34.4	0	0	1.41	0	----	----
[ST] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	146.5	164.5	10	9.3	6.3	4.07	4.92	4.39	7.74
	Notional	101.3	73.5	10.1	4.4	13	2.78	4.63	----	----
[ST] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	151.4	138.9	10.3	7.8	6.3	4.07	4.92	4.39	7.74
	Notional	101.3	72	10.1	4.3	13	2.78	4.63	----	----
[ST] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	239.7	204.4	16.4	11.5	6.3	4.07	4.92	4.39	7.74
	Notional	164.5	84.3	16.4	5.1	15.4	2.78	4.63	----	----
[ST] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	222.1	229.6	15.2	12.9	7.2	4.07	4.92	4.39	7.74
	Notional	102.2	41.7	10.2	2.5	12.5	2.78	4.63	----	----
[ST] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	59.3	116	4	6.5	6.3	4.07	4.92	4.39	7.74
	Notional	39.2	60.8	3.9	3.6	10.5	2.78	4.63	----	----
[ST] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	87	294.8	5.9	16.6	7.4	4.07	4.92	4.39	7.74
	Notional	55.7	65	5.6	3.9	12	2.78	4.63	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	129.9	0	42.9	0	15.6	0.84	0	1	0
	Notional	119.9	0	23.6	0	31.3	1.41	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