energycouncil
engineering sustainable buildings

Energy Statement
Ref: Z22050

Buildings 3-7
Industrial Development

at

Lincoln Way,
Clitheroe,
Lancashire,
BB7 1NX

for 320180236P

Avalon Town Planning

BREEAM ACCREDITED PROFESSIONAL
BSI UKAS FS 560187
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Contents

Executive Summary

This Energy Statement has been developed in support of the planning application for the proposed development of the industrial development of Buildings 3-7 at Lincoln Way, Clitheroe. The proposed buildings consists of single storey industrial areas that are unheated, with small office and amenity areas. The development is required to achieve compliance under Building Regulations Approved Document Part L2A (2013).

This statement will evaluate the technical and economic feasibility of using both passive and low and zero carbon technologies and will assess the practical levels of CO_2 reduction possible for this development to comply with the following Ribble Valley Borough Council policy documents:

- Core Strategy 2008-2028 A Local Plan for Ribble Valley (2014)

The following low and zero carbon technologies have been evaluated:

- Biomass
- Wind
- Biogas
- Air Source Heat Pumps & Exhaust Air Heat Pumps
- Geothermal
- Combined Heat & Power (CHP)
- Solar Hot Water
- Solar Photovoltaic

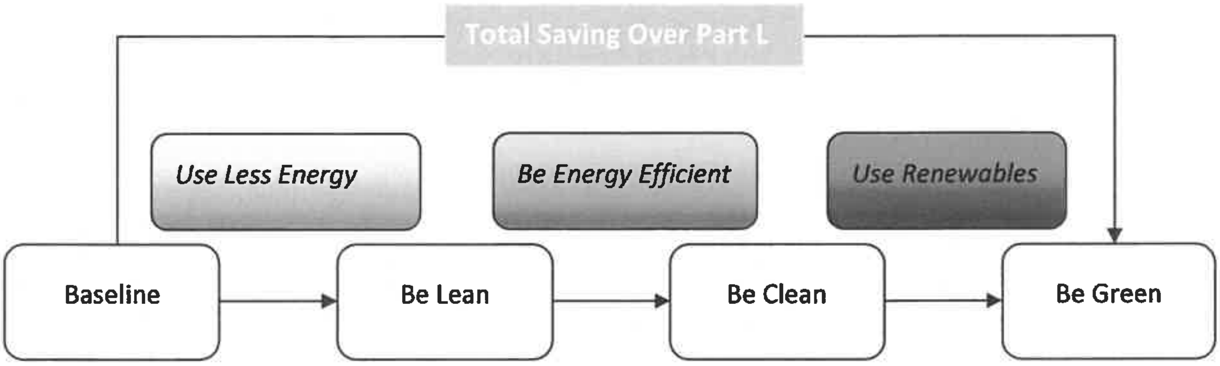
The approach for Buildings 3-7 at Lincoln Way, Clitheroe is to embed sustainability into the heart of the development through a range of design measures based on the 'Be Lean, Be Clean, Be Green' design hierarchy. Measures will include:

1) Enhanced building fabric to meet Building Regulation ADL2A 2013
2) Enhanced air tightness and thermal bridging
3) Heating and cooling to office areas by a highly-efficient electric heating system
4) Hot water will be provided by a highly efficient instantaneous system
5) Efficient lighting control strategy with CFL or LED type fittings
6) A rooftop mounted 15kWp photovoltaic panel array

An assessment of CO_2 emissions has been made based on the Simplified Building Energy Model (SBEM) methodology to comply with Approved Document Part L2A (2013) and in line with the requirements of Ribble Valley Borough Council planning policy.

Summary

The development has been provided with energy savings through the use of passive improvement measures such as improved energy efficiency. This passive approach to compliance will complement the integrated approach to the sustainable energy objectives of the national and local policies.



The principles of a 'Be Lean, Be Clean, Be Green' design philosophy have been applied, which results in a 7% improvement over Building Regulations Part L2A 2013, as indicated in Table 1.

Table 1 - Proposed development CO_2 emissions against Building Regulations Part L2A 2013

	Total CO2 Emissions ($KgCO_2$/Yr)
	Total
Baseline Emissions of Development (pre improvement)	**44,902**
Proposed Strategy	**41,556**
Total Reduction in Energy ($KgCO_2$/yr)	**3,346**
Percentage Improvement in Carbon Emissions (above Bldg Regs ADL2A 2013)	**7%**

A full design specification that confirms inputs used within the Part L2A 2013 calculations is provided within the appendices of this report.

1. Introduction

The proposed development consists of a number of industrial buildings at Lincoln Way, Clitheroe. The proposed buildings consist of single storey industrial areas that are unheated, with small office and amenity areas. The development is required to achieve compliance under Building Regulations Approved Document Part L2A (2013).

Supporting information is provided within this report for the proposed energy strategy to be considered on site in accordance with the following planning policies:

- Core Strategy 2008-2028 A Local Plan for Ribble Valley (2014)
- National Planning Policy Framework (2012)

Throughout this report, passive design techniques, energy efficient equipment and appropriate low carbon technologies will be appraised in line with the 'Be Lean, Be Clean, Be Green' philosophy of relevant planning documents and the Energy Hierarchy.

An assessment of CO_2 emissions will be made based on the calculation methodology dictated by the Simplified Building Energy Model (SBEM) methodology to comply with Approved Document Part L2A (2013) and in line with the requirements of Ribble Valley Borough Council planning policy.

1.1. Location

The area of land for the proposed development at Lincoln Way, Clitheroe, BB7 1NX, is shown in Figure 1 below. Clitheroe town centre is located around one mile to the south west of the site.

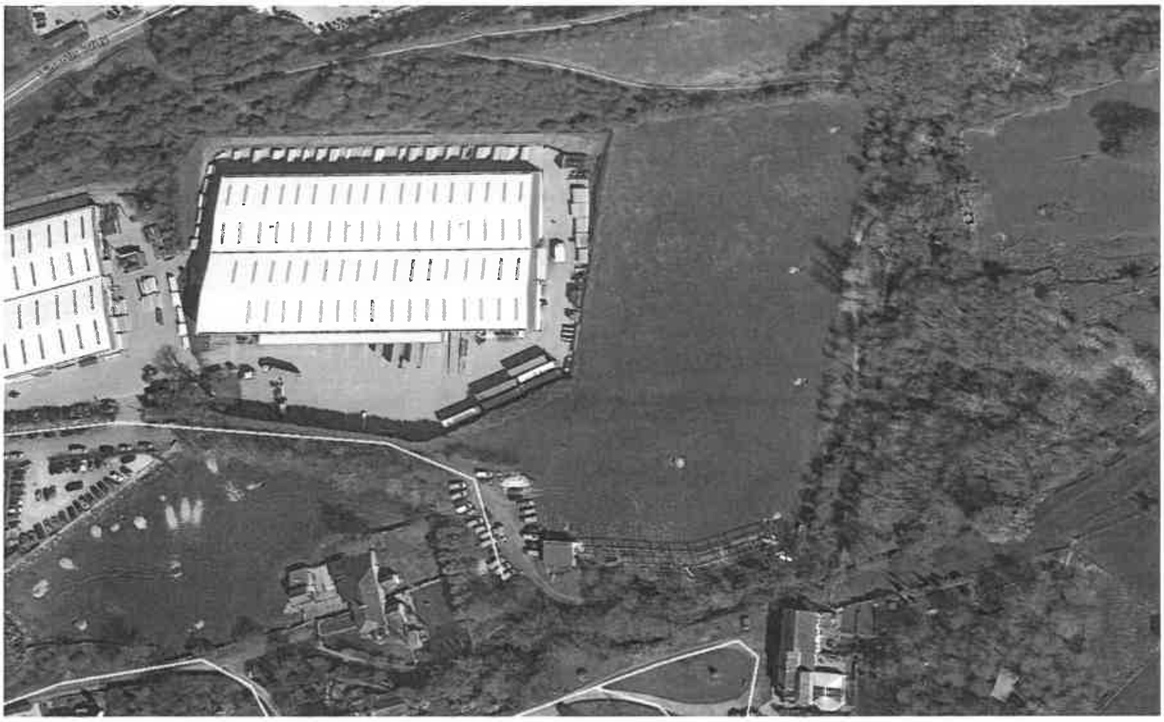


Figure 1 - Location and surrounding area of proposed Lincoln Way development

The site is located off Lincoln Way, with existing industrial units to the west of the site. Farming land and buildings are to the south of the site. The area of land for development was previously a golfing range, and is currently unoccupied.

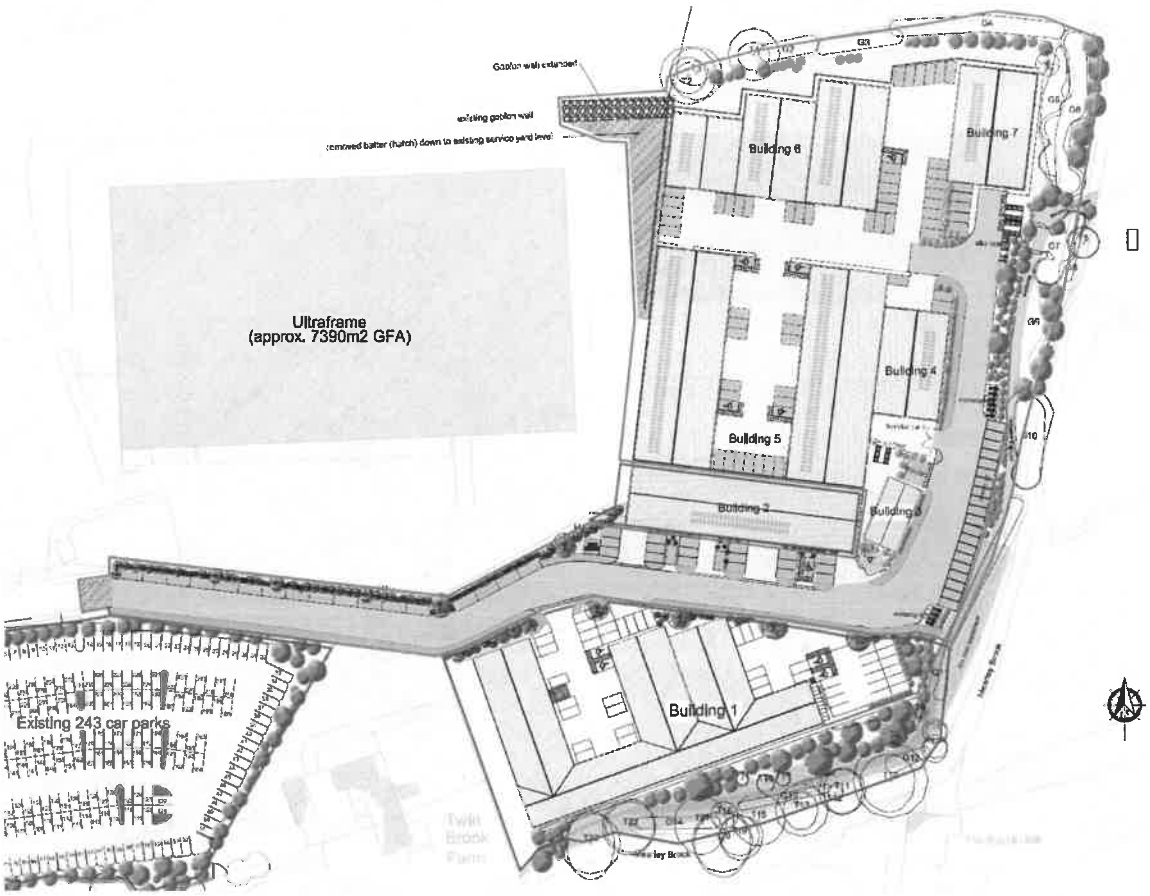


Figure 2 – Site plan for the proposed Lincoln Way development

The proposed development consists of number of new build industrial units. The plan in Figure 2 above shows Buildings 3 – 7 in the top right, which will be further broken down into a number of tenanted units. The red line boundary incorporates the proposed development of Buildings 3 – 7, with a private link road and car parking provided for each. Buildings 1 and 2 shown above are not covered as part of this energy statement.

1.2. Floor Plans

Figure 3 – Lincoln Way, Buildings 3 – 7 proposed unit layouts (Building 2 not included within this report)

All units of the proposed industrial buildings are shown in Figure 3. The following unit areas are proposed:

Building Number	Unit Name	Gross Floor Area	
Building 3	Office 1	60 m^2	480 m^2
	Office 2	60 m^2	
	Office 3	60 m^2	
	Office 4	60 m^2	
	Office 5	60 m^2	
	Office 6	60 m^2	
	Office 7	60 m^2	
	Office 8	60 m^2	
Building 4	Unit 19	231 m^2	439 m^2
	Unit 20	208 m^2	
Building 5	Unit 21	75 m^2	1988 m^2
	Unit 21A	75 m^2	
	Unit 22	148 m^2	
	Unit 23	174 m^2	
	Unit 24	174 m^2	
	Unit 25	174 m^2	
	Unit 26	174 m^2	
	Unit 27	174 m^2	
	Unit 28	174 m^2	
	Unit 29	174 m^2	
	Unit 30	174 m^2	
	Unit 31	148 m^2	
	Unit 32	75 m^2	
	Unit 32A	75 m^2	
Building 6	Unit 33	152 m^2	1238 m^2
	Unit 34	152 m^2	
	Unit 35	206 m^2	
	Unit 36	206 m^2	
	Unit 37	86 m^2	
	Unit 37A	86 m^2	
	Unit 38	175 m^2	
	Unit 39	175 m^2	
Building 7	Unit 40	181 m^2	543 m^2
	Unit 41	181 m^2	
	Unit 42	181 m^2	

2. Policy Drivers for Energy Efficiency and Renewable Energy

This section presents a range of planning policy that is applicable to the proposed development of Buildings 3 – 7 at Lincoln Way, at both a national and a local level.

2.1. National Policy

The National Planning Policy Framework was published in March 2012 and sets out the government's planning policies for England and they should be applied. Table 2 sets out the relevant energy standards for new developments and provides an indication of the design response to be provided.

Table 2 – Key National Planning Policy Requirements and Design Responses

Section	Policy Requirements	Design Response
10. Meeting the challenge of climate change, flooding and coastal change	When setting any local requirement for a building's sustainability, do so in a way consistent with the Government's zero carbon buildings policy and adopt nationally described standards.	This development will follow the principles set out in Ribble Valley Borough Council's Core Strategy 2008-2028: A Local Plan for Ribble Valley, using a 'Be Lean, Be Clean, Be Green' approach in reducing operational carbon emissions.
	Comply with adopted Local Plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable.	An overview of current decentralised energy schemes in Clitheroe and an assessment on the potential for future schemes in relation to this development is provided in Section 5 of this report.
	Take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.	This energy statement appraises site specific information to determine the most appropriate approach to minimise energy consumption.

2.2. Local Policy

The adopted Ribble Valley Borough Council's Core Strategy 2008-2028: A Local Plan for Ribble Valley provides a set of guidelines for new development. All relevant energy policy within these documents is provided within this section together with a design response.

Table 3 – Key Local Planning Policy Requirements and Design Responses

Core Strategy 2008-2028: A Local Plan for Ribble Valley		
Section	**Policy Requirements**	**Design Response**
EN3: SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE (Energy extracts only)	Proposals for the development of new renewable energy generation facilities, including onshore wind turbine technologies, will be considered. This will require the consideration of many factors including the need to reduce the area's carbon footprint whilst also recognising its exceptional environmental and landscape context. All development should optimise energy efficiency by using new technologies and minimising the use of energy through appropriate design, layout, material and landscaping and address any potential issues relating to flood risk. On larger schemes, planning permission will only be granted for developments on sites that deliver a proportion of renewable or low carbon energy on site based on targets elaborated within the relevant Development Management policy and also incorporate recycled or reclaimed materials or minimise the use of energy by using energy efficiency solutions and technologies. Where developments fail to achieve any of these, it must be demonstrated why this cannot be achieved.	This energy statement provides an appraisal of the renewable technologies that are appropriate for use on this development in Section 6. This development will follow the energy hierarchy principles of the 'Be Lean, Be Clean, Be Green' approach, to ensure that energy and carbon reduction is applied through fabric and system efficiencies, prior to the addition of renewable energy technologies (a photovoltaic array). An overview of the energy strategy and the development's performance against Part L2A of the Building Regulations is provided in Section 7 of this report.

3. Methodology

The first step of the full energy strategy assessment has been to undertake a baseline energy assessment. The baseline energy assessment consists of calculating the total CO_2 emissions of the development to meet Building Regulations and then compare the proposed improvement measures against this baseline. Building Regulations Part L2A 2013 (SBEM) applies to the development and provides carbon emissions from regulated energy.

The building can then be benchmarked/thermally modelled using the energy hierarchy:

1. Be Lean *A reduction in energy use as a result of passive design and energy efficiency*
Thermal performance of envelope (U-values) Glazing design Airtight construction Efficient mechanical ventilation and heat recovery Variable speed fans and pumps Energy Efficient lighting
2. Be Clean *A focus on supplying energy to the development through efficient means*
Connect to low carbon heat networks Develop site wide heat network from single energy centre On site CHP Provide energy efficient individual heating
3. Be Green *The installation of renewable technologies to meet energy demand where possible*
Consider the feasibility of renewable energy technologies Assess the integration of renewable technologies based on the above measures

The development must be provided with energy savings through the use of thermal improvements to fabric (a 'fabric first' approach), followed by other clean energy solutions (energy efficiency improvements, district heating, etc.) and finally the use of renewable energy technologies, where practical. This hierarchy complements the integrated approach to the sustainable energy objectives of the Ribble Valley Borough Council's Core Strategy 2008-2028: A Local Plan for Ribble Valley.

The planning policies require a full review of the technical and economic feasibility of the following renewable technologies:

- Biomass heating
- Biomass combined heat and power
- Solar hot water
- Solar photovoltaic
- Ground source heat pumps
- Air source heat pumps / exhaust air heat pumps
- Wind power

To achieve the targets set the development must achieve a balance between fabric, heating and control, ventilation and air leakage improvements, the amount of zero or low carbon technology installed and the capital, life cycle and running costs and maintenance and operation.

Feasible renewable energy technologies have been considered during the assessment to ensure the most suitable renewable energy is chosen for the demands of this scheme. The pros and cons of each technology with respect to this site are considered as part of this statement.

4. Passive Design and Energy Efficiency

The approach of the development is to embed sustainability into the heart of the design from the outset of the project design process. The design will be developed with sustainable solutions, taking into account the relevant policies and strategies of the Ribble Valley Borough Council's Core Strategy 2008-2028: A Local Plan for Ribble Valley.

The development will seek to consider all aspects and principles of sustainable development, taking into account environmental, social and economic impacts.

4.1. Passive Design Measures

The philosophy for the site is to achieve as much of the necessary reduction in carbon emissions through the use of passive design techniques and energy efficient measures as possible, before resorting to the use of LZCs. This ensures that the highest standards of building fabric and energy efficiency are achieved.

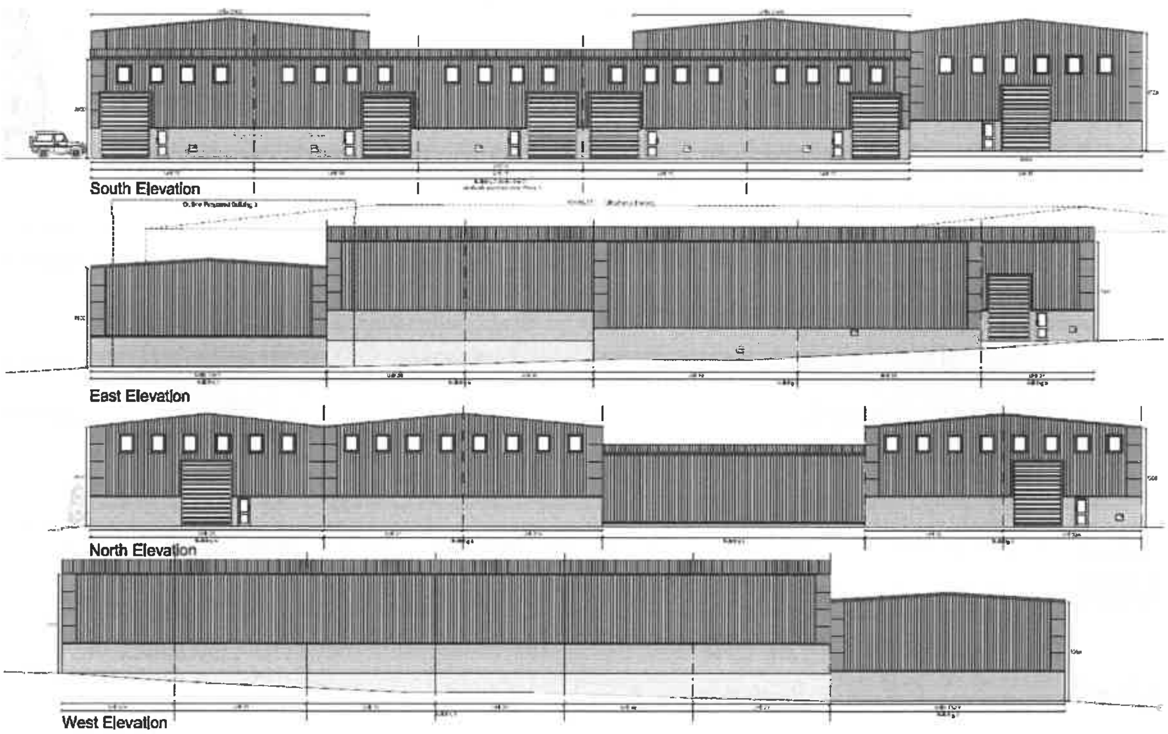


Figure 4 – Elevations of the proposed Lincoln Way industrial units

This will be undertaken through a fabric first energy efficient design approach with high levels of thermal efficiency and a reduction in energy demand through efficient lighting design.

5. District & Communal Heating Networks

This section outlines how consideration of energy supplied efficiently from a district heating network can be provided to the development in line with the energy hierarchy.

5.1. Decentralised Heating Networks

The energy policy reaffirms the view that energy generated by centralised power stations and transmitted through the national grid is highly inefficient and wasteful.

One of priorities for reducing CO_2 emissions is to reduce reliance on centralised power stations. This means increasing the use of local, low-carbon energy supplies through de-centralised energy systems.

Decentralised plant generally means any heating and hot water and/or electricity generation provided on a district wide (DHN) or site wide (CHN) basis. DHN and CHN can typically include combined heat and power equipment (CHP). CHP is an engine which, when running, generates electricity and heats water which can then be distributed around a development.

Benefits of district heating networks can include:

- Provision of low carbon / lower cost heat to domestic and commercial customers
- Diversification of the energy mix
- Reductions in region-wide carbon emissions
- Targeting and reduction of fuel poverty
- Potential long term revenue streams for local authorities
- Alignment with regeneration programmes
- Driving the growth of the low carbon services sector

However, there are currently no existing district heating networks near to the site, and the development of a decentralised system would not be feasible or beneficial for a project of this scale and type. An extract from the ADE District Heating Installation Map[1] has been highlighted in Figure 5, indicating the nearest networks in Bailrigg, Preston and Halifax.

[1] https://www.theade.co.uk/resources/publications/district-heating-installation-map

Figure 5 – Location of site in relation to existing and proposed heat networks (site location marked by red spot)

6. Renewable Energy Technologies

Energy Council have reviewed options for the use of on-site renewable energy/Low or Zero Carbon Technology (LZT) in line with the policy aspirations of Ribble Valley Borough Council's Core Strategy 2008-2028: A Local Plan for Ribble Valley. This renewable energy statement/strategy reviews the technical and economic feasibility of the following technologies –

- Solar Photovoltaic
- Solar Hot Water
- Ground Source Heat Pumps
- Air Source Heat Pumps / Exhaust Air Heat Pumps
- Micro Wind Power
- Biomass

6.1. Photovoltaics (PV)

Photovoltaic panels convert sunlight into electricity to run lights and appliances. Photovoltaic panels use cells to convert light into electricity. A PV cell normally consists of 1 or 2 layers of a semi conducting material such as silicon. When light shines on a cell it generates energy causing electricity to flow, the higher the light intensity is, the more electricity flows.

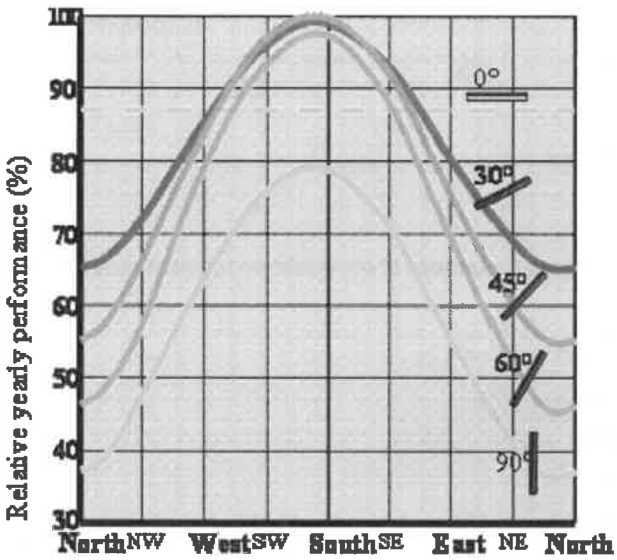


Figure 6 - Performance of photovoltaic panel orientation

The amount of energy PV cells generate is referred to as Kilowatt Peak (KWp). PV arrays now come in a variety of shapes and colours, ranging from grey 'solar tiles' that look like roof tiles to panels and transparent cells that you can use on conservatories and glass to provide shading as well as generating electricity. Solar panels are not light and the roof must be strong enough to take their weight, especially if the panel is placed on top of existing tiles. For flat roofs the panels can be mounted on A-frames to give the optimum angle.

The optimum panel inclination for solar collection is 35°, oriented due south; however panels that are inclined between 35° and 45° and oriented south of west or east are generally suitable. If solar collectors are oriented away from due south then a larger surface area will be required to generate a set amount of energy. The effect of non-optimal orientation is illustrated by the graph in Figure 6.

The use of photovoltaic panels have been applied for use on all units to ensure that the emissions generated from the grid electricity demand is reduced where possible.

Figure 7 - Photovoltaic array on a pitched roof

6.2. Solar Thermal HW Panels

Solar panel heating uses the radiant energy from the sun to heat hot water, most commonly for domestic hot water needs. There are two types of collectors used for solar water heating – flat plate collectors and evacuated tubes collectors. The systems function successfully in all parts of the UK, as they can work in diffuse light conditions. The collector should be mounted on a 10-60 degrees pitch facing south, although other variations can be used, south is the most efficient.

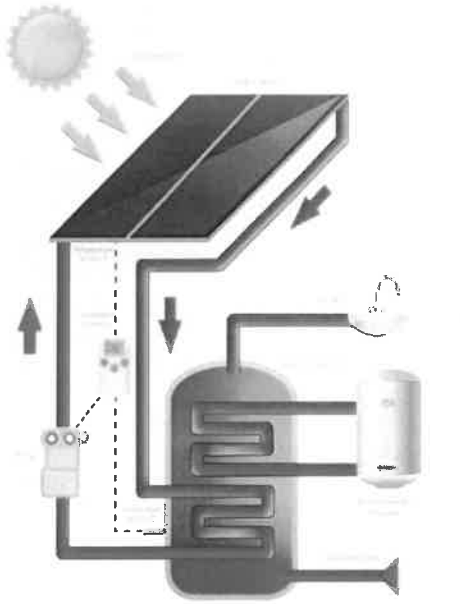


Figure 8 - The principles of a solar thermal system

The cost of installing the system is dependent on the distance between the solar collector and the hot water storage and therefore costs vary. The closer the collectors are to the hot water storage, the less pipe work is required. Annual maintenance checks are recommended. The solar collectors are connected to a condensing boiler via a HW cylinder with twin coil.

They are a 'simple' and guaranteed technology which will act as a pre-heat for the Hot Water and Heating usage. Payback between capital cost and energy saving can normally be achieved within 12 – 20 years, subject to usage type.

The use of solar thermal panels, work best in conjunction with individual heating systems for dwellings. The orientation of the development is fine for the utilisation of solar water heating to provide domestic hot water however it is not expected to achieve significant carbon savings due to the levels of hot water usage.

6.3. Ground Source Heat Pump (GSHP)

GSHPs have been developed specifically for the housing market and are now considered to be an established reliable technology. The GSHP would be sized to cater for the heating and domestic hot water requirements. Typically, they are more suited to apartments as a centralised system would be installed with multiple bore holes to a depth of up to 125 metres depending on the ground conditions. GSHPs use a heat exchanger to extract heat from the earth.

The efficiency of ground source heat pumps is measured by Co-efficient of Performance (CoP), this is the ratio of units of heat output for each unit of electricity used to drive the compressor and pump for the ground loop. Average CoP is around 2-4 although some systems may produce a greater rate of efficiency. This means that for every unit of electricity used to pump the heat, 2-4 units of heat are produced, making it an efficient way of heating a building. If grid electricity is used for the compressor and pump, then there is the opportunity to consider a range of energy suppliers to benefit from the lowest running costs, for example by choosing an economy 10 or economy 7 tariff.

Due to the relatively small scale of this development, GSHPs are not considered an appropriate design solution due to the installation costs.

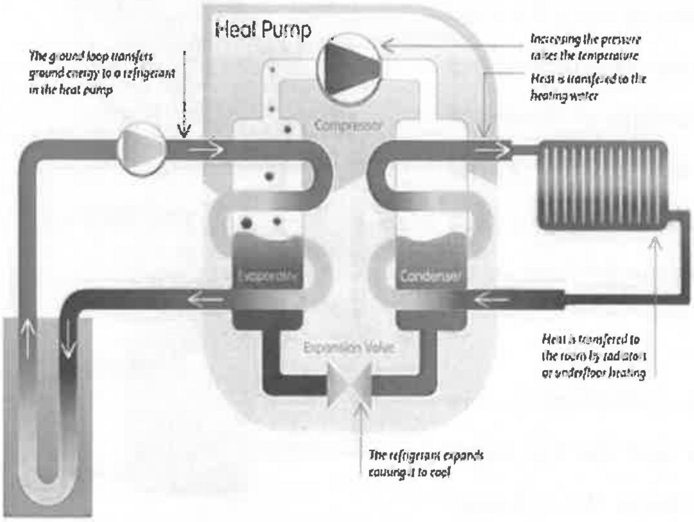


Figure 9 - Principles of a GSHP system

6.4. Air Source Heat Pump/Exhaust Air Heat Pump

Air source heat pumps (ASHP) and exhaust air heat pumps (EAHP) work in a similar way to GSHP. Air source heat pumps can be fitted on the external façade or in the roof space. An air source heat pump uses small amounts of electricity to take in large quantities of air and extract heat. The efficiency of ASHP is measured by Coefficient of Performance (CoP); this is the ratio of units of heat output for each unit of electricity used to drive the system. Average CoP is around 2-4 although some systems may produce a greater rate of efficiency.

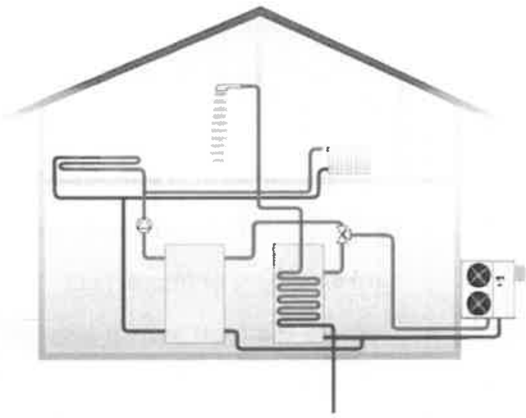


Figure 10 - Principles of an ASHP system

Exhaust air heat pumps such as the NIBE F370 work in a similar manner to ASHP units but have only indoor units (no outdoor compressors) and in addition they also recover heat from their integral exhaust air ventilation system. These units work well on apartment blocks and dwellings where mains gas is unavailable or unsuitable for a development. They are expensive in terms of capital cost of the equipment, installation and the enhanced structural requirements.

ASHPs are considered an appropriate low carbon technology for this scheme for the office areas within the industrial units, which are likely to require year round conditioning. However, initial energy modelling suggests that these areas would be more carbon efficient and financially viable with electric panel heaters and a photovoltaic array.

6.5. Micro Wind Power

Wind power is one of the cleanest and safest methods of generating electricity. However, wind power is unfeasible due to the fact the development is in an urban area and local wind conditions would not be sufficient to provide enough power. Most small wind turbines generate Direct Current (DC) electricity. Systems that are not connected to the national grid require battery storage and an inverter to convert DC electricity into Alternating Current (AC) which is mains electricity.

There are two types of wind turbine available:

- Roof mounted – Installed on the roof of the development
- Mast mounted – Which are free standing

Important issues to consider when using wind turbines are:

- Wind speed increases with height so it's best to have the turbine high on a mast or tower.
- Generally speaking the ideal site is a smooth top hill with a flat, clear exposure, free from excessive turbulence and obstructions such as large trees, dwellings or other buildings.
- Small scale wind power is particularly suitable for remote off grid locations where conventional methods of supply are expensive or impractical.
- Where the local annual average wind speed is 6 m/s or more.
- Where there are no significant nearby obstacles such as buildings, trees or hills that are likely to reduce the wind speed or increase turbulence

Figure 11 - Mounted wind turbine

As this development is in an urban area there will be obstacles which reduce wind speed. The average wind speed in this area is 3.9 m/s at a height of 10 metres, which is less than the 6 m/s required. Therefore, micro wind is not a viable technology for this development.

6.6. Biomass

Biomass is a generic name for any fuel produced from organic sources and falls into mainly two categories:

- Woody biomass- forest products, untreated wood products, energy crops and wood pellets
- Non-wood biomass – liquid biofuels (such as biodiesel, bioethanol) or animal waste industrial municipal products and high energy crops such as rape seed, sugar cane and maize.

For domestic properties the fuel used is normally wood pellets, wood chips or wood logs. For larger applications, biomass boilers replace conventional fossil fuel boilers and come with an automated feed by screw drives from hoppers.

Biomass systems require more cleaning than gas or oil boilers and they must be capable of being taken out of service for cooling and cleaning whilst maintaining the building heating supply particularly in communal heating systems. Centralised gas boilers are therefore still required to support the biomass boiler, which would be the lead boiler. The size of the dedicated plant rooms is substantial. Fuel availability, delivery and storage are also important issues to consider.

Air quality issues are also an important factor when looking to install biomass. The cost of the fuel depends on the type, delivery distances and whether it is obtained as simple waste product or from another organisation. The cost of wood pellets is currently a little more expensive than mains gas, and woodchip is approx. 30% cheaper, however prices are fluctuating rapidly in the bio-fuel market at the present time creating uncertainty over their take up.

Figure 12 - Biomass boiler and hopper

Biomass CHP is still relatively new to the UK market and is more suitable to large developments where energy demand does not require significant modulation. There are technical issues with small scale Biomass CHP and until these can be resolved and proven the take up of these systems in the UK and Europe has been slow.

Overall carbon savings of 40%+ are achievable with biomass technology. Biomass is more suited to a communal heating system; there is insufficient space to accommodate the equipment and fuel storage to facilitate a biomass boiler. Furthermore, there are noise and air quality issues associated with this type of technology. For this reason biomass is discounted.

7. Energy Assessment of Proposed Scheme

The proposed development of Buildings 3 – 7 at Lincoln Way has adopted the principles of the 'Be Lean, Be Clean, Be Green' approach. The thermal performance of the modelled elements in the proposed development is indicated in Table 4.

Table 4 - Fabric efficiency in the preliminary Buildings 3-7, Lincoln Way energy model

	U-value (W/m^2K)	G Value	Light Transmittance
Roof	0.25	n/a	n/a
Ground Floor	0.20	n/a	n/a
External Wall	0.16	n/a	n/a
External Glazing	1.60	0.40	0.71
Rooflights	1.90	0.55	0.70
Pedestrian Door	2.20	n/a	n/a
Vehicle Access Door	1.50	n/a	n/a

The most practical and economically feasible solution for the development is a good quality thermally insulated fabric, air tight envelope, passive improvements and the use of highly efficient building services to condition spaces.

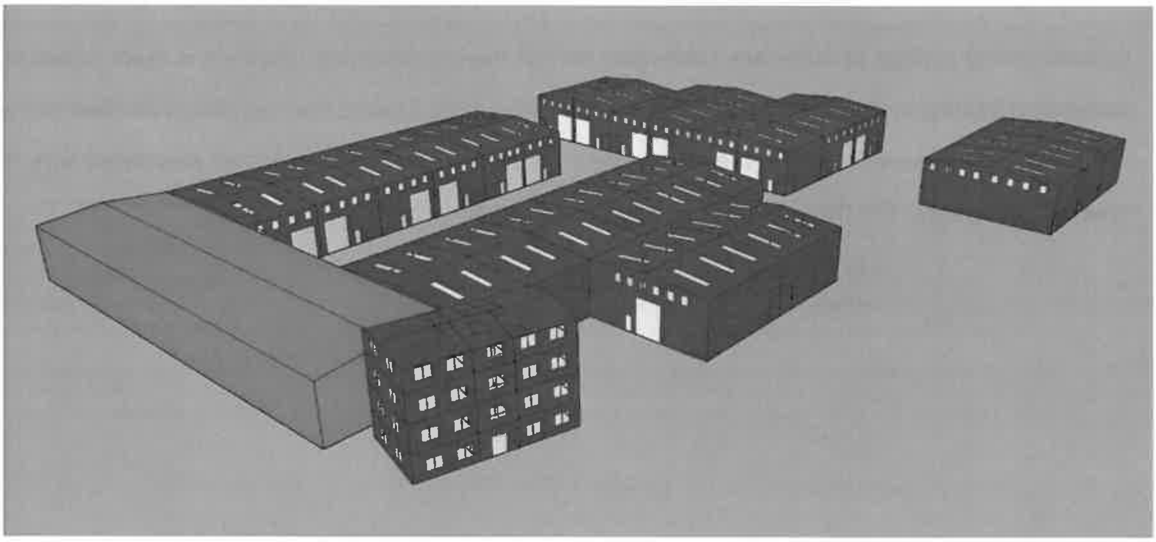


Figure 13 – Buildings 3-7 of Part L2A model within IES-VE 2017

A preliminary model design has been developed within IES-VE 2017 to understand the likely performance of the development against Approved Document Part L2A 2013. A full overview of inputs within the model is provided within the appendices of this report.

The results in Table 5 indicate that a 7% improvement can be achieved through the adoption of passive design techniques, energy efficiency measures and a 15kWp photovoltaic array. This provides a 3,346kg reduction in annual carbon emissions above Part L2A 2013 compliance.

Table 5 - Results of preliminary model Part L2A 2013 calculations

		Building 3	Building 4	Building 5	Building 6	Building 7
Floor area (m^2)		572	453	2145	1323	574
Heating and cooling demand [MJ/m^2)	Notional	146.38	11.01	17.61	16.44	16.05
	Actual	88.65	10.93	17.28	15.74	14.95
Primary energy (kWh/m^2)	Notional	98.25	30.89	37.25	36.33	34.63
	Actual	171	31.17	41.29	42.46	38
Total emissions (kg/m^2)	Notional	23.2	5.9	7.3	7.1	6.8
	Actual	23.1	5.3	6.4	6.8	5.6
Annual emissions (kg)	Notional	13,277	2,672	15,656	9,393	3,904
	Actual	13,220	2,400	13,725	8,996	3,215
Improvement over Building Regulations Part L2A 2013 (%)		**0.4**	**10.2**	**9.6**	**4.2**	**17.6**
		7.4				

8. Conclusion

Following the 'Be Lean, Be Clean, Be Green' hierarchy, the proposed design solutions are predicted to reduce the total carbon emissions by 3,346 Kg/CO_2/yr from the baseline emissions of 44,902kg/CO_2/yr. This equates to a 7% carbon reduction from the calculated baseline regulated energy emissions.

The approach for the proposed development of Buildings 3-7 at Lincoln Way is to embed sustainability into the heart of the development through a range of design measures based on the 'Be Lean, Be Clean, Be Green' design hierarchy. Measures will include:

1) Enhanced building fabric to meet Building Regulation ADL2A 2013
2) Enhanced air tightness and thermal bridging
3) Heating and cooling to office areas by a highly-efficient electric heating system
4) Hot water will be provided by a highly efficient instantaneous system
5) Efficient lighting control strategy with CFL or LED type fittings and daylight dimming
6) A rooftop mounted photovoltaic panel array (totalling 15kWp across Buildings 3 – 7 as defined in Section 9.2 of this report)

8.1. Low/ Zero Carbon Technologies (LZT) Review

- Photovoltaic panels have been incorporated for the development, with a rooftop array totalling 15kWp reducing the grid electricity demand for workshop, office and amenity areas.
- Solar Thermal Hot Water is not considered a viable option as an accurate estimate of hot water demand is not known, however it is not expected to be a major energy contributor.
- Biomass has been discounted as it poses problems in terms of air quality, delivery of fuel, storage and transportation for deliveries etc. It would require a centralised larger plant space for storing fuel, which is not suitable.
- Micro-wind turbines do not work on this type of development due to problems with wind turbulence and mounting of the units. The wind speeds in the area are not conducive to wind power electricity generation and there would be issues with turbulence, wind shading, noise and air traffic.
- GSHPs are not viable for site because of spatial and financial costs. There is no room to accommodate a GSHP vertical bore and associated communal plant room, ground conditions are unknown and systems are very costly.

- ASHP and/or NIBE units have been discounted from this development due to financial viability reasons.

An overall 7% improvement in CO_2 emissions above the Building Regulations baseline is proposed to support our application and to meet policy requirements.

Table 6 - Summary of Carbon Emissions

	Total CO2 Emissions ($KgCO_2/Yr$)
	Total
Baseline Emissions of Development (pre improvement)	**44,902**
Proposed Strategy	**41,556**
Total Reduction in Energy ($KgCO_2/yr$)	**3,346**
Percentage Improvement in Carbon Emissions (above Bldg Regs ADL2A 2013)	**7%**

9. Appendices

9.1. LZT Feasibility Table

Technology	Technical Feasibility	Carbon Savings	Estimated Costs	Financial Viability
Solar photovoltaics	South facing aspects of the roof could support a rooftop array to ensure energy consumption is reduced sufficiently.	A 0.5kWp system could save around 204 kg of CO2 per year.	Average cost for such a system is around £1.5K.	Current potential income generation is around £230 per annum, with a fuel cost saving of around £60 per year.
Wind	Average wind speeds on the site according to the NOABL Wind Speed Database are 3.9m/s. To be technically feasible a minimum of 6m/s is required, therefore this site is not considered feasible.	N/A	N/A	N/A
Micro Hydro	There is no capacity for micro hydro on this site since there are no local water courses available.	N/A	N/A	N/A
District Heating	There are currently no existing or planned district heating networks to facilitate connection at this stage.	N/A	N/A	N/A
Solar Hot Water	This technology has been discounted as the level of hot water usage in each dwelling does not merit a storage system, which poses space issues.	Around 270 kg of CO2 per year per dwelling.	£3-5K per dwelling	Income generation from RHI in a 4 person household would be in the region of £340 / year (per dwelling) with a fuel saving of around £65 per year per dwelling
Heat Pumps	GSHP: Ground conditions on site are unknown, and installation of coils are likely not economically viable for this project. ASHP: An electric heat pump has been discounted based on financial viability reasons.	GSHP: 2,100 to 3,300 kg CO2 per year per dwelling ASHP: 1,700 to 2,700 kg CO2 per year per dwelling.	GSHP @ £13-20K per dwelling ASHP: £7-11K per dwelling	GSHP: £2,590 minimum annual RHI income generation per dwelling with fuel saving of £440 per year minimum per dwelling ASHP: £920 minimum annual RHI income generation per dwelling with fuel saving of £335 per year minimum per dwelling
Biomass	The small scale of this development would not facilitate the installation of biomass boilers due to the space required for pellet storage.	N/A	N/A	N/A

9.2. Energy Model Inputs for Part L2A 2013 Compliance

Item	Brief description	Notes.	Confirm
	The following information is required for the design submission (as per requirements of approved doc L2A).	Please note submission is now in two stages. A) **Design**, B) As installed	
1. Building Details			
1.1	Building Regulations Part L2A 2016 applies.		
1.2	Full Building address is: Buildings 3-7 Lincoln Way		
1.3	Building Owner is: James Alpe		
1.4	Electric Power Factor Correction = <0.90		
2. Floor Construction Details			
2.1	Ground floor is insulated to achieve the U-value stated opposite.	U-Value = 0.20 W/m²K	
3. Wall Construction Details			
3.1	External Walls incl any Solid and Opaque Panels are 120mm Kingspan KS1000RW to achieve the U-value stated opposite.	U-Value = 0.16 W/m²K	
4. Roof Construction Details			
4.1	The roof is insulated to achieve the U-value stated opposite.	U-Value = 0.25 W/m²K	
5. Openings			
5.1	External personnel doors are installed to achieve the U-value opposite.	U-Value = 2.2 W/m²K	
5.2	Vehicle access doors are installed to achieve the U-value opposite.	U-Value = 1.5 W/m²K	
5.3	All Windows incl. any Curtain Walling Vision Panels are double glazed with low-e glass to achieve the standards indicated opposite.	U-Value = 1.6 W/m²K G-Value = 0.40	
5.4	All roof lights are installed to achieve the U-value opposite.	U-value = 1.9 W/m²K G-value = 0.55	
6. Ventilation			
6.1	This Design Stage SBEM calculation assumes an air permeability of 5m³/hr.m² at 50pa will be achieved for side lit spaces and 7m³/hr.m² at 50pa for top lit spaces.		
6.2	Continuously running extracts are installed to the toilet areas.	SFP = 0.3 W/l/s	
6.3	Extracts are provided to kitchen areas in Building 3.	SFP = 0.5 W/l/s	
6.3	All other areas of the building are naturally ventilated.		
7. Space Heating and Cooling			
7.1	Heating is provided to all areas by electric panel heaters.	Efficiency = 1	
7.2	Heating systems are provided with central time control and local time and temperature controls.		
7.3	Heating and Cooling systems are metered but not provided with automatic monitoring and targeting with alarms for out-of-range values warn of out of range values.		
8. Water Heating			
8.1	The hot water services to all areas of the building will be provided by an instantaneous electric hot water system.		
8.2	There is no secondary circulation to the development.		
9. Lighting and lighting controls			
9.1	All light fittings in the workshop/industrial areas have an average luminous efficacy of 100 lamp lumens/circuit Watt.		
9.2	All light fittings in the office and amenity areas have an average luminous efficacy of 80 lamp lumens/circuit Watt.		
9.3	All industrial/workshop areas will have daylight dimming controls on the lighting units.		

9.4	All other areas will be provided with manual switching only, there are no intelligent lighting controls.		
9.5	Light fitting energy use is metered but the system does not warn of out of range values.		
10. Renewables			
10.1	A photovoltaic array is provided to all of the buildings, with the capacities opposite.	Building 3 = 7.5kWp Building 4 = n/a Building 5 = 3kWp Building 6 = 3kWp Building 7 = 1.5kWp Total = 15kWp	
11. Other			
11.1	All fans are in accordance with the minimum requirements of 'Non-Domestic Building Services Compliance Guide, 2013' in terms of Specific Fan Power.		
11.2	A Building Log Book will be provided following the guidance in CIBSE TM31, Building Log Book Toolkit.		
11.3	Calculations for the U-values stated above will be carried out by the Design Team/Architect.		
11.4	Building Regulations Part L2A 2016 apply. Please confirm that all fixed building services are in accordance with the minimum standards set out in paragraphs 2.45-2.48 of Building Regulations Part L2A 2013.		

9.3. BRUKL Report

Provided at the end of this report.

9.4. Index of Tables and Figures

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Z22050 Lincoln Way Building 3

As designed

Date: Tue Apr 17 10:42:11 2018

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.9

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.9

BRUKL compliance check version: v5.4.a.1

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

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	23.2
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	23.2
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	23.1
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	0.16	0.16	BL00001D:Surf[5]
Floor	0.25	0.2	0.2	BL00001D:Surf[0]
Roof	0.25	0.25	0.25	B3000025:Surf[3]
Windows***, roof windows, and rooflights	2.2	1.6	1.6	BL00001D:Surf[1]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	1.5	1.5	B300000A:Surf[1]
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
m³/(h.m²) at 50 Pa	10	5

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Z22050 Lincoln Way Building 4

As designed

Date: Mon Apr 16 10:14:54 2018

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.9

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.9

BRUKL compliance check version: v5.4.a.1

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

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	5.9
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	5.9
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	5.3
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	0.16	0.16	B4000002:Surf[1]
Floor	0.25	0.2	0.2	B4000002:Surf[0]
Roof	0.25	0.25	0.25	B4000004:Surf[13]
Windows***, roof windows, and rooflights	2.2	1.6	1.6	B4000004:Surf[10]
Personnel doors	2.2	2.2	2.2	B4000004:Surf[1]
Vehicle access & similar large doors	1.5	1.5	1.5	B4000004:Surf[2]
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	7

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Z22050 Lincoln Way Building 5

As designed

Date: Mon Apr 16 12:17:35 2018

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.9

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.9

BRUKL compliance check version: v5.4.a.1

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

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	7.3
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	7.3
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	6.6
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.16	0.16	B5000001:Surf[1]
Floor	0.25	0.2	0.2	B5000001:Surf[0]
Roof	0.25	0.25	0.25	B5000002:Surf[11]
Windows***, roof windows, and rooflights	2.2	1.6	1.6	B5000002:Surf[9]
Personnel doors	2.2	2.2	2.2	B5000002:Surf[2]
Vehicle access & similar large doors	1.5	1.5	1.5	B5000004:Surf[2]
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	7

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Z22050 Lincoln Way Building 6

As designed

Date: Mon Apr 16 10:52:59 2018

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.9

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.9

BRUKL compliance check version: v5.4.a.1

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

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	7.1
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	7.1
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.16	0.16	B6000003:Surf[1]
Floor	0.25	0.2	0.2	B6000003:Surf[0]
Roof	0.25	0.25	0.25	B6000005:Surf[14]
Windows***, roof windows, and rooflights	2.2	1.6	1.6	B6000005:Surf[11]
Personnel doors	2.2	2.2	2.2	B6000005:Surf[1]
Vehicle access & similar large doors	1.5	1.5	1.5	B6000005:Surf[4]
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	7

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Z22050 Lincoln Way Building 7

As designed

Date: Mon Apr 16 11:17:57 2018

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.9

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.9

BRUKL compliance check version: v5.4.a.1

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

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	6.8
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	6.8
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	5.6
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	$U_{a\text{-Limit}}$	$U_{a\text{-Calc}}$	$U_{i\text{-Calc}}$	Surface where the maximum value occurs*
Wall**	0.35	0.16	0.16	BL000005:Surf[1]
Floor	0.25	0.2	0.2	BL000005:Surf[0]
Roof	0.25	0.25	0.25	B7000006:Surf[5]
Windows***, roof windows, and rooflights	2.2	1.6	1.6	B7000006:Surf[3]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	1.5	1.5	B7000006:Surf[1]
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	7

LOCATION PLAN

Site: Proposed Industrial Units
Lincoln Way
Clitheroe
BB7 1QD

Notes:
All work is to be carried out to the latest current British standards Codes of Practice and recognised working practices.
All work and materials should comply with Health and Safety legislation and to be approved by the Local Authority Planning / Building Control Officer.
All dimensions are in millimetres unless where explicitly shown otherwise. The contractor should check and clarify all dimensions as work proceeds and notif
Avalon Chartered Town Planning are not liable for work undertaken prior to Full Planning Consent and/or Building Regulations Approval