Unit 4 - Gateway 36, Barnsley

Energy Strategy – Rev P02

28th November 2022

Inspiring Built Environments

MEP
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Building Physics

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Executive Summary

FHP have been appointed by Harworth Group to produce an Energy Strategy for the proposed development known as Unit 4, Gateway 36, Barnsley.

This report will outline the strategy for achieving compliance with Building Regulations Part L2A 2013 and with the appropriate planning policies contained with the Barnsley Local Plan Adopted 2019 which specifically for this development are CC1, CC2 and RE1.

The strategy also highlights to Harworths the strategy that should followed into the full design of the development.

To achieve compliance with the 3 planning policies, minimum Building Regulations Part L2A 2013 requires achievement, review and ideally inclusion of Low Zero Carbon / Renewable Technologies are required and BREEAM 'VERY GOOD' is required.

BREEAM 2018 'VERY GOOD' minimum requirements with regards to Energy have been met as there are no minimum requirement for the above status with section ENE01 of the BREEAM 2018 criteria.

A feasibility study has also been carried out for the use of Low Zero Carbon / Renewable technologies and discounted where applicable with appropriate reasoning.

The Energy Hierarchy Be Lean, Be Clean, Be Green has been utilised to achieves compliance with the appropriate planning policies and forms the basis of the strategy.

The below results show the improvement between the existing and the proposed developments.

Table 1 – Results Table

	kg/CO_2/m^2.annum	**Reduction in CO_2 %**	**BREEAM Credits**
Target Emission Rate (TER)	11.1	**28%**	**3 Credits Awarded, 'Very Good' Energy Standard**
Building Emission Rate (BER)	7.9		

These results demonstrate that the proposed development complies with all applicable planning policies, BREEAM requirements under Energy and exceeds Building Regulations Part L 2A 2013 requirements.

The following table is a summary of the specification used to achieve compliance with the planning policies and standards set out within this Energy Strategy.

Table 2 – Summary Specification

Element / System	**Performance / Efficiencies**
Fabric	
External Walls	0.35 U-value
Floor	0.09 Avg U-value
Roof	0.25 U-value
Windows	1.50 U-value / 0.35 g-value
Rooflight	1.80 U-value / 0.58 g-value
Vehicle Doors	1.50 U-value
Air Permeability	5.00 $M^3/h/m^2$ at 50 Pa
Heating / Cooling / Ventilation	
VRF	SCOP – 3.50 SEER – 4.00 EER – 3.50
Hot Water	Electric Point of Use Instantaneous Hot Water Efficiency – 100%
Electric Heater (Where applicable)	Efficiency – 100%
Mechanical Ventilation Heat Recovery	Specific Fan Power – 1.30 W/l/s Heat Recovery Efficiency – 75%
Local Extract Fans (e.g., WC's)	Specific Fan Power 0.5 W/l/s Flow rate – 6 ACH
Electrical	
Lighting	100lm/circuit W to all spaces
Lighting Controls	Daylighting dimming where applicable and occupancy sensing where applicable
Renewable	
Photovoltaic Panels (PV)	Minimum of 200m^2 or approx. 27,000kwh/Annum

Introduction

This report summarises the Energy Strategy for the proposed redevelopment of Unit 4, Gateway 36 Industrial Estate, Barnsley. The purpose of this report is to assist with the planning application by demonstrating compliance with Building Regulations Part L2A 2013, appropriate planning policies contained within Barnsley Councils Local Plan adopted 2019 and, BREEAM very good minimum requirements.

As the development forms part of a larger masterplan which has already been registered with Building Control as a whole, prior to the 15th June 2022 when Building Regulations Part L was updated, the development can be designed to comply with 2013 Building Regulations in line with Part L conventions.

The development consists of one large warehouse that consists of two floors of office space along with associated communal and transient spaces.

In line with the National Planning Policy Framework and taking inspiration from the London Plan which is leading the way of the Low Carbon design requirements with regards to Local Authorities, the energy assessment has been modelled following a 3-stage approach to reducing regulated carbon emissions. This is otherwise known as the Energy Hierarchy.

The assessment has used the energy hierarchy as part of the design strategy that prioritises passive design in a Be Lean, Be Clean and Be Green approach:

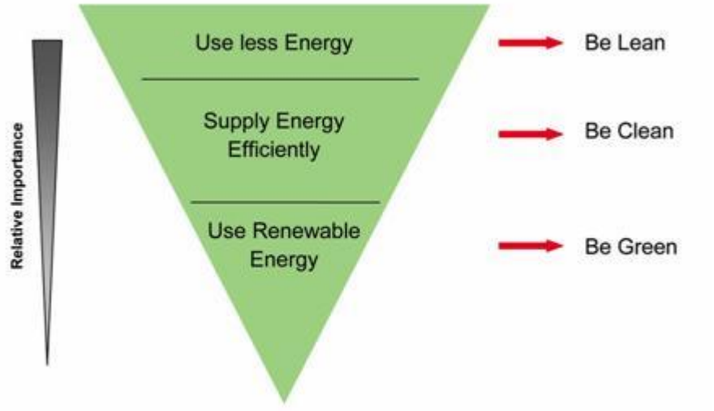


Figure 2 – Energy Hierarchy

Be Lean

This element of the Hierarchy looks to reduce the buildings energy demand by having a 'Lean' building fabric. This is achieved by designing lower U values for wall, floors, roofs, windows etc. As part of this design, solar gains, shading elements and orientation of the sites should be taken into as well during the design phase. This lower energy demand in turn lowers the amount of CO_2 produced by regulated energy.

Be Clean

To review how the energy to the development is supplied, can this be generated on site via a clean / sustainable source or can this be generated off site and directed appropriately to the development. In particular this looks at things like District Heating Networks, on site Combined Heat & Power (CHP) generation. This doesn't look at renewable grid electricity generation however. This 'Clean' energy supply looks to reduce the CO_2 further.

Be Green

The final aspect is to look at the use of onsite renewable technologies such as PV to offsite any CO_2 emissions that are generated by the building. A brief investigation to the most suitable renewable technology will be carried out.

Objectives

The objectives of this Energy Strategy are as follows:

- Review the applicable standards, requirements and targets as set out by Barnsley Council
- Determine the anticipated CO_2 performance of the development.
- Determine the Energy Contribution from Low or Zero Carbon Technologies if applicable
- Achieve appropriate compliance with BREEAM 'Very Good'.



Figure 2 - Site Plan

Development Description

The development consists of one large industrial unit located near Jct 36 of M1 near Hoyland. This forms one element of a larger masterplan but for the purposes of this planning application, and specifically this energy strategy, we are specifically focused on this project.

This unit consists of a large warehouse space, two stories of open plan office space, associated communal spaces and access to the open roof terraced area.

Plans & Drawings

The figures below give an example of the layouts and site plan to give context to the building and its orientation.

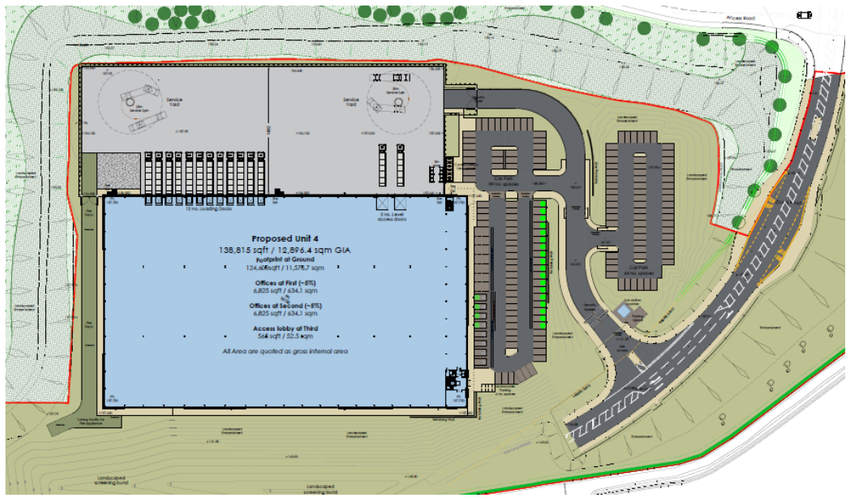


Figure 3 – Site Plan

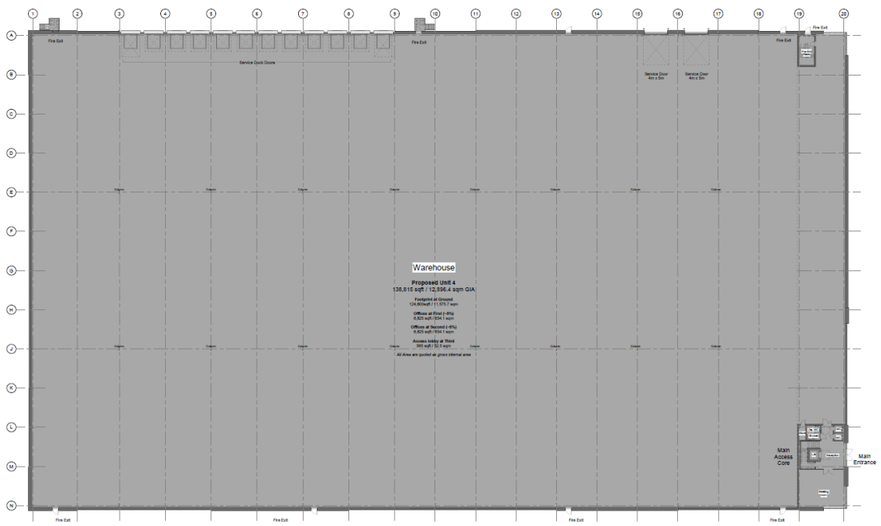


Figure 4 – Ground Floor Plan

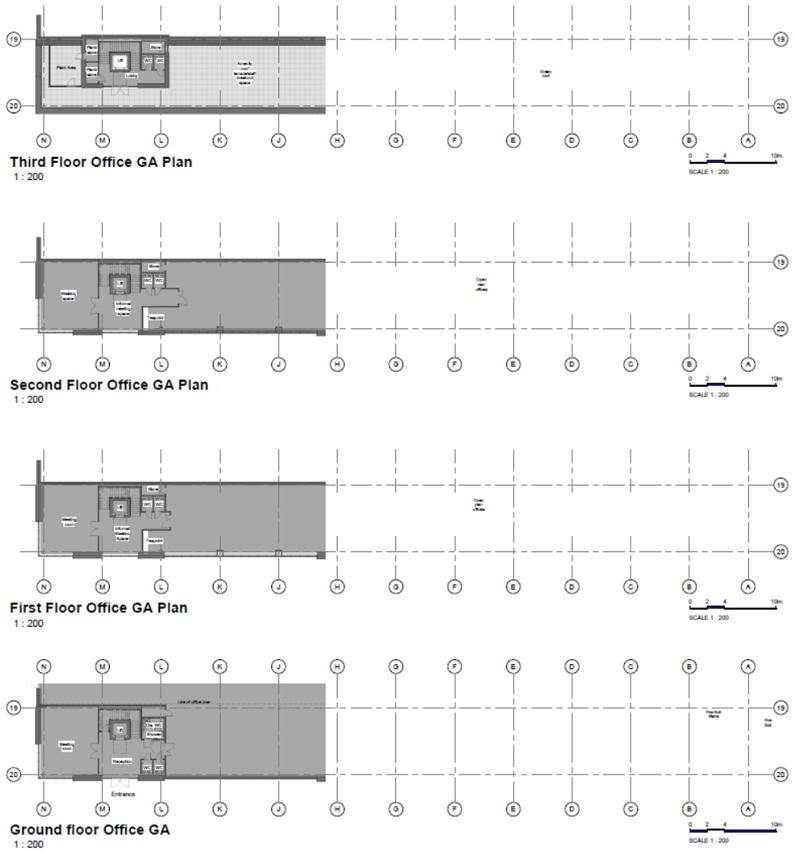


Figure 5 – Upper Floor Plans

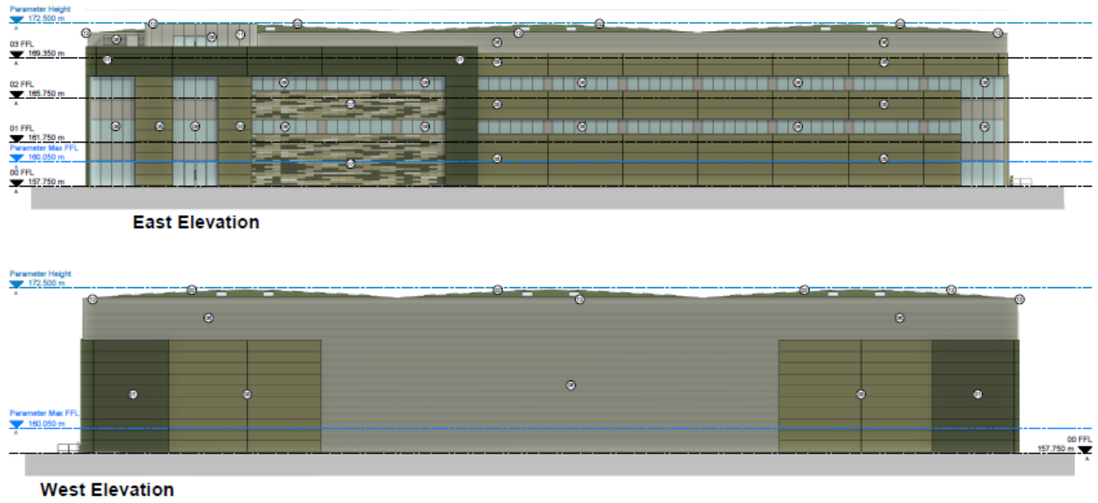


Figure 6 – East & West Elevations



Figure 7 – North & South Elevations

Utilised Drawing List

The energy model has been constructed using the drawings listed in the below table. This is to reference the current set of information that has been provided FHP.

Table 3 – Utilised Drawings

Description	Discipline	Reference	Revision
Location Plan	Architectural	12006-4-100	A
Existing Site Plan	Architectural	12006-4-101	A
Proposed Site Plan	Architectural	12006-4-111	-
Ground Floor Plan	Architectural	12006-4-(P)120	-
Proposed Office GA Plans (1F-3F)	Architectural	12006-4-(P)121	-
Proposed Roof Plan	Architectural	12006-4-(P)124	-
Proposed Elevations	Architectural	12006-4-(P)125	-
Proposed Indicative Sections	Architectural	12006-4-(P)126	-

Policies and Drivers

There can be several motives that drive an energy strategy in a certain direction, this is derived from several different policies and requirements. Many of these policies can have significant impacts upon the way in which the design is conceived.

Current Policy Framework

The policies considered when preparing this strategy are contained within Building Regulations Part L and the local authorities local planning policies.

The specific policies and drivers' documents that are applicable to this proposed development include:

- Building Regulations Part L2A 2013
- National Planning Policy Framework (NPPF)
- Barnsley Council Local Plan adopted 2019
- BREEAM ENE 01 'Very Good' Minimum Standards

Building Regulations Part L2A (2013)

A revised version of Part L was launched on June 15th 2022, however this development requires compliance with the previous version of Building Regulations Part L2A 2013 as this development has already been registered with Building Control prior to June 15th, 2022. This is in line with the Building Regulation Conventions.

Part L2A is split into 5 criteria that must be met to achieve compliance. These are as follows:

- Criterion 1 – The Building Emission Rate (BER)
- Criterion 2 – Limits on design flexibility
- Criterion 3 – Limiting solar gains in summer
- Criterion 4 – Building performance consistent with the BER
- Criterion 5 – Provision for energy efficient operation of the building

Criterion 4 & 5 are specifically considered during the construction and the post construction stage of the development. As such Criterion 1-3 will primarily be focused on within this report.

Criterion 1 – The Building Emission Rate (BER)

In accordance with regulation 26 the calculated CO_2 emission rate for the building (BER) must not be greater than the Target CO_2 Emission Rate (TER), which is determined by a set of notional criteria set out within paragraphs 2.7 to 2.36 within Building Regulation Part L2A 2013 document in accordance with the approved National Calculation Methodology (NCM).

Criterion 2 – Limits on Design Flexibility

Table 3 within Approved Document Part L2A 2013 sets out the limiting standards for the properties of fabric elements of the building. The stated value represents the area-weighted average value for all elements of that type. In general, achievement of the TER is likely to need better fabric performance than that set out in the following table.

In addition, there are limiting values for equipment efficiencies, controls, energy metering etc.

Table 4 – Limiting U values

Element	Limiting U value (W/m²/k)
Wall	0.35
Floor	0.25
Roof	0.25
Windows	2.20
Personnel Doors	2.20
Vehicle Access & Similar large Doors	1.50
High Usage Entrance Doors	3.50

Table 5 – Limiting Building Air Permeability

Air Permeability	Worst Acceptable Standard
$M^3/h/m^2$ at 50 Pa	10.00

Criterion 3 – Limiting Solar Gains

Guidance in the approved document Part L2A 2013 sets out the approach to limiting solar gains by way of building fabric means regardless of whether the building is mechanically cooled or not. The amount of solar gains is measured against a reference glazing systems.

In essence spaces should not exceed the NCM derived reference for solar gains and should utilise passive means to limit this.

Planning Policies

Barnsley Metropolitan Borough Council

Barnsley council has an adopted Local Plan which is the main strategic document which is used as the guide for new developments within the region. There are 3 specific policies within the adopted Local Plan relating to carbon emisisons, cliamte change and renewable technology for new developments:

- CC1: Climate Change – Carbon Dioxide Reduction
- CC2: Sustainable Design and Construction – BREEAM
- RE1: Low Carbon and Renewable Energy – Carbon Dioxide Reduction from renewables

Policy CC1 Climate Change

We will seek to reduce the causes of and adapt to the future impacts of climate change by:

Giving preference to development of previously developed land in sustainable locations;

Promoting the reduction of greenhouse gas emissions through sustainable design and construction techniques;

Locating and designing development to reduce the risk of flooding;

Promoting the use of Sustainable Drainage Systems (SuDS);

Promoting and supporting the delivery of renewable and low carbon energy; and

Promoting investment in Green Infrastructure to promote and encourage biodiversity gain.

Figure 8 – Barnsley Local Plan Policy CC1

The policy above states that support will be given to developments that reduce greenhouses gas emissions through sustainable design techniques. This does not states a specific reduction is CO_2 is required but more the ethos of sustainable design must be carried through.

Policy CC2 Sustainable Design and Construction

Development will be expected to minimise resource and energy consumption through the inclusion of sustainable design and construction features, where this is technically feasible and viable.

All non-residential development will be expected, to achieve a minimum standard of BREEAM 'Very Good' (or any future national equivalent). This should be supported by preliminary assessments at planning application stage.

Figure 9 - Barnsley Local Plan Policy CC2

The policy above clearly states that all non-residential buildings proposed must achieve BREEAM 'Very Good', as a result this energy strategy will focus on achieving the appropriate credits under the Energy ENE 01 criteria.

Policy RE1 Low Carbon and Renewable Energy

All developments will be expected to seek to incorporate initially appropriate design measures, and thereafter decentralised, renewable or low carbon energy sources in order to reduce carbon dioxide emissions and should at least achieve the appropriate carbon compliance targets as defined in the Building Regulations.

We will allow development that produces renewable energy as long as there is no material harm upon:

The character of the landscape and appearance of the area;

Living conditions;

Biodiversity, Geodiversity and water quality;

Heritage assets, their settings and cultural features and areas;

Key views of, from or to scenic landmarks or landscape features;

Highway safety, or

Infrastructure including radar.

In assessing effect, we will consider appropriate mitigation which could reduce harm to an acceptable level.

Proposals will be expected to include information regarding their efficiency.

Proposals must be accompanied by information that shows how the local environment will be protected, and that the site will be restored when production ends.

Figure 10 - Barnsley Local Plan Policy RE1

Policy RE1 requires the development to meet the minimum Building Regulations and review the feasibility of the use of low carbon or renewable technology, which falls in line with the energy hierarchy.

BREEAM ENE 01

Policy CC2 of Barnsley Council Local Plan Adopted 2019 requires all new non-residential developments must achieve BREEAM 'Very Good'.

ENE 01 Energy section of the BREEAM criteria awards credits for reductions made to CO_2 and Primary Energy. To achieve credits requires a performance improvement progressively better than the relevant national building regulations compliant standards. However there is no minimum number of credits to be awarded for 'very good'.

Methodology

In order to determine CO_2 reduction, a BRUKL document needs to be produced, this is also required for Building Control to sign off compliance with Approved Document Part L2A 2013. To produce the BRUKL document, an energy model has been constructed utilising appropriate software as described in the following sections.

The inputs into the energy model follow the energy hierarchy as described previously in this report. Utilising a fabric first approach for the passive aspects of the development, then moving to the active elements and reviewing the most energy efficient systems. Finally reviewing the feasibility of low carbon / renewable technologies.

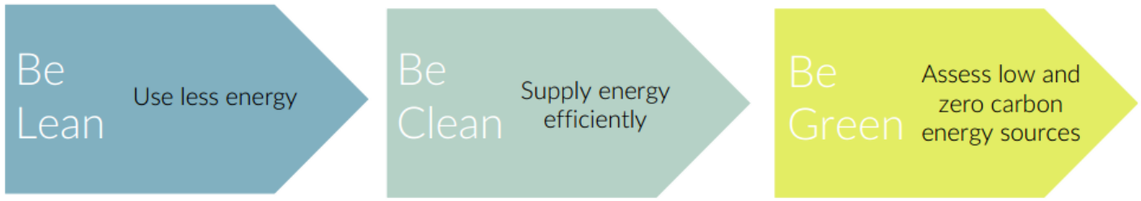


Figure 11 – Energy Hierarchy

The benchmark that the results are compared against are all derived from the National Calculation Methodology (NCM) 'Notional' building. This is a reflection of the building which is the same size and shape as proposed, but with notional baseline inputs for fabric and systems. This produces the TER which the BER is compared against.

Energy Modelling

In order to assess the development's performance, FHP have calculated the Actual building model to compare the Building Carbon Emissions (BER) against the Target Carbon Emissions (TER).

The resulting BRUKL document has then been inputted into the BREEAM Ene 01 calculator to determine the amount of credits awarded within this section to ensure compliance with Barnsley Local Plan policy requirements.

The BRUKL for the simulation is contained within Appendix A of this report. The model has been constructed utilising the proposed thermal envelope constructions contained within Table 5. Building services efficiencies have been simulated based on the typical values which are in line and in some cases exceed the minimums stated in the Non-domestic Building Services Compliance Guide.

In carrying out the assessment, FHPP utilised a dynamic simulation software package, Virtual Environment (VE) software suite from Integrated Environmental Solutions (IES). This is a fully validated commercially available software package that is available for the purpose of demonstrating compliance with the Building Regulations requirements of Approved Document Part L2A (2013 ADPL2A).

Integrated Environmental Solutions Virtual Environment (IESve) is a Dynamic Simulations Modelling (DSM) software package that has the capabilities of enabling the user to create a virtual representation of a building.

The results presented in this report were calculated using the approved compliance software IESve 2022 (v2022.1.0.0).

The IESve model for the proposed development was drawn to geometry within the drawings documented earlier within this report.

Weather Data

The CIBSE 'Test Reference Year' (TRY) weather file for Leeds is used to assess Criterion 1 and Criterion 3 of ADL2A 2013 as determined using the DCLG SBEM Weather Locations map. The TRY consists of hourly data for twelve typical months, selected from approximately 20-year data sets, and smoothed to provide a composite, but continuous, 1 year sequence of data. They enable the likely energy consumption of buildings to be assessed by simulation under typical weather conditions.

Thermal Modelling Disclaimer

The calculations produced by FHP have been carried out with the information provided by Harworth to assess building energy and carbon performance of the development.

It should be noted that the data generated by this work is obtained using computer simulations. These simulations are the best means of predicting the performance of the building at this stage. Full certainty can only be achieved by measuring the performance of the building and associated systems after a period of use.

The actual energy usage for the building once occupied may vary from the calculated values used in this simulation. These differences will occur due to a number of variable parameters between the modelled building and the actual building. Such differences will include the hours, levels of occupancy, how the plant is used and the design criteria with regards to how the rooms are environmentally controlled.

Whilst the simulations have been undertaken in good faith using reasonable skill and care, FHP can take no responsibility for differences between the computer simulations and the actual performance of the completed building due to the inherent complexity and variability of the physics in a building and its environment.

Should actual operational energy elements be required, it is suggested that a CIBSE TM54 calculation and report be produced separately.

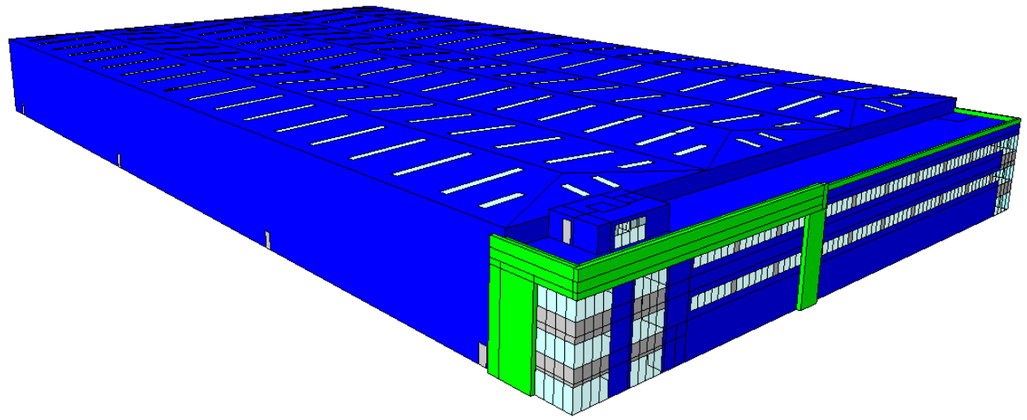


Figure 12 – IESve Model of the proposed development

Energy Strategy

As identified earlier in this report, the approach to the energy strategy is based on an energy hierarchy, and the Be Lean, Be Clean, Be Green approach to achieve the following.

Summary of Development Targets

The key minimum energy targets for the development are summarised below:

- Achieve minimum compliance with Building Regulations AD L2A for carbon emissions.
- Review the feasibility of the use of Renewable technology.
- Report the credits awarded for BREEAM ENE 01 section.

Be Lean – Use Less Energy

The energy demand for the building has been reduced through optimising the building fabric and increasing the performance of the existing shell. The following has been developed to achieve this:

- Maximise the use of natural daylight.
- Solar shading to reduce overheating.
- Improve building fabric.
- Reduce air permeability.

A summary of the proposed fabric performance values is provided below along with a comparison of the Notional and limiting Building U-Values for a new construction in Part L2A.

Table 6: Fabric Performance

Element	Limiting U value (W/m²/k)	Notional U-Value (W/m²/K)	Proposed U-Value (W/m²/K)
External Walls	0.35	0.26	0.35
Floor	0.25	0.22	0.09 Avg
Roof	0.25	0.18	0.25
Windows	2.20	1.60 / 0.4 g-value	1.50 / 0.35 g-value
Rooflight	2.20	1.80 / 0.6 g-value	1.80 / 0.58 g-value
Vehicle Doors	1.50	1.50	1.50

Table 7 – Limiting Building Air Permeability

Air Permeability	Worst Acceptable Standard	Proposed
$M^3/h/m^2$ at 50 Pa	10.00	5.00

Passive Measures

Passive design measures are those which reduce the energy demand within buildings.

These are the most effective and robust measures for reducing CO2 emissions as the performance of the solutions (e.g. wall insulation), is unlikely to deteriorate significantly with time or be subject to change by future property owners. In this sense, we can be confident that the benefits of these measures will continue at a similar level for the duration of their installation.

The Development has taken a 'fabric first' approach to reducing energy demand and CO2 emissions. Initial targets have been set for the design team to achieve, with detailed confirmation of the fabric performance requirements being calculated at the relevant stage in the design.

Improving Glazing

The U value for the glazing proposed is significantly improved from the limiting U-value and improved over the notional U-value, down to 1.50 $W/m^2/k$ with a G value of 0.35. This gives good thermal performance and aids with limiting solar gains which ensures criterion 3 compliance.

Thermal Insulation

Adequate thermal insulation of a building's façade is not only crucial to reducing energy demand but key to securing occupant thermal comfort. The building energy demand can be significantly reduced through the provision of an efficient thermal envelope, by reducing the thermal transmittance of the building envelope where appropriate and reduce heating requirements.

The U values of the external walls as an average throughout the development is 0.35 $W/m^2/k$, this is due to the development primarily consisting of unheated space, therefore the impact of a low fabric U-value is greatly diminished.

The Ground floor is significantly improved over the limiting and notional U-values due to the perimeter over area calculation, given that the uninsulated area of the warehouse actually maintains a constant temperature for the majority of the time. The occupied area are assumed to be insulated.

The Roof will be insulated to a 0.25 U-value level, this is in line with the limiting values. Again due to the majority of the space being unheated this value is effective.

Air Permeability

This level has been proposed to be 5.00 $m^3/h/m^2$ at 50Pa, this is a reasonable level of fabric sealing and lowers heat loss significantly. However, this level still leaves room for design flexibility.

Active Measures

The energy demand of the development will be further reduced by the incorporation of active energy efficiency measures in the design of the mechanical and electrical engineering systems. The following energy efficiency measures have been considered for use on the development:

Lighting

The development will be provided with energy efficient lighting through the use of LED in all rooms. 100 lumen/watt have been applied to the proposed building simulation in order improve the efficiency of the lighting.

Ventilation

Ventilation is important to maintain good indoor air quality by providing fresh air and extracting vitiated air. Providing fresh air minimises the risk of stale and stagnant air and limits the risk of condensation or mould growth.

Ventilation can also be used to reduce the amount of heat loss from a building by utilising an efficient heat recovery system. It can also aid thermal comfort in summer months by removing warm air from the space.

The Development will have a dedicated Mechanical Ventilation Heat Recover either through an Air Handling Unit or individual units. coupled to a heat exchanger. This will enable warm extracted air to be recovered (up to 80%) and delivered to the supply air without cross contamination. In this mode, the AHU unit reduces space heating demand whilst having the ability to control the ventilation rate required to achieve good indoor air quality. The heat recovery mechanism will be provided with a bypass to avoid returning hot air to spaces in summer months. Ductwork will be rigid type, circular wherever possible, with minimal flexible ductwork (for connections only) to prevent inefficiencies in delivery air to each space.

The Air Handling Units and Mechanical Ventilation Heat Recovery units are being designed to have a good practice Specific Fan Powers (SFPs) and heat recovery (where possible) as follows:

- Office areas: SFP = 1.3 W/l/s with heat recovery @75% efficiency

The toilets will include mechanical extract ventilation to remove odour and other contaminants. The fans will be centralised, and will be driven by energy efficient motors with a Specific Fan Power of 0.5 W/l/s.

Domestic Hot water

Hot water will be delivered by point of use electric sources, this means that no storage is required, therefore no energy lost through storage losses. And with it being electric, for every KW of electrical energy in, the same KW of heat is produced, therefore this is a very efficient way of providing hot water for a development of this type.

Metering and Controls

The Development will benefit from energy monitoring devices which will allow building managers to review energy use. This will be linked to the electrical and heat systems.

Heating systems will be provided with zonal, programmable thermostatic controls linked to a master control panel which will allow occupants to control each zone independently for maximum flexibility. Hot water will be separately programmable.

Lighting in communal areas will be linked to presence detection to minimise unnecessary use. In terms of central plant, metering and controls will be provided in accordance with the requirements of the Building Regulations and other pertinent guidance. Large items of plant will be separately metered.

The control of the heating, cooling, and ventilation and lighting systems will be fundamental to operational energy efficiency.

Be Clean – Use Clean Energy

This section refers to the site utilising 'clean energy', this refers to connecting to a district heating network or having on-site combined heat and power (CHP) generation.

Upon review of the UK Heat Map that references the current District Heating Networks in the UK, it has been determined that there is no network in the area or proposed to be in the area in the near future.

Therefore, this has been discounted for use on the proposed building.

A CHP can be used to provide head for space heating and domestic hot water to a building as a by-product of generating electrical energy on site. In order to maximise savings from a CHP unit, both the electricity generated, and the heat produced need to be used. This can be a limiting factor where buildings have a low heat demand. CHP can reduce the CO_2 emissions of a building by up to 30%. However, due to the building being an office, there is a very low hot water demand, meaning that there will be no base load of heat during summer months.

CHP would not be an appropriate method of producing heat and power on the proposed building and it is suggested that it is not used on the development.

Be Green – Use Low Carbon or Renewable Energy

The final section refers to the use of Low Zero Carbon Technology / Renewable technology to further lower the building CO_2 emissions.

A review of Low Zero Carbon and Renewable Technologies has been conducted with the viability of each investigated for this site and the conclusions of which are described in the following sections.

Solar Thermal

Solar thermal panels operate by capturing solar energy and transferring this via glycol to a thermal store to generate hot water. These systems can operate at efficiencies up to ~75% thus a high yield of energy can be derived from small collector areas.

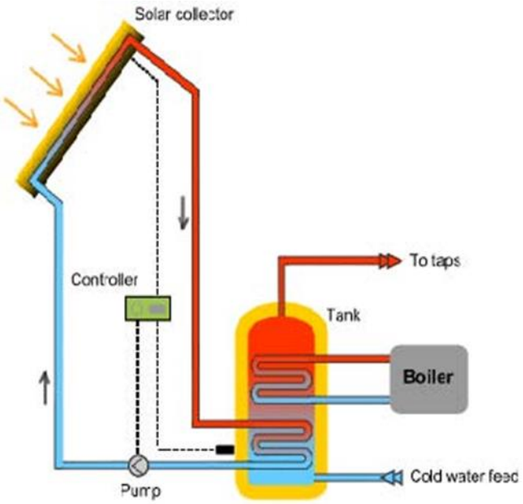


Figure 13 – Solar Thermal Diagram

However, there is not a high demand for hot water due to the building being developed into an office building. As a result, solar thermal panels are not proposed for this development.

Micro Wind Turbines



Figure 14 – Micro Wind Turbine

For efficient operation and to yield high energy output, wind turbines require a smooth laminar flow of air. The Development is located within a dense urban environment; therefore, the wind flow profile is erratic and consequently, not conducive to high annual yields. Moreover, mounting wind turbines on the roofs of the Development could result in unacceptable vibration and resonance being felt within the building. The turbines are also likely to generate noise which may be a nuisance to neighbouring properties. This scenario is likely to result in the turbines being switched off.

It is likely that turbines will be met with restraint by local planning department due to aesthetic and noise issues as described above. Therefore, this technology will not be considered for the development.

Biomass Boiler



Figure 15 – Biomass Boiler

Biomass boilers burn wood fuel or other bio-fuel sources to generate heat. These boilers can operate at high efficiencies, comparable to condensing gas boilers. However, they require a large fuel store to maintain continuous operation during the winter months. As such, area take for such plant is high. Furthermore, fuel deliveries in city-centre locations can prove difficult and security of fuel supply is an important consideration. Biomass boilers also result in higher emissions levels of Nitrous Oxide (NOx) in comparison with gas boilers. This can have a negative impact on the local air quality, a key issue throughout any town centre.

It is likely that the use of a biomass boiler could yield significant regulated CO2 emissions savings, however this would also likely result in an increase of NOx emissions from the Development as well as a significant store footprint and the complication of regular fuel deliveries. Therefore, the use of biomass boilers at the Development will not be considered.

Air Source Heat Pumps



Figure 16 – Air Source Heat Pumps

A heat exchanger extracts the heat from the air. A heat pump raises the temperature of the refrigerant via the compression cycle (also used in refrigerators) to supply heating the building, but in reverse cycle to provide cooling to the internal environment in the summer.

Otherwise known as VRF, Variable Refrigerant Flow units. These could be either ceiling mounted cassette units, wall mounted units or floor mounted units. This would have the benefit of also providing cooling to each room in summer months.

Air Source Heat Pumps use electricity as fuel, however their efficiency in both heating and cooling modes can be over 4 times as efficient as electrical panel heating, meaning for every 1KW of electricity you can achieve 4kW of heating or cooling dependant on unit sizes etc.

The outdoor units can be located anywhere and are not dependant on orientation. They need to be externally mounted and in a local compound to be safe.

As such this technology has been proved as feasibly and will be utilised to provide heating and cooling for all office, meeting and reception spaces.

Solar Photovoltaic Panels (PV)



Figure 17 – PV Panels

Photovoltaic panels generate electrical energy which can be used to offset the electrical energy used within a building – a significant proportion of the total energy demand for an office building. In order to maximise output photovoltaic panels are best orientated toward the sun when at its greatest intensity. In the UK optimum output of a panel is achieved when orientated due south and angled at 35° from the horizontal, but substantial yields can still be achieved with panels arranged away from this optimum.

As the development has a large roof area, the potential for PV inclusion is significant and the building usage is predominantly through the day where electrical demand is at it's greatest, as such PV is the most suitable renewable technology for this development.

A minimum of approximately 200m^2 of PV has currently been included for the development which equates to 27000kWh per annum of generation at this stage. It is proposed that this minimum amount will be carried through to completion with the provisions made for additional amounts to be included either during the design process or post occupancy.

Specification Summary

The table below gives an overview of the overall inputs into the model, assumed efficiencies and specification currently being proposed.

Table 8: Specification Summary

Element / System	Performance / Efficiencies
Fabric	
External Walls	0.35 U-value
Floor	0.09 Avg U-value
Roof	0.25 U-value
Windows	1.50 U-value / 0.35 g-value
Rooflight	1.80 U-value / 0.58 g-value
Vehicle Doors	1.50 U-value
Air Permeability	5.00 M^3/h/m^2 at 50 Pa
Heating / Cooling / Ventilation	
VRF	SCOP – 3.50 SEER – 4.00 EER – 3.50
Hot Water	Electric Point of Use Instantaneous Hot Water Efficiency – 100%
Electric Heater (Where applicable)	Efficiency – 100%
Mechanical Ventilation Heat Recovery	Specific Fan Power – 1.30 W/l/s Heat Recovery Efficiency – 75%
Local Extract Fans (e.g., WC's)	Specific Fan Power 0.5 W/l/s Flow rate – 6 ACH
Electrical	
Lighting	100lm/circuit W to all spaces
Lighting Controls	Daylighting dimming where applicable and occupancy sensing where applicable
Renewable	
Photovoltaic Panels (PV)	200m^2 or approx. 27,000kwh/Annum

Results

The building's Target carbon emissions (TER) has been identified through simulation to be 144,806.16kgCO_2/annum for the total development.

The building's actual carbon emissions (BER) for the new proposed building has been calculated at 103,060.24kgCO_2/annum using the approved simulation software. This is a reduction of 28.82% in CO_2 over Building Regulations Part L2A 2013.

The table below demonstrates a breakdown of where the majority of CO_2 emissions are being drawn from, without the inclusion of renewable technology. Renewable technology reduces the CO_2 emissions by 3,913.68kgCO_2/annum.

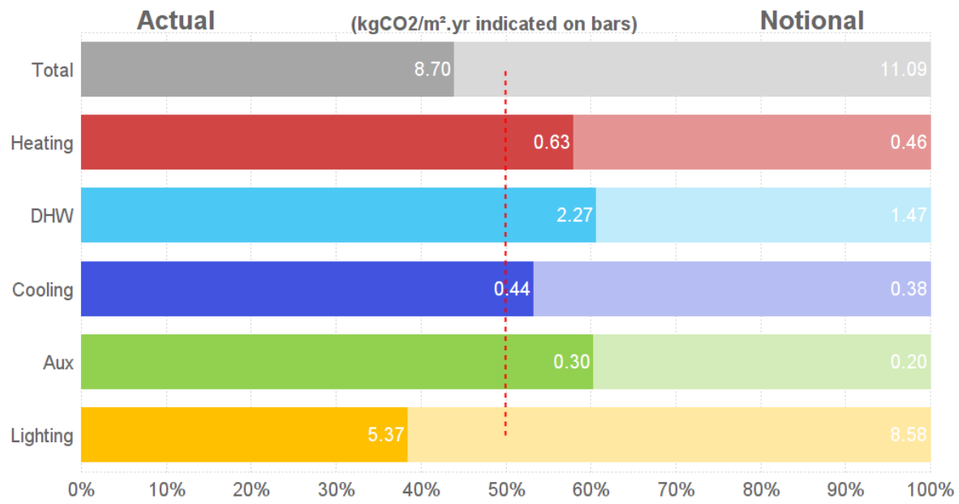


Figure 18 – Carbon summary (kgCO2/m2.yr)

Table 9: Development Carbon Emissions

	kg/CO_2/m^2.annum	Reduction in CO_2 %	BREEAM Credits
Target Emission Rate (TER)	11.1	**28%**	**3 Credits Awarded, 'Very Good' Energy Standard**
Building Emission Rate (BER)	7.9		

3 Credits have been awarded under the ENE01 section of BREEAM 2018 which complies with the minimum for the VERY GOOD required minimum requested requirements within the Barnsley Local Plan Policy CC2.

Conclusions

The simulation of Unit 4, Gateway 36, Barnsley has identified that the proposed development will achieve compliance with Building Regulations Part L2A 2013 as required by the early registration with Building Control.

It also identifies that the development achieves the requirements contained within Barnsley Council Local Plan Policy CC1 by reducing greenhouse gasses by the utilisation of Low Zero Carbon technology and the use of renewable technology.

The report also confirms compliance with Barnsley Council Local Plan Policy CC2 by demonstrating compliance with ENE01 BREEAM credits by achieving a 28% reduction in CO_2 and being awarded 3 Credits for 'VERY GOOD' status.

Finally the Barnsley Council Local Plan Policy RE1 by utilising both Air Source Heat Pumps and the inclusion or PV for the renewable aspect of the policy.

In conclusion the proposed development exceeds both the minimum Building Regulations requirements, planning policy requirements and the BREEAM requirements.

Appendix A – Preliminary As Designed BRUKL

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Gatway 36 Unit 4 Option 1

As designed

Date: Mon Nov 21 09:20:40 2022

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.15

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.15

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

Certifier details

Name: Paul Arnold

Telephone number: 01132350860

Address: 1A Brewery Place, Leeds, LS10 1NE

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	11.1
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	11.1
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	7.9
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.35	0.35	00000000:Surf[9]
Floor	0.25	0.09	0.09	00000000:Surf[0]
Roof	0.25	0.25	0.25	00000007:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.5	1.5	00000010:Surf[0]
Personnel doors	2.2	2.2	2.2	0000000E:Surf[1]
Vehicle access & similar large doors	1.5	1.5	1.5	00000010:Surf[23]
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

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

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- System 01 - HVAC VRF MVHR

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.5	3.5	0	-	0.75
Standard value	2.5*	2.6	N/A	N/A	0.5
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. For types <=12 kW output, refer to EN 14825 for limiting standards.

2- System 02 - HVAC EPH EV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0	-	-
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- System 3 - DHW_Electric Instantaneous

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

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
00-01- Meeting Room	-	-	-	1.3	-	-	-	-	-	-	N/A
00-07 - WC	-	-	0.5	-	-	-	-	-	-	-	N/A
00-08- WC	-	-	0.5	-	-	-	-	-	-	-	N/A
00-06- Dis WC / Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
00-03 - Reception	-	-	-	1.3	-	-	-	-	-	-	N/A
01-01- Meeting Room	-	-	-	1.3	-	-	-	-	-	-	N/A
01-07- Tea Point	-	-	-	1.3	-	-	-	-	-	-	N/A
01-08- Office	-	-	-	1.3	-	-	-	-	-	-	N/A
02-01- Meeting Room	-	-	-	1.3	-	-	-	-	-	-	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	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
02-07- Tea Point	-	-	-	1.3	-	-	-	-	-	-	N/A
01-08- Office	-	-	-	1.3	-	-	-	-	-	-	N/A
01-06- WC	-	-	0.5	-	-	-	-	-	-	-	N/A
01-05- WC	-	-	0.5	-	-	-	-	-	-	-	N/A
01-03- Lobby	-	-	-	1.3	-	-	-	-	-	-	N/A
02-06- WC	-	-	0.5	-	-	-	-	-	-	-	N/A
02-05- WC	-	-	0.5	-	-	-	-	-	-	-	N/A
02-03- Lobby	-	-	-	1.3	-	-	-	-	-	-	N/A
03-07- WC	-	-	0.5	-	-	-	-	-	-	-	N/A
03-06- WC	-	-	0.5	-	-	-	-	-	-	-	N/A
03-04- Lobby	-	-	-	1.3	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
00-01- Meeting Room	100	-	-	337
00-07 - WC	-	100	-	19
00-08- WC	-	100	-	19
00-05- Store	100	-	-	6
00-06- Dis WC / Shower	-	100	-	32
00-02- Stair	-	100	-	40
00-03 - Reception	-	100	25	103
01-01- Meeting Room	100	-	-	337
01-04- Store	100	-	-	6
01-02- Stair	-	100	-	39
01-07- Tea Point	100	-	-	56
00-10-Stair	-	100	-	37
01-08- Office	100	-	-	3170
01-09- Stair	-	100	-	37
02-01- Meeting Room	100	-	-	337
02-04- Store	100	-	-	6
02-02- Stair	-	100	-	35
02-07- Tea Point	100	-	-	56
01-08- Office	100	-	-	3170
01-09- Stair	-	100	-	35
03-03- Stair	-	100	-	26
03-05- Store	100	-	-	5
01-06- WC	-	100	-	19
01-05- WC	-	100	-	19
01-03- Lobby	-	100	-	51
02-06- WC	-	100	-	19
02-05- WC	-	100	-	19
02-03- Lobby	-	100	-	51

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
03-07- WC	-	100	-	17
03-06- WC	-	100	-	17
03-01- Plant	100	-	-	23
03-02- Plant	100	-	-	22
03-04- Lobby	-	100	-	33
00-09- Warehouse	100	-	-	50632

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00-01- Meeting Room	NO (-44.3%)	NO
00-03 - Reception	NO (-25.5%)	NO
01-01- Meeting Room	NO (-51%)	NO
01-07- Tea Point	NO (-93.7%)	NO
01-08- Office	NO (-54.3%)	NO
02-01- Meeting Room	NO (-58.1%)	NO
02-07- Tea Point	NO (-94%)	NO
01-08- Office	NO (-56.4%)	NO
01-03- Lobby	NO (-34.9%)	NO
02-03- Lobby	NO (-43.9%)	NO
03-04- Lobby	NO (-73.2%)	NO
00-09- Warehouse	NO (-33.5%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	13045.6	13045.6
External area [m^2]	29417.4	29417.4
Weather	LEE	LEE
Infiltration [m^3/hm^2@ 50Pa]	5	3
Average conductance [W/K]	8433.22	9389.69
Average U-value [W/m^2K]	0.29	0.32
Alpha value* [%]	9.95	10

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
100	**B8 Storage or Distribution**
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

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

	Actual	Notional
Heating	1.22	0.96
Cooling	0.84	0.76
Auxiliary	0.59	0.4
Lighting	10.34	16.95
Hot water	4.37	4.62
Equipment*	31.28	31.28
TOTAL**	**17.35**	**23.68**

* 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	2.07	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	21.23	18.31
Primary energy* [kWh/m^2]	53.27	61.86
Total emissions [kg/m^2]	7.9	11.1

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	262.8	0	91.3	0	9.7	0.8	0	1	0
	Notional	217.7	0	70.1	0	11.1	0.86	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	116	82.7	9.9	8.1	5.4	3.26	2.84	3.5	4
	Notional	72.1	99.4	7.8	7.3	3.6	2.56	3.79	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.35	00000000:Surf[9]
Floor	0.2	0.09	00000000:Surf[0]
Roof	0.15	0.25	00000007:Surf[1]
Windows, roof windows, and rooflights	1.5	1.5	00000000:Surf[5]
Personnel doors	1.5	2.2	0000000E:Surf[1]
Vehicle access & similar large doors	1.5	1.5	00000010:Surf[23]
High usage entrance doors	1.5	-	No High usage entrance doors in building

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

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

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