Energy Assessment

Former GSK site, Stockley Park, Hillingdon

2202 Rev 02

July 20

Revision record

Revision	Description	Date	Prepared by	Checked by	Approved by
01	Preliminary issue for information	17/07/2020	IA	NBE	NBE
02	Comments included	21/07/2020	IA	NBE	NBE

Disclaimer

This report has been prepared by Yonder Limited, with all reasonable skill, care and diligence within the terms of the contract with the client, and in line with our general terms and conditions of business.

We disclaim any responsibility to the client and others of any matters outside the scope above.

Whilst the simulations have been undertaken in good faith using reasonable skill and care, Yonder Limited 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.

This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or part thereof, is made known. Any such party relies on the report at its own risk.

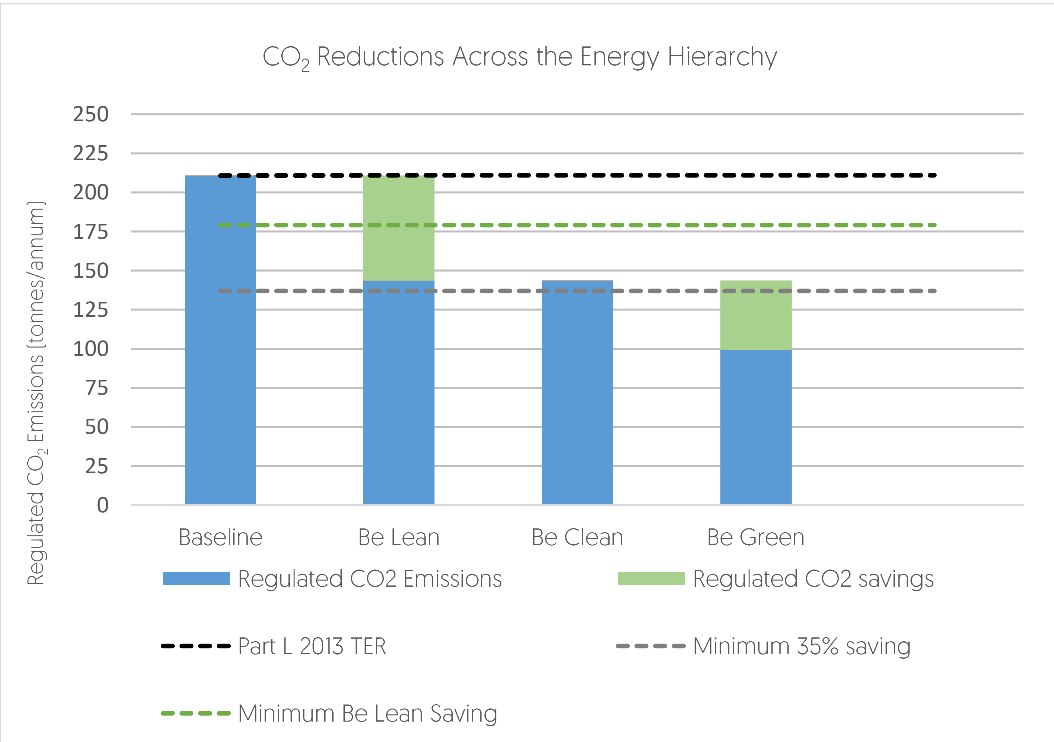
Executive summary

This report details the results of the energy assessment of this proposed development in line with the New London Plan Intend to Publish (ItP) 2019.

The proposed development is for two Class B1c/B2/B8 units with ancillary office with office spaces, one building is 18,500 m^2 and the other 13,650 m^2. Both units will it be classed as a Major Development and therefore will be expected to achieve a minimum on site CO_2 saving of 35% in line with the energy strategy following the London Plan Energy Hierarchy. In line with London Plan Intend to Publish (ItP) 2019 and the pre-application comments, it is expected that the development should achieve the 35% CO_2 reductions using SAP10 carbon factors. In addition, the development is expected to achieve net zero carbon, either on site or off site with any carbon shortfall to net zero being paid into the relevant borough's carbon offset fund. All calculations have been presented using SAP10 carbon factors, although SAP 2012 and SAP 10 figures are reported in the Appendix.

The below figure and table shows that the development will achieve a 32% CO_2 Be Lean saving. Total CO_2 emission calculations show that the predicted Building Emissions Rate (BER) improves on the Baseline Target Emissions Rate (TER) by 53%, therefore far exceeding the minimum London Plan requirements of 35%. The approach to meeting this carbon saving is in line with that prescribed by Greater London Authority Energy Assessment Guidance (October 2018).

The shortfall in net zero carbon will be met via an offset payment of £178,200.



	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	67	32%
Savings from heat network / CHP	0	0%
Savings from renewable energy	45	21%
Total Cumulative Savings	**112**	**53%**

The calculation confirms that not all carbon savings can be achieved onsite to achieve net zero carbon, therefore the below cash contribution is required.

Cumulative carbon emissions for offset payment (tonnes CO_2 over 30 years)	2,970
Cash contribution	£178,200

Appendix B contains BRUKL output documents for each stage of the Energy Hierarchy.

Contents

Introduction

The purpose of this report is to demonstrate that the proposed scheme will comply with the New London Plan ItP and the proposed pre-planning advice. The report has been written in line with Greater London Authority guidance on preparing energy assessments as part of planning applications (October 2018) but also the emerging draft consultation guidance on preparing energy assessments 2020 as mentioned in the pre-application advice received for this site.

The model input data is based upon the information provided and as detailed throughout this document and in Appendix A.

Accreditation Details	
Name:	Ian Andrews
Assessor Number:	LCEA176847
Accreditation Scheme:	CIBSE Certification Limited
Qualifications:	NOS5
Trading Name:	Yonder Limited
Address:	Third Floor, Concordia Works, 30 Sovereign Street, Leeds LS1 4BA
Telephone No:	01134 931 280

Planning Policy - London Plan 2019

The emerging New London Plan is expected to be adopted in late 2020. The New London Plan Intend to Publish was published in December 2019 and has been through examination. The Mayor and SOS are currently discussing the proposed amendments. Those policies to which no amendments are sought are considered to have weight in determining planning applications. The relevant policy relating to minimising greenhouse gas emissions is below;

Minimising Greenhouse Gas Emissions

Policy SI2 Minimising greenhouse gas emissions

A Major development should be net zero-carbon116C. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

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

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

3) be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site. Where zero-carbon is used in the Plan it refers to net zero-carbon – see glossary for definition.

3A) 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 Regulations117 is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:

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

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

Managing Heat Risk

The relevant policy relating to managing heat risk is detailed below;

Policy SI4 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 high ceilings

4) provide passive ventilation

5) provide mechanical ventilation

6) provide active cooling systems.

9.4.1 Climate change means London is already experiencing higher than historic average temperatures and more severe hot weather events. This, combined with a

Draft London Plan – consolidated changes version – Clean July 2019

growing population, urbanisation and the urban heat island effect, means that London must manage heat risk in new developments, using the cooling hierarchy set out above Whilst the cooling hierarchy applies to major developments, the principles can also be applied to minor development.

9.4.2 In managing heat risk, new developments in London face two challenges - the need to ensure London does not overheat (the urban heat island effect) and the need to ensure that individual buildings do not overheat. The urban heat island effect is caused by the extensive built up area absorbing and retaining heat during the day and night leading to parts of London being several degrees warmer than the surrounding area. This can become problematic on the hottest days of the year as daytime temperatures can reach well over 30˚C and not drop below 18˚C at night. These circumstances can lead many people to feel too hot or not be able to sleep, but for those with certain health conditions, and 'at risk' groups such as some young or elderly Londoners, the effects can be serious and worsen health conditions. Green infrastructure can provide some mitigation of this effect by shading roof surfaces and through evapotranspiration. Development proposals should incorporate green infrastructure in line with Policies G1 Green infrastructure and G5 Urban greening.

9.4.3 Many aspects of building design can lead to increases in overheating risk, including high proportions of glazing and an increase in the air tightness of buildings. Single-aspect dwellings are more difficult to ventilate naturally and are more likely to overheat, and should normally be avoided in line with Policy D4 Housing quality and standards. There are a number of low-energy measures that can mitigate overheating risk. These include solar shading, building orientation and solar-controlled glazing. Occupant behaviour will also have an impact on overheating risk. The Mayor's London Environment Strategy sets out further detail on actions being taken to address this.

9.4.4 Passive ventilation should be prioritised, taking into account external noise and air quality in determining the most appropriate solution. The increased use of air conditioning systems is not desirable as these have significant energy requirements and, under conventional operation, expel hot air, thereby adding to the urban heat island effect. If active cooling systems, such as air conditioning systems, are unavoidable, these should be designed to reuse the waste heat they produce. Future district heating networks are expected to be supplied with heat from waste heat sources such as building cooling systems.

9.4.5 The Chartered Institution of Building Services Engineers (CIBSE) has produced guidance on assessing and mitigating overheating risk in new developments, which can also be applied to refurbishment projects. TM 59 should be used for domestic developments and TM 52 should be used for non-domestic developments. In addition, TM 49 guidance and datasets should also be used to ensure that all new development is designed for the climate it will experience over its design life. Further information will be provided in guidance on how these documents and datasets should be used.

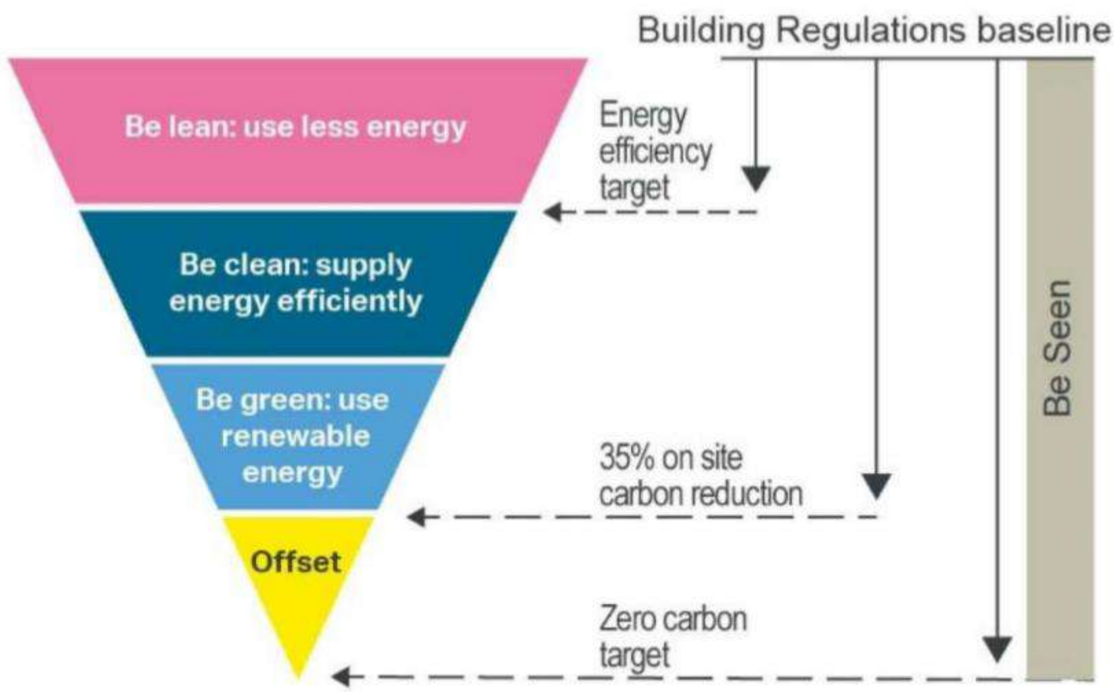
Methodology

IES Virtual Environment dynamic thermal simulation software version 2019.2.0.0 has been used to carry out the calculations and simulations required to demonstrate compliance with Policy SI2 of the London Plan.

The simulations for criterion 1 CO_2 emission calculations have been carried out utilising the Apache calculation engine, which is an approved calculation method validated for ADL2A Compliance Calculations. The BRUKL compliance check version is v5.6.a.1.

The CO_2 emission rate calculations use the National Calculation Methodology (NCM) standard activity templates which are assigned to each activity zone for the purpose of Building Regulations CO_2 compliance. These templates set out the occupancy profiles usage, internal gains and plant operation in each zone.

This energy strategy has been prepared using the London Plan Energy Assessment guidance 2020 and follows the energy hierarchy are detailed in thus document. The below image shows the Energy Hierarchy.



External weather data

The Chartered Institute of Building Services Engineers (CIBSE) weather files (TRY and DSY) are used mainly to show compliance with UK Building Regulations. They contain whole-year weather variables for various locations throughout the UK designed for use in dynamic thermal simulation.

TRY data, Test Reference Year, contains 'typical' weather data for the selected location, and is used primarily for assessment of criterion 1 (CO_2 emissions) of Building Regulations Part L (England / Wales) and Section 6 (Scotland).

London weather data has been used for each calculation along the Energy Hierarchy.

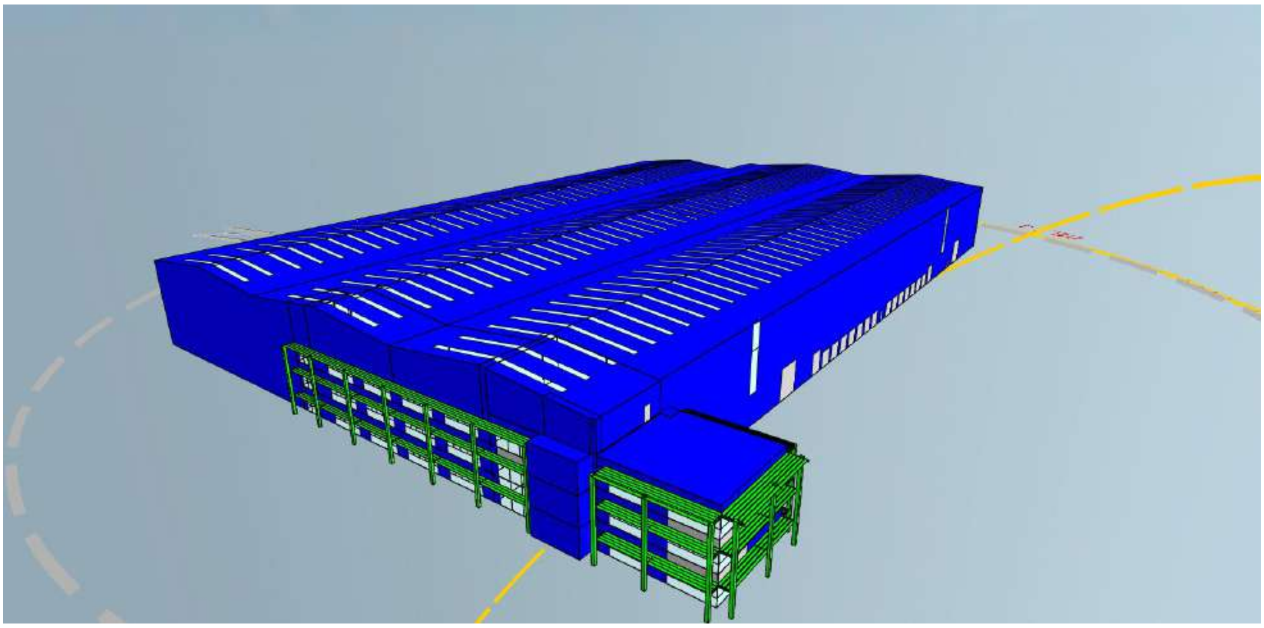
Model data

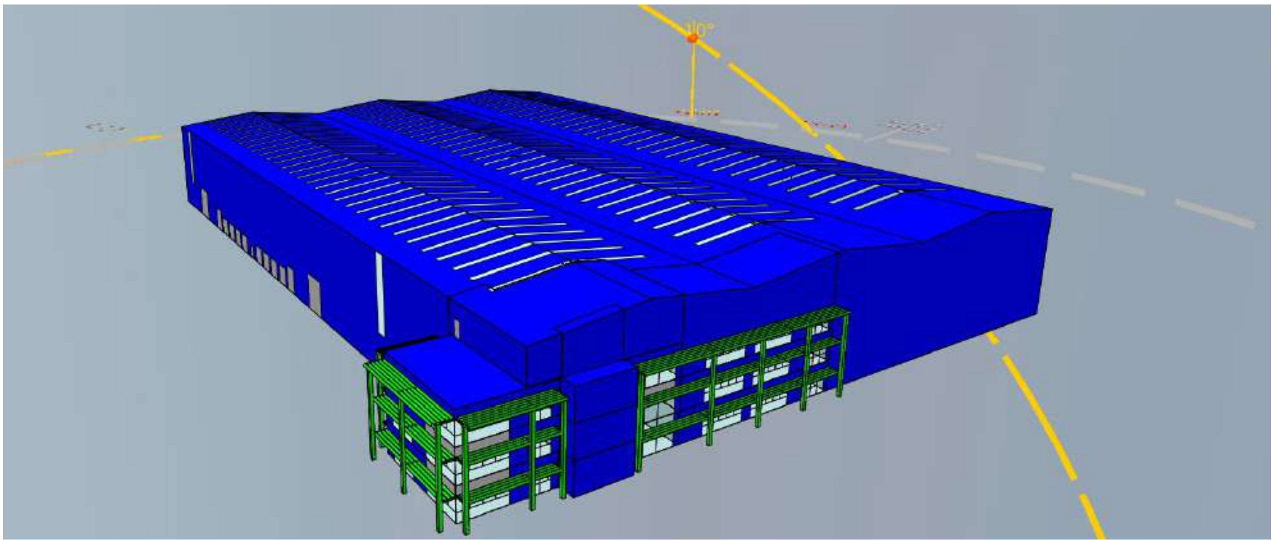
The thermal model has been built using the input data detailed in Appendix A and the information detailed throughout this document.

Incoming drawing register

Drawing title	Discipline	Drawing number	Revision
DC2 Plan	Architecture	30928-PL-205	A
DC1 Plan	Architecture	30928-PL-202	A
DC1 Elevations	Architecture	30928-PL-203	B
DC2 Elevations	Architecture	30928-PL-206	B

Model Images





Energy hierarchy – Be Lean

Demand reduction (Be Lean)

8.1. All applications referred to the Mayor are expected to exceed Building Regulations requirements (Part L 2013) through demand reduction measures alone (see Figures 1 and 2). This should be achieved for domestic and non-domestic uses. Energy assessments must therefore set out the demand reduction measures specific to the development and demonstrate the extent to which they meet and then exceed Building Regulations. Measures typically include both architectural and building fabric measures (passive design) and energy efficient services (active design), as described in the SPG. Introducing demand reduction features is encouraged at the earliest design stage of a development. Applicants should note that the Mayor has set new efficiency targets in the new draft London Plan:

1. Domestic developments should achieve at least a 10 per cent improvement on Building Regulations from energy efficiency

2. Non-domestic developments should achieve at least a 15 percent improvement on Building Regulations from energy efficiency.

A summary of demand reduction measures is listed below.

Input data

Element	Description	Proposed area-weighted u-value (W/m2.K)	Area-weighted average (Table 3, AD L2A (a))
External Walls	Metal, insulation, metal	0.35	0.35
Internal Walls (Warehouse/Office)	Plasterboard, insulation Plasterboard	0.35	n/a
DC1 Warehouse Ground Floor	Ground, concrete	0.11	0.25
DC2 Warehouse Ground Floor	Ground, concrete	0.16	0.25
Office Ground-Contact Floors	Ground, insulation, concrete	0.25	0.25
Internal Floors	Ceiling Tiles, cavity, concrete, screed	n/a	n/a
Roof	Metal, insulation, metal	0.23	0.25
Rooflights	Triple glazed polycarbonate	1.30	2.20
Windows	Doubled Glazed LowE	1.50	2.20
Pedestrian doors	Insulated doors	2.20	2.20
Vehicle access and similar large doors	Insulated doors	1.50	1.50

Element	Description	g-value (BS EN 410)	Light transmittance (LT)
General Glazing	Doubled Glazed LowE	0.36	0.65
Curtain Wall Glazing	Doubled Glazed LowE	0.36	0.65
Rooflights	Triple glazed polycarbonate	0.55	0.58

Air Permeability	Description	This building (Design Value) m3/(h.m2) @ 50 Pa	Worst acceptable standard m3/(h.m2) @ 50 Pa
DC1		1.5	10
DC2		1.5	10

Metering

System	Metered?	Warn out of range values?
Lighting	Yes	Yes
HVAC	Yes	Yes

Power factor correction

Assumed to be installed, achieving a PFC of >0.95

HVAC details

Heating to all office areas spaces via gas fried boilers serving radiators with a heating efficiency of 96%.
Supply & Extract Ventilation AHUs to have a maximum specific fan power of 1.55 W/l/s with a heat recovery efficiency of 75%.
Dirty extract supplied via a central twin fan with a maximum specific fan power of 0.5 W/l/s

Hot water

The building is to be served by gas fired boilers with a seasonal efficiency of 96% with a storage volume of 500 l with a standing loss of 0.007 kWh/l/day with a 180 m secondary circulation loop length. Circulation losses are assumed to be 8.62 W/m with a pump power of 200 W. This system is augmented with a solar water heating system consisting of 11 m^2 flat solar collector. Full details of the solar heating system are provided in the input data section.

Be Lean Results

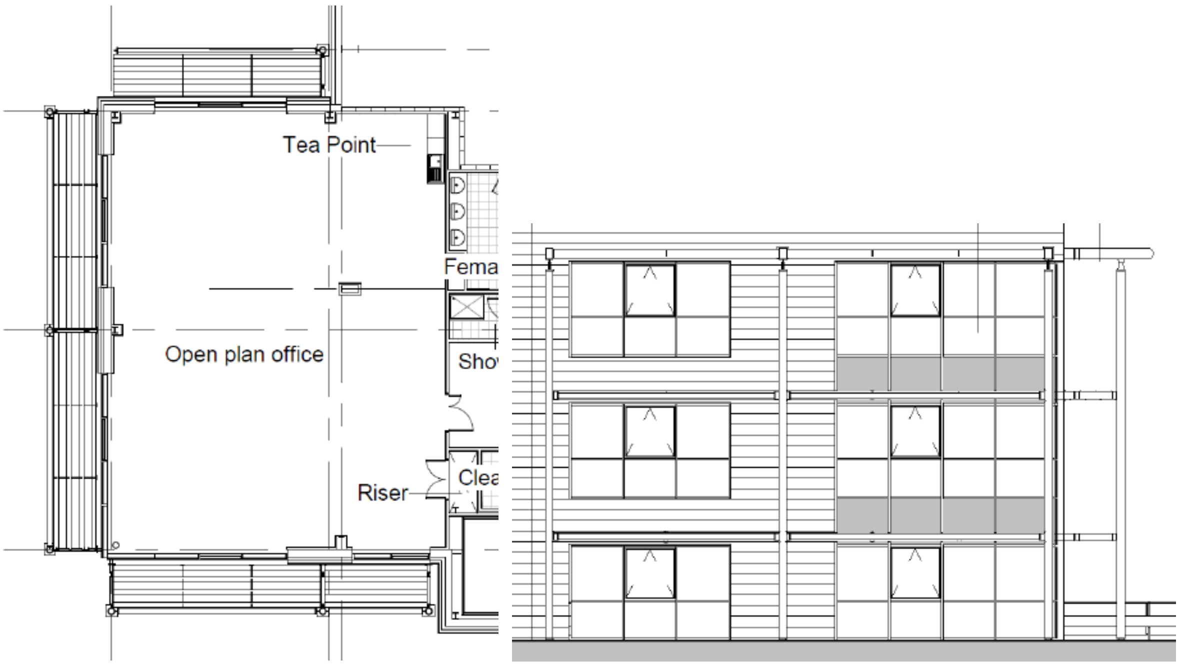
As can be seen from the below table, savings from fabric and buildings services are expected to reduce the CO_2 emissions by 32% across the site achieving the minimum Be Lean savings required by London Plan 2019.

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	67	32%
Savings from heat network / CHP	-	-
Savings from renewable energy	-	-
Total Cumulative Savings	**167**	**32%**

Overheating

As this proposed building has followed the similar building design of neighbouring industrial units it is reasonable to expect these units overheating and indeed ventilation strategy should comply with the requirements of TM52 for the London TM49 weather files as required by London Plan 2019. The buildings will follow the cooling hierarchy and a brief summary of the measures being proposed to minimise overheating are below;

1. Buildings orientated to reduce solar gains, with the majority of windows facing north, east or west.
2. Lower amounts of glazing.
3. Reduction of internal gains where possible.
4. External shading to minimise solar gains to the office spaces.
5. Glazing G-values as low as 0.36 to reduce solar gains to the spaces.
6. Top hung unrestricted openable windows to promote natural ventilation as well multiple openings in different orientations to promote cross ventilation as shown below.
7. Mechanical ventilation with a potential to be used overnight for night-time cooling.
8. Mechanical ventilation with a cooling coil to reduce supply temperature to no lower than 16 degrees.



At detailed design stage a full dynamic simulation overheating model in accordance with CIBSE TM52 with the London TM49 weather files will be completed to ensure the building complies with the requirements of London Plan 2019 for managing heat risk. At this stage there is a strategy in place that should comply with the requirements, however, if additional ventilation is required there is the option to increase to number of window openings, increased mechanical ventilation and other measures such as internal blinds.

Energy hierarchy – Be Clean

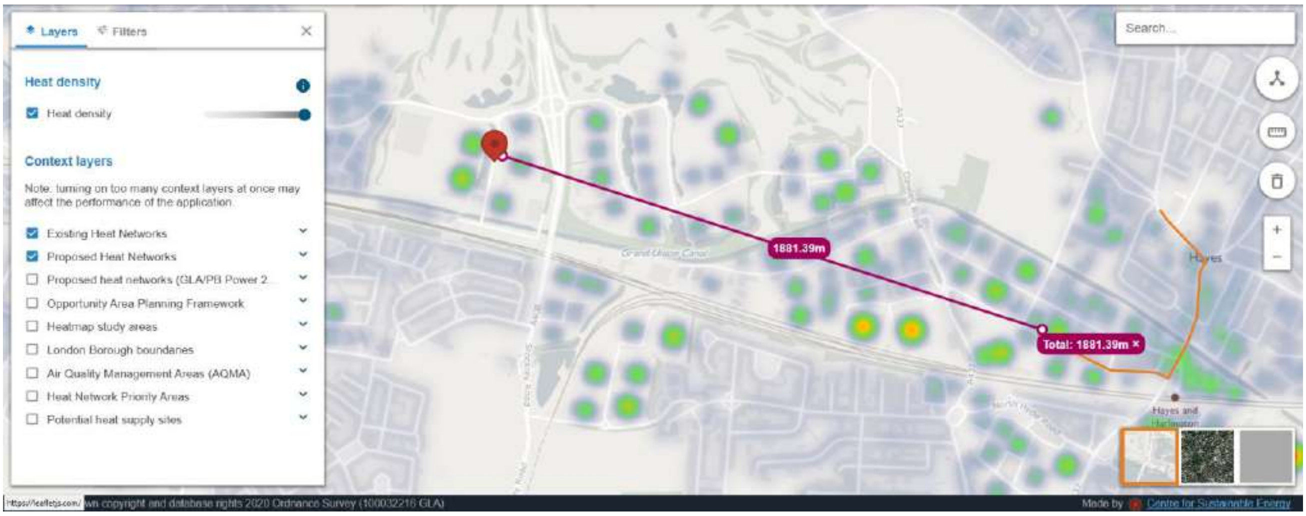
GLA Energy Assessment Guidance
10.1 Once demand for energy has been minimised, all planning applications must demonstrate how their energy systems will supply energy efficiently and reduce CO_2 emissions. The table below should be used to select the appropriate scale of system.

Hierarchy for selecting an energy system	
Connection to an area wide heat network	*Where proposed developments are located near to existing or planned networks, connection must be prioritised.*
Communal heating system	***Site-wide heat network*** *Where proposed developments are located in areas of decentralised energy potential, but no heat networks currently exist or are planned, developers should provide a site-wide heat network served by a single energy centre to future proof the development for easy connection to a wider heat network in the future.* ***Building-level heating system*** *Appropriate for single building applications or low-density developments with residential blocks, where no district heating networks are planned or feasible.*
Individual heating system	*Appropriate for low density individual housing, where no district heating networks are planned or feasible, and where evidence is provided that a site-wide heat network is uneconomic.*

District Heating

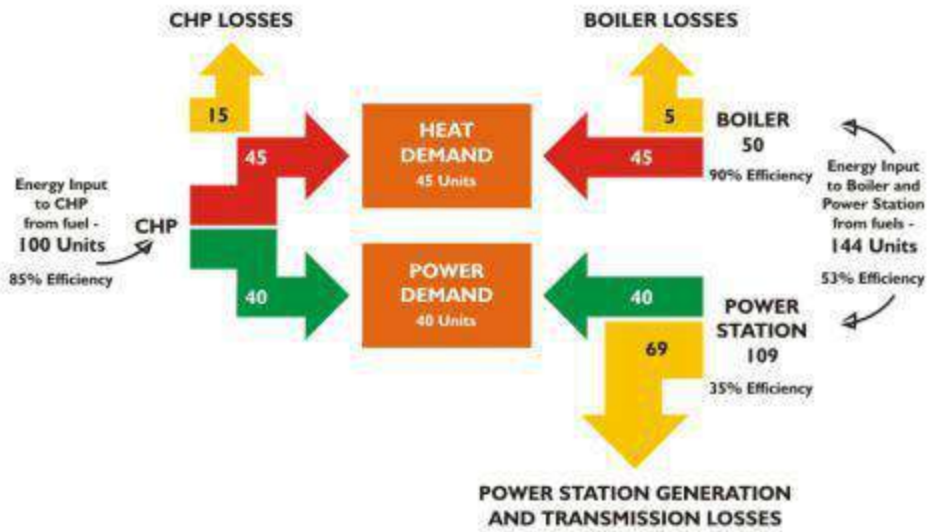
The London Heat Map indicates that there are no existing or proposed site-wide heat networks existing or planned within 500m of the development, therefore connection is not feasible. However, the use of mains gas in a building-level heating system means that connection to a future heat network may be possible.

Because no district heating or CHP system is proposed for the building, there is no BRUKL for the Be Clean scenario.



Combined Heat & Power (CHP)

Combined heat and power systems use a gas fuelled engine to generate both electricity and heat. CHP, or co-generation as it is also known, is the process of capturing and using the waste heat produced by the generation of electricity.



By generating heat and power simultaneously, CHP can reduce carbon emissions by up to 30% as shown above, compared to the separate means of conventional generation via a boiler and power station.

To make CHP viable it normally needs to operate for a minimum of 17 hours a day, 7 days a week, with minimal stopping and starting. If there is not a sufficient base load the CHP will keep tripping out. Excess heat generated by the CHP can be 'dumped' by an Intercooler, however if the heat rejection is too high the system becomes financially unviable. CHPs should generally only be sized on hot water generation requirements. The lack of a continuous demand for hot water, and summer shut-down of the heating system means that this technology is unlikely to be financially attractive or give reasonable CO_2 savings for the proposed building at present.

Combined heat and Power is unlikely to be viable. CHP technology benefits projects where a suitable base loading is present. It is anticipated that the heating and hot water loading may be intermittent.

Be Green low/zero carbon technology

GLA Energy Assessment Guidance
11.1 Energy assessments should set out consideration of and commitment to installing renewable energy technologies in line with Policy 5.7 of the London Plan. Within the main body of the energy assessment, detailed site-specific analysis should only be provided for those renewable energy technologies considered feasible. Site specific analysis for those technologies not considered feasible should be included in an appendix.

11.2 The GLA expects all major development proposals to maximise on-site renewable energy generation. This is regardless of whether a 35 per cent target has already been reached through earlier stages of the energy hierarchy. In particular, solar PV should be maximised on roof spaces.

11.3 Information required on renewable energy generation:
- *An assessment of what is achievable and compatible with the measures already implemented in steps one and two of the energy hierarchy should be provided.*
- *Applicants should provide calculations to demonstrate that their chosen renewable system or systems will reduce CO_2 emissions. The percentage CO_2 reduction from renewable energy should be expressed relative to the Part L 2013 regulated energy baseline.*
- *High efficiency systems (e.g. state of the art PV panel models) and innovative technologies should be considered in the interest of maximising on-site CO_2 reductions.*
- *If a number of renewable energy technologies are proposed, it will be important to demonstrate how they will work in tandem and, where applicable, how they will be integrated into a heat network (for heat generating technologies) and, again where applicable, also how they will integrate with a cooling system/strategy.*

This section looks at how this development can achieve required CO2 reductions through Be Green measures. A summary LZC feasibility study is included within the appendix. In order to comply with London Plan 2019 and the pre-application target to achieve a 68% CO_2 reduction (using SAP 2012) in line with other similar industrial buildings built nearby then solar PV and solar Thermal will be utilized reach this target. Using SAP 10 carbon factors Be

Solar PV

In order to achieve and go beyond the minimum 35% CO_2 reductions required by London Plan it will be necessary to install the follow amounts of solar PV to the two industrial units;

DC1 – 792 m^2 equating to 120 kWp capable of generating **99,505 kWh/annum**

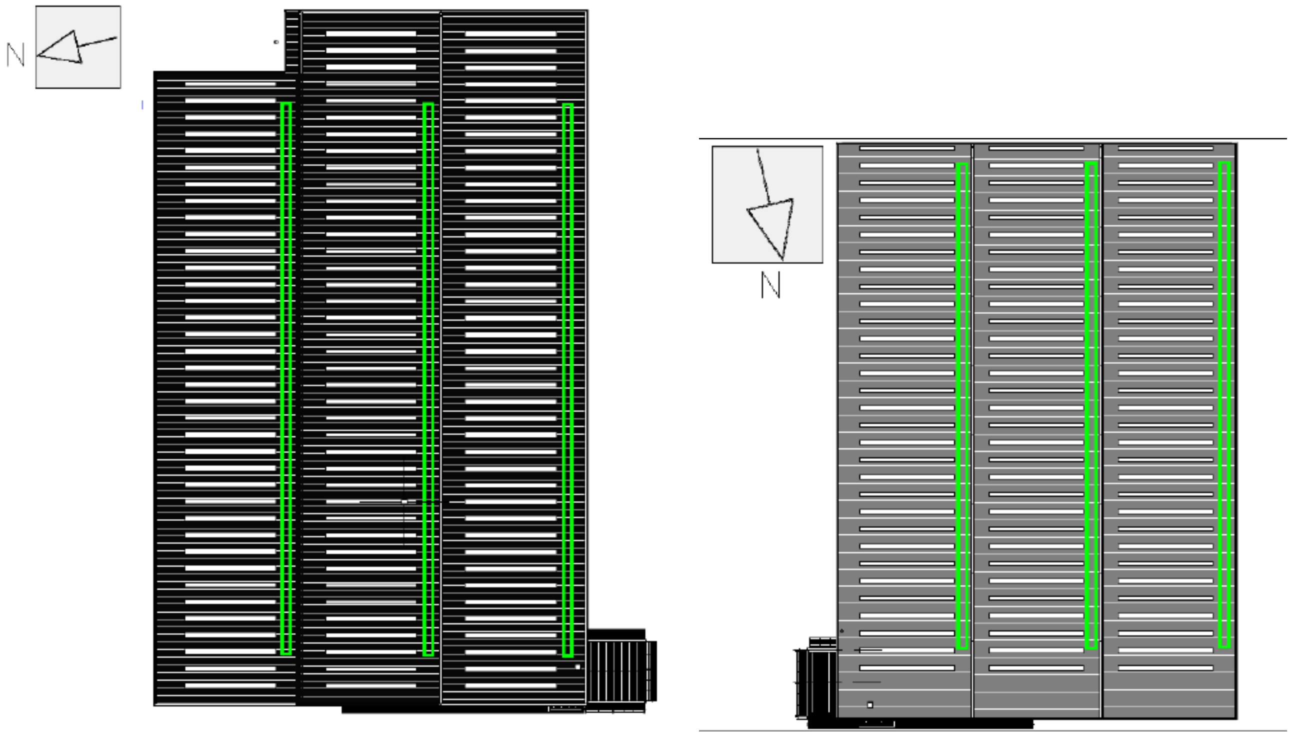
DC2 – 673 m^2 equating to 102 kWp capable of generating **80,322 kWh/annum**

Site Total – 1,465 m^2, 222 kWp generating **179,827 kWh/annum**

All the above calculation used a PV module efficiency of 15.15% and inverter efficiency of 95% with no near shading assumed. This has been calculated using IES VE 2019 software. Full details of the data input for solar PV can be found in the appendix.

The above calculations were using only the south facing roofs for DC1 and both the West South West, the north facing roof of DC1 have been discounted in the basis of these roofs only producing around 15% less generation than the south facing roofs would. On the roof plans below the areas in green are potentially suitable locations for the installation of solar PV whilst taking into account using the optimal panel orientation and making sure there is adequate space around the panels for maintenance access of the PV panels and rooflights. The area between the rooflights has been left clear in case the rooflight area were to change.

In line with the Be Seen policy of London Plan 2019, both solar PV systems will need to be monitored and energy generation reported for at least 5 years.



DC1 and 2 solar PV Roof Layout

Solar Thermal

Solar Thermal has been included as a suitable source of renewable energy to provide hot water for the two units alongside the gas fired hot water system due to the high hot water demand and being compatible with the current hot water heating design. It is envisaged that a combined solar hot water cylinder will be installed to allow a contribution to the annual hot water requirements for each industrial unit. Based on similar buildings adjacent to this site's designs, the following amount of solar thermal has been included in the Be Green solution. Full details of the data input for solar thermal can be found in the appendix.

DC1 – 11 m^2 capable of producing 6,288 kWh/annum

DC2 – 11 m^2 capable of producing 6,137 kWh/annum

Be Green Results

The below table shows that solar PV and Thermal have the potential reduce CO_2 emissions by 44.5 tonnes/annum equating to a 21% Be Green saving in accordance with the Energy Hierarchy. This renewable energy saving comprises 2.6 tonnes of CO_2 reduction from solar thermal providing hot water and 41.9 tonnes of CO_2/annum from solar PV.

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	67	32%
Savings from heat network / CHP	0	0%
Savings from renewable energy	45	21%
Total Cumulative Savings	**112**	**53%**

Appendices

Appendix A SAP 2012 and 10 Summary

Appendix B Thermal model input data

Appendix C BRUKL output documents

Appendix D LZC Technology Conclusions

Appendix A SAP 2012 and 10 Summary

SAP 2012 PERFORMANCE	SAP10 PERFORMANCE

DOMESTIC

SAP 2012 PERFORMANCE

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	0	
After energy demand reduction	0	
After heat network / CHP	0	
After renewable energy	0	

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	0	#DIV/0!
Savings from heat network / CHP	0	#DIV/0!
Savings from renewable energy	0	#DIV/0!
Cumulative on site savings	**0**	**#DIV/0!**
Annual savings from off-set payment	0	-
	(Tonnes CO2)	
Cumulative savings for off-set payment	**0**	-
Cash in-lieu contribution (£)	**0**	

SAP10 PERFORMANCE

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	0	
After energy demand reduction	0	
After heat network / CHP	0	
After renewable energy	0	

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	0	#DIV/0!
Savings from heat network / CHP	0	#DIV/0!
Savings from renewable energy	0	#DIV/0!
Cumulative on site savings	**0**	**#DIV/0!**
Annual savings from off-set payment	0	-
	(Tonnes CO2)	
Cumulative savings for off-set payment	**0**	-
Cash in-lieu contribution (£)	**0**	

NON-DOMESTIC

SAP 2012 PERFORMANCE

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	365	563
After energy demand reduction	210	563
After heat network / CHP	210	563
After renewable energy	114	563

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	155	42%
Savings from heat network / CHP	0	0%
Savings from renewable energy	96	26%
Total Cumulative Savings	**251**	**69%**

Table 5: Shortfall in regulated carbon dioxide savings

	Annual Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	**128**	-
Shortfall	-123	-3,695
Cash in-lieu contribution (£)	**-221,694**	-

SAP10 PERFORMANCE

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	211	253
After energy demand reduction	144	253
After heat network / CHP	144	253
After renewable energy	99	253

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	67	32%
Savings from heat network / CHP	0	0%
Savings from renewable energy	45	21%
Total Cumulative Savings	**112**	**53%**

Table 5: Shortfall in regulated carbon dioxide savings

	Annual Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	74	-
Shortfall	-38	-1,135
Cash in-lieu contribution (£)	**-68,126**	-

SITE-WIDE

SAP 2012 PERFORMANCE

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2013 baseline	365		
Be lean	210	155	42%
Be clean	210	0	0%
Be green	114	96	26%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**-3,695**	-

SAP10 PERFORMANCE

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2013 baseline	211		
Be lean	144	67	32%
Be clean	144	0	0%
Be green	99	45	21%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**-1,135**	-

Building use	Energy demand following energy efficiency measures (MWh/year)						
	Space Heating	Hot Water	Lighting	Auxilary	Cooling	Unregulated electricity	Unregulated gas
Domestic	0	0	0	0	0	0	0
Non-domestic	73	366	198	30	0	1085	0

	Target Fabric Energy Efficiency (kWh/m²)	Dwelling Fabric Energy Efficiency (kWh/m²)	Improvement (%)
Development total			

	Area weighted average non-domestic cooling demand (MJ/m^2)	Total area weighted non-domestic cooling demand (MJ/year)
Actual	0	0
Notional	0	0

Appendix B Thermal model input data

Input Data Sheet

General Details

Project Name:	DC1 and 2 , Ironbridge Road, Hayes
Project Nr:	2202
Project Engineer:	Ian Andrews

Site Details

CIBSE Weather File:	London
Orientation (North angle from vertical):	103 & 193
Building Type:	B8: Warehouse/storage (Warehouse)
Name:	
Address Line 1	DC1 and 2
Address Line 2	Ironbridge Road
Address Line 3	
Address Line 4	
City:	London
Postcode:	
UPRN:	

Building Owner

Name:	
Telephone:	
Street Address:	
City:	
Postcode:	

Building Details

PFC equipment installed?:	Yes
Electric power factor:	>0.95
Lighting systems metered?:	Yes
Warns for out-of-range values?:	Yes
Project Complexity:	Level 5

Simulation Settings

Calculation Method:	Apache
Time Step:	10 minutes
Reporting Interval:	30 minutes
Preconditioning:	20 days

Notes

Cells shaded in light grey have drop down boxes for selections

Cells shaded in light purple are automatically copied or calculated

Cells shaded in Yellow are assumptions made at this stage of the assessment

Project Name:	DC1 and 2 , Ironbridge Road, Hayes
Project Nr:	2202
Project Engineer:	Ian Andrews

Ref.	Zone Name	NCM Activity
1	Showers/Dis WC	NCM Ware: Changin Facilities
2	Circulation	NCM Ware: Circulation area
3	Reception	NCM Ware: Reception
4	Office	NCM Ware: Office (Warehouse Open)
5	Tea Point	NCM Ware: Office (Warehouse: Tea)
6	Toilet	NCM Ware: Toilet
7	Cleaners	NCM Ware: Cupboard
8	Plant	NCM Ware: Light plant room
9	Warehouse/Undercroft	NCM Ware: Warehouse storage

Notes

Cells shaded in light grey have drop down boxes for selections

Cells shaded in light purple are automatically copied or calculated

Cells shaded in Yellow are assumptions made at this stage of the assessment

Project Name:	DC1 and 2 , Ironbridge Road, Hayes
Project Nr:	2202
Project Engineer:	Ian Andrews

Element	Description	Proposed area-weighted u-value (W/m2.K)	Area-weighted average (Table 3, AD L2A (a))
External Walls	Metal, insulation, metal	0.35	0.35
Internal Walls (Warehouse/Office)	Plasterboard, insulatation Plasterboard	0.35	n/a
DC1 Warehouse Ground Floor	Ground, concrete	0.11	0.25
DC2 Warehouse Ground Floor	Ground, concrete	0.16	0.25
Office Ground-Contact Floors	Ground, insulation, concrete	0.25	0.25
Internal Floors	Ceiling Tiles, cavity, concrete, screed	n/a	n/a
Roof	Metal, insulation, metal	0.23	0.25
Rooflights	Triple glazed polycarbonate	1.30	2.20
Windows	Doubled Glazed LowE	1.50	2.20
Pedestrian doors	Insulated doors	2.20	2.20
Vehicle access and similar large doors	Insulated doors	1.50	1.50

Element	Description	g-value (BS EN 410)	Light transmittance (LT)
General Glazing	Doubled Glazed LowE	0.36	0.65
Curtain Wall Glazing	Doubled Glazed LowE	0.36	0.65
Rooflights	Triple glazed polycarbonate	0.55	0.58

Air Permeability	Description	This building (Design Value) m3/(h.m2) @ 50 Pa	Worst acceptable standard m3/(h.m2) @ 50 Pa
DC1		1.5	10
DC2		1.5	10

Notes

Cells shaded in light grey have drop down boxes for selections

Cells shaded in light purple are automatically copied or calculated

Cells shaded in Yellow are assumptions made at this stage of the assessment

Project Name:	DC1 and 2 , Ironbridge Road, Hayes
Project Nr:	2202
Project Engineer:	Ian Andrews

HVAC System Details	HVAC system name	HVAC 1: LTHW NV	HVAC 2: LTHW EV	HVAC 3: LTHW MVHR	DHW 1: Gas-Fired Boiler w/solar thermal
	NCM System Type	Central heating using water: radiators	Central heating using water: radiators	Central heating using water: radiators	Central heating using water: radiators
Heating	Heat source	LTHW boiler	LTHW boiler	LTHW boiler	LTHW boiler
	Fuel	Natural Gas	Natural Gas	Natural Gas	Natural Gas
	Does system use CHP?	No	No	No	No
	Heat Gen. SEER	0.96	0.96	0.96	0.96
Cooling	Pack chiller type	-	-	-	-
	Pack chiller power	-	-	-	-
	SEER	-	-	-	-
	EER	-	-	-	-
	Mixed Mode	-	-	-	-
System Adjustment	Ductwork Leakage Tested	Class worse than A, or not tested	Class worse than A, or not tested	Class worse than A, or not tested	-
	AHU Leakage Tested	Class worse than 3, or not compliant	Class worse than 3, or not compliant	Class worse than 3, or not compliant	-
	SFP (W/l/S)	-	0.5	1.55	-
	Variable Speed Pumps	Variable speed differential sensor across pump	Variable speed differential sensor across pump	-	-
Metering Provision	Met.	Yes	Yes	Yes	Yes
	Alarm for out of range	Yes	Yes	Yes	Yes
Ventilation	Cooling/vent. Mechanism	-	-	Air conditioning	-
	Air Supply Mechanism	-	-	Central balanced	-
	Heat Recovery Method	-	-	Plate heat exchanger	-
	Heat Recovery Efficiency	-	-	75.0%	-
Zonal Ventilation & Extract (Entered at Zone Level)	Mechanical supply?	No	No	Yes	No
	Specific fan power (W/l/s)	-	-	1.6	-
	Local mechanical exhaust?	No	Yes	No	No
	Specific fan power (W/l/s)	-	0.5	-	-
	Extract flow rate	-	6-10ACH	-	-
	Extract remote from room?	-	Yes	-	-
	Demand controlled ventilation type	-	N/A	Speed / CO2	-

Notes

Cells shaded in light grey have drop down boxes for selectior

Project Name:	DC1 and 2 , Ironbridge Road, Hayes
Project Nr:	2202
Project Engineer:	Ian Andrews

Cells shaded in light purple are automatically copied or calculated
Cells shaded in Yellow are assumptions made at this stage of the assessment

Project Name:	DC1 and 2 , Ironbridge Road, Hayes
Project Nr:	2202
Project Engineer:	Ian Andrews

Apache System Title:		DHW 1: Gas-Fired Boiler w/solar thermal
Associated Room Type:		All areas
System	**Parameter**	
Domestic Hot Water	DHW Delivery Efficiency	100.0%
	Generator Type	Water Heater
	Fuel Type	Natural Gas
	Does the system have storage?	Yes
	Storage Volume (litres)	250
	Storage Losses (kWh/l day)	0.007
	Does the system have secondary circulation?	Yes
	Circulation Losses (W/m)	8.62
	Pump Power (kW)	0.2
	Loop Length (m)	180
	Time Switch?	yes
Solar Water Heating	**Panel**	
	Area (m^2)	11
	Azimuth (^{o} clockwise from North)	180
	Tilt (^{o} from horizontal)	35
	Shading Factor	1
	Degradation Factor	0.99
	Conversion Efficiency at Ambient Temperature	0.76
	First Order Heat Loss Coefficient (W/m^2K)	4
	Second Order Heat Loss Coefficient (W/m^2K)	0.01
	Flow Rate ($l/h.m^2$)	50
	Pump Power (kW)	0.2
	Heat Exchanger Effectiveness	0.4
	Cylinder	
	Volume (Litres)	250
	Storage Loss at max. temperature (kWh/l.day)	0.007

Notes
Cells shaded in light grey have drop down boxes for selections

Cells shaded in light purple are automatically copied or calculated

Cells shaded in Yellow are assumptions made at this stage of the assessment

Input Data Sheet

Renewable Systems

Project Name:	DC1 and 2 , Ironbridge Road, Hayes
Project Nr:	2202
Project Engineer:	Ian Andrews

System	Parameter	DC1	DC2
PVS Generator	PV array type	Mono-crystalline	Mono-crystalline
	Derive performance parameters from PV array type?	yes	yes
	PV module efficiency	0.1515	0.1515
	Reference irradiance for NOCT (W/m^2)	800	800
	Nominal cell temp. (NOCT) (^{O}C)	45	45
	Temp. Coefficient for module efficiency	0.004	0.004
	Degradation factor	0.99	0.99
	Shading factor	1	1
	Electrical conversion efficiency	0.95	0.95
	Area (m^2)	792	673
	Annual Generation (kWh)	99,505	80,322
	Azimuth (^{O} clockwise from North)	103	77
	Inclination (^{O} from horizontal)	7	7
Wind Generator	Hub height (m)	None proposed	
	Rated power (kW)		
CHP Generator	Fuel type	None proposed	
	Performance at rated output:		
	Heat output (kW)		
	Thermal efficiency		
	power efficiency		
	Performance at minimum output:		
	Fraction of rated heat output		
	Thermal efficiency		
	power efficiency		
	Profile for heat matching strategy		

Notes

Cells shaded in light grey have drop down boxes for selections

Cells shaded in light purple are automatically copied or calculated

Cells shaded in Yellow are assumptions made at this stage of the assessment

Input Data Sheet

Lighting Details

Project Name:	DC1 and 2 , Ironbridge Road, Hayes
Project Nr:	2202
Project Engineer:	Ian Andrews

Zone Name	Efficacy (lm/W)	Photoelectric Control Type (Switching / Dimming)	Photoelectric Sensor Type (Standalone / Addressable)	Back Sensor? (Yes / No)	Parasitic power (W/m²)	Occ. Sensing	Parasitic power (W/m²)
Showers/Dis WC	100	-	-	-	0.1	Auto-on-off (Foc = 0.90)	0.1
Stairs	100	-	-	-	0.1	None (Foc = 1.0)	0.1
Landing	100	Dimming	Standalone	No	0.1	Auto-on-off (Foc = 0.90)	0.1
Circulation	100	-	-	-	0.1	Auto-on-off (Foc = 0.90)	0.1
Reception	100	Dimming	Standalone	No	0.1	Auto-on-off (Foc = 0.90)	0.1
Office	100	Dimming	Standalone	No	0.1	Auto-on-off (Foc = 0.90)	0.1
Tea Point	100	-	-	-	0.1	Auto-on-off (Foc = 0.90)	0.1
Toilet	100	-	-	-	0.1	Auto-on-off (Foc = 0.90)	0.1
Cleaners	100	-	-	-	0.1	Auto-on-off (Foc = 0.90)	0.1
Plant	100	-	-	-	0.1	Auto-on-off (Foc = 0.90)	0.1
Warehouse/Undercroft	120	Dimming	Standalone	No	0.01	Auto-on-off (Foc = 0.90)	0.01
Display Lighting	100	-	-	-	-	-	-

Notes

Cells shaded in light grey have drop down boxes for selections

Cells shaded in light purple are automatically copied or calculated

Cells shaded in Yellow are assumptions made at this stage of the assessment

Appendix C BRUKL output documents

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

2202 - Ironbridge Road Hayes - DC1 - BE LEAN

As designed

Date: Fri Jul 10 08:07:16 2020

Administrative information

Building Details

Address: DC1, Hayes, -

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12

BRUKL compliance check version: v5.6.a.1

Owner Details

Name: -

Telephone number: -

Address: -, -, -

Certifier details

Name: Ian Andrews

Telephone number: 01134 931 280

Address: Yonder Ltd, Third Floor, Concordia Works, 30 Sovereign Street, Leeds, LS1 4BA

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	11.2
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	11.2
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	6.3
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	0.35	0.35	XX000000:Surf[25]
Floor	0.25	0.11	0.25	XX000001:Surf[0]
Roof	0.25	0.23	0.23	DC000027:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.34	1.5	DC000005:Surf[1]
Personnel doors	2.2	2.2	2.2	DC00003E:Surf[4]
Vehicle access & similar large doors	1.5	1.5	1.5	DC00000C:Surf[251]
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = 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

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	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- HVAC 1: LTHW NV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.3	0	-
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					YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

2- HVAC 3: LTHW MVHR

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.3	0	0.75
Standard value	0.91*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

3- HVAC 2: LTHW EV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.3	0	-
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.

1- DHW 1: Gas-Fired Boiler

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.96	0.007
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**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
DC1.00.004 Reception	-	-	-	1.6	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
DC1.00.010 Open Plan Office	-	-	-	1.6	-	-	-	-	-	-	N/A
DC1.00.011 Tea Point	-	-	-	1.6	-	-	-	-	-	-	N/A
DC1.00.009 Cleaners	-	-	0.5	-	-	-	-	-	-	-	N/A
DC1.00.005 Male WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC1.00.006 Female WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC1.00.013 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC1.01.010 Open Plan Office	-	-	-	1.6	-	-	-	-	-	-	N/A
DC1.01.009 Cleaners	-	-	0.5	-	-	-	-	-	-	-	N/A
DC1.01.005 Male WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC1.01.006 Female WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC1.01.013 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC1.01.011 Tea Point	-	-	-	1.6	-	-	-	-	-	-	N/A
DC1.02.010 Open Plan Office	-	-	-	1.6	-	-	-	-	-	-	N/A
DC1.02.009 Cleaners	-	-	0.5	-	-	-	-	-	-	-	N/A
DC1.02.005 Male WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC1.02.006 Female WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC1.02.013 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC1.02.011 Tea Point	-	-	-	1.6	-	-	-	-	-	-	N/A
DC1.01.001b Tea Point	-	-	-	1.6	-	-	-	-	-	-	N/A
DC1.01.001a Open Plan Office	-	-	-	1.6	-	-	-	-	-	-	N/A
DC1.02.001a Open Plan Office	-	-	-	1.6	-	-	-	-	-	-	N/A
DC1.02.001b Tea Point	-	-	-	1.6	-	-	-	-	-	-	N/A
DC1.00.012b Dis WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC1.00.012a Dis Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC1.01.012b Dis WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC1.01.012a Dis Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC1.02.012b Dis WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC1.02.012a Dis Shower	-	-	0.5	-	-	-	-	-	-	-	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	
DC1.00.001 Undercroft	120	-	-	1309
DC1.00.003 Stairs 02	-	100	-	58
DC1.00.004 Reception	-	100	100	308
DC1.00.007 Corridor	-	100	-	53
DC1.00.008 Stairs 01	-	100	-	63
DC1.00.010 Open Plan Office	100	-	-	1204
DC1.00.011 Tea Point	100	-	-	26
DC1.00.009 Cleaners	100	-	-	6
DC1.00.005 Male WC	-	100	-	61
DC1.00.006 Female WC	-	100	-	57
DC1.00.013 Shower	-	100	-	11

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
DC1.01.003 Stairs 02	-	100	-	58
DC1.01.007 Corridor	-	100	-	53
DC1.01.008 Stairs 01	-	100	-	63
DC1.01.010 Open Plan Office	100	-	-	1204
DC1.01.009 Cleaners	100	-	-	6
DC1.01.005 Male WC	-	100	-	61
DC1.01.006 Female WC	-	100	-	57
DC1.01.013 Shower	-	100	-	11
DC1.01.004 Link Corridor	-	100	-	25
DC1.01.011 Tea Point	100	-	-	26
DC1.02.003 Stairs 02	-	100	-	51
DC1.02.007 Corridor	-	100	-	53
DC1.02.008 Stairs 01	-	100	-	63
DC1.02.010 Open Plan Office	100	-	-	1204
DC1.02.009 Cleaners	100	-	-	6
DC1.02.005 Male WC	-	100	-	61
DC1.02.006 Female WC	-	100	-	57
DC1.02.013 Shower	-	100	-	11
DC1.02.011 Tea Point	100	-	-	26
DC1.02.004 Landing	-	100	-	147
DC1.01.001b Tea Point	100	-	-	63
DC1.01.001a Open Plan Office	100	-	-	2052
DC1.02.001a Open Plan Office	100	-	-	2057
DC1.02.001b Tea Point	100	-	-	74
DC1.03.001 Plant	100	-	-	556
DC1.03.002 Stair 01	-	100	-	34
DC1.00.012b Dis WC	-	100	-	15
DC1.00.012a Dis Shower	-	100	-	8
DC1.01.012b Dis WC	-	100	-	15
DC1.01.012a Dis Shower	-	100	-	8
DC1.02.012b Dis WC	-	100	-	15
DC1.02.012a Dis Shower	-	100	-	8
DC1.00.002 Warehouse	120	-	-	58562

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?
DC1.00.001 Undercroft	NO (-17.9%)	NO
DC1.00.004 Reception	NO (-0.6%)	NO
DC1.00.010 Open Plan Office	NO (-52%)	NO
DC1.00.011 Tea Point	NO (-83.3%)	NO
DC1.01.010 Open Plan Office	NO (-51.8%)	NO
DC1.01.011 Tea Point	NO (-83.3%)	NO
DC1.02.010 Open Plan Office	NO (-56.3%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
DC1.02.011 Tea Point	NO (-84.9%)	NO
DC1.01.001b Tea Point	NO (-74.7%)	NO
DC1.01.001a Open Plan Office	NO (-43.3%)	NO
DC1.02.001a Open Plan Office	NO (-45.5%)	NO
DC1.02.001b Tea Point	N/A	N/A
DC1.00.002 Warehouse	YES (+11.9%)	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 [m²]	18495.4	18495.4
External area [m²]	42080.8	42080.8
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	2	3
Average conductance [W/K]	13414.2	13445.7
Average U-value [W/m²K]	0.32	0.32
Alpha value* [%]	9.96	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/m²]

	Actual	Notional
Heating	2.09	1.47
Cooling	0	0
Auxiliary	0.89	0.55
Lighting	6.21	16.38
Hot water	10.64	10.61
Equipment*	32.98	32.98
TOTAL**	**19.82**	**29.01**

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	6.73	4.58
Primary energy* [kWh/m²]	36.77	65.41
Total emissions [kg/m²]	6.3	11.2

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	83	0	25.6	0	2.1	0.9	0	0.96	0
	Notional	74.9	0	24.1	0	1.2	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	114.2	0	37	0	17.6	0.86	0	0.96	0
	Notional	91.9	0	29.6	0	18.7	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	53.5	0	16.5	0	8.3	0.9	0	0.96	0
	Notional	30.1	0	9.7	0	4.9	0.86	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.35	DC00003E:Surf[5]
Floor	0.2	0.11	XX000000:Surf[0]
Roof	0.15	0.23	DC000027:Surf[0]
Windows, roof windows, and rooflights	1.5	1.3	DC00003E:Surf[0]
Personnel doors	1.5	2.2	DC00003E:Surf[4]
Vehicle access & similar large doors	1.5	1.5	DC00000C:Surf[251]
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	2

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

2202 - Ironbridge Road Hayes - DC2- BE GREEN

As designed

Date: Thu Jul 16 15:42:56 2020

Administrative information

Building Details

Address: DC2, Hayes, -

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12

BRUKL compliance check version: v5.6.a.1

Owner Details

Name: -

Telephone number: -

Address: -, -, -

Certifier details

Name: Ian Andrews

Telephone number: 01134 931 280

Address: Yonder Ltd, Third Floor, Concordia Works, 30 Sovereign Street, Leeds, LS1 4BA

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	11.5
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	11.5
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	3.6
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	0.27	0.35	DC000040:Surf[13]
Floor	0.25	0.17	0.25	DC000040:Surf[0]
Roof	0.25	0.23	0.23	DC000068:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.34	1.5	DC000081:Surf[2]
Personnel doors	2.2	2.2	2.2	DC0000A3:Surf[36]
Vehicle access & similar large doors	1.5	1.5	1.5	DC0000A3:Surf[32]
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]

U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]

U_{i-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

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	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- HVAC 1: LTHW NV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.3	0	-
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					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

2- HVAC 3: LTHW MVHR

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.3	0	0.75
Standard value	0.91*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

3- HVAC 2: LTHW EV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.3	0	-
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.					

1- DHW 1: Gas-Fired Boiler w/solar thermal

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.96	0.007
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		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
DC2.00.004 Reception	-	-	-	1.6	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
DC2.00.005 Male WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.00.006 Female WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.00.007 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.00.009a Dis WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.00.009b Dis Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.00.010 Cleaners	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.02.005 Male WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.02.006 Female WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.02.007 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.02.009a Dis WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.02.009b Dis Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.02.010 Cleaners	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.01.005 Male WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.01.006 Female WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.01.007 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.01.009a Dis WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.01.009b Dis Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.01.010 Cleaners	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.00.012d Tea Point	-	-	-	1.6	-	-	-	-	-	-	N/A
DC2.00.012 Open Plan Office	-	-	-	1.6	-	-	-	-	-	-	N/A
DC2.01.012b Tea Point	-	-	-	1.6	-	-	-	-	-	-	N/A
DC2.01.012a Open Plan Office	-	-	-	1.6	-	-	-	-	-	-	N/A
DC2.01.001a Open Plan Office	-	-	-	1.6	-	-	-	-	-	-	N/A
DC2.01.001b Tea Point	-	-	-	1.6	-	-	-	-	-	-	N/A
DC3.02.01b Tea Point	-	-	-	1.6	-	-	-	-	-	-	N/A
DC3.02.012 Open Plan Office	-	-	-	1.6	-	-	-	-	-	-	N/A
DC3.02.00.001a Open Plan Office	-	-	-	1.6	-	-	-	-	-	-	N/A
DC3.02.00.001b Tea Point	-	-	-	1.6	-	-	-	-	-	-	N/A

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	Lamp	Display lamp	
Standard value	60	60	22	
DC2.00.001 Undercroft	120	-	-	701
DC2.00.003 Stairs 02	-	100	-	63
DC2.00.004 Reception	-	100	100	337
DC2.00.005 Male WC	-	100	-	63
DC2.00.006 Female WC	-	100	-	59
DC2.00.007 Shower	-	100	-	10
DC2.00.008 Corridor	-	100	-	53
DC2.00.009a Dis WC	-	100	-	15
DC2.00.009b Dis Shower	-	100	-	8
DC2.00.010 Cleaners	100	-	-	6
DC2.00.011 Stairs 01	-	100	-	66

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
DC2.02.00.003 Stairs 02	-	100	-	56
DC2.02.00.004 Landing	-	100	-	161
DC2.02.005 Male WC	-	100	-	63
DC2.02.006 Female WC	-	100	-	59
DC2.02.007 Shower	-	100	-	10
DC2.02.008 Corridor	-	100	-	53
DC2.02.009a Dis WC	-	100	-	15
DC2.02.009b Dis Shower	-	100	-	8
DC2.02.010 Cleaners	100	-	-	6
DC2.02.011 Stairs 01	-	100	-	66
DC2.01.003 Stairs 02	-	100	-	63
DC2.01.005 Male WC	-	100	-	63
DC2.01.006 Female WC	-	100	-	59
DC2.01.007 Shower	-	100	-	10
DC2.01.008 Corridor	-	100	-	53
DC2.01.009a Dis WC	-	100	-	15
DC2.01.009b Dis Shower	-	100	-	8
DC2.01.010 Cleaners	100	-	-	6
DC2.01.011 Stairs 01	-	100	-	66
DC2.01.004 Link Corridor	-	100	-	27
DC2.00.012d Tea Point	100	-	-	30
DC2.00.012 Open Plan Office	100	-	-	1030
DC2.01.012b Tea Point	100	-	-	30
DC2.01.012a Open Plan Office	100	-	-	1030
DC2.01.001a Open Plan Office	100	-	-	1084
DC2.01.001b Tea Point	100	-	-	43
DC3.02.01b Tea Point	100	-	-	30
DC3.02.012 Open Plan Office	100	-	-	1030
DC3.02.00.001a Open Plan Office	100	-	-	1084
DC3.02.00.001b Tea Point	100	-	-	43
DC2.00.002 Warehouse	120	-	-	42526
DC2.03.001 Plant	100	-	-	773
DC2.03.002 Stairs 01	-	100	-	51

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?
DC2.00.001 Undercroft	NO (-26.7%)	NO
DC2.00.004 Reception	NO (-27.9%)	NO
DC2.00.012d Tea Point	NO (-49.2%)	NO
DC2.00.012 Open Plan Office	NO (-54.3%)	NO
DC2.01.012b Tea Point	NO (-49.3%)	NO
DC2.01.012a Open Plan Office	NO (-54.4%)	NO
DC2.01.001a Open Plan Office	NO (-64.8%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
DC2.01.001b Tea Point	NO (-80.1%)	NO
DC3.02.01b Tea Point	NO (-54%)	NO
DC3.02.012 Open Plan Office	NO (-59.4%)	NO
DC3.02.00.001a Open Plan Office	NO (-67.7%)	NO
DC3.02.00.001b Tea Point	NO (-81.7%)	NO
DC2.00.002 Warehouse	YES (+19.9%)	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?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	13637.1	13637.1
External area [m²]	31733.4	31733.4
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	2	3
Average conductance [W/K]	10354.6	9334.86
Average U-value [W/m²K]	0.33	0.29
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/m²]

	Actual	Notional
Heating	2.48	1.82
Cooling	0	0
Auxiliary	0.99	0.61
Lighting	6.09	16.2
Hot water	11.88	12.24
Equipment*	34.87	34.87
TOTAL**	**21.45**	**30.88**

* 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	5.89	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0.45	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	8	5.65
Primary energy* [kWh/m²]	38.72	67.48
Total emissions [kg/m²]	3.6	11.5

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	86.7	0	26.7	0	2.1	0.9	0	0.96	0
	Notional	80.4	0	25.9	0	1.2	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	115.6	0	37.5	0	17.5	0.86	0	0.96	0
	Notional	93.1	0	30	0	18.6	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	53	0	16.3	0	8.3	0.9	0	0.96	0
	Notional	27.7	0	8.9	0	4.9	0.86	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.26	DC0000A3:Surf[47]
Floor	0.2	0.16	DC0000A3:Surf[151]
Roof	0.15	0.23	DC000068:Surf[0]
Windows, roof windows, and rooflights	1.5	1.3	DC0000A3:Surf[0]
Personnel doors	1.5	2.2	DC0000A3:Surf[36]
Vehicle access & similar large doors	1.5	1.5	DC0000A3:Surf[32]
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	2

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

2202 - Ironbridge Road Hayes - DC2- BE LEAN

As designed

Date: Fri Jul 10 10:22:40 2020

Administrative information

Building Details

Address: DC2, Hayes, -

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12

BRUKL compliance check version: v5.6.a.1

Owner Details

Name: -

Telephone number: -

Address: -, -, -

Certifier details

Name: Ian Andrews

Telephone number: 01134 931 280

Address: Yonder Ltd, Third Floor, Concordia Works, 30 Sovereign Street, Leeds, LS1 4BA

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	11.5
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	11.5
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	6.8
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	0.27	0.35	DC000040:Surf[13]
Floor	0.25	0.17	0.25	DC000040:Surf[0]
Roof	0.25	0.23	0.23	DC000068:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.34	1.5	DC000081:Surf[2]
Personnel doors	2.2	2.2	2.2	DC0000A3:Surf[36]
Vehicle access & similar large doors	1.5	1.5	1.5	DC0000A3:Surf[32]
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]

U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]

U_{i-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

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	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- HVAC 1: LTHW NV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.3	0	-
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					YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

2- HVAC 3: LTHW MVHR

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.3	0	0.75
Standard value	0.91*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

3- HVAC 2: LTHW EV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.3	0	-
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.

1- DHW 1: Gas-Fired Boiler

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.96	0.007
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**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
DC2.00.004 Reception	-	-	-	1.6	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
DC2.00.005 Male WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.00.006 Female WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.00.007 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.00.009a Dis WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.00.009b Dis Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.00.010 Cleaners	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.02.005 Male WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.02.006 Female WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.02.007 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.02.009a Dis WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.02.009b Dis Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.02.010 Cleaners	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.01.005 Male WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.01.006 Female WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.01.007 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.01.009a Dis WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.01.009b Dis Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.01.010 Cleaners	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.00.012d Tea Point	-	-	-	1.6	-	-	-	-	-	-	N/A
DC2.00.012 Open Plan Office	-	-	-	1.6	-	-	-	-	-	-	N/A
DC2.01.012b Tea Point	-	-	-	1.6	-	-	-	-	-	-	N/A
DC2.01.012a Open Plan Office	-	-	-	1.6	-	-	-	-	-	-	N/A
DC2.01.001a Open Plan Office	-	-	-	1.6	-	-	-	-	-	-	N/A
DC2.01.001b Tea Point	-	-	-	1.6	-	-	-	-	-	-	N/A
DC3.02.01b Tea Point	-	-	-	1.6	-	-	-	-	-	-	N/A
DC3.02.012 Open Plan Office	-	-	-	1.6	-	-	-	-	-	-	N/A
DC3.02.00.001a Open Plan Office	-	-	-	1.6	-	-	-	-	-	-	N/A
DC3.02.00.001b Tea Point	-	-	-	1.6	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
DC2.00.001 Undercroft	120	-	-	701
DC2.00.003 Stairs 02	-	100	-	63
DC2.00.004 Reception	-	100	100	337
DC2.00.005 Male WC	-	100	-	63
DC2.00.006 Female WC	-	100	-	59
DC2.00.007 Shower	-	100	-	10
DC2.00.008 Corridor	-	100	-	53
DC2.00.009a Dis WC	-	100	-	15
DC2.00.009b Dis Shower	-	100	-	8
DC2.00.010 Cleaners	100	-	-	6
DC2.00.011 Stairs 01	-	100	-	66

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
DC2.02.00.003 Stairs 02	-	100	-	56
DC2.02.00.004 Landing	-	100	-	161
DC2.02.005 Male WC	-	100	-	63
DC2.02.006 Female WC	-	100	-	59
DC2.02.007 Shower	-	100	-	10
DC2.02.008 Corridor	-	100	-	53
DC2.02.009a Dis WC	-	100	-	15
DC2.02.009b Dis Shower	-	100	-	8
DC2.02.010 Cleaners	100	-	-	6
DC2.02.011 Stairs 01	-	100	-	66
DC2.01.003 Stairs 02	-	100	-	63
DC2.01.005 Male WC	-	100	-	63
DC2.01.006 Female WC	-	100	-	59
DC2.01.007 Shower	-	100	-	10
DC2.01.008 Corridor	-	100	-	53
DC2.01.009a Dis WC	-	100	-	15
DC2.01.009b Dis Shower	-	100	-	8
DC2.01.010 Cleaners	100	-	-	6
DC2.01.011 Stairs 01	-	100	-	66
DC2.01.004 Link Corridor	-	100	-	27
DC2.00.012d Tea Point	100	-	-	30
DC2.00.012 Open Plan Office	100	-	-	1030
DC2.01.012b Tea Point	100	-	-	30
DC2.01.012a Open Plan Office	100	-	-	1030
DC2.01.001a Open Plan Office	100	-	-	1084
DC2.01.001b Tea Point	100	-	-	43
DC3.02.01b Tea Point	100	-	-	30
DC3.02.012 Open Plan Office	100	-	-	1030
DC3.02.00.001a Open Plan Office	100	-	-	1084
DC3.02.00.001b Tea Point	100	-	-	43
DC2.00.002 Warehouse	120	-	-	42526
DC2.03.001 Plant	100	-	-	773
DC2.03.002 Stairs 01	-	100	-	51

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?
DC2.00.001 Undercroft	NO (-26.6%)	NO
DC2.00.004 Reception	NO (-27.9%)	NO
DC2.00.012d Tea Point	NO (-49.6%)	NO
DC2.00.012 Open Plan Office	NO (-54.7%)	NO
DC2.01.012b Tea Point	NO (-49.7%)	NO
DC2.01.012a Open Plan Office	NO (-54.8%)	NO
DC2.01.001a Open Plan Office	NO (-64.7%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
DC2.01.001b Tea Point	NO (-80.1%)	NO
DC3.02.01b Tea Point	NO (-54.5%)	NO
DC3.02.012 Open Plan Office	NO (-59.7%)	NO
DC3.02.00.001a Open Plan Office	NO (-67.8%)	NO
DC3.02.00.001b Tea Point	NO (-81.8%)	NO
DC2.00.002 Warehouse	YES (+19.9%)	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?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	13637.1	13637.1
External area [m^2]	31733.4	31733.4
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	2	3
Average conductance [W/K]	10354.6	9334.86
Average U-value [W/m^{2}K]	0.33	0.29
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	2.49	1.82
Cooling	0	0
Auxiliary	0.97	0.61
Lighting	6.09	16.2
Hot water	12.4	12.24
Equipment*	34.87	34.87
TOTAL**	**21.94**	**30.88**

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

Energy Production by Technology [kWh/m^2]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	8.01	5.66
Primary energy* [kWh/m^2]	39.29	67.48
Total emissions [kg/m^2]	6.8	11.5

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	86.8	0	26.7	0	2.1	0.9	0	0.96	0
	Notional	80.4	0	25.9	0	1.2	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	115.7	0	37.5	0	17.5	0.86	0	0.96	0
	Notional	93.1	0	30	0	18.6	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	53.1	0	16.4	0	8.3	0.9	0	0.96	0
	Notional	27.7	0	8.9	0	4.9	0.86	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

Key Features

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

Building fabric

Element	U_{i-Typ}	U_{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.26	DC0000A3:Surf[47]
Floor	0.2	0.16	DC0000A3:Surf[151]
Roof	0.15	0.23	DC000068:Surf[0]
Windows, roof windows, and rooflights	1.5	1.3	DC0000A3:Surf[0]
Personnel doors	1.5	2.2	DC0000A3:Surf[36]
Vehicle access & similar large doors	1.5	1.5	DC0000A3:Surf[32]
High usage entrance doors	1.5	-	No High usage entrance doors in building

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
$m^3/(h.m^2)$ at 50 Pa	5	2

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

2202 - Ironbridge Road Hayes - DC2- BE GREEN

As designed

Date: Thu Jul 16 15:42:56 2020

Administrative information

Building Details

Address: DC2, Hayes, -

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12

BRUKL compliance check version: v5.6.a.1

Owner Details

Name: -

Telephone number: -

Address: -, -, -

Certifier details

Name: Ian Andrews

Telephone number: 01134 931 280

Address: Yonder Ltd, Third Floor, Concordia Works, 30 Sovereign Street, Leeds, LS1 4BA

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	11.5
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	11.5
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	3.6
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	0.27	0.35	DC000040:Surf[13]
Floor	0.25	0.17	0.25	DC000040:Surf[0]
Roof	0.25	0.23	0.23	DC000068:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.34	1.5	DC000081:Surf[2]
Personnel doors	2.2	2.2	2.2	DC0000A3:Surf[36]
Vehicle access & similar large doors	1.5	1.5	1.5	DC0000A3:Surf[32]
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

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

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	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- HVAC 1: LTHW NV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.3	0	-
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					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

2- HVAC 3: LTHW MVHR

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.3	0	0.75
Standard value	0.91*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

3- HVAC 2: LTHW EV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.3	0	-
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.					

1- DHW 1: Gas-Fired Boiler w/solar thermal

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.96	0.007
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		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
DC2.00.004 Reception	-	-	-	1.6	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
DC2.00.005 Male WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.00.006 Female WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.00.007 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.00.009a Dis WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.00.009b Dis Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.00.010 Cleaners	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.02.005 Male WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.02.006 Female WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.02.007 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.02.009a Dis WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.02.009b Dis Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.02.010 Cleaners	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.01.005 Male WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.01.006 Female WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.01.007 Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.01.009a Dis WC	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.01.009b Dis Shower	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.01.010 Cleaners	-	-	0.5	-	-	-	-	-	-	-	N/A
DC2.00.012d Tea Point	-	-	-	1.6	-	-	-	-	-	-	N/A
DC2.00.012 Open Plan Office	-	-	-	1.6	-	-	-	-	-	-	N/A
DC2.01.012b Tea Point	-	-	-	1.6	-	-	-	-	-	-	N/A
DC2.01.012a Open Plan Office	-	-	-	1.6	-	-	-	-	-	-	N/A
DC2.01.001a Open Plan Office	-	-	-	1.6	-	-	-	-	-	-	N/A
DC2.01.001b Tea Point	-	-	-	1.6	-	-	-	-	-	-	N/A
DC3.02.01b Tea Point	-	-	-	1.6	-	-	-	-	-	-	N/A
DC3.02.012 Open Plan Office	-	-	-	1.6	-	-	-	-	-	-	N/A
DC3.02.00.001a Open Plan Office	-	-	-	1.6	-	-	-	-	-	-	N/A
DC3.02.00.001b Tea Point	-	-	-	1.6	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
DC2.00.001 Undercroft	120	-	-	701
DC2.00.003 Stairs 02	-	100	-	63
DC2.00.004 Reception	-	100	100	337
DC2.00.005 Male WC	-	100	-	63
DC2.00.006 Female WC	-	100	-	59
DC2.00.007 Shower	-	100	-	10
DC2.00.008 Corridor	-	100	-	53
DC2.00.009a Dis WC	-	100	-	15
DC2.00.009b Dis Shower	-	100	-	8
DC2.00.010 Cleaners	100	-	-	6
DC2.00.011 Stairs 01	-	100	-	66

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
DC2.02.00.003 Stairs 02	-	100	-	56
DC2.02.00.004 Landing	-	100	-	161
DC2.02.005 Male WC	-	100	-	63
DC2.02.006 Female WC	-	100	-	59
DC2.02.007 Shower	-	100	-	10
DC2.02.008 Corridor	-	100	-	53
DC2.02.009a Dis WC	-	100	-	15
DC2.02.009b Dis Shower	-	100	-	8
DC2.02.010 Cleaners	100	-	-	6
DC2.02.011 Stairs 01	-	100	-	66
DC2.01.003 Stairs 02	-	100	-	63
DC2.01.005 Male WC	-	100	-	63
DC2.01.006 Female WC	-	100	-	59
DC2.01.007 Shower	-	100	-	10
DC2.01.008 Corridor	-	100	-	53
DC2.01.009a Dis WC	-	100	-	15
DC2.01.009b Dis Shower	-	100	-	8
DC2.01.010 Cleaners	100	-	-	6
DC2.01.011 Stairs 01	-	100	-	66
DC2.01.004 Link Corridor	-	100	-	27
DC2.00.012d Tea Point	100	-	-	30
DC2.00.012 Open Plan Office	100	-	-	1030
DC2.01.012b Tea Point	100	-	-	30
DC2.01.012a Open Plan Office	100	-	-	1030
DC2.01.001a Open Plan Office	100	-	-	1084
DC2.01.001b Tea Point	100	-	-	43
DC3.02.01b Tea Point	100	-	-	30
DC3.02.012 Open Plan Office	100	-	-	1030
DC3.02.00.001a Open Plan Office	100	-	-	1084
DC3.02.00.001b Tea Point	100	-	-	43
DC2.00.002 Warehouse	120	-	-	42526
DC2.03.001 Plant	100	-	-	773
DC2.03.002 Stairs 01	-	100	-	51

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?
DC2.00.001 Undercroft	NO (-26.7%)	NO
DC2.00.004 Reception	NO (-27.9%)	NO
DC2.00.012d Tea Point	NO (-49.2%)	NO
DC2.00.012 Open Plan Office	NO (-54.3%)	NO
DC2.01.012b Tea Point	NO (-49.3%)	NO
DC2.01.012a Open Plan Office	NO (-54.4%)	NO
DC2.01.001a Open Plan Office	NO (-64.8%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
DC2.01.001b Tea Point	NO (-80.1%)	NO
DC3.02.01b Tea Point	NO (-54%)	NO
DC3.02.012 Open Plan Office	NO (-59.4%)	NO
DC3.02.00.001a Open Plan Office	NO (-67.7%)	NO
DC3.02.00.001b Tea Point	NO (-81.7%)	NO
DC2.00.002 Warehouse	YES (+19.9%)	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?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	13637.1	13637.1
External area [m^2]	31733.4	31733.4
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	2	3
Average conductance [W/K]	10354.6	9334.86
Average U-value [W/m^{2}K]	0.33	0.29
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	2.48	1.82
Cooling	0	0
Auxiliary	0.99	0.61
Lighting	6.09	16.2
Hot water	11.88	12.24
Equipment*	34.87	34.87
TOTAL**	**21.45**	**30.88**

* 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	5.89	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0.45	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	8	5.65
Primary energy* [kWh/m^2]	38.72	67.48
Total emissions [kg/m^2]	3.6	11.5

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	86.7	0	26.7	0	2.1	0.9	0	0.96	0
	Notional	80.4	0	25.9	0	1.2	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	115.6	0	37.5	0	17.5	0.86	0	0.96	0
	Notional	93.1	0	30	0	18.6	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	53	0	16.3	0	8.3	0.9	0	0.96	0
	Notional	27.7	0	8.9	0	4.9	0.86	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.26	DC0000A3:Surf[47]
Floor	0.2	0.16	DC0000A3:Surf[151]
Roof	0.15	0.23	DC000068:Surf[0]
Windows, roof windows, and rooflights	1.5	1.3	DC0000A3:Surf[0]
Personnel doors	1.5	2.2	DC0000A3:Surf[36]
Vehicle access & similar large doors	1.5	1.5	DC0000A3:Surf[32]
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	2

Appendix D LZC Technology Conclusions

Wind turbines

This technology potentially offers low annual CO_2 emission reduction, along with a high capital cost. This option has been discounted due low wind speeds of 4.9 m/s in this area making a wind turbine unviable[1]

There is potential to export electrical energy generated by this technology back to the grid.

Air Source Heat Pump (VRF)

This technology offers the potential to save 20.9 % carbon emissions; the system has been discounted due to the medium cost and long payback. In addition, the inclusion of this technology may include cooling which would go against the cooling hierarchy of London Plan 2019. If cooling were to be omitted and use radiators the efficiency of an air source heat pump is much lower and potentially add more in running costs compared with gas solution this site is opting for.

This technology would be utilised for on-site generation only.

Ground Source Heat Pumps

This technology offers the potential to save 25% carbon emissions; the system has been discounted due to its high capital costs, long payback period and constraints of the site.

This technology would be utilised for on-site generation only.

Biomass heating

This technology offers the potential to save 52 % in CO_2 emissions. This option has been discounted due the additional space requirement for the location of the boiler and fuels store, and a potential legacy issue for the supply of fuel for the end user meaning that once the RHI payments end biomass will cost more than gas bringing a payback of 16 years. In addition, this option would require a backup heating source, increasing costs and payback periods.

This technology would be utilised for on-site generation only.

Combined Heat and Power

The system has been discounted due to available plants space, ongoing maintenance requirements and the low demand meaning as it is unlikely to achieve full power generation throughout the year.

[1] https://www.rensmart.com/Maps#NOABL

This technology would be utilised for on-site generation only.

The below table shows the feasibility of LZC technology that was assessed for the London plan.

LZC Technology	Annual CO_2	Result	Capital Cost (£)	Result	Payback Period	Result	Recommendation
				Renewable Technologies			
Photovoltaics (PV)	28.9	High	222,000	Medium	9.4	High	High
Solar Water Heating	1.7	Low	17,715	Low	10.0	High	Medium
Biomass Heating	52.1	High	99,925	Low	16.1	High	Medium
				Low Carbon Technologies			
Heat Pump (VRF)	20.9	High	249,813	Medium	65.3	High	Low
Ground Source Heat Pump	25.0	High	499,625	Medium	21.5	High	Low

Note: All heat pump technologies have been assessed based on the reduction of heating only, as per Annex VI of Directive 2009/28/EC.

Score Criteria:

Score	Annual CO_2 Reduction (%)	Capital Cost (£)	Payback Years
High	7	>£750,000	>7
Medium	3 to 7	£200,000 to £750,000	3 to 7
Low	3	<£200,000	<3

3	200,000	3
7	750,000.00	7

Engineering a better environment

Third Floor
Concordia Works
30 Sovereign Street
Leeds LS1 4BA

+44 (0)1134 931 280
info@yonderconsulting.co.uk
yonderconsulting.co.uk