



Knowsley
(Image Business Park) Ltd

Planning Application
for Development
at
Site 3
Image Business Park
Knowsley

Energy Strategy

Issue 2



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c/o Seybourne Estates Ltd

Client Address 180 Piccadilly
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Property: Site 3, Image Business Park
Knowsley

Project Reference: 4911

Issue: Issue 2

Date: August 2021

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Checked by: MDC

Validated by: MDC



EXECUTIVE SUMMARY

The development consists of a single warehouse unit with associated office accommodation. The unit is to be built as a shell warehouse with the office spaces being provided with natural ventilation via openable windows and heating and fitted out to a Category A standard.

The energy strategy adopts a hierarchical approach using passive and low energy design technologies to reduce baseline energy demand and CO₂ emissions followed by the application of low and zero carbon technologies. This strategy is in line with the relevant Knowsley Council planning policies.

As there is no applicable carbon emission reduction target within the Knowsley Council planning policies the baseline target for the development is to comply with Building Regulations Part L2A: 2013 by demonstrating that the proposed unit achieves the TER. However, the applicant intends to reduce carbon emissions by a further 10% using on-site renewable energy technology.

The focus of this energy strategy is on CO₂ reduction by using a highly efficient building envelope with high efficiency mechanical and electrical services.

Investigations have been undertaken to identify whether any work has progressed on the park with regard to a decentralised energy network. Our understanding is that there is no current or planned scheme agreed at this time so a connection is not part of the proposal. However, a safeguarded route has been noted from the site boundary to the likely position of a boiler room to allow for connection should a system become available.

The carbon dioxide emission and savings values for the proposed development are as follows:

	CO ₂ Emissions (Tonnes per annum)	
	Regulated	Unregulated
Baseline Building Regulations 2013 Part L Compliant Development	143.42	195.18
After passive/low energy (energy demand) reduction	129.41	181.17
After potential decentralised measures	129.41	181.17
After renewable energy	114.47	166.23

	CO ₂ Savings (Regulated only)	
	Tonnes per annum	%
Savings from passive/low energy (energy demand) reduction	14.01	9.8%
Savings from potential decentralised measures	0.00	0.0%
Savings from renewable energy	14.94	11.5%
Total Cumulative Savings	28.95	20.2%

The development has been shown to comply with the Building Regulations Part L2A: 2013 requirements. In fact, the development has improved upon the baseline target by 9.8% just by using passive design measures and efficient technology to reduce energy demand. Furthermore, the emissions are reduced by another 11.5% with the inclusion of a roof mounted solar photovoltaic array to generate renewable electricity. The total emissions savings are 20.2% below the baseline for Part L2A 2013.



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1.00 INTRODUCTION

1.01 Purpose

This report has been prepared on behalf of the Applicant for the proposed development at Site 3, Image Business Park, Knowsley. This document assesses the proposed energy strategy and demonstrates how it seeks to satisfy the applicable Knowsley Council policies on energy and carbon dioxide emission.

The report contains the predicated energy and carbon emission assessment results for the development and identifies savings from the proposed passive and energy efficiency technologies to be incorporated into the scheme.

The energy and carbon dioxide emission assessment has been undertaken using dynamic simulation modelling software EDSL TAS Version 9.5.1. Based on the building design submitted with the planning application the modelling identifies the energy and carbon dioxide savings related to the building envelope design and efficient mechanical and electrical services systems.

1.02 Proposed Development

The development consists of a single warehouse unit with associated office accommodation. The main warehouse area is to be built as shell with the associated office spaces being provided with heating and natural ventilation via openable windows and fitted out to a Category A standard.

By its speculative nature, the final use of the industrial unit cannot be defined at this early stage. It is assumed for estimating energy usage that the shell warehouse areas will be unheated although this will ultimately be dependent on the future tenant's bespoke requirements.

The fitting out of the industrial area for a specific process would require bespoke systems to suit the tenants' individual needs which would all require assessment under ADL2B.

The proposed servicing strategy for the industrial unit will be as follows:

- Warehouse heating No heating, see the note below.
- Office area heating Radiators fed by gas fired boiler LTHW system.
- Core area heating Electric panel heaters.
- Domestic hot water Electrically powered point-of-use and instantaneous shower systems.

For thermal assessment purposes the shell warehouse area is assumed to be unheated. A gas service will be provided to the space but left capped off for extension by the tenant as considered necessary to serve either convector unit heaters or radiant tubular heaters if required by a tenant. Additionally, it is assumed that the future tenant fit-out warehouse lighting will utilise LED luminaires with photocell dimming and PIR occupancy controls. The efficacy of all lighting is set at 80lm/w but higher efficacies are achievable.



2.00 POLICY REVIEW

2.01 National Policy

The National Planning Policy Framework sets out the planning policies for England that are to be taken into account within local planning policies. The framework itself does not have specific policies but identifies the purpose of achieving sustainable development.

2.02 Knowsley Council

The energy strategy has been produced for the proposed development in accordance with the requirements of the Knowsley Council Local Plan Core Strategy January 2016. The relevant policies are as follows:

Policy CS22

Sustainable and Low Carbon Development

Sustainable Construction Principles

- 1) *New development will be required to meet high standards of sustainable design and construction and minimise carbon emissions. This should be achieved by:*
 - a) *Designing new buildings for flexible uses throughout their lifetime;*
 - b) *Avoiding the creation of adverse local climate conditions by using natural systems to avoid internal overheating and excessive heat generation;*
 - c) *Ensuring developments are comfortable and safe for users;*
 - d) *Making the most effective and sustainable use of water, aggregates and other resources;*
 - e) *Limiting energy use by incorporating high standards of insulation, heat retention, natural ventilation and passive solar techniques;*
 - f) *Landscaping (including measures such as green walls or roofs) to create shelter and reduce any heat island effect;*
 - g) *Using sustainable materials from local suppliers where possible;*
 - h) *Supplying energy efficiently and incorporating decentralised energy systems, using renewable and low carbon energy where feasible;*
 - i) *Managing flood risk, including through the use of Sustainable Drainage*
 - j) *Systems (SuDS) and flood resilient design for infrastructure and property;*
and
 - k) *Promoting sustainable waste practices in new and existing developments.*

Low Carbon Development, Community Energy Fund and Allowable Solutions

- 2) *Government targets for carbon reduction in new development are expected to be implemented through updates to the Building Regulations. Where it is not technically feasible or economically viable to meet the requirements on site, contributions to the Council's Community Energy Fund may be accepted as one of a range of options under the Government's proposed 'Allowable Solutions' mechanism. The Fund will be used to support carbon reduction initiatives in Knowsley and potentially the wider Liverpool City Region.*



Sustainable Construction Targets

- 3) *Local targets for sustainability in relation to specific development areas or sites may be outlined in the Local Plan: Site Allocations and Development Policies.*

Priority Zones and Decentralised Energy Networks

- 4) *Knowsley Industrial Park and Knowsley Business Park are identified as a 'Priority Zone'. Within this area the Council and its partners will facilitate renewable and low carbon infrastructure by (subject to feasibility) requiring new development to:*
 - a) *Make provision for connection to an existing or planned decentralised energy network; and*
 - b) *Be designed to enable future connectivity in terms of proposed site layout, infrastructure and heating provision, including consideration of connections at a later date or phase.*
- 5) *Subject to opportunity and need, additional 'Priority Zones' may be identified in the Local Plan: Site Allocations and Development Policies.*

Policy CS23

Renewable and Low Carbon Infrastructure

- 1) *The Council will support proposals that will produce and distribute decentralised, low carbon and renewable energy, provided that they do not cause significant harm (in terms of their number, scale, siting or cumulative impacts) to:*
 - a) *Natural resources, biodiversity, geodiversity, water and air quality and, landscape character;*
 - b) *Aviation and transport safety;*
 - c) *Historical and cultural assets;*
 - d) *Public amenity and living conditions; or*
 - e) *Openness and amenity of the Green Belt, except in very special circumstances.*
- 2) *Proposals must be accompanied by information that shows how the local environment will be protected, and how the site will be restored when energy production ends. Proposals resulting in an unacceptable impact must be mitigated by appropriate measures agreed by the Council.*



3.00 OUTLINE METHODOLOGY

3.01 Energy Strategy

The fundamental approach for the energy strategy is as follows:

- Establish the baseline energy demand in line with statutory requirements in terms of Building Regulations Part L2A : 2013 compliance using accredited thermal modelling software plus allowance for energy consumed by elements not covered in the 2013 Building Regulations.
- Adopt passive and low energy design techniques in order to reduce the energy demand for the development beyond the baseline energy demand requirements.
- Assess the potential decentralised heating, cooling and power measures available to suit this development and establish potential energy/carbon dioxide reduction for viable solutions (clean scheme).
- Assess the potential low and zero carbon (renewable) technologies to suit the development and establish potential energy/carbon dioxide reduction for viable solutions.
- Establish the anticipated energy and carbon dioxide emission reductions for the development using Building Regulations 2013 calculation methodologies.

This approach is in line with the principles detailed within the relevant policy statements and regulatory guidelines listed in section 2.00.

3.02 Energy Strategy Target

As there is no applicable carbon emission reduction target within the Knowsley Council planning policies the target for the development is simply to comply with Building Regulations Part L2A: 2013 by demonstrating that the proposed unit achieves the TER.

Furthermore, the applicant intends to provide a minimum 10% carbon emissions reduction by renewable technology alone, in addition to the savings achieved to meet Building Regulations.



4.00 ENERGY DEMAND ASSESSMENT

4.01.01 General

The energy demand assessment work has been undertaken using EDSL TAS dynamic simulation software Version 9.5.1 that incorporates the SBEM calculation methodology in line with Building Regulations Part L2A : 2013 requirements in order to generate a predicted annual CO₂ emission rate.

Within the energy demand assessment the following fuel carbon dioxide emission intensity factors have been used in line with Part L2A : 2013.

Fuel	kg CO ₂ / kWhr
Natural gas	0.216
Grid supplied electricity	0.519
Grid displaced electricity	0.519

4.01.02 Regulated and Un-regulated Energy

For completeness a “whole energy” approach has been taken for this energy strategy whereby the baseline analysis is corrected for unregulated energy use.

Therefore this energy strategy shows how policy compliance for the “regulated” energy can be achieved at the development and makes reference to the estimated “un-regulated” energy usage by means of energy benchmarks.

For clarity “regulated” and “un-regulated” energy are summarised as follows:

- Regulated Energy This is the energy covered by Approved Document L2A of the Building Regulations i.e. the energy used in heating, cooling, fans and pumps plus domestic hot water
- Un-regulated Energy This is energy used within a building that is not covered by the Building Regulations i.e. the energy used for general small power loads, lifts, external lighting, catering electricity etc.

The planning policy CO₂ reduction targets are based in “regulated” energy only. Hence the % CO₂ emission savings target is not adversely affected by the estimated “un-regulated” energy in a building.

The assessed un-regulated energy uses for the proposed uses at the site are as follows:

Industrial Unit:	General small power Lifts External lighting Catering electricity
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4.01.03 Energy Benchmarks

The “un-regulated” energy use and benchmarks for this framework energy strategy have been derived from data and guidance taken from the following Chartered Institute of Building Services Engineers (CIBSE) documents:

- CIBSE Guide F – Energy Efficiency in Buildings: 2012
- CIBSE Technical Memorandum – Energy Benchmarks TM46: 2008



The un-regulated energy use values have been derived from the CIBSE Guide F Benchmark Section. The specific benchmarks used and the resultant estimated un-regulated energy values are as follows:

Industrial Unit: Industrial unit benchmarks good practice type 5 (distribution and warehouse) of 9.0 kWh/m²/year. This equates to 4.67 kgCO₂/m²

4.02 Baseline Scheme

The baseline demand is the Building Regulations Part L2A: 2013 target emission rate (TER).

The Part L2A: 2013 TER is derived from the thermal model based on the National Calculation Methodology (NCM). The review has been carried out utilising the TAS dynamic thermal modelling software version 9.5.1 that has achieved accreditation from the Department of Communities and Local Government (DCLG).

The baseline CO₂ emissions for the unit are modelled as follows:-

	CO ₂ Emission (kg CO ₂ /m ² /year)
Heating	0.67
Cooling	0.00
Fans and Pumps	0.15
Lighting	9.42
Domestic Hot Water	2.69
Part L2A: 2013 TER	12.94
Unregulated Uses	4.67
Total	17.61

The annual CO₂ emission resulting from the baseline demand equates to the following:

	CO ₂ Emission (tonnes CO ₂ /year)
Without un-regulated uses	143.42
With un-regulated uses	195.18

4.03 Energy Efficiency Measures

The energy strategy prioritises the reduction in energy consumption and hence CO₂ emissions through the building envelope design together with the use of efficient mechanical and electrical services.

The passive and low energy design principles that have been adopted in the current design include:

- High performance glazing.
- Improved building fabric.
- Low building air leakage rate (3.0 m³/hr/m² @ 50 Pa, which represents a 70% improvement over the minimum 2013 Building Regulations requirements).
- Variable speed fans and pumps



- Low energy lighting (LED) lighting to the office, core and warehouse areas.
- Automatic lighting control with occupancy and daylight dimming controls

The Building Regulations thermal model analysis identifies the following CO₂ emissions for the unit:-

	Baseline Scheme (kg CO₂/m²/year)	Lean Scheme (kg CO₂/m²/year)
Heating	0.67	0.52
Cooling	0.00	0.00
Fans and pumps	0.15	0.14
Lighting	9.42	6.99
Domestic Hot Water	2.69	4.02
Part L2A : 2013 Total	12.94	11.68
Unregulated Power	4.67	4.67
Total	17.61	16.35

	CO₂ Emissions (Tonnes per annum)	
	Regulated	Unregulated
Baseline Scheme	143.42	195.18
Lean Scheme	129.41	181.17

	Regulated Carbon Dioxide Savings	
	Tonnes CO₂ per year	% Improvement
Be lean: savings from energy demand reduction	14.01	9.8%

The calculated emissions reduction at the Lean stage of the hierarchy is 9.8% based upon the baseline building to meet Part L2A regulations.



5.00 DECENTRALISED HEATING, COOLING AND POWER ASSESSMENT

5.01 General

The potential use of decentralised heating, cooling and power for the building has been assessed in relation to the following:

- Decentralised heating & cooling
- Combined heat and power (CHP)
- Combined cooling heat and power (CCHP/trigeneration)

5.02 Decentralised Heating and Cooling

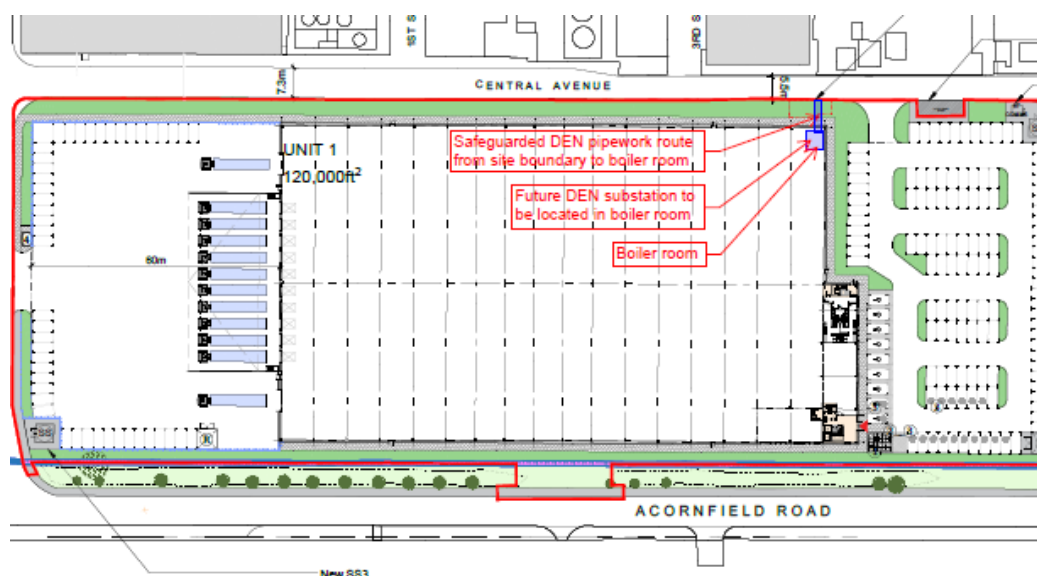
Decentralised heating and cooling relates to a central system that provides the necessary heating and cooling water to more than one use or part of a building or to more than one building. For example a decentralised heating system can comprise central boiler plant that provides heat to separate dwellings and similarly a decentralised cooling system can comprise central refrigeration plant that provides cooling to individual retail units in a shopping centre.

Two types of decentralised heating and cooling schemes have been considered for the development.

1. Connection to a district energy network (DEN)
2. The provision of a development decentralised energy centre

District Energy Network

Knowsley Industrial Park and Business park are identified as 'Priority Zone' for the purposes of prioritising connections to renewable and low carbon infrastructure. Investigations have been undertaken to identify whether any work has progressed on the industrial park with regard to a decentralised or district energy network. Our understanding is that there is no current or planned scheme agreed at this time so a connection is not part of the proposal. However, a safeguarded route has been noted from the site boundary to the likely position of a boiler room within the unit to facilitate a connection with minimal impact should a heat network become available in the future. The proposed route is outlined in the site plan below.





Decentralised Energy Centre

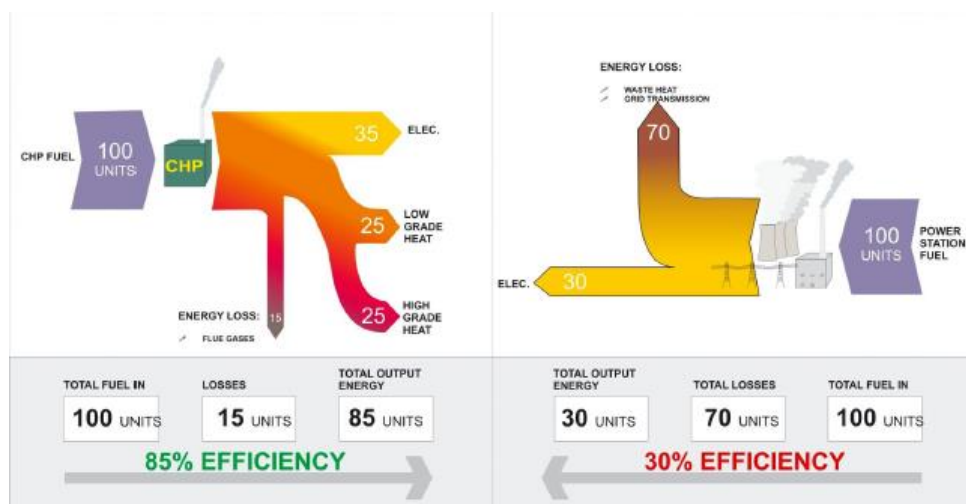
The provision of a decentralised energy centre (DEC) to serve the industrial development has been reviewed. This would incorporate gas fired boilers or heat pumps to provide the heating and hot water base load for the development with an air cooled chiller to provide chilled water to facilitate the comfort cooling. It was concluded as not viable for the development for the following reasons:

- The heating load to the warehouse element of the industrial unit may not ever be realised. The warehouse element of the industrial unit will be provided on a shell and core basis with the area being unheated. The future tenant may or may not wish to heat the warehouse. The developer's experience is that it is very common for the warehouse area to remain unheated.
- A low temperature hot water (LTHW) based system would not be the preferred choice of heating medium if a tenant chose to heat the warehouse area. LTHW as the primary heating medium means that a convective heating system would need to be provided to the warehouse area. Convective heating systems are not best suited for use in tall spaces as excessive temperature gradients will occur between the warehouse floor and the underside of the roof. Direct gas fired heating installations are preferred by tenants.
- The additional plant central plant room and external plant space along with the below ground distribution heating and cooling pipework adds a significant capital cost to the project, which would have an adverse effect on the scheme financial viability.

5.03 Combined Heat and Power

Combined Heat and Power (CHP) generates electricity on site and recovers a proportion of the waste heat for use in heating and/or hot water generation for the building. This allows the overall efficiency to be significantly greater than the electricity generated via power stations feeding the National Grid. The CHP plant typically uses gas as the primary energy source and often incorporates a thermal store. Biomass fuelled CHP is possible however this is typically only for larger schemes that can accommodate a CHP unit that has a minimum thermal output of 50 to 100kW.

The requirement for the single industrial unit would be a CHP unit with a thermal output in the range of 8 to 12kW. This thermal output requirement is too small for a biomass CHP to be applicable and commercially available.





CHP systems are typically considered only to be viable where they are able to run for at least 5000 hours per annum and have an appropriate year round heating demand.

For the industrial unit the domestic hot water requirement is low along with the relatively low heating demand for the core areas as the offices are heated via the air source heat pumps (variable refrigerant flow systems). Therefore, due to the low heat demand, a CHP plant will not operate for the recommended minimum 5000 hours per annum run time. Hence the use of a CHP plant is not considered to be a viable technology for the industrial unit.

5.04 Combined Cooling, Heat and Power



Combined Cooling, Heat and Power (CCHP) that is often referred to as trigeneration uses the same principles as detailed above for a CHP system however the heat produced is also used to generate cooling via an absorption chiller. The CCHP plant can make use of heat generated by the CHP plant in buildings with a cooling demand.

Similar to CHP plant the CCHP system is typically considered only to be viable where they are able to run for at least 5,000 hours per year and have an appropriate year round usage for the heat generated from the CCHP plant.

The absorption chiller incorporated within CCHP scheme has a very low efficiency and the intention is for the CHP to be used to heat the majority of the domestic hot water base demand requirements. In addition the proposed comfort cooling systems via air source heat pumps (variable refrigerant flow systems) provide a solution with lower carbon emissions for the development. Therefore a CCHP plant is not considered suitable for the development.

5.05 Decentralised Heating, Cooling and Power Analysis

For the reasons noted above there are no economically viable or carbon emission reduction beneficial decentralised heating, cooling and power sources applicable to the development.

The proposed strategy to use gas boilers serving hot water circuits can be easily adapted to be served by a district heating network, should the local proposal be built out in the future. A safeguarded route has been noted from the site boundary to the likely position of a boiler room within the unit to facilitate a connection with minimal impact should a heat network become available in the future.



6.00 RENEWABLE ENERGY ASSESSMENT

6.01 General

The potential use of renewable energy technology has been undertaken for the following:

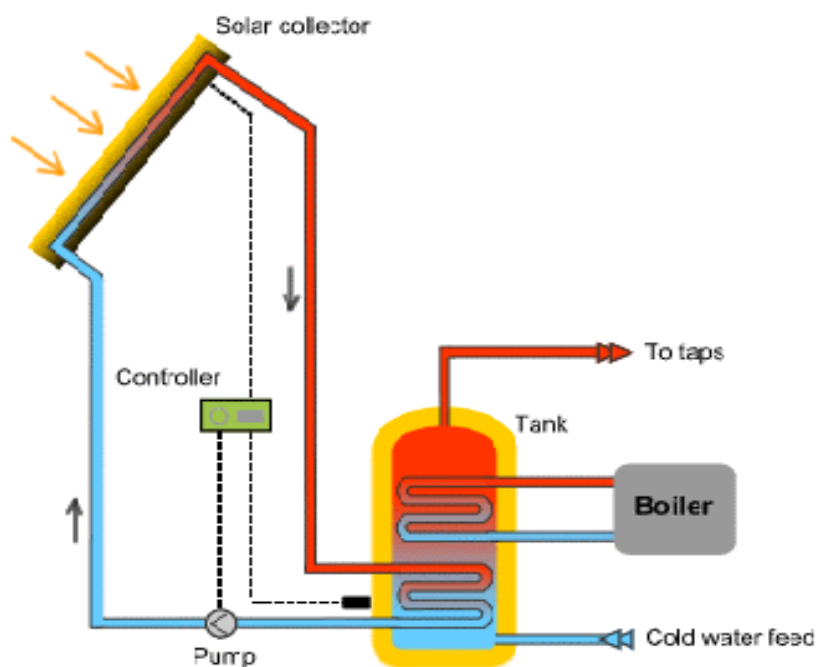
- Solar water heating
- Wind turbines
- Photovoltaic cells
- Biomass
- Ground source heating and cooling
- Air source heating and cooling
- Fuel cell

6.02 Solar Water Heating

Solar thermal panels utilise the sun's energy to generate hot water for use within the building. The panels are commonly provided in either flat plate or evacuated tube arrangements. The panels are ideally located facing south at an approximate 30° inclination angle in areas where they are not subjected to shade.



The development has the potential to use solar water heating to pre-heat the domestic hot water service, and hence it is considered viable for the development.



The unit has the potential to use solar water heating to pre-heat the domestic hot water service. However, as an industrial unit's domestic hot water demand is typically very low, solar water heating has not been proposed for the development.

6.03 Wind Turbines

Wind turbines generate electrical energy derived from kinetic energy provided by the local wind resource. The performance of wind turbines depends greatly on the wind speed and turbulence that in turn is influenced by the terrain and installation height.





In urban areas non-laminar wind flow occurs as a result of turbulence due primarily to adjacent buildings. There is growing evidence of urban wind turbines failing to perform in line with manufacturer's estimated outputs and as a result wind turbines are likely to produce only modest power outputs with corresponding low carbon dioxide emission reduction within urban sites.

For the reasons detailed above a wind turbine is not considered viable for the development.

6.04 Photovoltaic Cells

Photovoltaic (PV) panels utilise the sun's energy to generate electricity. The optimum location for PV panels is south-facing at an approximate 30° inclination angle in areas where they are not subjected to shade.





The unit has unshaded roof area that could be utilised for PV panels. The industrial/warehouse unit has been modelled in the lean option with roof lights and thus the amount of roof area available to use for PV and solar thermal panels is partly restricted. That aside, it is considered that PV's could be successfully integrated at roof level running with the inclined roof angles to the industrial/warehouse unit.

The following quantity of PV is required to meet the target 10% carbon reduction from onsite renewable energy technology.

	Units	Site 3
PV Panel Area	m ²	240
Approximate Peak Electrical Output	kWp	44.6
Annual Carbon Emission Reduction	kgCO ₂ /m ²	1.35
	Tonnes CO ₂ /year	14.9
Offset of CO₂ Emissions	%	11.54

6.05 Biomass

Biomass is considered to be a renewable fuel source as the CO₂ absorbed during the growth period is assessed as being approximately equal to the CO₂ emitted during combustion and hence deemed "carbon neutral". Biomass for boilers is typically wood either in chip or pellet form.



Biomass boilers require fuel storage together with associated transportation and delivery to the store location. Biomass boilers also increase the NOx emissions when compared to gas fired boilers.



As noted in section 5.03 of this report the base heating demand for the industrial unit is low. The plant space requirements for a biomass installation are large when compared to a gas fired boiler installation. Therefore, utilising a biomass solution would be an inefficient use of space for this development.

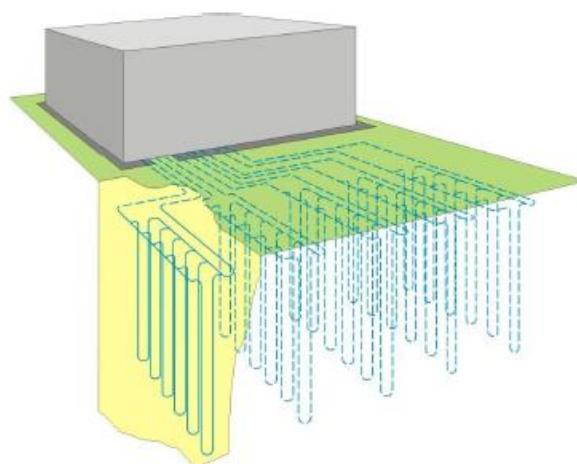
A communal heating system is not appropriate for the commercial development, see section 5.02 of this report. When considering a biomass solution this is exacerbated by the additional plant area requirements for the fuel storage and delivery.

For this development there is no realistic space within the overall development for the fuel storage together with the site constraints related to the associated delivery requirements. In addition there are on-going concerns with regard to the potential impact on local air quality.

For the reasons defined above the use of biomass is not considered viable for the development.

6.06 Ground Source Heating and Cooling

Ground source heating and cooling systems utilises the principle during heating mode of upgrading heat from the ground to a usable temperature and during cooling mode of rejecting heat from the building into the ground. There are two primary methods utilising either open or closed loop systems.



The open loop system extracts water, typically from the chalk aquifer, and uses this water in either the heating or cooling process before rejecting this heat back to the aquifer in a separate borehole. The open loop system requires licence approval from the Environment Agency that typically has a 10 year duration.

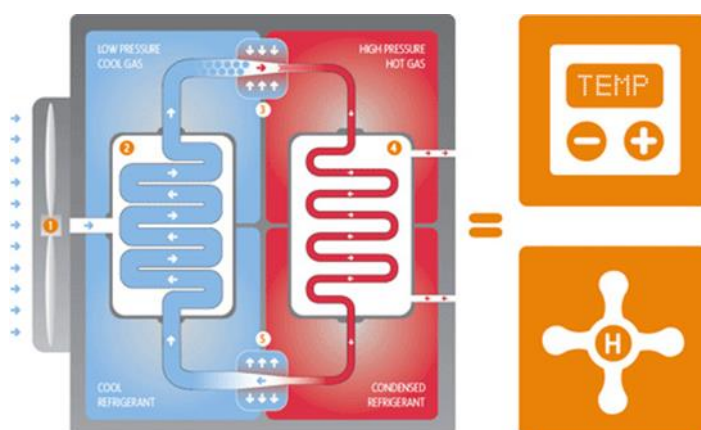
The closed loop system dissipates heat to or extracts heat from the ground via pipework circuits that are typically inserted into vertical boreholes. These generally do not require Environment Agency licences as no extraction of water from the aquifer takes place.

Generally for both the open and closed loop options heat pumps are used in order to generate the heating and cooling water temperatures needed within a building.

GSHP are technically viable for use at the development. However as air source heat pumps in their variable refrigerant flow (VRF) format are also technically viable, the GSHP solution which is considerably more expensive to install, has not been considered viable for the development.

6.07 Air Source Heating and Cooling

Air sourced heat pump (ASHP) works on the same principals as a ground source heat pump (GSHP) however the medium in which heat is extracted is the external air rather than the ground. The ASHP can be reversed to provide cooling when required. ASHP will generally have a lower seasonal coefficient of performance when compared to GSHP.



Air source heat pumps in their variable refrigerant volume (VRF) format are suitable for use in the development. However due to the small size of the development, no need to provide



comfort cooling to the office accommodation and the ability of the proposed plant to connect to a future district heat network, it is not considered cost effective to include heat pumps at this location.

6.08 Fuel Cell

The fuel cell technology essentially converts chemical energy into both electrical and heat energy. The cell needs to be continually supplied with hydrogen (derived from either a piped or storage source) and oxygen (derived from air) which are combined and the chemical reaction produces electrical energy, heat energy and water vapour.

The fuel cell requires a hydrogen fuel source that can either be from a piped source (not currently available) or from stored gas. However the more usual approach currently in the UK is to use natural gas in order to generate the hydrogen required to operate the fuel cell.

Fuel cells have various commercial and technical limitations. There is a high initial capital cost together with there being few established suppliers and a very limited specialist design, installation and maintenance capabilities. Certain fuel cell elements require regular replacement imposing a significant on-going cost implication. The fuel cells themselves are generally large, heavy and require fresh air ventilation.

Due to the initial capital cost, space requirements and on-going maintenance costs fuel cells are not considered viable for this development.

6.09 Renewable Energy Analysis

The proposed renewable energy sources for the development are:

Photovoltaic panels - 240 m² to provide a contribution towards the electrical demand

The thermal model for the unit has been repeated incorporating the renewable energy technology proposed and the results are:

	Baseline Scheme (kg CO ₂ /m ² /year)	Lean Scheme (kg CO ₂ /m ² /year)	LZC Scheme (kg CO ₂ /m ² /year)
Heating	0.67	0.52	0.52
Cooling	0.00	0.00	0.00
Fans and pumps	0.15	0.14	0.14
Lighting	9.42	6.99	6.99
Domestic Hot Water	2.69	4.02	4.02
Displaced Electricity	0.00	0.00	-1.35
Part L2A : 2013 Total	12.94	11.68	10.33
Unregulated Power	4.67	4.67	4.67
Total	17.61	16.35	15.00

The total carbon emissions predicted by the modelling at each stage of the energy hierarchy is as set out below;



	CO₂ Emissions (Tonnes per annum)	
	Regulated	Unregulated
Baseline Building Regulations 2013 Part L Compliant Development	143.42	195.18
After passive/low energy (energy demand) reduction	129.41	181.17
After potential decentralised measures	129.41	181.17
After renewable energy	114.47	166.23

The carbon savings at each stage of the energy hierarchy are shown below;

	CO₂ Savings (Regulated only)	
	Tonnes per annum	%
Savings from passive/low energy (energy demand) reduction	14.01	9.8%
Savings from potential decentralised measures	0.00	0.0%
Savings from renewable energy	14.94	11.5%
Total Cumulative Savings	28.95	20.2%

It is demonstrated that 11.5% carbon saving is achieved versus the Lean stage by incorporating renewable energy technology at the final 'Green' stage of the energy hierarchy.



7.00 OVERALL BUILDING ANALYSIS

7.01 Carbon Reduction

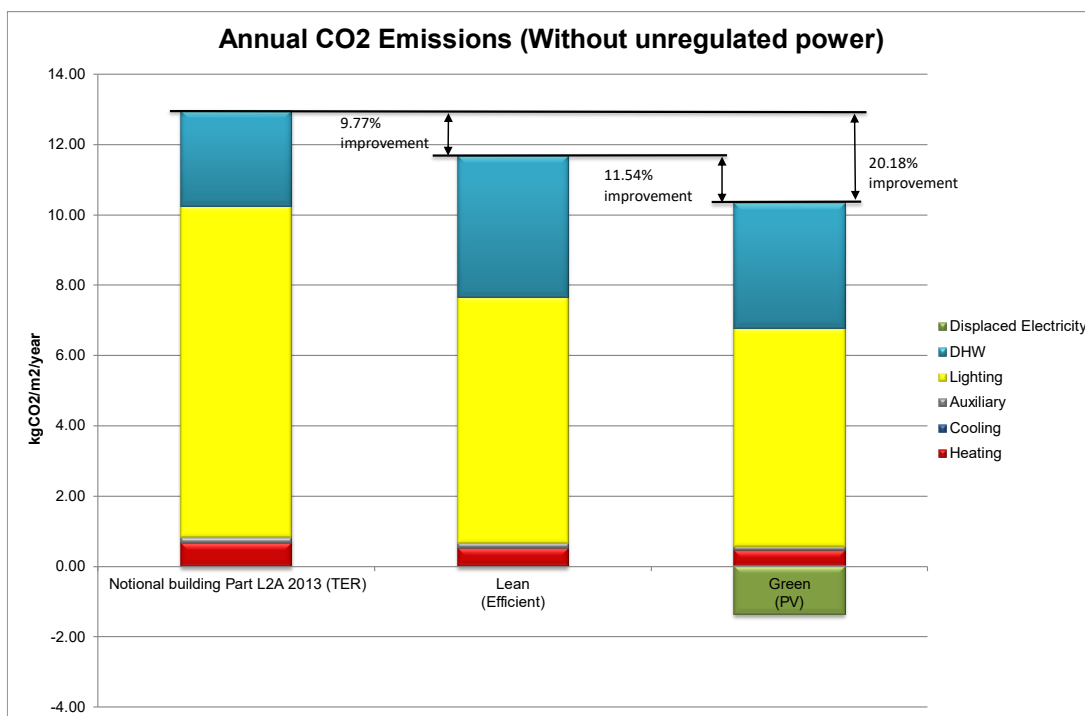
The overall building analysis can then be summarised as follows:

	Tonnes CO2 /year		
	Baseline Scheme	Lean Scheme (with passive/low energy)	LZC Scheme
Building Regulations Compliant	143.42	129.41	114.47
Allowing for Un-regulated Uses	195.18	181.17	166.23

These values are shown in diagrammatic form below that shows the following principles:

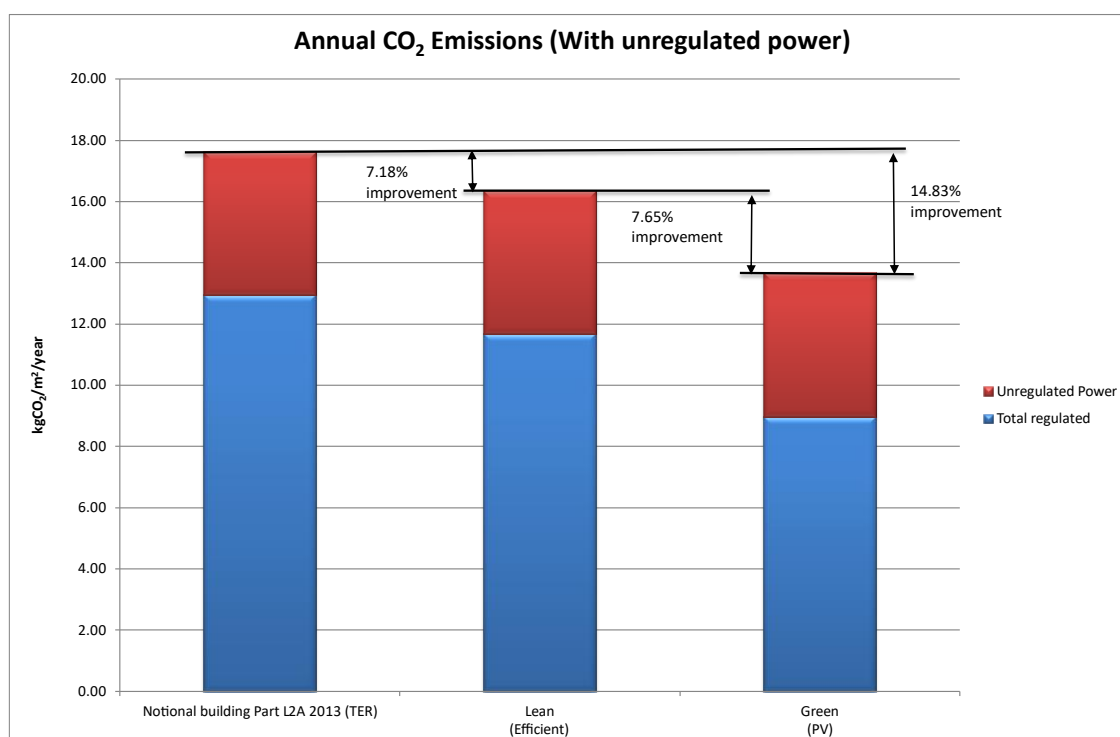
	Regulated Energy	
	Lean Scheme (with passive/low energy)	LZC Scheme
Improvement over baseline scheme	9.77%	20.18%
Improvement over lean scheme	-	11.54%

	Unregulated Energy	
	Lean Scheme (with passive/low energy)	LZC Scheme
Improvement over baseline scheme	7.18%	14.83%
Improvement over lean scheme	-	7.65%



Based on the regulated power results indicated above the proposed scheme, incorporating passive and energy efficiency measures and renewable energy technology, provides a carbon emissions reduction of 20.18 % when compared to the baseline Building Regulation 2013 (TER) compliant scheme.

The results at each stage of the hierarchy including unregulated power are below;





The predicted annual CO₂ emissions data is as follows:

	Tonnes CO ₂ /year		
	Baseline Scheme	Lean Scheme (with passive/low energy)	LZC Scheme
Building Regulations Compliant	143.42	129.41	114.47
Allowing for Un-regulated Uses	195.18	181.17	166.23

The carbon emission savings as a result of the proposed measures based on the current design are predicted as follows:

	CO ₂ Savings (Regulated only)	
	Tonnes per annum	%
Savings from passive/low energy (energy demand) reduction	14.01	9.8%
Savings from potential decentralised measures	0.00	0.0%
Savings from renewable energy	14.94	11.5%
Total Cumulative Savings	28.95	20.2%

The proposed strategy to use gas boilers serving a hot water circuit can be easily adapted to be served by a district heating network, should the local proposal be built out in the future. A safeguarded route has been noted from the site boundary to the likely position of a boiler room within the unit to facilitate a connection with minimal impact should a heat network become available in the future.



8.00 CONCLUSIONS

In line with the relevant planning policies and guidelines, the energy strategy for the proposed development has adopted a hierarchical approach of using passive and low energy design technologies to reduce the baseline energy demand, and hence CO₂ emissions, followed by the application of low and zero carbon technologies as appropriate.

The focus of the energy strategy is on CO₂ reduction from the building by adopting a highly efficient building envelope solution together with high efficiency mechanical and electrical services incorporating heat recovery. The renewable energy technologies assessment is based on using solutions that are technically proven with low maintenance implications taking into account the energy efficiency strategies being proposed in the current design.

The following passive and low energy design measures have been incorporated into the proposed development:

- High performance glazing
- Improved building fabric
- Low building air leakage rate
- Variable speed fans and pumps.
- Low energy lighting.
- Automatic lighting control with occupancy sensors (auto on, auto off).

The decentralised heating, cooling and power assessment has indicated that no district energy network connections are viable for the scheme. However, a safeguarded route has been noted from the site boundary to the likely position of a boiler room within the unit to facilitate a connection with minimal impact should a heat network become available in the future.

The potential renewable energy technologies have been assessed taking into account the particular development constraints. Passive and low energy design measures proposed for the lean scheme provide a significant improvement over the Building Regulations Part L2A:2013 baseline. However, additional renewable energy technology in the form of photovoltaic (PV) panels are proposed for the project to provide a further 10% carbon saving.

The above measures result in the following carbon dioxide emission savings:

	CO ₂ Savings (Regulated only)	
	Tonnes per annum	%
Savings from passive/low energy (energy demand) reduction	14.01	9.8%
Savings from potential decentralised measures	0.00	0.0%
Savings from renewable energy	14.94	11.5%
Total Cumulative Savings	28.95	20.2%



APPENDICES

1. BRUKL Report Lean

Project name

Shell and Core

Plot 3 Unit 1 - Lean

As designed

Date: Wed Aug 25 12:04:38 2021

Administrative information

Building Details

Address: Plot 3 , Image Business Park, Knowsley, L33 7UF

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.1"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.1

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

Certifier details

Name: Matt Jenkins

Telephone number: 01932 781641

Address: Watkins Payne Partnership, Sunbury-on-Thames,
TW16 7AHCriterion 1: The calculated CO₂ emission rate for the building must not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	12.9
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	12.9
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	11.7
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	0.24	0.24	Wall External 0.5
Floor	0.25	0.22	0.22	Ground Floor
Roof	0.25	0.18	0.18	Roof
Windows***, roof windows, and rooflights	2.2	1.33	1.51	Window Opening 1
Personnel doors	2.2	2.2	2.2	Door Personnel
Vehicle access & similar large doors	1.5	1.5	1.5	Door Vehicle w5.1 h 5.4
High usage entrance doors	3.5	-	-	No high usage entrance doors in project
U _a -Limit = Limiting area-weighted average U-values [W/(m ² K)] U _a -Calc = Calculated area-weighted average U-values [W/(m ² K)] U _i -Calc = Calculated maximum individual element U-values [W/(m ² K)]				
* There might be more than one surface where the maximum U-value occurs. ** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows. *** Display windows and similar glazing are excluded from the U-value check. N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.				

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

Building services

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

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

1- Electric panel NV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
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.					

2- Centralised extract Electric (12 Zones)

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

3- LTHW gas boiler NV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.93	-	-	-	-
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- Point of use

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0.01
Standard value	1	N/A

2- Instant

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

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I			
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard	
Toilet FlrG 1	-	-	0.5	-	-	-	-	-	-	-	N/A	
Toilet FlrG 2	-	-	0.5	-	-	-	-	-	-	-	N/A	
Changing 1	-	-	0.5	-	-	-	-	-	-	-	N/A	
Toilet Flr1 2	-	-	0.5	-	-	-	-	-	-	-	N/A	
Changing 2	-	-	0.5	-	-	-	-	-	-	-	N/A	
Toilet Flr 2 2	-	-	0.5	-	-	-	-	-	-	-	N/A	
Toilet Flr 2 3	-	-	0.5	-	-	-	-	-	-	-	N/A	
Toilet Flr 2 4	-	-	0.5	-	-	-	-	-	-	-	N/A	
Toilet FlrG 32	-	-	0.5	-	-	-	-	-	-	-	N/A	
Toilet FlrG 34	-	-	0.5	-	-	-	-	-	-	-	N/A	
Toilet FlrG 35	-	-	0.5	-	-	-	-	-	-	-	N/A	
Toilet FlrG 36	-	-	0.5	-	-	-	-	-	-	-	N/A	

Shell and core configuration

Zone	Assumed shell?
Office Flr1 1	NO
Office Flr1 2	NO
Office Flr1 3	NO
Office Flr1 4	NO
Circulation (Staircase) 1	NO
Circulation (Staircase) 2	NO
Toilet FlrG 1	NO
Toilet FlrG 2	NO
Store 1	NO
Store 2	NO
Changing 1	NO
Circulation Flr1 2	NO
Circulation FlrG 2	NO
Circulation FlrG 3	NO
Circulation FlrG 4	NO
Toilet Flr1 2	NO
Circulation Flr1 1	NO
Changing 2	NO
Office floor 2 1	NO
Office floor 2 2	NO
Office floor 2 3	NO
Office floor 2 4	NO
Circulation (Staircase) 4	NO
Circulation (Staircase) 94	NO
Toilet Flr 2 2	NO
Toilet Flr 2 3	NO
Toilet Flr 2 4	NO
Circulation Flr 2 2	NO
Circulation Flr 2 4	NO
Circulation FlrG 1	NO

Shell and core configuration

Zone	Assumed shell?
Circulation FlrG 21	NO
Toilet FlrG 32	NO
Toilet FlrG 34	NO
Toilet FlrG 35	NO
Toilet FlrG 36	NO

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
Office Flr1 1		80	-	-	1456
Office Flr1 2		80	-	-	445
Office Flr1 3		80	-	-	668
Office Flr1 4		80	-	-	311
Circulation (Staircase) 1		-	80	-	67
Circulation (Staircase) 2		-	80	-	91
Toilet FlrG 1		-	80	-	135
Toilet FlrG 2		-	80	-	138
Store 1		80	-	-	24
Store 2		80	-	-	11
Changing 1		-	80	-	23
Circulation Flr1 2		-	80	-	29
Circulation FlrG 2		-	80	-	21
Circulation FlrG 3		-	80	-	20
Circulation FlrG 4		-	80	-	12
Toilet Flr1 2		-	80	-	102
Ware 1 Main		80	-	-	54007
Ware 2 Undercroft		80	-	-	756
Ware 3 Undercroft		80	-	-	676
Circulation Flr1 1		-	80	-	51
Changing 2		-	80	-	7
Office floor 2 1		80	-	-	1437
Office floor 2 2		80	-	-	403
Office floor 2 3		80	-	-	659
Office floor 2 4		80	-	-	298
Circulation (Staircase) 4		-	80	-	46
Circulation (Staircase) 94		-	80	-	34
Toilet Flr 2 2		-	80	-	34
Toilet Flr 2 3		-	80	-	33
Toilet Flr 2 4		-	80	-	33
Circulation Flr 2 2		-	80	-	24
Circulation Flr 2 4		-	80	-	45
Circulation FlrG 1		-	80	-	60
Circulation FlrG 21		-	80	-	37
Toilet FlrG 32		-	80	-	42
Toilet FlrG 34		-	80	-	30

General lighting and display lighting		Luminous efficacy [lm/W]			
Zone name		Luminaire	Lamp	Display lamp	General lighting [W]
	Standard value	60	60	22	
Toilet FlrG 35		-	80	-	31
Toilet FlrG 36		-	80	-	27

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?
Office Flr1 1	NO (-47%)	NO
Office Flr1 2	NO (-42%)	NO
Office Flr1 3	NO (-39%)	NO
Office Flr1 4	NO (-60%)	NO
Ware 1 Main	NO (-62%)	NO
Ware 2 Undercroft	NO (-34%)	NO
Ware 3 Undercroft	NO (-29%)	NO
Office floor 2 1	NO (-45%)	NO
Office floor 2 2	NO (-79%)	NO
Office floor 2 3	NO (-38%)	NO
Office floor 2 4	NO (-64%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m ²]	11081	11081
External area [m ²]	26299	26299
Weather	MAN	MAN
Infiltration [m ³ /hm ² @ 50Pa]	3	3
Average conductance [W/K]	7469	8940
Average U-value [W/m ² K]	0.28	0.34
Alpha value* [%]	3.17	3.17

* 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	1.65	2.63
Cooling	0	0
Auxiliary	0.28	0.3
Lighting	13.48	18.63
Hot water	7.74	8.44
Equipment*	30.49	30.49
TOTAL **	23.14	29.99

* 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 & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	5.47	8.17
Primary energy* [kWh/m ²]	69.02	69.02
Total emissions [kg/m ²]	11.7	12.9

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

HVAC Systems Performance										
System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Other local room heater - unfanned, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity										
Actual	68.2	0	18.9	0	0	1	0	1	0	
Notional	104.7	0	35.5	0	0	0.82	0	----	----	
[ST] Other local room heater - unfanned, [HS] Room heater, [HFT] Electricity, [CFT] Electricity										
Actual	97.2	0	27	0	21.5	1	0	1	0	
Notional	163.7	0	55.5	0	25.9	0.82	0	----	----	
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
Actual	53.3	0	16.8	0	1.3	0.88	0	0.93	0	
Notional	76.3	0	25.9	0	1.3	0.82	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	0.24	Wall External 0.5
Floor	0.2	0.22	Ground Floor
Roof	0.15	0.18	Roof
Windows, roof windows, and rooflights	1.5	1.3	Rooflight
Personnel doors	1.5	2.2	Door Personnel
Vehicle access & similar large doors	1.5	1.5	Door Vehicle w5.1 h 5.4
High usage entrance doors	1.5	-	No high usage entrance doors in project
U _{i-Typ} = Typical individual element U-values [W/(m²K)]			U _{i-Min} = Minimum individual element U-values [W/(m²K)]
* There might be more than one surface where the minimum U-value occurs.			

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



2. BRUKL Report Green

Project name

Shell and Core

Plot 3 Unit 1 - Green

As designed

Date: Wed Aug 25 12:48:26 2021

Administrative information

Building Details

Address: Plot 3 , Image Business Park, Knowsley, L33 7UF

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.1"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.1

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

Certifier details

Name: Matt Jenkins

Telephone number: 01932 781641

Address: Watkins Payne Partnership, Sunbury-on-Thames,
TW16 7AHCriterion 1: The calculated CO₂ emission rate for the building must not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	12.9
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	12.9
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	10.3
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 -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.24	0.24	Wall External 0.5
Floor	0.25	0.22	0.22	Ground Floor
Roof	0.25	0.18	0.18	Roof
Windows***, roof windows, and rooflights	2.2	1.33	1.51	Window Opening 1
Personnel doors	2.2	2.2	2.2	Door Personnel
Vehicle access & similar large doors	1.5	1.5	1.5	Door Vehicle w5.1 h 5.4
High usage entrance doors	3.5	-	-	No high usage entrance doors in project
U _a -Limit = Limiting area-weighted average U-values [W/(m ² K)] U _a -Calc = Calculated area-weighted average U-values [W/(m ² K)] U _i -Calc = Calculated maximum individual element U-values [W/(m ² K)] * There might be more than one surface where the maximum U-value occurs. ** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows. *** Display windows and similar glazing are excluded from the U-value check. N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.				

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

Building services

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

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

1- Electric panel NV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
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.					

2- Centralised extract Electric (12 Zones)

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

3- LTHW gas boiler NV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.93	-	-	-	-
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- Point of use

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0.01
Standard value	1	N/A

2- Instant

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

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

Shell and core configuration

Zone	Assumed shell?
Office Flr1 1	NO
Office Flr1 2	NO
Office Flr1 3	NO
Office Flr1 4	NO
Circulation (Staircase) 1	NO
Circulation (Staircase) 2	NO
Toilet FlrG 1	NO
Toilet FlrG 2	NO

Shell and core configuration

Zone	Assumed shell?
Store 1	NO
Store 2	NO
Changing 1	NO
Circulation Flr1 2	NO
Circulation FlrG 2	NO
Circulation FlrG 3	NO
Circulation FlrG 4	NO
Toilet Flr1 2	NO
Circulation Flr1 1	NO
Changing 2	NO
Office floor 2 1	NO
Office floor 2 2	NO
Office floor 2 3	NO
Office floor 2 4	NO
Circulation (Staircase) 4	NO
Circulation (Staircase) 94	NO
Toilet Flr 2 2	NO
Toilet Flr 2 3	NO
Toilet Flr 2 4	NO
Circulation Flr 2 2	NO
Circulation Flr 2 4	NO
Circulation FlrG 1	NO
Circulation FlrG 21	NO
Toilet FlrG 32	NO
Toilet FlrG 34	NO
Toilet FlrG 35	NO
Toilet FlrG 36	NO

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	Lamp	Display lamp	
Standard value	60	60	22	
Office Flr1 1	80	-	-	1456
Office Flr1 2	80	-	-	445
Office Flr1 3	80	-	-	668
Office Flr1 4	80	-	-	311
Circulation (Staircase) 1	-	80	-	67
Circulation (Staircase) 2	-	80	-	91
Toilet FlrG 1	-	80	-	135
Toilet FlrG 2	-	80	-	138
Store 1	80	-	-	24
Store 2	80	-	-	11
Changing 1	-	80	-	23
Circulation Flr1 2	-	80	-	29
Circulation FlrG 2	-	80	-	21
Circulation FlrG 3	-	80	-	20

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
Circulation FlrG 4		-	80	-	12
Toilet Flr1 2		-	80	-	102
Ware 1 Main		80	-	-	54007
Ware 2 Undercroft		80	-	-	756
Ware 3 Undercroft		80	-	-	676
Circulation Flr1 1		-	80	-	51
Changing 2		-	80	-	7
Office floor 2 1		80	-	-	1437
Office floor 2 2		80	-	-	403
Office floor 2 3		80	-	-	659
Office floor 2 4		80	-	-	298
Circulation (Staircase) 4		-	80	-	46
Circulation (Staircase) 94		-	80	-	34
Toilet Flr 2 2		-	80	-	34
Toilet Flr 2 3		-	80	-	33
Toilet Flr 2 4		-	80	-	33
Circulation Flr 2 2		-	80	-	24
Circulation Flr 2 4		-	80	-	45
Circulation FlrG 1		-	80	-	60
Circulation FlrG 21		-	80	-	37
Toilet FlrG 32		-	80	-	42
Toilet FlrG 34		-	80	-	30
Toilet FlrG 35		-	80	-	31
Toilet FlrG 36		-	80	-	27

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?
Office Flr1 1	NO (-47%)	NO
Office Flr1 2	NO (-42%)	NO
Office Flr1 3	NO (-39%)	NO
Office Flr1 4	NO (-60%)	NO
Ware 1 Main	NO (-62%)	NO
Ware 2 Undercroft	NO (-34%)	NO
Ware 3 Undercroft	NO (-29%)	NO
Office floor 2 1	NO (-45%)	NO
Office floor 2 2	NO (-79%)	NO
Office floor 2 3	NO (-38%)	NO
Office floor 2 4	NO (-64%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m ²]	11081	11081
External area [m ²]	26299	26299
Weather	MAN	MAN
Infiltration [m ³ /hm ² @ 50Pa]	3	3
Average conductance [W/K]	7469	8940
Average U-value [W/m ² K]	0.28	0.34
Alpha value* [%]	3.17	3.17

* 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	1.65	2.63
Cooling	0	0
Auxiliary	0.28	0.3
Lighting	13.48	18.63
Hot water	7.74	8.44
Equipment*	30.49	30.49
TOTAL **	23.14	29.99

* Energy used by equipment does not count towards the total for consumption or calculating emissions.

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

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	2.6	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	5.47	8.17
Primary energy* [kWh/m ²]	69.02	69.02
Total emissions [kg/m ²]	10.3	12.9

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

HVAC Systems Performance										
System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Other local room heater - unfanned, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity										
Actual	68.2	0	18.9	0	0	1	0	1	0	
Notional	104.7	0	35.5	0	0	0.82	0	----	----	
[ST] Other local room heater - unfanned, [HS] Room heater, [HFT] Electricity, [CFT] Electricity										
Actual	97.2	0	27	0	21.5	1	0	1	0	
Notional	163.7	0	55.5	0	25.9	0.82	0	----	----	
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
Actual	53.3	0	16.8	0	1.3	0.88	0	0.93	0	
Notional	76.3	0	25.9	0	1.3	0.82	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	0.24	Wall External 0.5
Floor	0.2	0.22	Ground Floor
Roof	0.15	0.18	Roof
Windows, roof windows, and rooflights	1.5	1.3	Rooflight
Personnel doors	1.5	2.2	Door Personnel
Vehicle access & similar large doors	1.5	1.5	Door Vehicle w5.1 h 5.4
High usage entrance doors	1.5	-	No high usage entrance doors in project
U _{i-Typ} = Typical individual element U-values [W/(m²K)]		U _{i-Min} = Minimum individual element U-values [W/(m²K)]	
* There might be more than one surface where the minimum U-value occurs.			

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