



Thornley & Lumb
Partnership Ltd.

Premier Inn Manchester Piccadilly Gardens Energy Strategy



Project

Premier Inn Manchester Piccadilly Gardens

Document

Energy Strategy

Client

Trafalgar Developments

Author

Nikolas Sotnyk BEng MCIBSE MInstP

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Thornley & Lumb Partnership Ltd.

Building Services Consultant Engineers

Century House

257 Cutler Heights Lane

Bradford

BD4 9JG

Tel: +44 (0) 1274 687 755

Email: nikolas.sotnyk@thornleylumb.co.uk

Website: www.thornleylumb.co.uk



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Executive Summary

This Energy Strategy produced by Thornley & Lumb on behalf of Trafalgar Developments details aspects of sustainable building design relating to energy and carbon emissions of the proposed Hotel development Premier Inn Manchester Piccadilly Gardens. The building fabric first design philosophy and efficient building services analysis are combined with the available Low and Zero Carbon LZC technology to provide a methodology for achieving a sustainable low energy use development. This process is illustrated by following the Energy Hierarchy which details the measures included at each stage. The Energy Hierarchy helps qualify the carbon emissions due to various measures by reporting the emission reductions at each stage based on an average carbon emissions calculations of a new build Premier Inn hotel.

Be Lean Measures

- Low external envelope u-values
- Low air permeability
- Low energy LED lighting & BMS
- Bedrooms mechanically ventilated with heat recovery

Be Clean Measures

- Same as Be Lean

Be Green Measures

- Air source heat pump ASHP providing space heating
- High efficiency CO₂ Heat Pump for hot water services HWS
- Sola PV photovoltaic panels generating on site zero carbon electricity

This Energy Strategy therefore confirms that the overall development's carbon emissions will be reduced **41%** below the Part L 2013 baseline

Chart to Show the Be Green Carbon Reductions

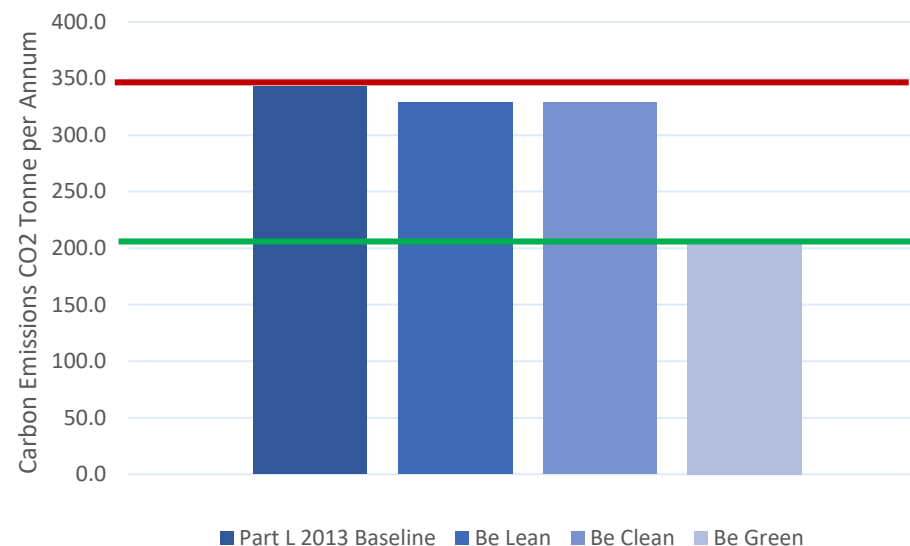


Chart to show the overall carbon reductions of the proposed development



Carbon Dioxide Emissions Per Annum for non-domestic Buildings

	Regulated CO ₂ Tonnes CO ₂ per annum	Unregulated CO ₂ Tonnes CO ₂ per annum
Baseline Part L (2013)	343.0	76.2
Including Be Lean Measures	328.9	76.2
Including Be Clean Measures	328.9	76.2
Including Be Green Measures	203.6	76.2

Regulated Carbon Dioxide Savings Per Annum for non-domestic Buildings

	Tonnes CO ₂ Per annum	Percentage Reduction %
Savings from Be Lean Measures	14.1	4.1
Savings from Be Clean Measures	0.0	0.0
Savings from Be Green Measures	125.3	38.1
Reduction Compared to Baseline	139.4	40.6



Contents

Document Control	3
Executive Summary.....	4
1.0 Introduction.....	7
1.1 Sustainable Low-Carbon Design	8
2.0 Design Considerations	9
2.1 Design Methodology	9
2.1.1 Energy Modelling Software.....	9
2.1.2 Carbon Emissions Calculations	9
2.2 National Planning Policy.....	10
2.2.1 Economic	10
2.2.2 Social	10
2.2.3 Environmental	10
2.3 Local Planning Policy	11
2.3.1 Policy EN6 – Target Framework for CO2 Emissions by Enabling Low and Zero Carbon Development	11
3.0 Be Lean: Reducing Energy Demand	12
3.1 Building Envelope and Fabric.....	12
3.1.1 Thermal Properties of Building Fabric.....	12
3.1.2 Thermal Bridging.....	12
3.1.3 Air-Tightness of Structure.....	13
3.1.4 Mechanical Ventilation.....	14
3.1.5 Low Energy Lighting & Control	15
4.0 Be Clean: Analysis of Decentralised Energy	16
4.1 Heat Distribution Network.....	16

5.0 Be Green: Analysis of Renewable Technology.....	17
5.1 Analysis of Available Renewable Technology	17
6.0 Carbon Emissions Reductions Energy	21
6.1 Low Energy Building Design and Energy Hierarchy	21
6.2 Establishing Baseline Emissions	22
6.3 Be Lean.....	23
6.4 Be Clean	24
6.5 Be Green.....	25
6.6 Overall Carbon Reductions.....	26
7.0 Conclusion	27



1.0 Introduction

The proposed development Premier Inn Manchester Piccadilly Gardens will consist of a twelve-storey building for hotel, bar/restaurant, and retail use. The development will involve a retail unit and associated staff amenities at ground level, with the hotel made up of 130 bedrooms to the upper floors with staff amenities, restaurant, and reception spaces on the first floor.

The proposed development will be designed with sustainability as the principle design metric and accordingly this Energy Strategy will detail how energy usage and carbon emissions have been minimised using the energy hierarchy Be Lean Be Clean Be Green (as developed by the Greater London Authority GLA).

The Energy Strategy considers future electricity grid decarbonisation and uses this to influence the proposed design. The decarbonisation of the Electricity Grid is not reflected in current carbon emissions calculations for Part L of the building regulations. However, this is due to be updated by the government and hence lower electricity grid carbon factors will be considered when developing this Energy Strategy.

The carbon reductions detailed in this Energy Strategy have been calculated using Part L accredited compliance dynamic simulation modelling DSM software IES VE Compliance DSM using average carbon emissions calculations of a new build Premier Inn hotel. This ensures that the proposed development's carbon emissions have been calculated using a more sophisticated carbon calculations methodology, as opposed to the more simplistic standard SBEM methodology.

Accordingly, this Energy Strategy will detail how the proposed development will be a low carbon sustainable development by following the four energy strategy design principles as detailed in Section 1.1 Sustainable Low Carbon Design.



Figure 1.0 Image to show the proposed development building energy model



1.1 Sustainable Low-Carbon Design

Thornley and Lumb will consider the sustainability of the proposed development and the building's energy usage throughout the design process by developing an energy strategy design philosophy. This will consist of four underling design principles which will be implemented to ensure the sustainability of the proposed development. The principles used to develop the energy strategy are: reduce demand, meet demand efficiently, supply from low carbon sources, supply from renewables.

Energy Strategy Design Principles

Reduce Demand

The energy demand of the building is intrinsically linked to the design of the building envelope and its services. Therefore, ensuring a thermally efficient and relatively air-tight building envelope will enable reduction in energy usage.

Meet Demand Efficiently

The application of building services which improve upon the minimum efficiencies detailed in the government's document the Non-Domestic Building Services Compliance Guide NDBSCG, will ensure that where energy is used for servicing the building, it is used efficiently with minimal wastage.

Supply from Low Carbon Sources

Where energy is used to service the building, the carbon emissions of the source will be taken into account as part of the design process. This involves using carbon factors of energy sources to calculate potential carbon emissions.

Supply from Renewable Sources

The further reduction of carbon emissions will be met with energy supply from renewable sources. These are zero carbon energy sources which provide servicing for the building without increasing the carbon emissions of the building.





2.0 Design Considerations

This section discusses the design considerations for the proposed Hotel development Premier Inn Manchester Piccadilly Gardens. This section will detail the design methodology and detail the planning criteria established by national and local policy.

2.1 Design Methodology

The energy usage figures used in this Energy Strategy have all been calculated using industry recognised software. The geometry of the building is modelled in the software and then all fixed building service efficiencies are integrated with the model to provide energy usage figures.

2.1.1 Energy Modelling Software

The IES VE software is dynamic building simulation modelling DSM application which includes industry standard thermal modelling and Part L compliance software. The dynamic simulation model utilises partial differential equations which are based on first-principles models of conductive, convective and radiative heat transfer. The equations used in the software are then driven by real weather data, using local climate and weather data for the specific locations. This information is then combined with the proposed building geometry and fixed building services efficiencies to calculate an hourly annual analysis of the building's energy usage. This dynamic simulation modelling of building allows the operational energy of a building to be predicted at design stage, to calculate the carbon emissions of the building at design stage carbon factors are used to convert annual operational energy into future carbon emissions.

2.1.2 Carbon Emissions Calculations

This Energy Strategy uses Part L carbon factors from L2A 2013, however if we calculated annual carbon emissions of the development using current UK Electricity Grid carbon factors, the annual carbon emissions would be significantly lower.

The Part L 2013 carbon factors overestimate carbon emission from electric building services by over 100% hence the new carbon factors proposed by the Government's initial SAP10.1, which are closer to the current carbon emission of the UK Electricity Grid, will show the carbon emissions will be reduced significantly compared to this Energy Strategy.

The carbon factors have changed in recent years due to the increasing amount of zero carbon and renewables generation used to provide grid electricity. Last year, in 2019, low carbon electricity generation was 54.2% of total grid electricity.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/875434/Press_Note_March_2020.pdf

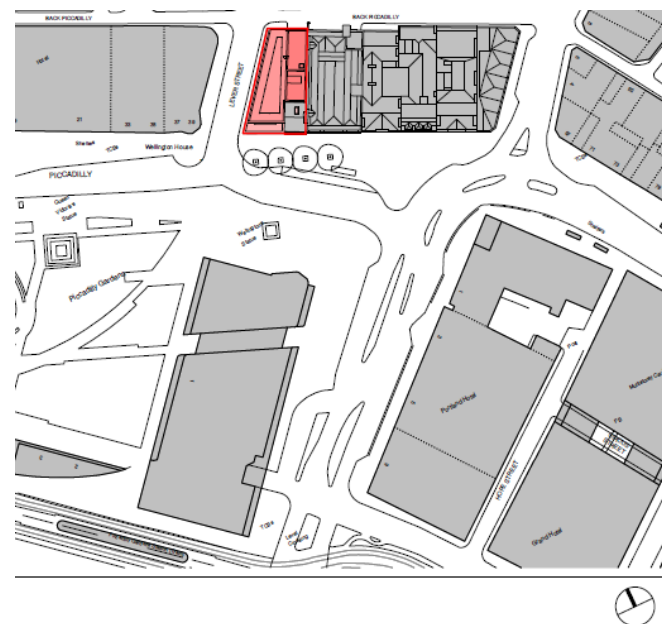


Figure 2.0 Image to show the orientation of the building



2.2 National Planning Policy

The National Planning Policy Framework (NPPF) was updated in February 2019. The document details that “the purpose of the planning system is to contribute to the achievement of sustainable development”. Applications for planning permission are determined in accordance with the development plan and local planning policy. Achieving sustainable development means that the planning system has three overarching objectives, which are independent and need to be pursued in mutually supportive ways.

2.2.1 Economic

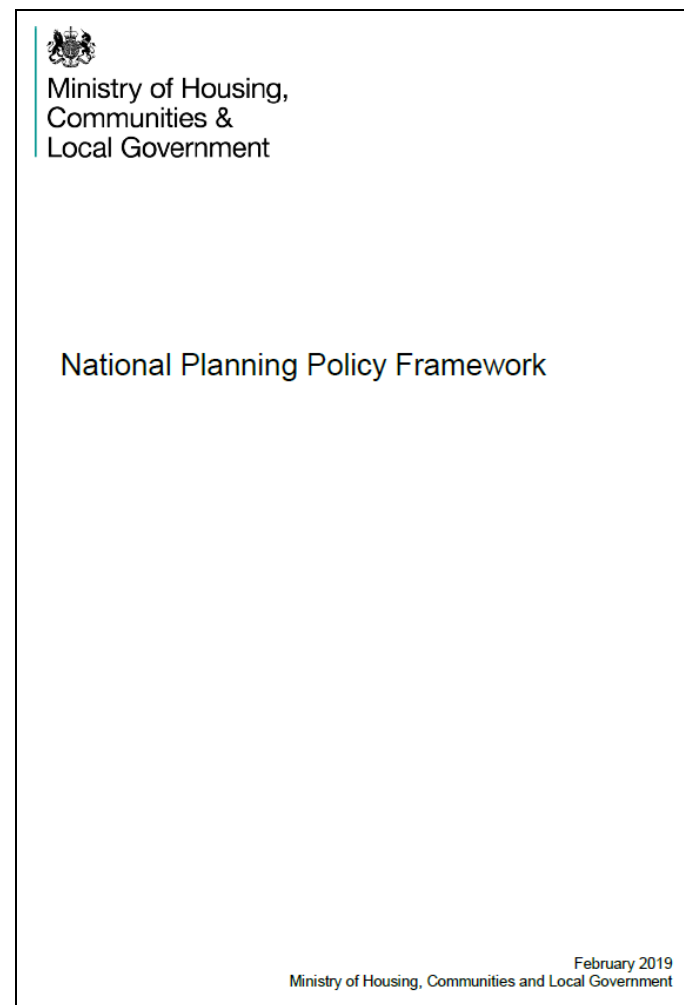
Contributing to help building a strong, responsive and competitive economy, by ensuring that sufficient land of the right type is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure.

2.2.2 Social

Supporting strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering a well-designed and safe built environment, with accessible services and open spaces that reflect current and future needs and support communities’ health, social and cultural well-being.

2.2.3 Environmental

Contributing to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.





2.3 Local Planning Policy

Manchester City Council have a Core Strategy, adopted in 2012, outlining a vision for Manchester from 2012 to 2027. The Core Strategy describes Manchester today and outlines the Council's vision for Manchester in 2027 along with the planning policies which will be used to deliver that vision. The relevant environmental, energy and carbon reduction planning policies are detailed below.

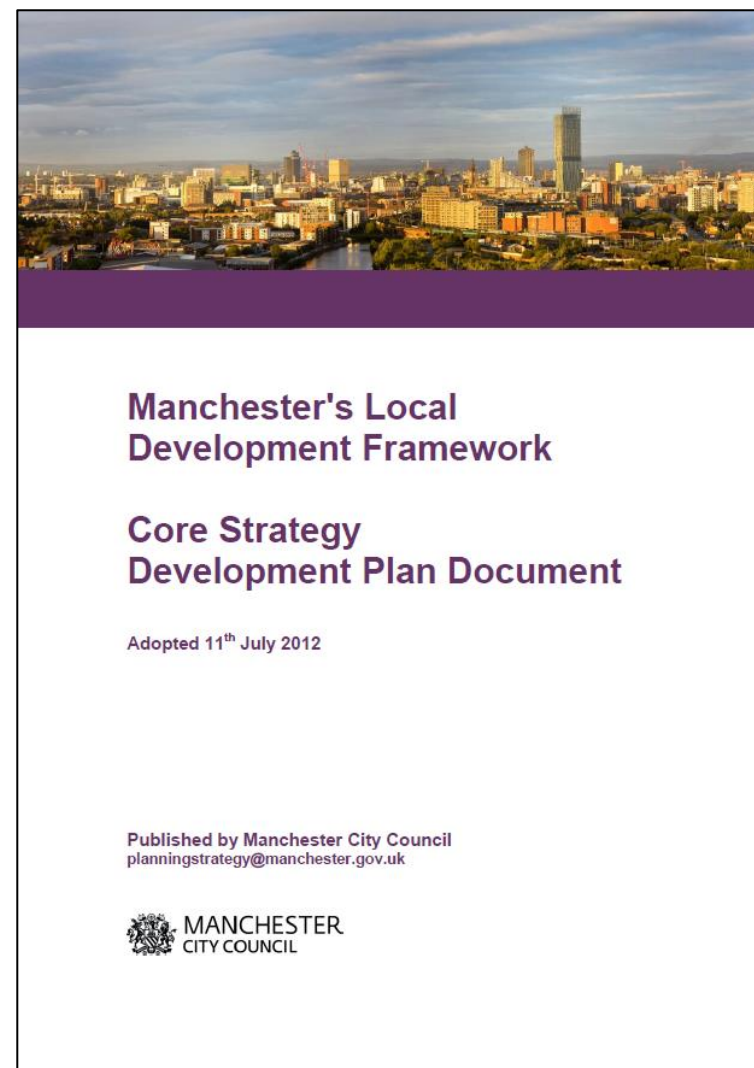
2.3.1 Policy EN6 – Target Framework for CO2 Emissions by Enabling Low and Zero Carbon Development

The aim of Policy EN6 is to ensure that all new developments “will be expected as a minimum to meet the target shown in Tables 12.1 or 12.2.” As defined by the guidelines within Policy EN6.

	Description	Target
Target 1	Network development area	CHP/DH anchor or connection or where not feasible, a 15% increase on Part L 2010
Target 2	Electricity intense buildings	+10% Increase on Part L 2010
Target 3	Micro generation area	+15% increase on Part L 2010

PI Piccadilly development falls into Table 12.2 – Target 3: Micro generation area. The minimum requirement for developments that fall under this classification is a “15% increase on Part L”. This 15% reduction in CO2 emissions, below the Part L 2010 TER, should be achieved through the provision of renewable and low carbon technologies.

- Achieve a 15% reduction in carbon emissions





3.0 Be Lean: Reducing Energy Demand

Consideration of energy usage is an integral part of any proposed development and each aspect of the Low Energy Building Design includes methods of conserving energy and promoting sustainability. This section of the Energy Strategy looks at how demand has been reduced by the minimum required efficiency defined by building regulations, known as the 'limiting parameter'. This minimum efficiency or limiting parameter is then compared with the Low Energy Building Design to assess the energy use of proposed Hotel development Premier Inn Manchester Piccadilly Gardens.

3.1 Building Envelope and Fabric

The energy usage of a building is intrinsically linked to the efficiency of the building envelope design, accordingly this section details how energy use is minimised by following energy strategy design principles in Section 1.1 and using a Passivhaus influenced fabric first design philosophy.

The reduction of heat loss through the building fabric is the most effective method of passively reducing energy usage. Building services will be replaced multiple times over the life of the building but it is less likely that the building fabric will be upgraded. Therefore, the reduction of u-value and the adoption of the Passivhaus design philosophy is the most effective method of reducing energy usage and carbon emissions over the full life cycle of the building.

3.1.1 Thermal Properties of Building Fabric

The energy usage of the building services associated with controlling the space temperature is dependent on the building envelope. The efficiency of the building envelope significantly affects energy usage as this is essentially a measure of how efficiently the internal building environment is thermally isolated from the external environment. The more efficient the isolation of internal from external environment, the less energy will be required for use in servicing the internal environment to meet optimum comfort levels.

3.1.2 Thermal Bridging

The proposed development has been designed to use accredited construction details ACD which will limit thermal bridging and reduce heat loss through the building envelope.

	Limiting Fabric Parameters W m ⁻² K ⁻¹	Low Energy Design Parameters W m ⁻² K ⁻¹	Percentage Improvement %
Roof	0.25	0.10	60
External Walls	0.35	0.15	57
Ground Floor	0.25	0.15	40
External Glazing	2.20	1.0	45

Table 3.1.1: Table comparing the limiting fabric from Part L2A of the building regulations with the proposed Low Energy Design

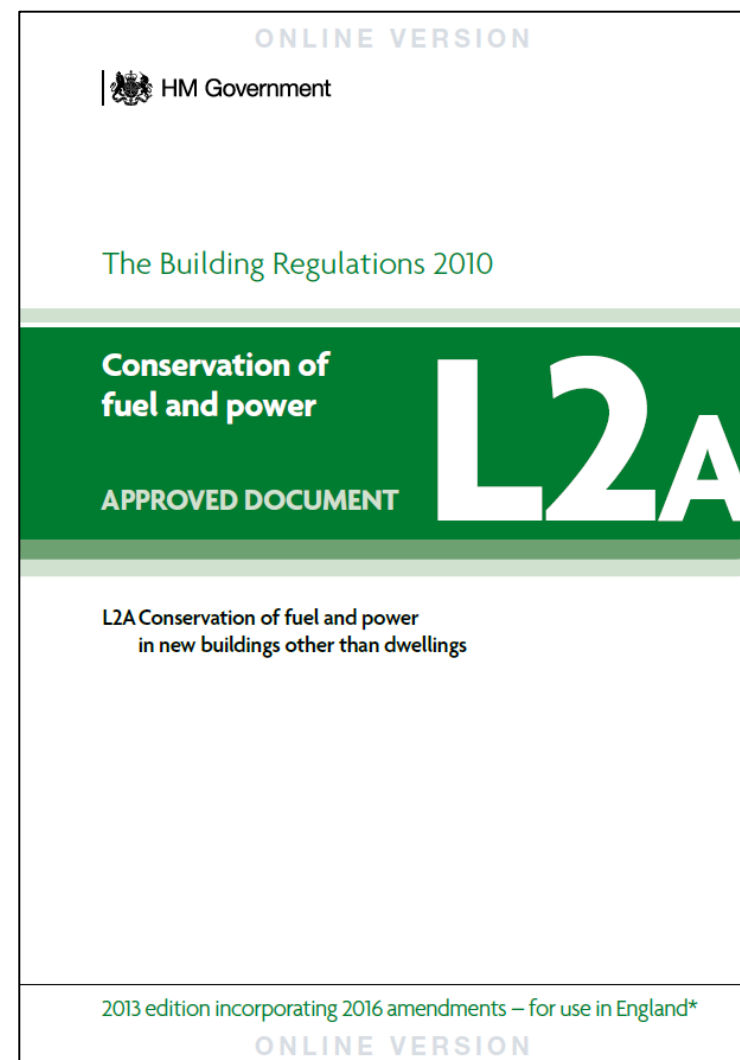


3.1.3 Air-Tightness of Structure

The energy usage of the building services associated with controlling internal environment are heavily dependent on the air-tightness of the building, which is essentially a measure of how efficient the building envelope is at resisting ingress of air from the external environment. Any ingress of air from the external environment will need to be conditioned by the building services to ensure the internal environment stays at the optimum level of comfort. Poor air tightness can result in higher operational energy costs and poor thermal comfort. Passivhaus standards specifically target very low air leakage rates associated with air-tight building to ensure operational energy is lowered and thermal comfort is improved. Accordingly, the reduction in air permeability and thereby external air ingress will reduce the demand upon the building services conditioning the area and proportionally reduce energy usage.

	Limiting Air Permeability $\text{m}^3 \text{ hr}^{-1} \text{ m}^{-2}$	Low Energy Design Permeability $\text{m}^3 \text{ hr}^{-1} \text{ m}^{-2}$	Percentage Improvement %
Air Permeability	10.0	5.0	50

Table 3.1.2: Table comparing the limiting air permeability from Part L2A with the proposed design.





3.1.4 Mechanical Ventilation

Premier Inn bedrooms will use the Vectaire heat recovery ventilation unit, which ensures the heat remains in the building internal environment, despite bringing in external atmospheric ‘fresh’ air to improve indoor air quality for the occupants.

The heat recovery unit uses an air to air heat exchanger to transfer heat from the internal spaces to the incoming external air. The air paths do not cross and there is no mixing of the air, the heat exchanger enables heat recovery between air streams. Thereby passively warming the external air and reducing the need for mechanical heating services to use energy to increase the temperature. This can reduce the heating energy required for the building by 80% and reduce wasted energy by ensuring less demand is placed on the space heating system.

The Specific Fan Power SFP of the heat recovery ventilation unit is a measure of how efficiently the unit can supply air to the space. This consists of a ratio of electrical absorbed power to volumetric airflow rate creating the specific fan power metric, in which a lower number is more efficient.

	Limiting Specific Fan Power SFP W l ⁻¹ s ⁻¹	Low Energy Design SFP W l ⁻¹ s ⁻¹	Percentage Improvement %
Specific Fan Power SFP	1.9	1.1	42.0
Heat Recovery Efficiency	50%	82%	64.0

Table 3.1.3: Table comparing the limiting ventilation efficiencies with the proposed Design.

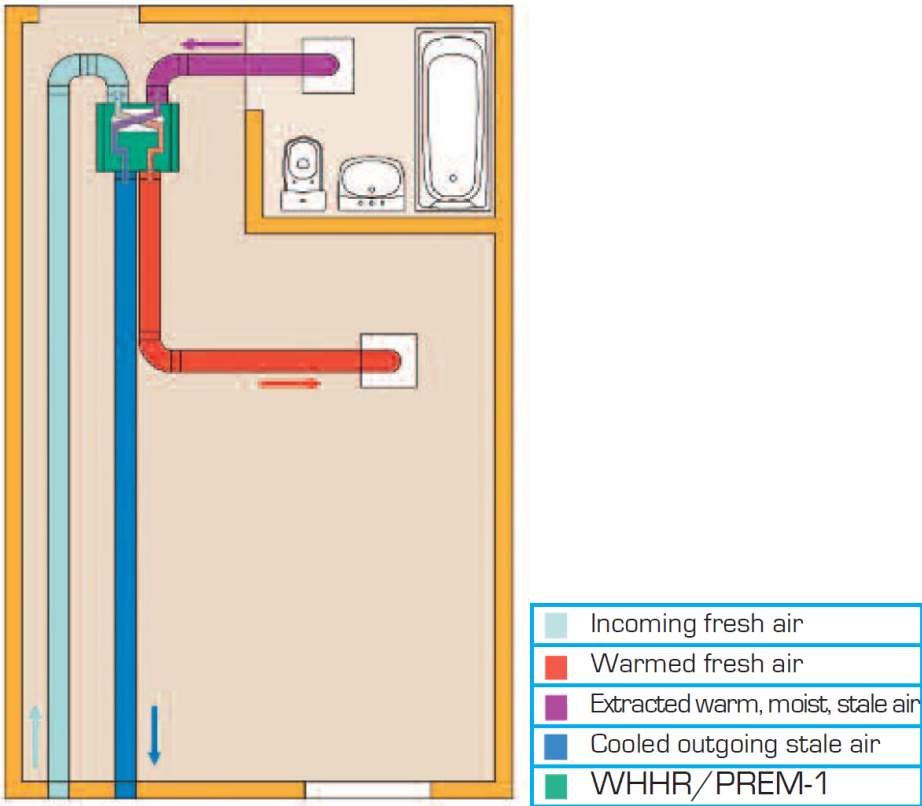


Image 3.1.3: Image to show a standard bedroom combined with a heat recovery ventilation unit.



3.1.5 Low Energy Lighting & Control

The energy required to illuminate the spaces of the development can be minimised by using low energy LED light fittings that minimise the energy and carbon emission used in artificial lighting. The artificial lighting has also been designed to incorporate lighting controls which will ensure that no electricity used for artificial lighting is wasted. This will ensure that carbon emissions are not created unnecessarily and that the building is a sustainable development.

The lighting controls

- Bedroom bathrooms – auto on/off control
- Corridor – auto on/off control
- Stairs – auto on/off control
- Laundry – auto on/off control
- Public Toilet – auto on/off control
- Office – auto on/off control
- Store – auto on/off control
- Team Room – auto on/off control
- Linen Room – auto on/off control

	Limiting Lumens per Circuit Watt Lm.W ⁻¹	Low Energy Design Value Lm.W ⁻¹	Percentage Improvement %
Lighting Efficiency	60	110	83

Table 3.1.4 Table comparing the limiting lighting efficiency with the proposed Low Energy Design Value





4.0 Be Clean: Analysis of Decentralised Energy

Decentralising the energy supply is important for high density developments, where the per flat or apartment application of renewable and LZC technology may have practical restrictions or offer poor lifecycle costs. The annual carbon emissions are dependent on the energy sources of the district energy scheme and each development's annual carbon emissions calculations are required to determine whether decentralised energy or grid electricity would produce lower carbon emissions.

4.1 Heat Distribution Network

Manchester City Council have investigated the potential for District Heating Networks in the City Centre and Policies En 04 and En 05 details the requirements for heat networks. The study by Arup identified heat networks in the following areas

- i. Manchester Oxford Road Corridor
- ii. Manchester Civic Quarter Phase 2
- iii. Salford Media City

The Media city heat network and Civic Quarter heat networks are existing and unfortunately not close enough to the proposed Premier Inn Manchester Piccadilly Gardens.

There are not currently any heat networks in the vicinity of the proposed Premier Inn Manchester Piccadilly Gardens therefore a connection will not be feasible. If a heat network is created in the future then a connection may be possible, however this would be subject to a Heat Network Feasibility Assessment which details the carbon, energy and economic argument for heat network connection for Premier Inn Manchester Piccadilly Gardens.





5.0 Be Green: Analysis of Renewable Technology

5.1 Analysis of Available Renewable Technology

The available renewable technology which will be considered for the proposed hotel development Premier Inn Manchester Piccadilly Gardens is detailed in the table below, along with potential benefits and any foreseeable issues. The table is provided to give a visual overview of the appropriate renewable technology and hence determine suitable renewable technology.

Technology Type	Description of Technology	Potential Benefits	Potential Issues	Valid for Application
PV Panels (Photovoltaic)	Photovoltaic solar arrays use solar radiation to create electricity, using a similar process to photosynthesis. Electrons are freed from atoms and the subsequent flow of electrons results in electric current.	Zero carbon emissions, 100% renewable technology Additional income due to government incentives Relatively maintenance free as no moving parts Visual impact can be low as can be placed out of sight. Noise free operation	Panels should face south and have sufficient angle to maximise capture Shadowing and detritus can lower performance over time Structure must be able to accommodate the weight of the panels. Required maintenance for cleaning panels	Yes (valid and recommended)



Technology Type	Description of Technology	Potential Benefits	Potential Issues	Valid for Application
Solar Thermal (Solar water heating)	Soar thermal installations use solar radiation to heat water. Evacuated tubes are installed in an area of maximum solar radiation. The heat is then transferred to the water and the heated water is then used to supplement the hot water requirement of the building.	Zero carbon emissions, 100% renewable technology Additional income due to government RHI scheme Relatively low maintenance as few moving parts Visual impact can be low as can be placed out of sight. Noise free operation	Tubes should face south and have sufficient angle to maximise capture Shadowing can affect energy generation performance The structure of the building must be able to accommodate the weight of the filled tubes. More benefit seen during the summer months	Yes (valid but not recommended due to area required to achieve required carbon reduction)



Technology Type	Description of Technology	Potential Benefits	Potential Issues	Valid for Application
Air Source Heat Pump ASHP (Space Heating)	Air source heat pumps transfer low grade thermal energy in the atmosphere for use in heating spaces or water heating.	RHI available for each kWh of energy generated	Potential for leak of refrigerant with high GWP relative to CO2	Yes (valid and recommended)
		Efficient operation utilising the low grade heat in the atmosphere.	Specialist maintained due to refrigerant handling laws	
		Proven and reliable technology	External condenser fans create noise.	
Ground Source Heat Pump GSHP	Ground source heat pumps use the Earth as a heat sink and transfer low grade thermal energy from the ground for use in the building. This energy can then be used for space heating/cooling or water heating.	Additional income generated due to RHI government incentives	Not 100% renewable as electricity creates carbon emissions	No (not valid for this site)
		Efficient operation utilising low grade heat in the ground	Ground survey required to determine feasibility of installation.	
		Noise free operation	Carbon emissions due to electricity as fuel	



Technology Type	Description of Technology	Potential Benefits	Potential Issues	Valid for Application
Air Source Heat Pump ASHP (Hot Water Heating)	Air source heat pumps transfer low grade thermal energy in the atmosphere for use in heating spaces or water heating.	RHI available for each kWh of energy generated Efficient operation utilising the low grade heat in the atmosphere. Proven and reliable technology	Potential for leak of refrigerant with high GWP relative to CO2 Specialist maintained due to refrigerant handling laws External condenser fans create noise.	Yes (valid and recommended)
(C)CHP (Cogeneration)	A cogeneration plant is a combustion engine using natural gas or biogas fuel to drive an alternator which produces electricity. The combustion process is cooled using water as a refrigerant. Trigeneration, or combined cooling, heat and power (CCHP), is the process by which waste heat produced by the cogeneration plant is used to generate chilled water for air condition or refrigeration, using an absorption chiller to provide this functionality.	Income generated by RHI (if served by renewable gas) Efficient generation of energy, minimising losses. Potential to export Electricity	Need to have sufficient, constant heat, cooling and electrical load Needs to operate for a majority percentage of the year	Yes (valid but not recommended due to NOx emissions and effect on air quality)

Table 5.1 Detailing the Low and Zero carbon technology options available for the proposed development



6.0 Carbon Emissions Reductions Energy

6.1 Low Energy Building Design and Energy Hierarchy

The Low Energy Building Design building and services design process uses the design principles outlined in Section 1.1 to ensure the energy use of the proposed development is as low as possible and that where energy is used, as little as possible is wasted. The design concepts used in the Low Energy Building Design have taken elements of the Passivhaus fabric first approach to the building design process. This approach significantly lowers the energy demand before the building services are considered in the design process by applying passive zero energy usage measures. Once the energy use of the building is sufficiently minimised, low energy building services and LZC technology are then utilised in the design. This ensures the carbon targets can be met and that energy needed to provide services and control the building internal environment is minimised.

The energy strategy has shown passive and active carbon reduction measures as part of the low energy building design. The carbon reductions for these measures will now be illustrated using the Energy Hierarchy. The energy hierarchy has been developed by the GLA for The London Plan and helps illustrate carbon reductions throughout each step of the low energy building design process. The sustainability principles outlined in Section 1.1 are used to drive the low energy design philosophy. The energy hierarchy is used to present and visualise carbon reductions. This is a carbon reduction methodology consisting of three main stages: Be Lean, Be Clean, Be Green which highlight carbon emissions from passive measures through to LZC technology.

Be Lean

The first stage in the energy hierarchy is 'Be Lean' which includes demand reduction measures designed to reduce energy usage passively.

Be Clean

The second stage in the energy hierarchy is 'Be Clean' assessment of clean energy sources district heating and CHP.

Be Green

The third and final stage is the application of renewable energy technologies.





6.2 Establishing Baseline Emissions

The baseline carbon emissions are determined by assessing the proposed development against the building regulations Part L compliance software. The regulated carbon emissions for this project have been calculated using Part L compliance software IES VE 2019 VE Compliance DSM.

This software uses the design information for the proposed development to create a notional 'target building' development. The carbon emissions for the notional building are then compared with the actual building's carbon emissions. Accordingly, a compliant development is then deemed to be one which the actual emissions BER is less than or equal to the notional 'target building' carbon emissions TER. The notional building uses standard building fabric and typical efficiency building services as detailed in the non-domestic building services compliance guide and further details in the national calculation methodology NCM for energy assessment.

The regulated carbon emissions are calculated for Part L compliance while unregulated carbon emissions for small power items like laptops, televisions and chargers are not currently assessed for Part L building regulations compliance.

The baseline carbon emissions are qualified by multiplying the TER generated using Part L compliance software and the floor area of the development. The TER has been calculated using a notional baseline development which includes heating provided by gas boilers. This will provide the baseline metric, for which all additional carbon emissions reductions are calculated against.

The proposed baseline carbon emissions

The baseline carbon emission are 343.0 tonnes per annum

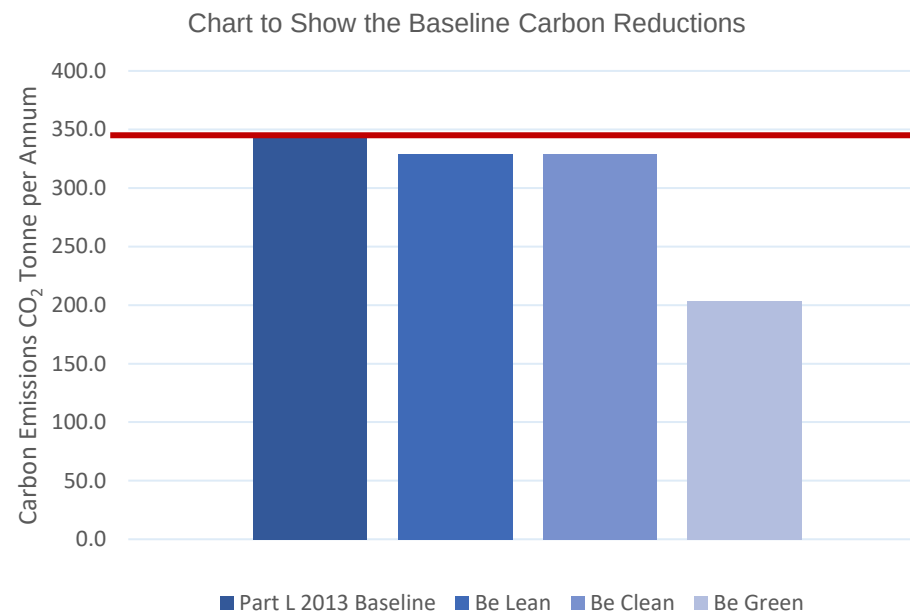


Chart 6.1: A chart to show the baseline carbon emissions of the proposed development

The red line shows the baseline building carbon emissions TER





6.3 Be Lean

The carbon emissions baseline has been calculated as detailed in Section 6.2. The Demand reduction phase of the energy hierarchy now uses the measures discussed in Section 3.0 Be Lean Reducing Energy Demand to illustrate the passive measures which have enabled the development to reduce carbon emissions.

The passive measures used in the proposed development are designed to reduce energy demand without using fuel in the process. Passive measures are applied before building services or low and zero carbon technology or renewable energy are applied.

This includes passive architectural design measures such as low u-value external element building fabric and low air permeability to reduce air ingress. Passive heat recovery ventilation can keep heat in the building by recovering heat from the external air using a heat exchanger. This heat can then be transferred to the incoming air without mixing of air streams or increase in energy usage of the building.

Low energy LED lighting can reduce energy usage and lighting controls can further reduce energy wastage by only utilising energy for the lighting services when they are needed.

The Passive Measures included in the development design are summarised below

- Low external element u-values
- Low air permeability
- Low energy LED lighting with lighting controls
- Metering of energy usage and BMS
- Bedroom serviced by mechanical ventilation heat recovery (MVHR) systems

The carbon reductions due to the Be Lean measures

The Be Lean measures achieve a carbon reduction of 4.1 %

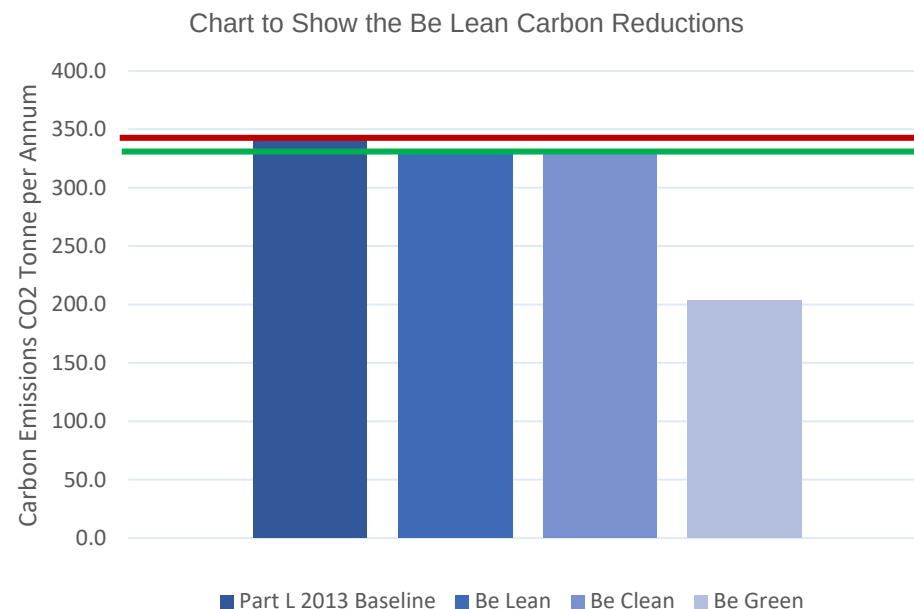


Chart 6.2: A chart to show the Be Lean carbon emissions reductions of the proposed development

The red line shows the baseline building carbon emissions TER



The green line shows the actual building carbon emissions BER





6.4 Be Clean

The analysis presented in Section 4.0 Be Clean Analysis of Decentralised Energy detailed the availability of heat networks which are currently in the vicinity of the proposed development Premier Inn Manchester Piccadilly Gardens.

The feasibility of utilising CHP for providing the hot water services in the proposed development has been assessed at part of the preliminary building services design. CHP can facilitate a cost saving by generating heat and power on site in one simultaneous process. The hotel would have a sufficient simultaneous demand for both heating for hot water services HWS and electricity demand of electrical baseload and given the low cost of natural fossil gas, this could provide low running costs. However, UK Electricity Grid decarbonisation is reducing the carbon emissions which previously would be gained from applying CHP as LZC technology. Utilising on site CHP for reducing carbon emissions was not deemed to be the most appropriate method of meeting the carbon reduction targets, due to minimal carbon reductions and the adverse effect on NOx emissions and hence air quality in the area.

The application of a district heating network will have no effect on local air quality if the development could connect to an existing local network, it is feasible that the hot water services design could be provided by a district heat network. However, the hotel is not situated close enough to an existing heat network which would make connection unfeasible. The carbon reductions are therefore constant between the Be Lean and Be Clean stages of the energy hierarchy and the Energy Strategy will focus on on-site renewable energy generation to facilitate further carbon reductions for the proposed development.

The carbon reductions due to the Be Clean measures

The Be Clean carbon emissions are constant at 4.1% reduction

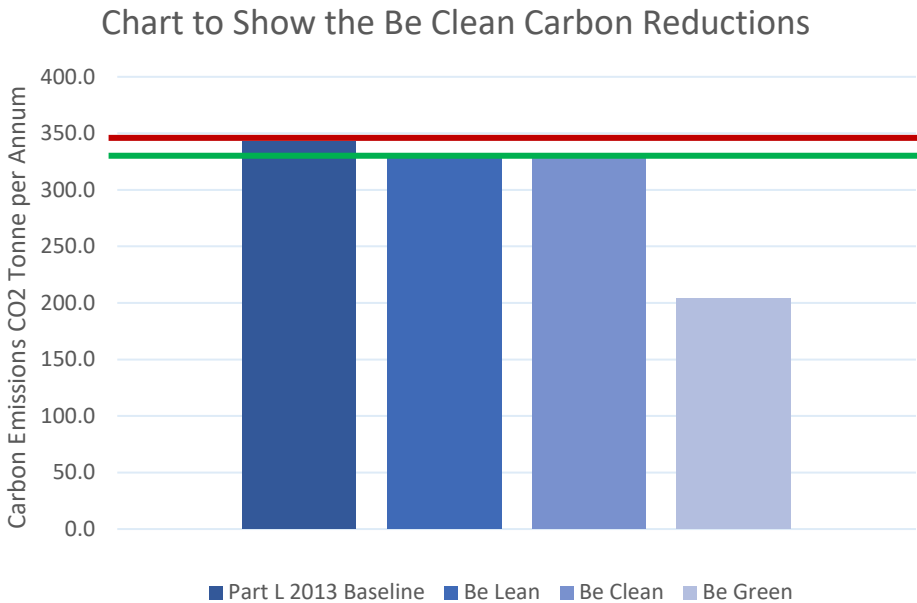


Chart 6.3: A chart to show the Be Clean carbon emissions reductions of the proposed development

The red line shows the baseline building carbon emissions TER



The green line shows the actual building carbon emissions BER





6.5 Be Green

The final stage of the energy hierarchy utilises renewable technology to further lower the carbon emissions of the development. Given that the measures in the Be Clean stage are unfeasible or would have an adverse effect on the air quality in the area, the carbon emissions reductions have been achieved using measures detailed as part of the Be Green stage of the energy hierarchy.

The building services design for the proposed development Premier Inn Manchester Piccadilly Gardens enables a significant reduction in carbon emissions by utilising Heat pumps for HWS and space heating of bedrooms and communal areas.

The application of space heating air source heat pumps will allow space heating system to have efficiencies of 400%, meaning that for every kWh of electricity used, 4 kWh of heat energy will be transferred from the external atmosphere into the building for use as space heating. The space heating air source heat pumps will be heat recovery heat pumps which can transfer energy between indoor units. This allows the air source heat pumps to transfer heat to other areas of the building, rather than constantly rejecting it into the external atmosphere. The use of heat recovery ASHP will allow heat transfer between areas of the building which have different activities and or solar gains lowering energy demand.

A CO₂ refrigeration cycle air source heat pump ASHP is to provide 100% of the hot water services, this enables a seasonal efficiency 430% using bin weather data. The high seasonal efficiency 4.3 SCOP of the heat pumps ensure that these are the lowest carbon method of providing hot water services. The high efficiency of the air source heat pumps reduces the energy demand for the hot water services, grid electricity usage and operational energy. The energy mix of the electricity grid is currently supplied by zero carbon sources which make up over 50% of annual electricity generation. Over the lifecycle of the building carbon emissions are expected to be reduced further than detailed in this Energy Strategy as the electricity grid continues to be decarbonised.

The Be Green stage of the Energy Hierarchy enables the development to meet the carbon reduction targets and as such provides a low carbon development.

The carbon reductions due to the Be Green measures

The Be Green measures achieve a carbon reduction of 38.1%

Chart to Show the Be Green Carbon Reductions

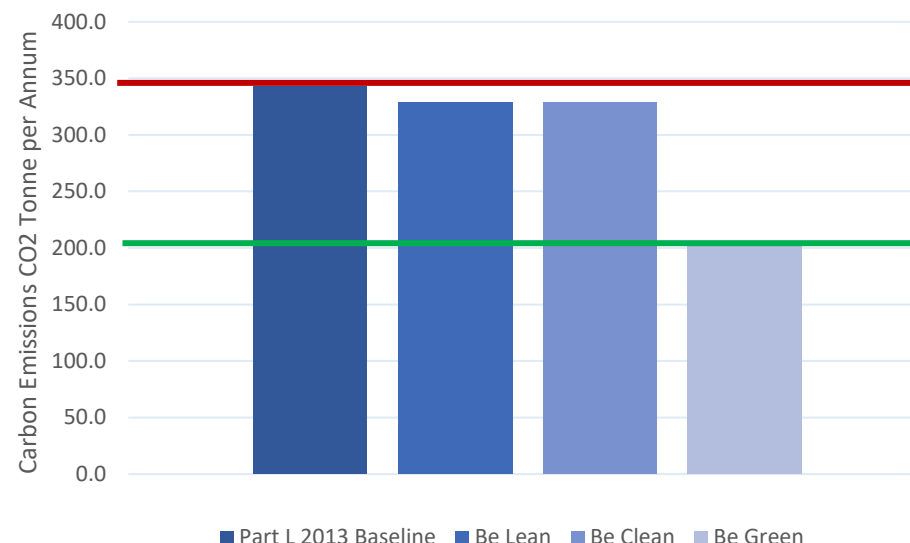


Chart 6.4: A chart to show the Be Green carbon emissions reductions of the proposed development

The red line shows the baseline building carbon emissions TER



The green line shows the actual building carbon emissions BER





6.6 Overall Carbon Reductions

Carbon Dioxide Emissions Per Annum for non-domestic Buildings

	Regulated CO ₂ Tonnes CO ₂ per annum	Unregulated CO ₂ Tonnes CO ₂ per annum
Baseline Part L (2013)	343.0	76.2
Including Be Lean Measures	328.9	76.2
Including Be Clean Measures	328.9	76.2
Including Be Green Measures	203.6	76.2

Figure 6.6.1 to show the carbon emissions of the proposed development

Regulated Carbon Dioxide Savings Per Annum for non-domestic Buildings

	Tonnes CO ₂ Per annum	Percentage Reduction %
Savings from Be Lean Measures	14.1	4.1
Savings from Be Clean Measures	0.0	0.0
Savings from Be Green Measures	125.3	38.1
Reduction Compared to Baseline	139.4	40.6

Figure 6.6.2 to show the carbon emissions reductions of the proposed development



7.0 Conclusion

The proposed development Premier Inn Manchester Piccadilly Gardens has followed the GLA's energy hierarchy to qualify the carbon emissions reduction targets have been met. This process has involved calculation of carbon emissions at each stage of the hierarchy, the Energy Hierarchy helps qualify the carbon emissions due to various measures by reporting the emission reductions at each stage based on an average carbon emissions calculations of a new build Premier Inn hotel. The carbon reductions detailed in this Energy Strategy have been calculated using Part L accredited compliance dynamic simulation modelling DSM software IES VE Compliance DSM. This ensures that the proposed development's carbon emissions have been calculated using a more sophisticated carbon calculations methodology, as opposed to the more simplistic standard SBEM methodology.

The first stage **Be Lean** of the energy hierarchy incorporates the below measures

- Low external element u-values
- Low air permeability
- Low energy LED lighting with lighting controls

The **Be Lean** measures facilitate a carbon reduction of **4.1%**

The **Be Clean** second stage is detailed in Section 6.4.

Third stage **Be Green** of the energy hierarchy includes

- Air source heat pump ASHP providing space heating
- High efficiency CO₂ Heat Pump for hot water services HWS
- Sola PV photovoltaic panels generating on site zero carbon electricity

The **Be Green** measures facilitate a carbon reduction of **38.1%**

This Energy Strategy proposes an all-electric building services strategy due to the adverse effect on local air quality proposed by decentralised or on-site combustion building services. This will ensure lower carbon emission at present and in addition, increasingly reduced carbon emissions as the electricity grid decarbonises. Accordingly, this Energy Strategy confirms that the overall development's carbon emissions will be reduced **41%** below the Part L 2013 baseline.

The energy hierarchy carbon reduction methodology has minimised energy usage and carbon emissions of the development Premier Inn Manchester Piccadilly Gardens to provide a sustainable low energy building.

Chart to Show the Be Green Carbon Reductions

