



**SUSTAINABILITY STATEMENT AND LOW/ZERO CARBON
REPORT**

**NEW HIGH BAY WAREHOUSE,
H-PACK, WREXHAM**

1483-REP-001
REVISION P01
08/11/2022

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1.0 Introduction

This report has been prepared for the purpose of demonstrating the proposed route to compliance with Building Regulations Part L for the new High Bay Warehouse for H-Pack at Davy Way, Wrexham.

The statement has been prepared to demonstrate the proposed development will meet the local policy requirements and assess the feasibility of low and zero carbon (LZC) technologies for the project.

The modelling shows that in order to achieve compliance with reasonable margin at this stage, renewable technologies would be required – from the feasibility it was established that a photovoltaic (PV) array would be the most suitable solution, and a yield of circa 43,500 kWh per annum is required. This equates to circa 120No. typical 375W PV panels.

2.0 Modelling Methodology

Using the Ratcliffe Groves Partnership architectural drawings current at the time of writing and this submission, a fully detailed model was produced in EDSL Tas. The model was created by a fully qualified Level 5 low carbon energy assessor, accredited via the software provider and CIBSE. The assessor is a Chartered Engineer, with over 20 years experience in building services design.

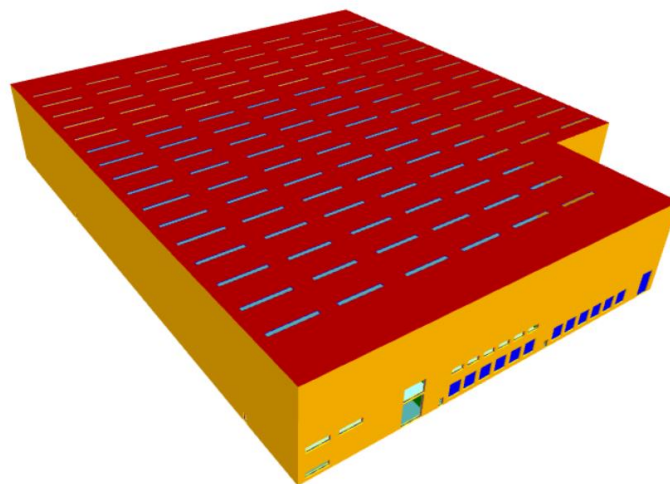


Figure 1: Screenshot of developed thermal model

The report takes into account the recognised energy hierarchy to “Be Lean, Be Clean, Be Green”, i.e. to minimise the building’s energy usage before applying renewable technologies to the design.

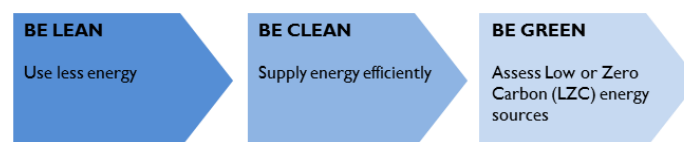


Figure 2: Energy Hierarchy

Further work will be required at later stages in the “design and build” process to ensure that the requirement to comply with the relevant targets and all statutory guidelines / local planning enforcement requirements are met in line with this report as the project progresses.

A review of the local planning policy (Wrexham Unitary Development Plan) has determined there is no requirement over and above compliance with Part L2A of the Building regulations noted or requested. An updated Local Development Plan appears to be in preparation, however is not yet in force. On this basis, the modelling and report have assessed the building on achieving compliance only. It should also be noted, the project has been registered with Building Control prior to 15th June 2022, so is

currently being assessed on the 2013 version of Part L and not the updated 2021 version. Not a start on site is required prior to 15th June 2023 in order for this to be applied, should this not be achieved this report will need to be updated to reflect the latest Building Regulations in force.

3.0 Energy Use in the Built Environment

In line with hierarchy of intervention it is essential to ensure that an efficient building and building services systems have been designed and proposed prior to the consideration of LZC technologies. Design measures that should be considered include, but are not limited to:

- Good insulation of walls, roofs and floors to reduce heat losses (but not at the expense of summertime overheating).
- Maximisation of potential for natural ventilation (where ambient noise levels and room function permit).
- Minimisation of requirements for mechanical cooling, by the application of good ventilation techniques.
- Reduction in electrical power usage via specification of efficient lighting controls, high efficiency luminaires and optimisation of daylighting through careful façade and building design.
- Specification of high efficiency plant/equipment.
- Minimising uncontrolled infiltration by robust construction details.
- Use of low energy ICT equipment.

To this end, the proposed design should promote reduced CO₂ emissions from delivered energy consumption by minimising operational energy demand through passive and best-practice measures. If these measures are incorporated then the addition of a renewable energy system will have a greater impact – renewable energy sources should not be used as an alternative to a well-designed building. The energy usage figures within this report have been based on reasonable but not unrealistic assumptions in line with good industry custom and practice at the present time.

4.0 Building and Services Design

The building services for the development should be designed with energy efficiency at the forefront, with plant and systems selected to have efficiencies in excess of those required by legislation to maximise carbon reduction. A summary of the assumed preliminary servicing strategy is provided below, which forms the basis of minimising energy usage of the development in line with the above.

4.1 Description of Services

Heating and cooling will be provided to the offices and canteen via high efficiency variable refrigerant flow/variable refrigerant volume (VRF/VRV) air source heat pump systems. These systems promote high efficiency and minimise energy use by moving heat or coolth around the building before the application of further primary energy to condition the space.

Remaining areas of the office zone, such as the stair cores, toilets etc. shall be heated via direct electric panel heaters.

The offices and canteen have been assumed with mechanical supply and extract ventilation, due to their single sided aspect and allow for future fit-out/partitioning of the spaces which may limit the possibility for natural ventilation.

Extract ventilation shall be provided to the changing areas, WC and cleaners store areas in line with Building Regulations Part F minimum requirements and CIBSE guidance.

Hot water will be generated at the point of use via electric water heaters, which minimises and storage and distribution energy loss.

Lighting is proposed as high efficiency LED lighting throughout. To minimise energy usage, daylight dimming in conjunction with presence/absence detection shall be utilised in the office areas. PIR presence control shall be utilised in all other ancillary areas.

It has been assumed that the warehouse shall be unheated and unconditioned at this stage. If this changes subject to any tenant fit-out (other than provision for frost protection), then the model and assessment will need to be reviewed and updated.

5.0 Building Fabric Input Parameters

Detailed specific constructions were determined with the architect prior to undertaking this pre-assessment, based on the current proposals being submitted and what is realistically achievable given the project constraints. These values were as follows:

- External Walls 0.35 W/m²K
- Ground Floor 0.25 W/m²K
- Exposed Roofs 0.25 W/m²K
- Windows/Doors/Rooflights 1.4 W/m²K, g-value 0.4
- Vehicle Access Doors 1.5 W/m²K

External windows and doors have been modelled to represent the information and opening sections as detailed on the elevations. From various model runs and analysis of the BRUKL document, a g-value of 0.4 was found to be adequate to achieve compliance with Criterion 3 in all rooms with the exception of the reception, and assist with minimising energy use through unwanted solar gain during the summer periods. An enhanced glazing spec or the provision of blinds will need to be considered for the reception area during detailed design in order to achieve compliance.

The above all meet or exceed the limiting values under Part L2A of the Building Regulations.

Equally, uncontrolled ventilation losses should be limited and the new building constructed to meet stringent air permeability targets. Whilst Part L limiting requirements are 10m³/m²/hr at 50Pa, a value of 3m³/m²/hr at 50Pa has been assumed for the development of this building to further reduce energy wastage. This is significantly below the limiting value, however should be easily achieved for a building of this size and nature with current construction methods.

6.0 Renewable and Low Carbon Technologies Feasibility

This section provides a brief overview of available renewable and low/zero carbon technologies, and discusses the advantages and disadvantages that are specific to the project. A tabulated summary of the technologies is provided at the end of this section.

6.1 Photovoltaic System (PV)

A PV system uses layers of semi-conductor material to produce electricity generated directly from sunlight. Several types of PV are available with varying costs and performance.

The efficiency is circa 20% for high performance panels, based on peak output under ideal conditions. For the panels to function effectively, they must be installed in an unshaded location, and correctly orientated based on the site latitude.



Figure 3: Typical roof mounted PV panels on a warehouse roof

Due to the design of the building, PV panels mounted on the roof would be feasible, and an ideal solution as the building is generally electrically heated.

6.2 Solar Thermal

Solar thermal panels convert solar radiation into thermal energy which can be used to supplement conventional heat generation methods such as gas boilers. There are 2 main types of system, evacuated tube collectors and flat plate collectors. Evacuated tube collectors can have efficiencies of up to 60%, and flat plate collectors of around 50%.

Similar to photovoltaic panels, the positioning of the panels requires careful consideration, however several manufactures of evacuated tube panels can lay their panels onto flat roofs without the requirement for A-frames as the tubes themselves can be set to the correct angle.

Our experience of this technology is due to the relatively low yields payback periods are high. They would also necessitate increased plant space for additional storage vessels, and would not be a cost effective addition to the current building design.

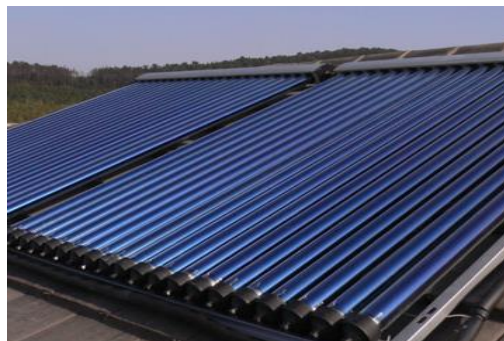


Figure 4: Evacuated tube solar thermal panels

6.3 Wind Turbines

Wind turbines convert the kinetic energy contained in wind into electricity. To ensure that they operate economically, most manufacturers recommend an average wind speed of 6ms⁻¹. The average wind speed for the site is approximately 5-6 m/s and whilst this is likely to be suitable for a reasonable yield, factors such as nearby obstacles (buildings, trees and planting), potential shadow flicker on the development and surrounding residential properties, noise etc. would suggest that this is not a suitable technology for consideration on this development.



Figure 5: Micro-Wind Turbine (multiple required for reasonable yield)

6.4 District Heating

District heating is a system for distributing heat generated in a centralized location through a system of insulated pipes for residential and commercial heating requirements such as space heating and water heating. The site does not benefit from being in proximity to a district heating network, therefore it cannot be considered further at this time.

6.5 Biomass

Biomass boilers can be used as an alternative to conventional gas boilers. Biomass, usually wood chips or pellets, are burned instead of gas. A conventional gas back-up boiler will typically still be provided to ensure the building demands are met in the event of mechanical failure or a problem with fuel supply. Biomass fuel is deemed low carbon as the fuel absorbs CO₂ whilst growing, and hence burning the fuel is merely releasing this carbon back into the atmosphere. It is not zero carbon; however, as there are carbon emissions associated with the farming, processing and transportation of the biomass.

There are two main types of solid biofuel; wood chips and wood pellets. Wood chips are cheaper to buy as they require less processing, however wood pellets have a higher energy density (in terms of kWh per m³ of fuel), and a more predictable moisture content because of its processed nature. However, this processing produces a higher costing fuel, but the regular size of wood pellets means that boilers operating on pellets are less prone to jamming and problems associated with delivery of fuel from the store.

Biomass boilers require storage for the fuel – the size of store depends on the size of boiler, and the required length of storage which is often determined by the frequency of deliveries and minimum delivery volumes. A 6 week frequency of delivery is a typical value for storage calculations. Discharge of flue gases, and inherent particulate such as ash, may also be an issue for this development.

Based on the nature of the site and the emphasis on electric as the main heating source, this technology is not considered appropriate for this development.

6.6 Heat Pumps

Heat pumps take a low grade source of heat e.g. a lake or external air, and through a process similar to that of a domestic refrigerator, “upgrade” the heat for use in a heating system, or for domestic hot water generation.

Air source heat pumps operate on the same principle as ground source heat pumps, but instead of using the earth as a heat source, they extract heat from external air. It is proposed to utilise air source heat pumps (in the form of high efficiency VRF heating/cooling systems) to serve the office areas.

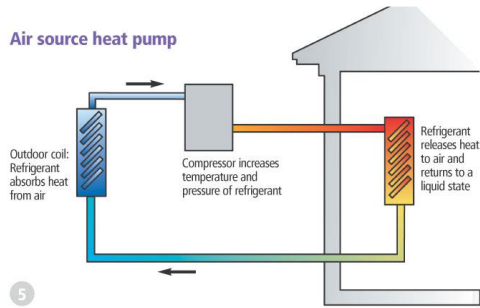


Figure 6: Air Source Heat Pump

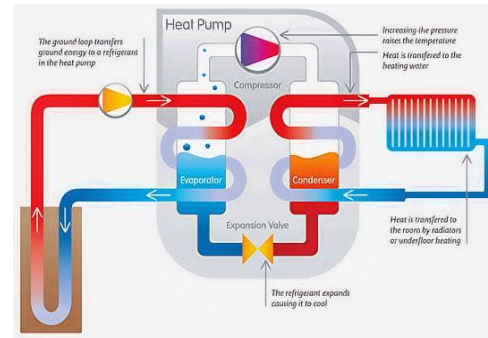


Figure 7: Ground Source Heat Pump

Ground source heat pumps would not be a cost effective or feasible addition to the current design due to the additional plant space required and servicing strategy proposed.

6.7 Combined Heat and Power (CHP)

Combined heat and power (CHP) systems comprise a generator to provide electricity, and a system to convert waste heat from the generator to useful heating energy.

Most CHP units use an automotive engine as the source of energy, so there is a maintenance requirement associated with their use.

There are also small-scale CHP units that can be run from liquid biofuel. These units generate heat and electricity with very low carbon emissions, however a reliable source of fuel would have to be sourced to make this a viable proposition for the development.

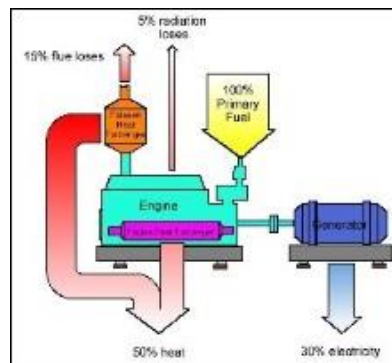


Figure 9: CHP Diagrammatic

Due to the servicing strategy proposed, CHP would not be deemed suitable for this development.

6.8 Summary

The technical feasibility of installing each LZC technology at the site has been assessed in order to discount any unsuitable options at an early stage. A summary of the feasibility process is presented in the following table:

Technology	Brief Description	Benefits	Issues/Limitations	Feasible for site
Solar Photovoltaic	Photovoltaic panels convert solar radiation into electrical energy	Low maintenance. No moving parts. Easily integrated into building design.	Any overshadowing affects panel performance. Panels ideally inclined and facing southerly direction.	Yes, ideal for site due to building design and proposed strategy
Solar Thermal	Solar thermal energy can contribute towards space heating and hot water requirements.	Low maintenance.	Limited output/high payback. Must be sized for the building base load hot water requirements. Panels ideally inclined and facing southerly direction	Yes but would require amendments to strategy
Wind Turbine	Wind generation equipment operates on the basis of wind turning a turbine to generate electricity. Small scale (1kW – 15kW) wind turbines can be pole or roof mounted.	Low maintenance/ On-going cost. Excess electricity can be exported to the grid	Planning issues. Aesthetic impact. Background noise. Space limitations on site. Minimum wind speed requirements. Wind survey to be undertaken to verify 'local' viability.	Yes, but would need to consider limitations
Biomass	Modern wood-fuel boilers are highly efficient, clean and almost carbon	Stable long term running costs. Potential good CO ₂ saving.	Large area needed for fuel delivery and storage. Reliable fuel supply chain required. Regular maintenance required. Significant plant space required. Air pollution / Clean Air Act limits use.	No
Ground Source Heat Pump (GSHP)	GSHP systems tap into the earth's considerable energy store to provide both heating and cooling to buildings.	Minimal maintenance. Unobtrusive technology. Flexible installation options to meet available site footprint.	Large area required for horizontal pipes. Full ground survey required to determine geology. More beneficial to the development if cooling is required. Integration with piled foundations must be done at an early stage.	No
Air Source Heat Pump	Electric air source heat pumps extract thermal energy from the surrounding air and transfer it to the working fluid (air or water).	Efficient use of fuel. Relatively low capital costs.	Specialist maintenance. Some additional plant space required. Potential noise issues from external condensers	Yes, to office areas etc.

Table 1: Summary of Renewable and Low Carbon Technology Energy Options

Technology	Brief Description	Benefits	Issues/Limitations	Feasible for site
Combined Heat and Power	A Combined Heat and Power (CHP) installation is effectively a mini on-site power plant providing both electrical power and thermal heat. CHP is strictly an energy efficiency measure rather than a renewable energy technology.	Potential high CO ₂ saving available. Efficient use of fuel. Excess electricity can be exported to the grid	Maintenance intensive. Sufficient base thermal and electrical demand required. Some additional plant space required.	No
District Heating	A system for distributing heat generated in a centralized location through a system of insulated pipes for residential and commercial heating requirements	Efficient use of boiler plant	Significant pipework network required, with associated losses. Not available for this site.	No

Table 1 (cont...): Summary of Renewable and Low Carbon Technology Energy Options

On the basis of the above, it is proposed to utilise a photovoltaic array if/where necessary to achieve compliance with Part L2A of the Building Regulations and reduce carbon emissions for the proposed building.

7.0 **Part L Compliance**

7.1 **Summary of Key Input Data**

As well as the u-values and design air permeability previously indicated, the following information summarises the key input information assumed for this analysis:

Weather File

The NCM Manchester TRY weather file has been utilised for the Part L analysis and is considered to accurately represent the weather for the proposed location based on the BRE SBEM Weather Locations Lookup tool.

HVAC Systems

Heat Pump Systems (based on actual equipment selections):

Heat source: Heat pump (electric): air source

Fuel type: Electricity

Cooling CoP: 3.8

Heating CoP: 4.0

Electric panel heaters to core/ancillary areas.

Warehouse untreated.

Mechanical extract is provided to cleaners, changing and WCs etc.

Mechanical extract: SFP: 0.5 W/l/s

Hot Water Services:

Hot water services are to be provided via point of use heaters

No circulating secondary return

Lighting

Lighting has been based on high efficiency LED luminaires suitable for each space.

Warehouse	140lm/W	PIR occupancy control plus daylight dimming
Offices	110lm/W	PIR occupancy control plus daylight dimming
All other areas	100lm/W	PIR occupancy control

7.2 Results and Compliance

Using the appropriate NCM profiles for each space, a Part L compliance assessment was undertaken using the model constructed.

All u-values and fabric information were taken as described above.

The baseline results were calculated as follows:

TER	17.7 kg.CO ₂ /m ² per annum
BER	18.4 kg.CO ₂ /m ² per annum

On this basis, the building did not comply with the requirements of Part L2A 2013 without further addition of renewable or Low and Zero Carbon (LZC) technologies, further review and assessment concluded that a photovoltaic array (PV) would be the most feasible method of achieving compliance (refer to section 6 of this report).

A PV array was selected based on circa 120No. 375W panels to achieve a yield of approximately 43,500 kWh per annum.

With the above PV array included the revised building results were calculated as follows which also demonstrates compliance with Part L2A:

TER	17.7 kg.CO ₂ /m ² per annum
BER with PV	17.0 kg.CO ₂ /m ² per annum

This provides a reasonable margin of compliance at this stage of the project, and demonstrates the proposed solution will achieve compliance with Building Regulations Part L2A and local policy requirements. The solution would also achieve an EPC A rating.

A copy of the draft BRUKL is provided in Appendix A for information.

Appendix A - BRUKL Report, As-designed

Project name

H-Pack

As designed

Date: Tue Nov 08 07:33:18 2022

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.4"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.4

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

Certifier details

Name:

Telephone number: 07527 065481

Address: Betton Consulting, Tower Court, Oakdale Road,
Clifton Moor, York, YO30 4XLCriterion 1: The calculated CO₂ emission rate for the building must not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	17.7
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	17.7
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	17
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 -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.35	0.35	External Wall
Floor	0.25	0.25	0.25	Ground Floor
Roof	0.25	0.25	0.25	Roof
Windows***, roof windows, and rooflights	2.2	1.4	1.4	Rooflight3
Personnel doors	2.2	1.39	1.39	Door
Vehicle access & similar large doors	1.5	1.5	1.5	Dock Level
High usage entrance doors	3.5	-	-	No high usage entrance doors in project
U _a -Limit = Limiting area-weighted average U-values [W/(m ² K)] U _a -Calc = Calculated area-weighted average U-values [W/(m ² K)] U _i -Calc = Calculated maximum individual element U-values [W/(m ² K)]				
* There might be more than one surface where the maximum U-value occurs. ** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows. *** Display windows and similar glazing are excluded from the U-value check. N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.				

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

Building services

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

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

1- Panel Heaters Nat Vent

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

2- Panel Heaters Extract Vent (5 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	0.5	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

3- VRF Mech Vent (4 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	3.8	-	1.2	0.75
Standard value	0.91*	2.6	N/A	1.1^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					
^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

1- Electric HWS

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0
Standard value	0.9*	N/A
* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.		

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		Zone	Standard
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1			
Male WC/Lockers	-	-	0.5	-	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
Female WC/Lockers	-	-	0.5	-	-	-	-	-	-	-	N/A
Cleaners	-	-	0.5	-	-	-	-	-	-	-	N/A
Dis WC	-	-	0.5	-	-	-	-	-	-	-	N/A
WC FF	-	-	0.5	-	-	-	-	-	-	-	N/A

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
Warehouse		140	-	-	47722
Open Plan Office 1		110	-	-	601
Open Plan Office 2		110	-	-	924
Canteen		-	100	-	210
Male WC/Lockers		-	100	-	162
Female WC/Lockers		-	100	-	161
Cleaners		100	-	-	21
Dis WC		-	100	-	55
Reception		-	100	22	218
Circ GF		-	100	-	199
Circ FF1		-	100	-	115
Circ FF3		-	100	-	234
Stair		-	100	-	268
Store GF		100	-	-	24
WC FF		-	100	-	101
Plant		100	-	-	161
Lobby Male		-	100	-	23
Lobby Female		-	100	-	23
Circ FF2		-	100	-	191

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?
Warehouse	NO (-58%)	NO
Open Plan Office 1	NO (-67%)	NO
Open Plan Office 2	NO (-53%)	NO
Canteen	NO (-74%)	NO
Reception	YES (+134%)	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?	NO
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]	15810	15810
External area [m ²]	41405	41405
Weather	MAN	MAN
Infiltration [m ³ /hm ² @ 50Pa]	3	3
Average conductance [W/K]	13553	13846
Average U-value [W/m ² K]	0.33	0.33
Alpha value* [%]	2.32	2.32

* 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	0.75	1.72
Cooling	0.23	0.23
Auxiliary	0.3	0.23
Lighting	12.05	18.01
Hot water	22.12	24.3
Equipment*	30.42	30.42
TOTAL **	35.46	44.48

* 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	2.75	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	6.3	9.25
Primary energy* [kWh/m ²]	108.87	84.14
Total emissions [kg/m ²]	17	17.7

* 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 SSEFF	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	78.3	0	21.7	0	0	1	0	1	0	
Notional	205	0	69.5	0	0	0.82	0	----	----	
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
Actual	222.6	0	61.8	0	26	1	0	1	0	
Notional	294.2	0	99.8	0	20.8	0.82	0	----	----	
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity										
Actual	21.1	134.8	1.5	9.9	5.8	4	3.8	4	3.8	
Notional	49.3	132.6	5.6	10.2	4.5	2.43	3.6	----	----	

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-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.35	External Wall
Floor	0.2	0.25	Ground Floor
Roof	0.15	0.25	Roof
Windows, roof windows, and rooflights	1.5	1.37	CW
Personnel doors	1.5	1.39	Door
Vehicle access & similar large doors	1.5	1.5	Dock Level
High usage entrance doors	1.5	-	No high usage entrance doors in project
U _{i-Typ} = Typical individual element U-values [W/(m²K)]			U _{i-Min} = Minimum individual element U-values [W/(m²K)]
* There might be more than one surface where the minimum U-value occurs.			

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	3