

Low & Zero Carbon Technologies Feasibility Study

JLL Sustainable Asset Services
December 2025



Contents

Contents	1
Executive Summary	2
Assessment Criteria & Methodology	3
Assessment Criteria	3
Methodology	3
Low and Zero Carbon Technologies Feasibility	4
Wind Turbines	4
Solar Photovoltaics	5
Solar Thermal	5
Biomass Boiler	6
Ground-Source Heat Pump	6
Air-Source Heat Pump	7
LZC Technology Savings	8
Conclusion	9

Record of Revisions

Revision	Reason for Issue	Issue Date	Prepared By	Reviewed By	Authorised By
01	Client Review	01/12/25	Matt Hails	Hamad Yoonus	Areti Makantasi
02	Response to comments	10/12/25	Matt Hails	Hamad Yoonus	Areti Makantasi

Executive Summary

This Low and Zero Carbon (LZC) Technologies Feasibility Study has been prepared by JLL’s Sustainable Asset Services team for the proposed development at 35 Wilson Road, Huyton, Liverpool. The scheme involves the development of 21,110m² warehouse at Huyton business park and is assessed against BREEAM UK New Construction (NC) Version 6.1.

This report presents the outcomes of the feasibility study carried out to assess the LZC technologies available to the site, in line with the requirements of ENE04: Low Carbon Design (1 Credit – Low and Zero Carbon Technologies).

The development will incorporate the following LZC technologies:

- Air Source Heat Pumps
- Solar Photovoltaic Panels

Table 1 below, summarises the energy modelling results and presents the energy and carbon savings resulting from the proposed LZC technologies, alongside their estimated payback periods.

Table 1: Energy Modelling Results

	Baseline	Incorporating ASHP and solar PV
Energy Consumption (kWh/year)	307,405	269,497 <i>(Calculated from spaced heating demand only)</i>
Energy Saved/Generated (kWh/year)		37,908
Carbon Emissions (kgCO ₂ /year)	45,316	28,322
Carbon Savings (kgCO ₂ /year)		16,993
Payback Period		ASHP – N/A Solar PV – 24 years

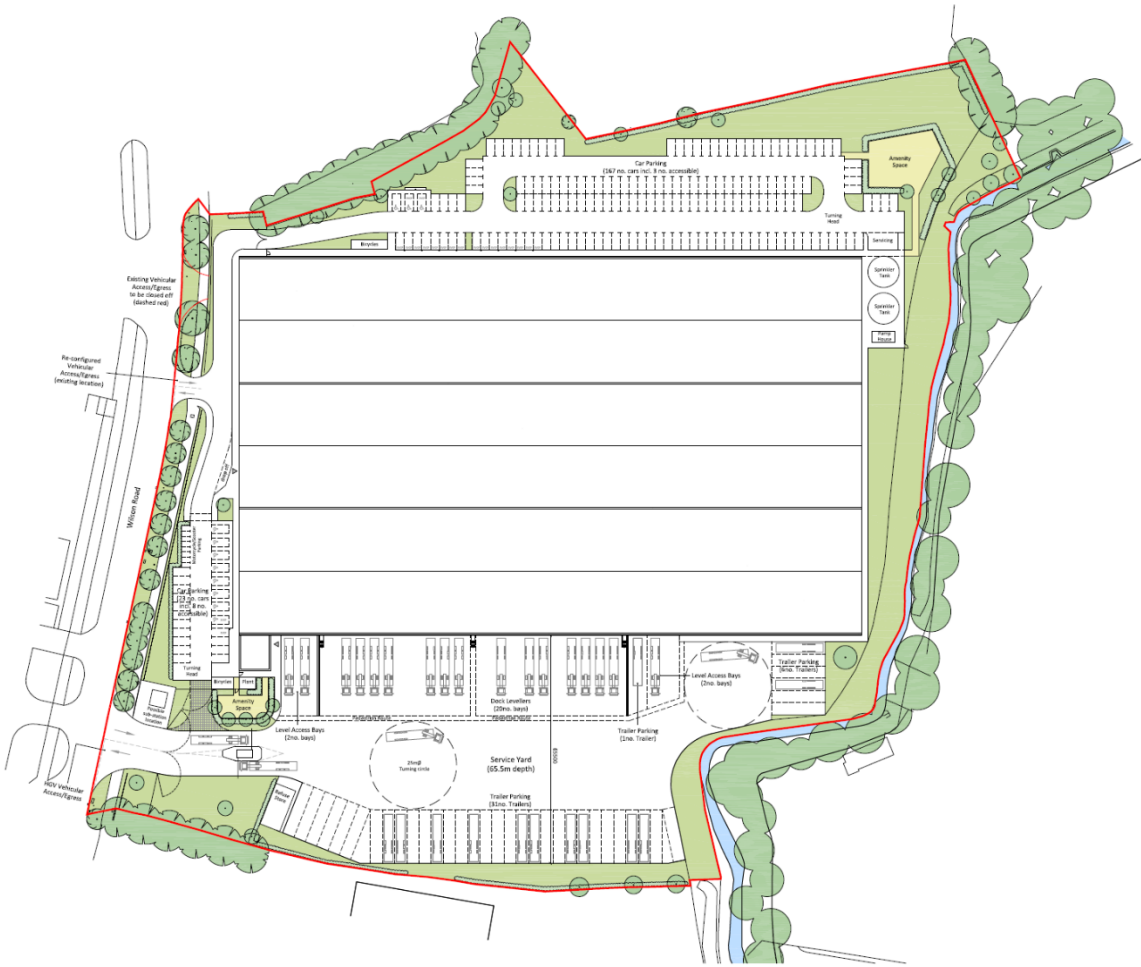


Figure 1: Red boundary outlines proposed development site plan

Assessment Criteria & Methodology

Assessment Criteria

Compliance with the requirements of BREEAM New Construction V6 – Energy Credit ENE04 Low and Zero Carbon Technologies is assessed against the subsequent criteria:

- An energy specialist completes a feasibility study by the end of Concept Design.
- Establish the most appropriate recognised local (on-site or near-site) low and zero carbon (LZC) energy sources for the building or development, based on the feasibility study.
- Specify local LZC technologies for the building or development in line with the feasibility study recommendations.
- Quantify the reduced regulated carbon dioxide (CO₂-eq) emissions resulting from the feasibility study.

Methodology

The following sits within the scope of this LZC technologies feasibility study:

- Energy generated from LZC energy source per year
- Carbon dioxide savings from LZC energy source per year
- Life cycle cost of the potential specification, accounting for payback
- Local planning criteria, including land use and noise
- Feasibility of exporting heat/electricity from the system
- Any available grants
- All technologies appropriate to the site and energy demand of the development.
- Reasons for excluding other technologies
- Where appropriate to the building type, connecting the proposed building to an existing local community CHP system or source of waste heat or power OR specifying a building/site CHP system or source of waste heat or power with the potential to export excess heat or power via a local community energy scheme.

The reduction in regulated carbon dioxide (CO₂-eq) emissions has been demonstrated by comparing regulated carbon dioxide (CO₂-eq) emissions with LZC technologies to the actual building-regulated emissions without LZCs.

The CO₂-eq savings associated with the proposed and specified LZC technologies have been estimated using dynamic simulation modelling software (IES Virtual Environment).

The energy supply used for the base case is mains gas and electricity. The base case also includes any passive design measures adopted for the first ENE04 credit. The actual building energy demands are calculated as for the passive analysis.

The carbon emissions factors used for the Building Regulations calculations (National Calculation Methodology) have been applied:

Table 2: Carbon Factors based on current Building Regulations (Part L 2021)

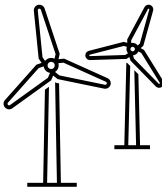
Fuel Type	Carbon Factor (kg of CO ₂ /kWh)
Mains Gas	0.210
Mains Electricity	0.136

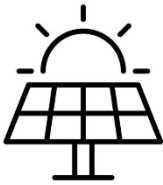
Low and Zero Carbon Technologies Feasibility

Technologies eligible to contribute to achieving the criteria must produce energy from renewable sources and meet all other ancillary requirements as defined by Directive 2009/28/EC of the European Parliament. Such directive defines energy from renewable sources to be energy from non-fossil fuel sources namely wind, solar, aerothermal, geothermal, hydrothermal, ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases. Notably, the direct only considered heat pumps a renewable technology when operated to supply heating.

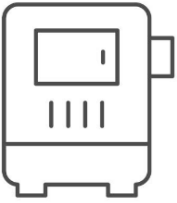
The LZC technologies applicable to 35 Wilson Road include the following:

- Wind Turbines
- Solar Photovoltaics
- Solar Thermal
- Biomass Boiler
- Ground-Source Heat Pump
- Air-Source Heat Pump

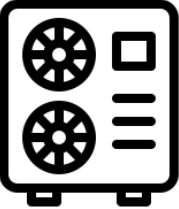
Wind Turbines	
	Economic viability of wind turbine installations requires adequate wind speeds at the proposed location. According to the SQWenergy report commissioned by the Department for Energy Security and Net Zero (DESNZ), locations must achieve minimum wind speeds of 5m/s measured at 45m above ground level. The Numerical Objective Analysis of the Boundary Layer (NOABL) wind map indicates regional wind speeds average 6.2 m/s at 45m height, satisfying the threshold. However, these figures represent broad regional estimates rather than site-specific measurements and do not account for localised factors such as surface roughness and microclimate variations.
Land Use	Wind turbine deployment requires careful spatial planning. Safety regulations mandate fall-over distances in public areas, whilst optimal energy generation requires strategic spacing to minimise wake effects. The site faces significant compatibility challenges. Surface roughness and spatial constraints make turbines unsuitable for the existing building. The site is also in close proximity to a residential areas which induce height restrictions.
Local Planning Requirements	The Knowsley Council Local Plan (2016) addresses renewable energy through Policy CS22, which establishes an energy hierarchy requiring developments to minimise carbon emissions on-site. The policy ensures that all new developments in Knowsley contribute to a low carbon future by minimising energy use, incorporating renewable or low carbon technologies, and adopting sustainable construction methods. However, the policy does not have specific planning guidance for wind turbines, nor could any be found on the council's website. General planning permission guidance and requirements are available on the Planning Portal, which provides information applicable across England.
Noise Impact	Noise emanating from wind turbine components and blade-wind interactions may create acoustic disturbances for both on-site office occupants and neighbouring property users. Additionally, building-mounted microturbines pose risks of acoustic resonance when vibrations occur at natural frequencies, potentially amplifying noise-related disruptions.
Limitations	The Betz limit states that the theoretical maximum efficiency of a wind turbine is 59.3%. This number then falls further with the installation of microscale turbines, which also have to be effectively co-located to mitigate against wake effects and reduced yields. Wind turbines in built up areas are therefore generally regarded as less effective than alternative renewable technologies.
Feasibility of Exporting Electricity to the Grid	The development will have an incoming supply of 420 kVA. This supply capacity indicates there could be some headroom for an export agreement to the grid. Consultation with the local district network operator (DNO) 'UK Power Networks' to establish current infrastructure capabilities and export patterns would be required.
Grants	The UK's Feed-in Tariff (FIT) scheme is no longer taking accepting new applications as of 2019. In terms of export tariffs, this has since been replaced by the Smart Export Guarantee (SEG), which allows businesses to earn payment for surplus renewable energy generation which is exported to the National Grid. SEG Licensees determine the rate and contract length SEG Generators will receive. Qualifying criteria requires the installation of wind technology to have a maximum capacity of 5MW.
Conclusion	Wind Turbines are not considered viable a viable renewable energy technology for the existing building – due to the noise and vibration issues associated with them in close proximity to residential areas. Smaller scale units would have to be use resulting in a reduced efficiency.

Solar Photovoltaics	
	Alongside ground mounted Solar PV arrays, ‘Building Applied’ (BAPV) and ‘Building Integrated’ (BIPV) solar photovoltaics arrays are products readily available on the market in the UK. Optimal array configuration in the UK consists of an azimuth of 180° (South) and a panel tilt of circa 30°. Diversion away from said configuration will produce reduced yields from the available irradiance. Array efficiency can also be greatly affected by localised and self-shading.
Land Use	It is recommended to install monocrystalline solar PV panels on to the roof of the facility. Building height and orientation means no significant self-shading should be incurred on site.
Local Planning Requirements	The Knowsley Council Local Plan (2016) addresses renewable energy through Policy CS22, which establishes an energy hierarchy requiring developments to minimise carbon emissions on-site. The policy ensures that all new developments in Knowsley contribute to a low carbon future by minimising energy use, incorporating renewable or low carbon technologies, and adopting sustainable construction methods. However, the policy does not have specific planning guidance for PV panels, nor could any be found on the council's website. General planning permission guidance and requirements which must be met are available on the PlanningPortal which is viable across England.
Noise Impact	No adverse noise impacts are associated with the operation of PV systems.
Limitations	Key limitations include the efficiency of commercially available solar cells and localised shading impacts. Monocrystalline panels represent the most efficient commercially available solar PV technology, with efficiency limited to approximately 22%. Higher efficiency Perovskite solar panels (~27%) are nearing commercial availability, though few companies currently offer this technology.
Feasibility of Exporting Electricity to the Grid	The development will have an incoming supply of 420 kVA. This supply capacity indicates there could be some headroom for an export agreement to the grid. Consultation with the local district network operator (DNO) ‘UK Power Networks’ to establish current infrastructure capabilities and export patterns would be required.
Grants	The UK’s Feed-in Tariff (FIT) scheme is no longer taking accepting new applications as of 2019. In terms of export tariffs, this has since been replaced by the Smart Export Guarantee (SEG), which allows businesses to earn payment for surplus renewable energy generation which is exported to the National Grid. SEG Licensees determine the rate and contract length SEG Generators will receive. Qualifying criteria requires the installation of photovoltaic arrays to have a maximum capacity of 5MW.
Storage	Battery storage requirements, should it be deemed necessary, will be determined in the subsequent design stages when the site’s energy consumption and potential for on-site generation is determined.
Conclusion	Solar photovoltaics are deemed a viable LZC technology for the development. An indicative 510m² PV array has been proposed, this allows for a 10% margin between the actual and target emissions rate.

Solar Thermal	
	Solar Thermal technology operates on the principle of heat transfer. Systems are configured in such a way that absorption tubes cycle a medium - whether that be water, air or solar fluid - that absorbs incoming solar radiation. Said medium then interacts with a heat exchanger to heat water stored within a cylinder. Solar thermal collectors are therefore classified as a renewable energy technology, though a pump is required to circulate the specified fluid within the system. As with solar photovoltaics, installation for optimal performance occurs at an inclination of ~30°.
Land Use	It is commonplace for solar thermal collectors to be installed using support structures on roof tops, making it compatible with the existing building. Said frames can be configured for optimal orientation and inclination to maximise solar heat absorption.
Local Planning Requirements	The Knowsley Council Local Plan (2016) addresses renewable energy through Policy CS22, which establishes an energy hierarchy requiring developments to minimise carbon emissions on-site. The policy ensures that all new developments in Knowsley contribute to a low carbon future by minimising energy use, incorporating renewable or low carbon technologies, and adopting sustainable construction methods. However, the policy does not have specific planning guidance for PV panels, nor could any be found on the council's website. General planning permission guidance and requirements which must be met are available on the PlanningPortal which is viable across England.
Noise Impact	Despite system components including a pump, no adverse noise impacts are anticipated to be associated with the operation of solar thermal systems.
Limitations	Intermittency of the system’s output means the technology would likely not be able to solely satisfy domestic hot water demands on site, particularly in cold periods.
Feasibility of Exporting Electricity to the Grid	N/A
Grants	Financial support for the installation of solar thermal technology does not currently exist for commercial applications in the UK.
Conclusion	Solar thermal technology is deemed not feasible for the existing building, owing to its unreliability in satisfying domestic hot water demands across an annual timeframe, requiring implementation as part of a bivalent or multivalent solution. The anticipated domestic hot water (DHW) load will be minimal, making solar thermal economically unviable.

Biomass Boiler	
	Energy is released during the operation of a biomass boiler via the burning of fuel comprised of organic matter. Wooden logs, pellets and chips are a commonplace fuel for such boilers. The technology is considered carbon neutral, owing to the remission of carbon that is sequestered during the growth phase of the fuel. The relatively short timeframe in which biomass crops can ‘renew’ themselves, is the differentiator when comparing this renewable fuel source to fossil fuels.
Land Use	Any prospective system would be paired with additional storage requirements for wood chips/organic pellets.
Local Planning Requirements	The Knowsley Council Local Plan (2016) addresses renewable energy through Policy CS22, which establishes an energy hierarchy requiring developments to minimise carbon emissions on-site. The policy ensures that all new developments in Knowsley contribute to a low carbon future by minimising energy use, incorporating renewable or low carbon technologies, and adopting sustainable construction methods. The policy does not give specific guidance in installing biomass boilers. However, biomass fuel use is not recommended at Wilson Road due to existing particulate pollution levels and logistics issues in transferring biomass fuel to the site.
Noise Impact	No excessive noise is associated with the general operation of biomass boilers. However, the processes of fuel feeding and transport/transfer of wood chips/organic pellets on site may incur a level adverse noise pollution.
Limitations	Emission of nitrogen oxides (NO _x) and particulate matter as part of the combustion process, can result in negative impacts on local air quality.
Feasibility of Exporting Electricity to the Grid	N/A
Grants	Financial support for the installation of biomass boilers does not currently exist for commercial applications in the UK.
Conclusion	Owing to storage space requirements and the emission of NO _x emissions and particulate matter, biomass boilers are not deemed a feasible low and zero carbon (LZC) technology for the existing building. Additionally, the anticipated heating load will be minimal and limited to office use only, making biomass systems economically unviable for such low demand. Security of supply would also present a significant issue, as biomass boilers require reliable fuel deliveries and on-site storage management to maintain consistent heating provision.

Ground-Source Heat Pump	
	At approximately 10-15m below the surface, ground temperatures in the UK remains stable year-round. Ground Source Heat Pumps (GSHPs) harness this natural stability by extracting thermal energy from the ground at these depths. Said heat exchange takes place with a fluid circulated through a closed loop underground collector configuration. Open circuit loop configuration can also be utilised, directly interacting with groundwater. This heat arrives to the heat pump's evaporator circuit, operating in a reverse refrigeration cycle. Via compression, the energy is amplified up to 3-5 times and released as low-grade heat through the condensing coil. Ground conditions on site and collector surface area are the two main determinants in system performance. It must be noted that GSHPs are a low carbon energy technology, owing to the fact power is required to pump liquid through the ground and operate the compressor as part of the refrigerant system.
Land Use	Dependent on local geothermal resource and geological characteristics, GSHP ground loops can be installed both vertically in a bore hole configuration and horizontally in trenches.
Local Planning Requirements	Negotiation with the Environment Agency (EA) will be required should a prospective installation require borehole drilling and interaction with a natural aquifer. The Knowsley Council Local Plan (2016) addresses renewable energy through Policy CS22, which establishes an energy hierarchy requiring developments to minimise carbon emissions on-site. The policy ensures that all new developments in Knowsley contribute to a low carbon future by minimising energy use, incorporating renewable or low carbon technologies, and adopting sustainable construction methods. However, the policy does not have specific planning guidance for Ground Source Heat Pumps, nor could any be found on the council's website. General planning permission guidance and requirements which must be met are available on the PlanningPortal which is viable across England.
Noise Impact	No significant adverse noise impacts are associated with the operation of GSHPs.
Limitations	Requirement for the negotiation with the Environment Agency (EA), potential significant excavation works, and the considerable CAPEX outlay stand as the limitations of the Ground Source Heat Pumps. Substantial excavation space is required to accommodate the ground source heat pump system, necessitating substantial adjacent outdoor areas (since Unit 4 is an existing building) and resulting in intrusive construction activities. Additionally, under Directive 2009/28/EC only the heating component of heat pumps is recognised as a renewable energy technology.
Feasibility of Exporting Electricity to the Grid	N/A
Grants	Financial support for the installation of new build non-public sector building Ground Source Heat Pumps (GSHPs) does not currently exist for commercial applications in the UK.
Conclusion	Owing to the significant limitations associated with the Ground Source Heat Pump (GSHP) technology, it is not proposed for the development at 35 Wilson Road.

Air-Source Heat Pump	
	An Air-Source Heat Pump (ASHP) is a system capable of transferring thermal energy between indoor and outdoor environments. Operating on the principle of a vapor compression cycle, ASHPs circulate refrigerant through a cycle of evaporation and condensation to efficiently capture heat from a source (air) and release it into a sink (building). ASHP's can also deliver space cooling provision, however only the heating component is recognised as a renewable energy technology under the European Parliament Directive 2009/28/EC. Components which make up an ASHP include an outdoor unit with evaporator coils and fan, a compressor that pressurises the cycling refrigerant, a condenser to release thermal energy and an expansion valve to control refrigerant flow. ASHPs can achieve coefficient of performance (COP) ratings of 2-4, meaning they deliver 2-4 units of thermal energy for each unit of electricity consumed.
Land Use	External space is required for the installation of plant equipment. Roof and ground level installations of external condensing units are commonplace.
Local Planning Requirements	The Knowsley Council Local Plan (2016) addresses renewable energy through Policy P70, which establishes an energy hierarchy requiring developments to minimise carbon emissions on-site. This policy includes provisions to "be green" through on-site renewable energy generation and storage systems. However, the policy does not have specific planning guidance for Air Source Heat Pumps, nor could any be found on the council's website. General planning permission guidance and requirements which must be met are available on the PlanningPortal which is viable across England.
Noise Impact	No significant adverse noise impacts are associated with the operation of ASHPs, assuming the external condensers are suitably located.
Limitations	System COP during winter months may be affected by lower ambient temperatures. Only the heating component of heat pumps are classified as a renewable energy technology.
Feasibility of Exporting Electricity to the Grid	N/A
Grants	Financial support for the installation of new build non-public sector building Air-Source Heat Pumps (ASHPs) does not currently exist for commercial applications in the UK.
Conclusion	Air-Source Heat Pumps (ASHPs) are proposed to provide space heating to the office space at 35 Wilson Road.

Summary of Findings:

The feasibility study conducted for the proposed development at 35 Wilson Road concluded that the feasible LZC technologies consist of:

- An indicative 510 m² of roof-mounted solar photovoltaic (PV) panels.
- Estimated 110 kW Air-Source Heat Pumps (ASHPs) for space heating provision.

This LZC feasibility study also determined the following:

- It is not feasible for the existing building to connect to an existing local community CHP system OR to an existing source of waste heat or power, as neither are available within a viable distance from the site.
- A site CHP system is deemed not feasible for the existing building, nor would it be proposed due to its associated carbon factor as defined under the latest iteration of Part L legislation.
- No source of waste heat or power with the potential to export excess via a local community energy scheme has been specified.

LZC Technology Savings

The proposed development will incorporate the following LZC technologies:

- An indicative 510 m² of roof-mounted solar photovoltaic (PV) panels.
- Estimated 110 kW Air-Source Heat Pumps (ASHPs) for space heating provision.

Table 3 presents the energy and carbon savings resulting from the incorporation of the proposed LZC technologies into the building energy model, alongside their payback periods.

Table 3 Energy Modelling Results

	Baseline	Incorporating ASHPs and solar PV
Energy Consumption (kWh/year)	307,405	269,497 <i>(Calculated from ASHP spaced heating demand only)</i>
Energy Saved / Generated (kWh/year)		37,908
Carbon Emissions (kgCO ₂ /year)	45,316	28,322
Carbon Savings (kgCO ₂ /year)		16,993
Payback Period		ASHP -N/A Solar PV – 24 years

Conclusion

This Low and Zero Carbon (LZC) technologies feasibility study has been conducted for the development at 35 Wilson Road, Huyton, Liverpool.

The development is assessed under BREEAM UKNC Version 6.1. This analysis has been carried out in compliance with ENE04 Low Carbon Design (1 Credit – Low and Zero Carbon Technologies).

The LZC technologies available to the site have been reviewed against the following parameters:

- Energy generated from LZC energy source per year
- Carbon dioxide savings from LZC energy source per year
- Life cycle cost of the potential specification, accounting for payback
- Local planning criteria, including land use and noise
- Feasibility of exporting heat/electricity from the system
- Any available grants
- All technologies appropriate to the site and energy demand of the development.
- Reasons for excluding other technologies
- Where appropriate to the building type, connecting the proposed building to an existing local community CHP system or source of waste heat or power OR specifying a building/site CHP system or source of waste heat or power with the potential to export excess heat or power via a local community energy scheme.

The LZC feasibility study concluded that the feasible LZC technologies for the development are:

- An indicative 510 m² of roof-mounted solar photovoltaic (PV) panels.
- Estimated 110 kW Air-Source Heat Pumps (ASHPs) for space heating provision.

The incorporation of these technologies is estimated to result in the following energy and carbon savings, and be accompanied by the aside estimated payback periods:

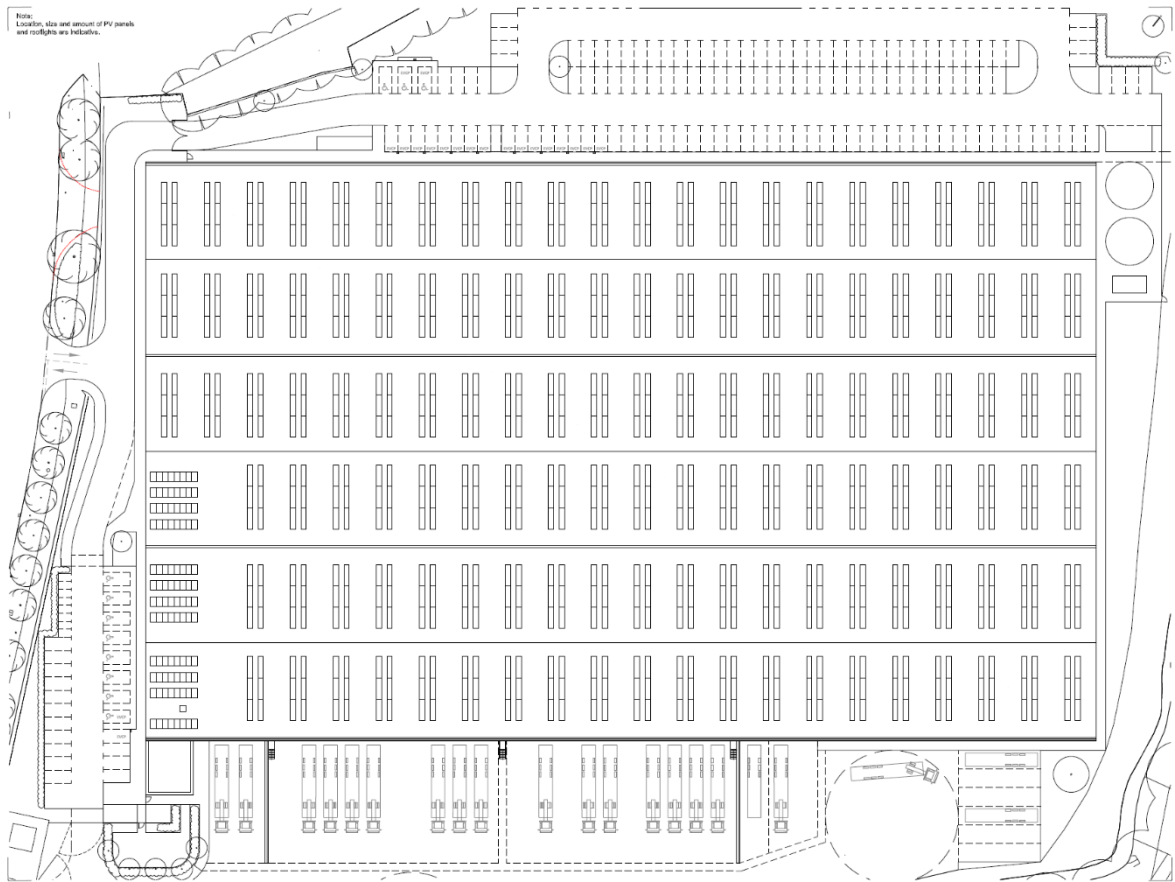


Figure 2: Indicative roof plan of the development at 35 Wilson Road.

Table 4 Energy Modelling Result

	Baseline	Incorporating ASHPs and solar PV
Energy Consumption (kWh/year)	307,405	269,497 <i>(Calculated from spaced heating demand only)</i>
Energy Saved / Generated (kWh/year)		37,908
Carbon Emissions (kgCO ₂ /year)	45,316	28,322
Carbon Savings (kgCO ₂ /year)		16,993
Payback Period		ASHP – N/A Solar PV – 24 years

BRUKL Output Document

 HM Government

Compliance with England Building Regulations Part L 2021

Project name

Linden Hill BRUKL 1

Date: Thu Nov 27 12:09:06 2025

As built

Administrative information

Building Details

Address: 35 Wilson Rd, Liverpool, L36 6AE

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.29

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.29

BRUKL compliance module version: v6.1.e.1

Foundation area [m²]: 533.64

The CO ₂ emission and primary energy rates of the building must not exceed the targets			
The building does not comply with England Building Regulations Part L 2021			
Target CO ₂ emission rate (TER), kgCO ₂ /m²:annum	1.61		
Building CO ₂ emission rate (BER), kgCO ₂ /m²:annum	2		
Target primary energy rate (TPER), kWh _{pe} /m²:annum	15.13		
Building primary energy rate (BPER), kWh _{pe} /m²:annum	20.11		
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER	

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency				
Fabric element	U _a -Limit	U _a -Calc	U _i -Calc	First surface with maximum value
Walls*	0.26	0.18	0.26	0_000003:Surf[0]
Floors	0.18	0.12	0.12	0_000004:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.15	0.15	0F000000:Surf[0]
Windows** and roof windows	1.6	1.34	1.34	0_000001:Surf[2]
Rooflights***	2.2	2.09	2.09	0_000003:Surf[2]
Personnel doors^	1.6	1.6	1.6	0_000001:Surf[1]
Vehicle access & similar large doors	1.3	1.3	1.3	0_000003:Surf[103]
High usage entrance doors	3	-	-	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)] * 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. *** Values for rooflights refer to the horizontal position. ^ For fire doors, limiting U-value is 1.8 W/m²K NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.				
Air permeability	Limiting standard	This building		
m³/(h.m²) at 50 Pa	8	3		

Technical Data Sheet (Actual vs. Notional Building)		
Building Global Parameters		Building Use
	Actual	Notional
Floor area [m²]	21786.4	21786.4
External area [m²]	50493.7	50493.7
Weather	MAN	MAN
Infiltration [m³/hm²@ 50Pa]	3	5
Average conductance [W/K]	14085.7	13435.5
Average U-value [W/m²K]	0.28	0.27
Alpha value* [%]	25	10
* Percentage of the building's average heat transfer coefficient which is due to thermal bridging		
% Area	Building Type	
	Retail/Financial and Professional Services	
	Restaurants and Cafes/Drinking Establishments/Takeaways	
	Offices and Workshop Businesses	
	General Industrial and Special Industrial Groups	
100	Storage or Distribution	
	Hotels	
	Residential Institutions: Hospitals and Care Homes	
	Residential Institutions: Residential Schools	
	Residential Institutions: Universities and Colleges	
	Secure Residential Institutions	
	Residential Spaces	
	Non-residential Institutions: Community/Day Centre	
	Non-residential Institutions: Libraries, Museums, and Galleries	
	Non-residential Institutions: Education	
	Non-residential Institutions: Primary Health Care Building	
	Non-residential Institutions: Crown and County Courts	
	General Assembly and Leisure, Night Clubs, and Theatres	
	Others: Passenger Terminals	
	Others: Emergency Services	
	Others: Miscellaneous 24hr Activities	
	Others: Car Parks 24 hrs	
	Others: Stand Alone Utility Block	

Energy Consumption by End Use [kWh/m²]		
	Actual	Notional
Heating	2.25	2.8
Cooling	0.41	0.31
Auxiliary	0.91	1.26
Lighting	4.55	3.77
Hot water	5.4	3.95
Equipment*	30.87	30.87
TOTAL**	13.54	12.07
* 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	1.46
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	0	1.46

Energy & CO ₂ Emissions Summary		
	Actual	Notional
Heating + cooling demand [MJ/m²]	13.3	15.94
Primary energy [kWh _{pe} /m²]	20.11	15.13
Total emissions [kg/m²]	2	1.61

BRUKL Output Document

 HM Government

Compliance with England Building Regulations Part L 2021

Project name

Linden Hill BRUKL 1As built

Date: Thu Nov 27 11:38:49 2025

Administrative information

Building Details

Address: 35 Wilson Rd, Liverpool, L36 6AE

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.29

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.29

BRUKL compliance module version: v6.1.e.1

Foundation area [m²]: 533.64

The CO₂ emission and primary energy rates of the building must not exceed the targets

Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	1.39
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	1.3
Target primary energy rate (TPER), kWh _{PE} /m ² annum	14.86
Building primary energy rate (BPER), kWh _{PE} /m ² annum	13.53
Do the building's emission and primary energy rates exceed the targets?	BER =< TERBPER =< TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	U _a -Limit	U _a -Calc	U _i -Calc	First surface with maximum value
Walls*	0.26	0.18	0.26	0_000003:Surf[0]
Floors	0.18	0.12	0.12	0_000004:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.15	0.15	0F000000:Surf[0]
Windows** and roof windows	1.6	1.34	1.34	0_000001:Surf[2]
Rooflights***	2.2	2.09	2.09	0_000003:Surf[2]
Personnel doors^	1.6	1.6	1.6	0_000001:Surf[1]
Vehicle access & similar large doors	1.3	1.3	1.3	0_000003:Surf[103]
High usage entrance doors	3	-	-	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)] * 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. *** Values for rooflights refer to the horizontal position. ^ For fire doors, limiting U-value is 1.8 W/m²K NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.				
Air permeability	Limiting standard	This building		
m³/(h.m²) at 50 Pa	8	3		

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use	
	Actual	Notional	% Area	Building Type
Floor area [m²]	21786.4	21786.4	100	Retail/Financial and Professional Services
External area [m²]	50493.7	50493.7		Restaurants and Cafes/Drinking Establishments/Takeaways
Weather	MAN	MAN		Offices and Workshop Businesses
Infiltration [m³/hm² @ 50Pa]	3	5		General Industrial and Special Industrial Groups
Average conductance [W/K]	14085.7	13435.5		Storage or Distribution
Average U-value [W/m²K]	0.28	0.27		Hotels
Alpha value* [%]	25	10		Residential Institutions: Hospitals and Care Homes
				Residential Institutions: Residential Schools
				Residential Institutions: Universities and Colleges
				Secure Residential Institutions
			Residential Spaces	
			Non-residential Institutions: Community/Day Centre	
			Non-residential Institutions: Libraries, Museums, and Galleries	
			Non-residential Institutions: Education	
			Non-residential Institutions: Primary Health Care Building	
			Non-residential Institutions: Crown and County Courts	
			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	

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	1.41	1.55
Cooling	0.65	0.31
Auxiliary	0.36	0.99
Lighting	4.55	3.77
Hot water	5.4	3.95
Equipment*	30.87	30.87
TOTAL**	12.37	10.57

* 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	3.64	0.6
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	3.64	0.6

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	13.3	15.94
Primary energy [kWh _{PE} /m²]	13.53	14.86
Total emissions [kg/m²]	1.3	1.39

JLL

30 Warwick Street
London
W1B 5NH

Matthew Hails
Sustainability Engineer, Sustainable Asset Services
Matthew.Hails@jll.com

Hamad Yoonus
Associate Engineer, Sustainable Asset Services
Hamad.Yoonus@jll.com

About JLL

JLL (NYSE: JLL) is a leading professional services firm that specializes in real estate and investment management.

JLL shapes the future of real estate for a better world by using the most advanced technology to create rewarding opportunities, amazing spaces and sustainable real estate solutions for our clients, our people and our communities.

JLL is a Fortune 500 company with annual revenue of \$18.0 billion, operations in over 80 countries and a global workforce of more than 94,000 as of March 31, 2020. JLL is the brand name, and a registered trademark, of Jones Lang LaSalle Incorporated. For further information, visit jll.com

www.jll.com

Jones Lang LaSalle

©2025 Jones Lang LaSalle IP, Inc. All rights reserved. All information contained herein is from sources deemed reliable; however, no representation or warranty is made to the accuracy thereof.

“Disclaimer: © 2025 Jones Lang LaSalle IP, Inc. All rights reserved.

This report is confidential and such report and the information contained within may only be used by the client. No part of this publication may be partially or wholly used, re-produced or transmitted in any form or by any means without prior consent of JLL. The report only provides initial guidance to the client and not advice. Further detailed design development will be required to fully evaluate any proposals or advice. JLL makes no representation or warranties as to the accuracy, completeness or suitability of the whole or any part of the report. JLL, its officers and its’ employees shall not be liable for any loss, liability, damage or expense arising directly or indirectly from any use or disclosure of or reliance on such report. JLL reserves the right to pursue criminal and civil action for any unauthorised use, distribution, or breach of such intellectual property.