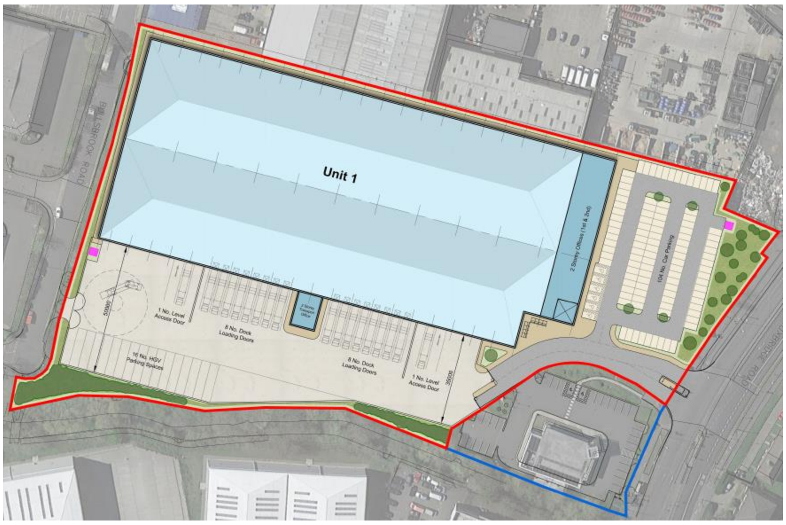
Energy Statement for

Bridgewater Retail Park, Hayes



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1.0 Executive Summary

The project is to construct a new 16,000m² Storage/Distribution Centre within Bridgewater Retail Park, Hayes, West London. The site is within the London Borough of Hillingdon.

A range of measures to improve sustainability and reduce energy consumption have been included:

- The development will achieve a significant carbon dioxide emissions reduction 35.2% improvement over regulated carbon emissions compared to the baseline.
- The development will achieve a BREEAM rating of Excellent.
- Heating and cooling to office spaces is to be provided by high efficiency VRV systems.
- Ventilation to office spaces shall be provided via void mounted heat recovery units.
- Domestic hot water shall be produced via localised electric point of use water heaters.
- Lighting is to be provided by high efficiency LED luminaires.
- Lighting will incorporate occupancy and daylight linked controls to reduce demand.
- A roof mounted PV array will be incorporated on building two with a collector area of 170m^2
- The Plot is being constructed as a 'shell & Core' project with only the office areas being fitted with services at the base build stage.

The carbon dioxide emissions for each stage in the hierarchy have been calculated as follows:

	Carbon dioxide emissions (tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building regulations	117	117
After energy demand reduction (be lean)	84	117
After heat network connection (be clean)	84	117
After renewable energy (be green)	78	117

The regulated carbon dioxide savings from each stage in the energy hierarchy are shown below:

	Regulated carbon dioxide savings	
	(tonnes CO2 per annum)	(%)
Be Lean: Savings from energy demand reduction	33	28.0%
Be clean: savings from heat network	0	0.0%
Be Green: savings from renewable energy	6	5.0%
Cumulative on-site savings	39	33.0
Carbon shortfall	2	N/A
	Tonnes (CO2)	
Cumulative savings for offset payment*	58 tonnes	
Cash-in-lieu contribution*	£3,470	

2.0 Introduction

This document has been produced to detail the energy and carbon reduction strategy for the new Storage/Distribution centre within Bridgewater Retail Park, Hayes, West London in the Borough of Hillingdon.

The proposal is for the redevelopment of the existing site to provide an industrial unit for B2/B8 usage, the existing buildings are to be vacated and demolished in a phased programme of works between 2022 and 2023.

The development shall comprise of an industrial/distribution unit with two storey offices and associated parking and services yards.

The development shall be constructed on a speculative basis with all fit out works to be carried out by future occupier.

2.1 Sustainability Rating Tools

The proposed new construction at Bridgewater Retail Park aims to achieve sustainability far in excess of minimum standards. To facilitate this and provide a metric against other buildings, BREEAM excellent certification will be targeted.

BREEAM assesses a building against a range of sustainability categories:

- Management
- Health & Wellbeing
- Energy
- Transport
- Water
- Materials
- Waste
- Land Use and Ecology
- Pollution
- Innovation

3.0 Planning Policy

3.1 The London Borough of Hillingdon Energy and Carbon Targets

The London Borough of Hillingdon's approach to sustainable development is underpinned by policies from the London Plan and the Hillingdon Local Plan (Local Plan Part 2 - Sustainability Appraisal, July 2014). Together these documents provide spatial policies, development management policies and site allocations to guide and manage development in the borough.

3.2 Hillingdon Local Plan Part 1

3.2.1 Policy EM1 – Climate Change Adaptation

The relevant requirements from this policy are listed below:

The Council will ensure that climate change mitigation is addressed at every stage of the development process by:

- Promoting the use of decentralised energy within large scale development whilst improving local air quality levels.
- Targeting areas with high carbon emissions for additional reductions through low carbon strategies. These strategies will also have an objective to minimise other pollutants that impact on local air quality. Targeting areas of poor air quality for additional emissions reductions.
- Encouraging the installation of renewable energy for all new development in meeting the carbon reduction targets savings set out in the London Plan. Identify opportunities for new sources of electricity generation including anaerobic digestion, hydroelectricity and a greater use of waste as a resource.

The Borough will ensure that climate change adaptation is addressed at every stage of the development process by:

- Promoting the inclusion of passive design(41) measures to reduce the impacts of urban heat effects

3.3 Hillingdon Local Plan Part 2

3.3.1 Policy DMEI : Reducing Carbon Emissions

A) All developments are required to make the fullest contribution to minimising carbon dioxide emissions in accordance with London Plan targets.

B) All major development proposals must be accompanied by an energy assessment showing how these reductions will be achieved.

C) Proposals that fail to take reasonable steps to achieve the required savings will be resisted. However, where it is clearly demonstrated that the targets for carbon emissions cannot be met onsite, the Council may approve the application and seek an off-site contribution to make up for the shortfall.

3.3.2 Policy DMEI 3: Decentralised Energy

A) All major developments are required to be designed to be able to connect to a Decentralised Energy Network (DEN).

B) Major developments located within 500 metres of an existing DEN, and minor new-build developments located within 100 metres, will be required to connect to that network, including provision of the means to connect to that network and a reasonable financial contribution to the connection charge, unless a feasibility assessment demonstrates that connection is not reasonably possible.

C) Major developments located within 500 metres of a planned future DEN, which is considered by the Council likely to be operational within 3 years of a grant of planning permission, will be required to provide a means to connect to that network and developers shall provide a reasonable financial contribution for the future cost of connection and a commitment to connect via a legal agreement or contract, unless a feasibility assessment demonstrates that connection is not reasonably possible.

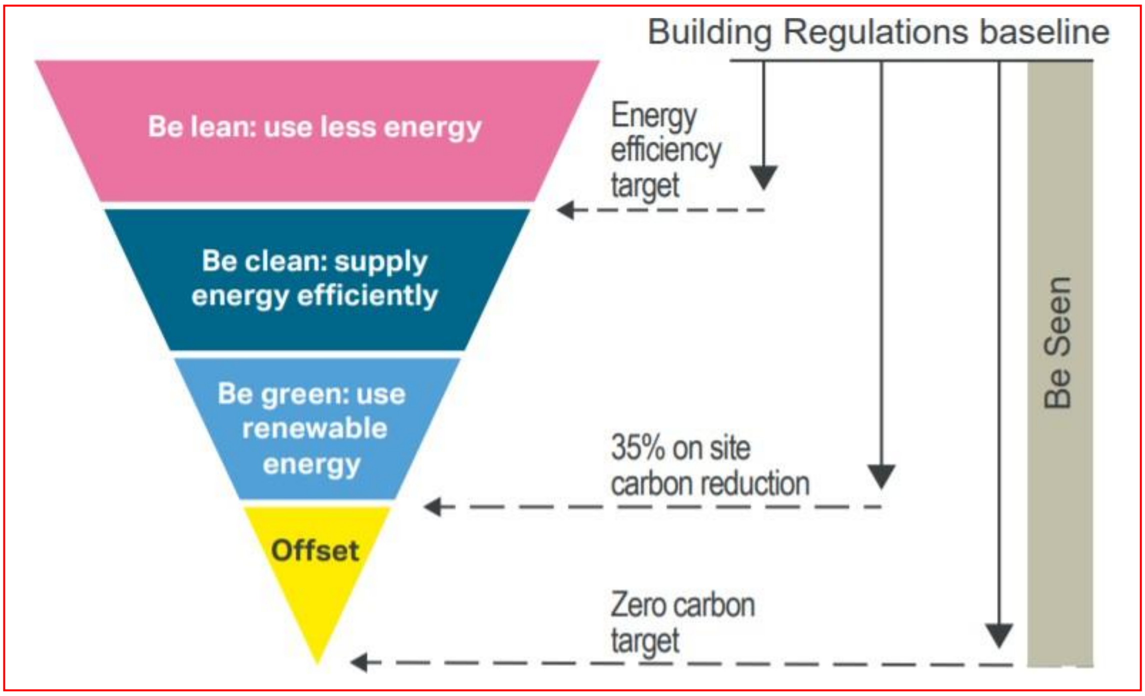
D) The Council will support the development of DENs and energy centres in principle, subject to meeting the wider policy requirements of this plan and in, particular on design and air quality.

3.4 The London Plan 2021 - Policy SI 2 Minimising greenhouse gas emissions

Many of the requirements below are only required for a “major development”. A non-domestic major development is one where the floor space is 1,000 square metres or more, or the site area is 1 hectare or more. As the proposed development’s floor area will exceed 1000 m2, requirements for major developments are applicable.

3.4.1 Policy SI 2 Minimising greenhouse gas emissions

The energy hierarchy should inform the design, construction and operation of new buildings. The priority is to minimise energy demand, and then address how energy will be supplied and renewable technologies incorporated. An important aspect of managing demand will be to reduce peak energy loadings.



Source: GLA

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 followingenergy 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 energyefficiently 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 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 beprovided, in agreement with the borough, either:

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

3.4.2 Policy SI 3 Energy Infrastructure

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

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.

E. 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.

3.4.3 Policy SI 4 Managing heat risk

A. Development proposals 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 highceilings

4) provide passive ventilation

5) provide mechanical ventilation

6) provide active cooling system

4.0 The London Plan – Energy Assessment

4.1 Introduction

The London Plan expects new and refurbished buildings to be evaluated using the following non-domestic energy hierarchy:

- Be Lean – passive design achieving demand reduction
- Be Clean – utilisation of local heat network or low carbon system
- Be Green – the inclusion of renewable technologies

The baseline for Part L2a will have input data which corresponds to the Building Regulations.

4.2 Loads

The following is required under the London Plan Policy SI2:

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

- through a cash in lieu contribution to the borough's carbon offset fund, or
- off-site provided that an alternative proposal is identified and delivery is certain

Policy SI2 then states:

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.

Since item **C** is focused on Building regulations and unregulated emissions are not discussed until item **E**, it can be determined that the requirement to achieve a 35% improvement and the remaining shortfall used to calculate offset are based on regulated energy.

This is backed up by the GLA's Energy Assessment Guidance 2020. As per the following extracts:

4.4 - The **regulated** carbon dioxide emissions reduction target for major domestic and non-domestic development is net zero carbon, with at least a 35% on-site reduction beyond Part L 2013 of the Building Regulations.

5.6 - Applicants using SAP 10.0 emission factors should continue to use the **current Building Regulations methodology** for estimating energy performance against Part L 2013 requirements (as outlined in Section6), but with the outputs manually converted for the SAP 10.0 emission factors.

6.2 - The following tables should be completed and presented separately for domestic uses, non-domestic uses and the entire site, to demonstrate compliance with the energy hierarchy and the carbon targets. Savings are to be expressed in tonnes of CO2 per annum, not kgCO2/m2 per annum. The calculation of unregulated carbon emissions should be done as part of the compliance with the 'be seen' policy and associated guidance.

Table 2: *The London Plan energy hierarchy*

	Carbon dioxide emissions (tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Baseline: Part L 2013 of the Building Regulations Compliant Development	A	
After energy demand reduction (be lean)	B	
After heat network connection (be clean)	C	
After renewable energy (be green)	D	

Table 3*: Regulated carbon dioxide savings from each stage of the energy hierarchy*

	Regulated carbon dioxide savings	
	(tonnes CO_2 per annum)	**(%)**
Be lean: Savings from energy demand reduction	A – B	(A – B)/A * 100
Be clean: Savings from heat network	B- C	(B – C)/A * 100
Be green: Savings from renewable energy	C – D	(C – D)/A*100
Cumulative on-site savings	A - D = E	(A – D)/A*100
Carbon shortfall	A - E = F	
	(tonnes CO_2)	
Cumulative savings for offset payment	F * 30 years = G	
Cash-in-lieu contribution	G * carbon dioxide offset price = H	

The tables above show that any offset payment should be based on the regulated emissions.

Under the glossary regulated emissions are defined as:

The CO_2 emissions arising from energy used by fixed building services**, as defined** in Approved Document Part L of the Building Regulations. These include fixed systems for lighting, heating, hot water, air conditioning and mechanical ventilation.

Approved Document Part L of the building regulations includes cases where there are exemptions where buildings or parts of buildings are not subject to the requirements of Part L and thus, their energy consumption is unregulated

5.0 Part L Review

5.1 Baseline

The development is a new construction, with well-insulated fabrics and glazing, as well as efficient lighting and systems.

The baseline is a design used for comparative purposes to measure and determine the improvements in energy consumption and carbon dioxide emissions by the building services.

The development is considered a new development and as such, must follow Part L2A regulations. The Part L2A target emissions rate (TER) will be used as the baseline for the development.

For the purposes of this review the notional building shall be taken as the baseline model.

5.1.1 Baseline Building - Fabric

Parameter	Baseline	Maximum Part L2a
Roof (W/m^2K)	0.18	0.25
Wall (W/m^2K)	0.26	0.35
Floor (W/m^2K)	0.22	0.25
Window (W/m^2K)	1.6	2.20
Glazing G-value	0.4	N/A
Vehicle Door	1.5	1.5

5.1.2 Baseline Building – Air Permeability

The baseline building has an air permeability of 3 m^2/m^2.hr @ Pa as per the approved Part L2a document.

5.1.3 Baseline Building – Hot Water System

Parameter	Proposed Performance	Criterion 2 Limits
Hot water generator type	Instantaneous hot water only	N/A
Hot water fuel type	Electricity	N/A
Hot water generator efficiency	100%	100%
Hot water delivery efficiency	95%	N/A
Hot water storage volume	N/A	N/A

5.1.4 Baseline Building - Lighting

The baseline building lighting has a luminaire efficacy of 60 lm/cW.

The baseline building has occupancy Detection in the following zones:

- Office areas
- Plant rooms
- Stores
- Circulation

In addition, the lighting has the following parameters:

- Daylight Dimming has also been applied to the perimeter office areas
- All sensors will have a maximum parasitic power of 0.3 W/m^2 of area served

5.1.5 Baseline Building – Heating and Cooling

Offices spaces (VRV)

Parameter	Baseline Performance	NDBSCG* Limits
NCM system type	VRV System	N/A
Heat source	Heat pump (electric)	N/A
Fuel	Electricity	N/A
Heating seasonal efficiency (SCOP)	4.5	2.5
Cooling system type	Heat pump (electric)	N/A
Cooling SEER	4.0	N/A
Cooling nominal EER	4.0	2.6
Cooling radiant fraction	0	N/A
Does the system have provisions for metering?	Yes	Yes
Does the metering warn “out of range values”?	Yes	N/A
Ventilation types	Zonal supply and extract ventilation unis serving a single room or zone with heating and heat recovery – With demand control	N/A
Ventilation SFP	0.9	1.9 W/l/s**
Heat Recovery Efficiency	70%	67%
Ductwork Leakage Rating	N/A	N/A
AHU Leakage Rating	L2	L2

**Non-Domestic Building Services Compliance Guide 2013 (NDBSCG).*

***Max allowable for a central balanced system with heating and heat recovery*

Other Areas i.e WC’s, Circulation etc.

Parameter	Baseline Performance	NDBSCG* Limits
NCM system type	Local Panel Heaters	N/A
Fuel	Electricity	N/A
Heating seasonal efficiency (SCOP)	1.0	N/A
Cooling system type	Heat pump (electric)	N/A
Does the system have provisions for metering?	Yes	Yes
Does the metering warn “out of range values”?	Yes	N/A
Ventilation types	Zonal supply and extract ventilation unis serving a single room or zone with heating and heat	N/A

	recovery – With demand control	
Ventilation SFP	0.9	1.9 W/l/s**
Heat Recovery Efficiency	70%	67%
Ductwork Leakage Rating	N/A	N/A
AHU Leakage Rating	L2	L2

**Non-Domestic Building Services Compliance Guide 2013 (NDBSCG).*

***Max allowable for a central balanced system with heating and heat recovery*

5.2 Be Lean

This section details the strategies and technologies that will be incorporated to minimise the building's energy consumption and therefore, its carbon dioxide (CO_2) emissions.

5.2.1 Building Fabric

The fabric values have been based on the current proposed future building regulations as outlined in the following document: *The Future Buildings Standard Consultation on changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for non-domestic buildings and dwellings; and overheating in new residential buildings.*

Parameter	**Baseline**	**Maximum Part L2a**
Roof (W/m²K)	0.16	0.25
Wall (W/m²K)	0.26	0.35
Floor (W/m²K)	0.18	0.25
Window (W/m²K)	1.6	2.20
Glazing G-value	0.66	N/A
Vehicle Door (W/m²K)	1.3	1.5
Rooflight (W/m²K)	1.6	2.2

5.2.2 Heating and Cooling

Space heating and cooling to office areas shall be provided by a variable refrigerant flow (VRV) system. When compared totraditional heating sources, such as a gas fired boiler, a VRV system can offer significant savings.

VRV systems are a type of heat pump that extract heat from the air and, through a cycle of expansion and compression, can extract heat from low external temperatures while still providing sufficient heat requirements. As the energy to heat the space is being extracted from the air rather than being generated, the amount of energy provided is greater than the electrical input. VRV systems can achieve a coefficient ofperformance (COP) in excess of 4.5, meaning that the heat output is 4.5 times the electrical input. VRV systems can use less than a quarter of the energy a gas fired boiler would use to heat the building.

Heating to ancillary spaces such as WC 's and Circulation areas shall be provided via wall mounted electric panel heaters complete with thermostatic control and 24 hour 7 day a week time control.

5.2.3 Ventilation

Ventilation will be provided by high efficiency fans with low specific fan powers (SFP) to minimise the energy consumption associated with ventilation. To further reduce energy demand ventilation system willinclude heat recovery to capture waste heat and reduce the building's heating demand.

Parameter	'Be Lean' Performance	NDBSCG* Limits
NCM system type	VRV System	N/A
Heat source	Heat pump (electric)	N/A
Fuel	Electricity	N/A
Heating seasonal efficiency (SCOP)	4.5	2.5
Cooling system type	Heat pump (electric)	N/A
Cooling SEER	4.0	N/A
Cooling nominal EER	4.0	2.6
Cooling radiant fraction	0	N/A
Does the system have provisions for metering?	Yes	Yes
Does the metering warn "out of range values"?	No	N/A
Ventilation types	Zonal supply and extract ventilation unis serving a single room or zone with heating and heat recovery – With demand control	N/A
Ventilation SFP	1.1	1.9 W/l/s**
Heat Recovery Efficiency	75%	67%
Ductwork Leakage Rating	N/A	N/A
AHU Leakage Rating	L2	L2

**Non-Domestic Building Services Compliance Guide 2013 (NDBSCG).*

***Max allowable for a central balanced system with heating and heat recovery*

Other Areas i.e WC's, Circulation etc.

Parameter	Baseline Performance	NDBSCG* Limits
NCM system type	Local Panel Heaters	N/A
Fuel	Electricity	N/A
Heating seasonal efficiency (SCOP)	1.0	N/A
Cooling system type	Heat pump (electric)	N/A
Does the system have provisions for metering?	Yes	Yes
Does the metering warn "out of range values"?	Yes	N/A
Ventilation types	Zonal supply and extract ventilation unis serving a single room or zone with	N/A

heating and heat recovery – With demand control

5.2.4 Hot Water

Heating is to be provided by localised point of use electric water heaters.

5.2.5 Proposed Building – Air Permeability (Be Lean)

The development will target an air permeability of 2 m^3/m^2.hr @ 50 Pa. This is significantly better than the maximum allowable permeability of 10 m^3/m^2.hr @ 50 Pa. This will help to reduce heating demands and peak cooling demands on hot days.

5.2.6 Proposed Building – Lighting (Be Lean)

Lighting will be provided by high efficiency lighting with a luminaire efficacy with an overall average for the building in the region of 120 lm/cW. This is twice as efficient as the minimum requirements under building regulations.

Occupancy Detection will be applied to zones where practical to reduce artificial lighting demand when not required.

In addition, the lighting has the following parameters:

- Daylight Dimming has also been applied to the office areas where there is adequate access to daylight.
- Lighting systems have provision for metering and have the facility to warn “out of range” values.

5.2.7 Proposed Building – Hot Water System (Be Lean)

Parameter	Proposed Performance	NDBSCG* Limits
Hot water generator type	Instantaneous point of use	N/A
Hot water fuel type	Electricity	N/A
Heating seasonal efficiency (SCOP)	100%	100%
Hot water delivery efficiency	95%	N/A
Hot water storage volume	N/A	N/A

**Non-Domestic Building Services Compliance Guide 2013 (NDBSCG).*

As hot water demand will be low for a building of this nature, point of use electric water heaters will be specified to reduce losses associated with storage and circulation inherent in central

5.3 Be Clean

The London heat map has been referred to and there are currently no existing heat networks within thevicinity of the site. There is a proposed Hillingdon network approximately 1785 m from the site.

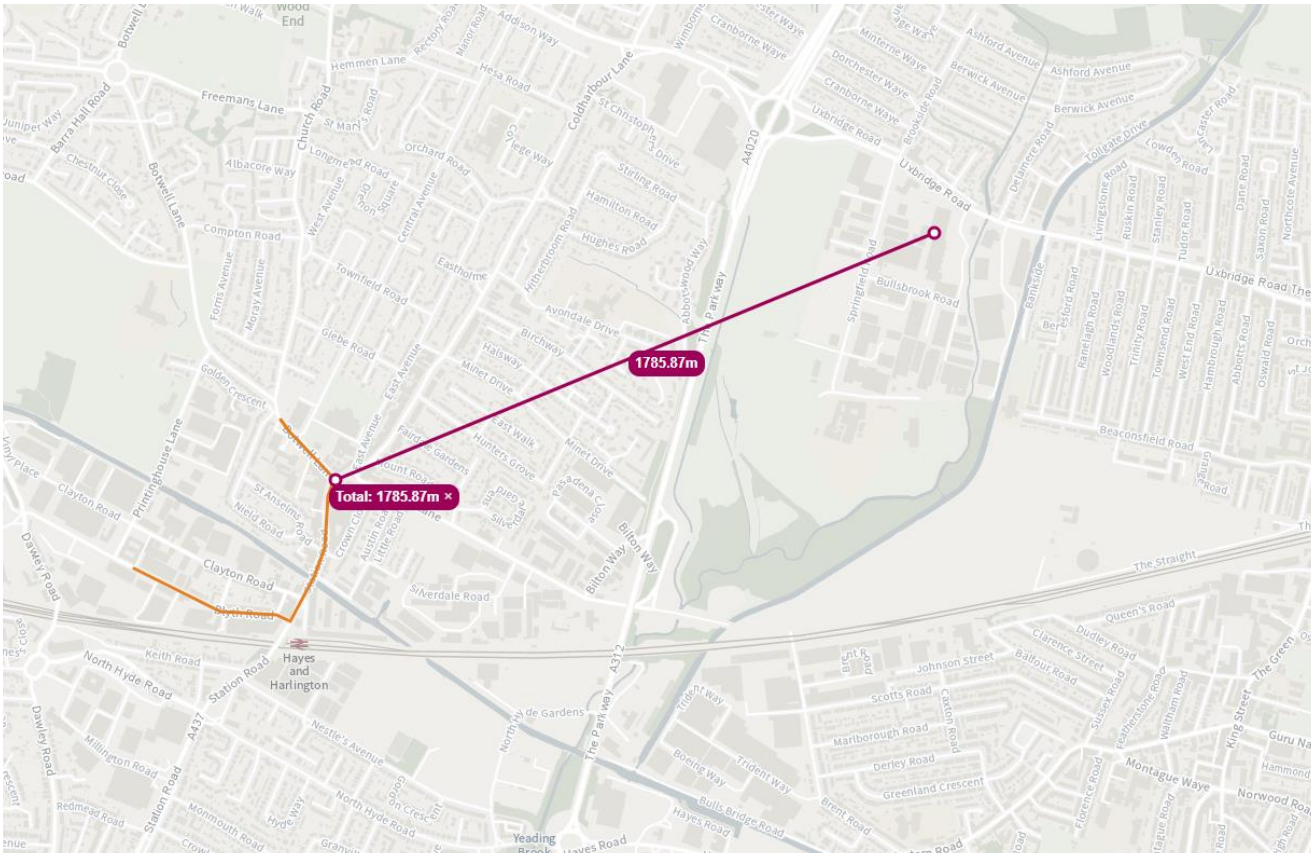


Figure 3 – Proposed nearby heat networks in orange, with the proposed site location shown by the red marker.

The proposed network is of too great a distance for connection to feasible. Furthermore, the proposed VRV heat pump system will achieve high efficiencies which are likely to show improvements on what the Euston Road Heat Network can offer while minimising distribution losses associated with large scale heat networks.

The proposed development will incorporate space for future plate heat exchangers to allow for future connection to a district heating scheme for export of low grade heat.

5.4 Be Green

An assessment has been undertaken to determine the feasibility of incorporating a range of LZC technologies. The assessment is detailed below.

LZC Technology	Overview	Application	Site Specific	Consider
Photovoltaics	Converts sunlight to DC electrical power. Requires inverter to convert to DC. Ideally located south facing roof.	Wide range of building types, schools, offices, hotels etc. Site with good access to solar radiation.	Roof space available for system consideration – 35kW Peak system to be installed	Yes
Community Heating	Utilises waste heat from process such as large-scale power generation where the majority of heating comes from waste heat.	Hotels, hospitals, leisure centres, some industrial premises.	Local district heating scheme unavailable	No
Air Source Heat Pump (Elec)	A heat exchanger extracts heat from the air. The heat pump raises the temperature of refrigerant via the compression cycle and reverse for cooling. Used for space heating, hot water and cooling.	All building types where heating and cooling required. Air to water suited for low temperature systems i.e. underfloor heating.	Heating and cooling required to scheme. Sufficient external space required for condensers – VRV heat pump system to be installed	Yes
CHP - Natural Gas	Generates both electricity and heat using fossil or renewable fuels.	Hotels, hospitals, leisure centres, some industrial premises.	Relatively low hot water requirement	No
Solar Hot Water Heating	Solar collectors (flat plate or tube) transfer energy into transfer liquid to a closed loop twin coil hot water cylinder. Ideally located south facing roof.	Domestic and commercial applications with high hot water load; leisure centres, canteens, washrooms.	Sufficient roof space, although fairly low hot water demand.	No
Air Source Heat Pump (Gas)	As electric heat pump using gas as fuel for the compressor. Relatively carbon efficient in comparison with gas fired boiler.	All building types where heating and cooling required. Air to water suited for low temperature systems i.e. underfloor heating.	Heating and cooling required to scheme. Sufficient external space required for condensers. Typical system efficiencies relatively low compared with electric	No

Ground Source Heat Pump (Elec)	Takes up heat from the ground and releases it at high temperatures. Heat can be used for space heating and domestic hot water.	All building types where heating and cooling required. Air to water suited for low temperature systems i.e. underfloor heating.	Heating and cooling required to scheme. Insufficient external space required for vertical bore holes or ground loop.	**No**
Water Source Heat Pump (Elec)	Takes up heat from a local water source, lake or river and releases it at relatively low temperatures. Heat can be used for space heating and domestic hot water	All building types where heating and cooling required. Air to water suited for low temperature systems i.e. underfloor heating	Heating and cooling required to scheme. Insufficient water course on site.	**No**
Geothermal Heat Pump (Elec)	Takes up heat from a local geothermal underground courses. Heat can be used for space heating and domestic hot water.	All building types where heating and cooling required. Air to water suited for low temperature systems i.e. underfloor heating.	No local geothermal activity.	**No**
Small Scall Hydro Power, Tidal Power, Wave Power	Small scale turbines in fast flowing rivers provide electrical power. Tidal wave platform movement generates energy.	Rural and costal situations required.	No access to fast flowing rivers and site located inland.	**No**
Wind Turbine	Turbine/generator converts wind energy to electrical power. Turbines available with outputs from 600W to 2MW	Large sized turbines in non-urban or off-shore locations will be more effective	Suburban are not suitable for large turbine.	**No**

5.5 Carbon Dioxide Emissions

The carbon dioxide emissions for each stage in the hierarchy have been calculated as follows:

	Carbon dioxide emissions (tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building regulations	117	117
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Cumulative on-site savings	39	33.0
Carbon shortfall	2	N/A
	Tonnes (CO2)	
Cumulative savings for offset payment*	58 tonnes	
Cash-in-lieu contribution*	£3,470	

5.6 Be Seen

The development will incorporate extensive submetering connected to a building management system (BMS). This will allow for detailed metering and monitoring of the building's energy use. If necessary, the annual energy use will be reported to the GLA to allow investigations into the "performance gap" (the difference between predicted and actual energy use) to be undertaken.

All necessary data will be uploaded to the "Be Seen" portal as follows:

- Contextual data
- Predicted energy use (based on part L calculations)
- Actual building energy use after the building has been occupied
- Generated renewable energy
- Energy storage
- Plant parameters
- Carbon emissions

5.7 Building Regulations

As the building is a new development, it must meet the energy efficiency requirements as detailed in approved Document Part L2A 2013.

Criterion 1 – The development's building emission rate (BER) is lower than the target emission rate (TER).

Criterion 2 - All building fabric and building services efficiencies comply with the minimum requirements.

Criterion 3 – All occupied or cooled zones do not exceed the solar gains limits.

The key pages from the BRUKL are shown in BRUKL is shown in Appendix A

Note that only Baseline and Be Green scenario BRUKLs are shown, the Be Lean BRUKL is the same as the Be Green BRUKL with the exception of the PV.

5.8 Managing Heat Risk

To ensure occupant comfort and to minimise the building's energy demand the London Plan "Cooling Hierarchy" has been considered.

5.8.1 Reduce the amount of heat entering the building

The building will incorporate the following measures:

- low G-value glass and blinds to limit the solar gain through the windows
- Spandrel panels below desk level and above ceiling level to eliminate solar gain where glazing would have no daylighting benefit.

- The building fabric is of a medium weight construction, utilising a highly insulated façade at ground floor to absorb direct solar gain, rather than allow it to permeate directly through a lightweight structure. The cladding in the upper floors consists of metal panels with highly insulated wool core with low U-value to minimise heat gains and losses (to exceed Part L targets).

- Extensive external shading is to be provided around the glazed office areas to significantly reducethe solar gain in summer.

5.8.2 Minimise Internal Heat Gains

The internal heat gains will consist of occupants, office equipment and lighting. While the design team cannot not influence the future tenant's occupancy and equipment loads, highly efficient LED lighting will be specified which will reduce the associated heat gains. Furthermore, this will be coupled with occupancy and daylight controls to ensure the lighting does not operate when it is not required.

Additionally, by utilising a VRV Heat pump system rather than a low temperature hot water system, heat gains from associated pipework have been minimised.

5.8.3 Manage the heat within the building through exposed thermal mass and high ceilings

The exposed internal thermal mass of concrete slabs and exposed high ceilings in the warehouse will assist to manage the internal heat within the building.

5.8.4 Provide Passive ventilation

Due to the potential high occupancy levels at future fit out stage passive ventilation is not appropriate.

5.8.5 Provide Mechanical Ventilation

Mechanical ventilation is to be provided in all occupied areas to provide an element of free cooling.

5.8.6 Provide Active Cooling systems.

Active cooling systems are provided via VRV heat pump systems in occupied spaces but due to the steps taken earlier in the cooling hierarchy, their demand will be reduced.

6.0 Summary

The project is to construct a new 16,000m² Storage/Distribution centre within Bridgewater Retail Park, Hayes, West London.The site is within the London Borough of Hillingdon.

A range of measures to improve sustainability and reduce energy consumption have been included:

- The development will achieve a significant carbon dioxide emissions reduction 35.2% improvement over regulated carbon emissions compared to the baseline.
- The development will achieve a BREEAM rating of Excellent.
- Heating and cooling to office spaces is to be provided by high efficiency VRV systems.
- Ventilation to office spaces shall be provided via void mounted heat recovery units.
- Domestic hot water shall be produced via localised electric point of use water heaters.
- Lighting is to be provided by high efficiency LED luminaires.
- Lighting will incorporate occupancy and daylight linked controls to reduce demand.
- A roof mounted PV array will be incorporated on building two with a collector area of $170m^2$
- The Plot is being constructed as a 'shell & Core' project with only the office areas being fitted with services at the base build stage.

The carbon dioxide emissions for each stage in the hierarchy have been calculated as follows:

	Carbon dioxide emissions (tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building regulations	117	117
After energy demand reduction (be lean)	84	117
After heat network connection (be clean)	84	117
After renewable energy (be green)	78	117

The regulated carbon dioxide savings from each stage in the energy hierarchy are shown below:

	Regulated carbon dioxide savings	
	(tonnes CO2 per annum)	(%)
Be Lean: Savings from energy demand reduction	33	28.0%
Be clean: savings from heat network	0	0.0%
Be Green: savings from renewable energy	6	5.0%
Cumulative on-site savings	39	33.0
Carbon shortfall	2	N/A
	Tonnes (CO2)	
Cumulative savings for offset payment*	58 tonnes	
Cash-in-lieu contribution*	£3,470	

7.0 Appendix A – BRUKL

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name — **Shell and Core**

Hayes

As designed

Date: Thu Jan 13 08:13:26 2022

Administrative information

Building Details

Address: Bridegwater Retail Park , Hayes, London, N17 0RU

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.b.0

Interface to calculation engine: Energy Simulator

Interface to calculation engine version: 10.07.01

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

Certifier details

Name: Carlton Garratt

Telephone number: 01384 397777

Address: Briar, Capstan House, Brierley Hill, DY5 1XL

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	14
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	14
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	9.3
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	0.26	0.26	"Wall 1"
Floor	0.25	0.11	0.15	"Exposed Floor 1"
Roof	0.25	0.16	0.16	"Exposed Roof 1"
Windows***, roof windows, and rooflights	2.2	1.6	1.6	"Window 1"
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	1.3	1.3	"Door 1 (Vehicle Access Door)"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

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

* 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	2.05

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Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	15875.1	15875.1
External area [m²]	37785.6	37785.6
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	2	3
Average conductance [W/K]	6042.58	11078.6
Average U-value [W/m²K]	0.16	0.29
Alpha value* [%]	6.2	20.02

* 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/m²]

	Actual	Notional
Heating	2.4	2.5
Cooling	2.4	1.64
Auxiliary	2.65	1.41
Lighting	10.77	20.8
Hot water	4.23	4.89
Equipment*	31.27	31.27
TOTAL**	**22.45**	**31.24**

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

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	1.61	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/m²]	176.81	258.4
Primary energy* [kWh/m²]	59.7	80.91
Total emissions [kg/m²]	9.3	14

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