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Six56, Warrington

Environmental Statement

Part 2 – Energy Technical Paper 12

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Contents

Tables and Figures:

Appendices: (none used)

1. Introduction

1.1. Ridge and Partners LLP are undertaking the production of the ES Technical Paper for Energy in the context of the Proposed Development as described in the ES Project Description.

1.2. This Paper examines the proposed Energy Strategy for the Proposed Development including the anticipated Energy demands and subsequent carbon emissions for the operational site.

1.3. The assessment will take into consideration the opportunities and limitations on the site in terms of a potential Energy Strategy. This will also consider the availability of utility supplies being gas, water and electricity and the impact on existing Utility services.

1.4. The assessment will take into consideration the type of buildings proposed on the development and subsequent energy demand and Carbon emissions.

1.5. A site wide energy strategy will be developed that will provide a template of design technologies and techniques for future construction of the buildings that meet the targets set out in the relevant government and local planning documents.

1.6. This Paper should be read in conjunction with the Utilities ES Technical Paper – 10.

2. Documents Consulted

2.1. The following baseline data has been used to undertake the Energy Assessment:

- ES Parameter Plans.
- Chartered Institute of Building Services (CIBSE) Guide 46
- Utility providers' existing drawings and apparatus details
- Ground conditions report
- Site environmental data

2.2. Climate Change Act (2008) – the Climate Change Act sets in place a legally binding agreement target to reduce carbon dioxide emissions by at least 80% by the year 2050 (based on (1990 levels as detailed in the Kyoto Protocol). The government must report every five years on progress through 'carbon budgets'. Much of the legislation in place is to ensure the UK meets the targets that are set out.

2.3. National Planning Policy Framework (NPPF) (2018) – (the Framework) requires local plans to plan positively to deliver renewable and low carbon technology developments. This is to help tackle climate change and address the environmental role of planning as set out in the Framework. This helps to meet the UK's legally binding target to reduce carbon emissions by 80% on 1990 levels by 2050:

2.4. In addition to the NPPF (2018) the following Core Strategy Local Plan Policies and Specific Planning Documents (SPD) will be followed;

- Regeneration Framework for Warrington 2009
- One Warrington: One Future - Where Everyone Matters – A Sustainable Community Strategy for Warrington 2009 to 2030
- Warrington Climate Change Strategy (2007)
- Warrington Local Transport Plan 2 (LTP2) 2006-2011
- Warrington's Local Pland Core Strategy (Local Planning Framework) Adopted in July 2014.

2.5. The Design and Construction Specific Planning Documents (SPD) states;

"Energy Efficiency In Use

Reducing the amount of energy needed to run and use buildings has a wider benefit in that it helps cut carbon emissions as well as reducing running costs for building users.

- The orientation of buildings can be used to increase solar gain, as direct sunlight into buildings helps reduce the need for lighting. This can be enhanced by larger windows on south-facing elevations and by the avoidance of deep-plan buildings. The provision of shading in sunny weather needs to be considered as part of this arrangement. The spatial relationship of buildings needs to be considered to minimise overshadowing.
- High insulation levels will reduce energy requirements and conserve heat. As well as insulation of roofs, walls and windows this should also include insulation

of pipes, ducts, boilers and hot water tanks. Building design can also improve insulation, such as enclosed central atriums rather than exposed courtyards in the centre of office blocks.

- The choice of heating and ventilation equipment will also affect energy use. Natural ventilation is preferable to mechanical ventilation. Localised rather than centralised controls will allow for bespoke temperature controls.
- The fitting out of buildings also will impact on energy use such as the use of energy-efficient lightbulbs, sensor lighting, "A" rated appliances and the type of heating system used (such as combined heat and power plants).
- The source of energy used is also important. Renewable energy from sources such as solar electricity generation systems (photovoltaic panels) and ground source heat pumps produce minimum carbon emissions. Where renewable energy technologies are to be used, they should be conceived as part of the overall design concept of a building and integrated into the architectural language of the building rather than added as an afterthought where possible."

3. Consultations

3.1. In response to the ES Scoping Request and consultation comments following the submittal of this Request, the following identifies the queries with relevant responses raised in the Councils Scoping Opinion;

3.2. All relevant utilities asset owners have been contacted to establish new utility Points of Connections (PoC's), and associated disconnections and diversions. A summary of the consultations is included in the table below.

Theme / Issue	Date	Consultee	Method	Summary of Discussion	Outcome / Output
Electricity connection	September 2018	Electricity Northwest (via Ameon utilities)	Submitted via e-mail though an IDNO (Ameon Utilities).	Proposals for full load capacities received from utility providers.	Agreement with utility providers for full load requirements
Gas connections	September 2018	Transco (via Ameon utilities)	Submitted via e-mail though an IDNO (Ameon Utilities).	Proposals for full load capacities received from utility providers.	Agreement with utility providers for full load requirements
Water Connections	September 2018	United Utilities (via Ameon utilities)	Submitted via e-mail though an IDNO (Ameon Utilities).	Proposals for full load capacities received from utility providers.	Agreement with utility providers for full load requirements

Table 12.1: Summary of Consultations and Discussions

3.3. During the preparation of the Technical paper the following consultations have been undertaken.

- Discussions with local Utility Suppliers

a) Electricity Northwest

b) United Utilities

c) Transco

d) British Telecom

3.4. Further discussions have been undertaken with the ES Consultant team to establish the opportunities and limitations on the site such as:

- Ground conditions - Cundall
- Acoustic Environment - Cundall
- Air Quality - RPS
- Building Orientations and location - Stephen George & Partners
- Utility Strategy and Capacity Availability – Ridge & Partners LLP

4. Methodology and Approach

Baseline methodology for scheme evolution / design

4.1. The principle method of how the team has integrated low energy and carbon reduction into the Proposed Development is to follow a 'Strategic Route'. This has steered the Team to focus on key aspects of the design at the appropriate juncture in the process.

4.2. The following Section explains how this strategic route has been followed:

i. Establish Client Requirements, Regulations & Benchmarks:

It is important from the onset to set out and establish the relevant criteria that is to be adopted and to understand what implications they have on the energy and sustainability strategy.

While these benchmarks, standards regulations etc. are fundamental in achieving statutory and regulatory compliance we believe this has been achieved in a way that does not distract from good sustainable and low energy design and avoid "box ticking" exercises.

4.3. Site Appraisal

It has been important to understand the opportunities and limitations of the site and surroundings in the context of the opportunity to implement renewable and low carbon technology.

Noise Quality

The acoustic study undertaken by Cundall has concluded that the site and the buildings are on the whole suitable for natural ventilation solutions from an acoustic perspective. These solutions could be applied to both the office elements of the units and subject to the use also applied to the employment unit (B8) elements.

Mean Wind Speeds

While mean wind speeds of the site are favourable (in excess of 4.5 m/s) for the production yield of energy from wind for the site, there are a number of key points for consideration and further investigation:

- Noise generated by wind turbines will not be conducive to the local residences.
- Flicker effect of wind turbines on the buildings on sunny days - prohibitive.
- Visual impact of wind turbines does not align with current Development Teams planning strategy.
- Proximity of existing Buildings & Wildlife

Site Layout

The site layout has been influenced by a number of factors including existing constraints of the site such as:

- Overhead low voltage cabling (running across the site fixed to wooden poles)
- Existing below ground services
- Overhead BT cables to the existing cottages.

Natural Daylight

At detailed design stage, feasible window positions and roof lights will take due regard of the guidance set out by the BRE document reviewing the skyline and the amount of skylight falling on a vertical wall or window.

The combination of maximising daylight and passive solar design will reduce both the reliance on artificial lighting and reduce the heating demand resulting in both energy and carbon reduction.

The measures adopted in targeting these daylight factors are:

- Optimum sizing of windows.
- Avoiding internal rooms.
- Minimising deep plan rooms.
- Light coloured internal finishes where appropriate.
- Glazing taken to underside of ceiling finish.
- Maximising floor to ceiling heights.
- Glass specification with good daylight penetration.
- Roof lights to employment units.

4.4. Baseline Carbon Emissions

Initial baseline carbon emissions have been established using CIBSE Benchmarking TM46 however, to establish a more refined and detailed energy predictions (and carbon emission prediction) a model for a typical employment unit has been produced to predict the energy use and predicted carbon emissions from the scheme.

4.5. Design

At the design stage a strategic process was followed to promote the implementation of Best Practice Carbon reduction methods and technologies:

This strategic route was as follows:

a) Reduce demand - Passive Measures

b) Meet demand efficiently - Energy Efficiency

c) Low & Renewable Technology

It is considered that following this route has promoted 'Best Value and Practice' in the incorporation of Renewable and Low Carbon Technologies.

Receptors

4.6. The geographical extent of the potential impact from the development are outlined in the following:

Designation	Receptors
International	Not Applicable
National	Not Applicable
Regional	Not Applicable
County	Not Applicable
Borough / District	Existing Utility Networks
Local/Neighbourhood	Existing residential receptors within the surrounding area, sit habits, ecological features and existing utility networks

Table 12.2: Receptors

Refer to the Key receptors plans in the Appendix 6 of the ES Part 1 Report.

Environmental Impacts

4.7. The extent of the CO_2 and NO_x emissions as a result of the Energy Strategy will have an impact on the current levels:

Magnitude	Environmental Impact
Substantial	Permanent/irreversible change to key characteristics of the strategic utility network (electric and gas) as a result of the energy demand with important consideration at a district scale plus increased CO_2 and NO_x emissions.
High	Permanent/irreversible change to key characteristics of the local utility network (gas and electricity) as a result of the energy demand with important consideration at a local level plus increased CO_2 and NO_x emissions
Moderate	Permanent/irreversible change to the local utility network (electricity and gas) that may result in temporary disruptions locally as a result of the energy demand plus increased CO_2 and NO_x emissions
Minor	Temporary change over a limited area to key characteristics of the utility network (electricity and gas). Impacts likely to occur (e.g. increase in loading due to the Proposed Development prior to completion of any necessary offsite infrastructure improvements) plus increased CO_2 and NO_x emissions
Negligible	Minor temporary change over a limited area to key characteristics network (electricity and gas). Impacts unlikely or rarely to occur and minimal increases to CO_2 and NO_x levels
Neutral	No impact on existing utility servicing CO_2 and NO_x

Table 12.3: Environmental Impacts

Significance of Effects

4.8. The significance of effect is determined using the significance matrix in Section 4 of the Environmental Statement Part One Report. This identifies the receptor level across the top of the matrix and the magnitude of environmental impact down the side and where they meet within the matrix identifies the significance of the effect.

Impact Prediction Confidence

4.9. It is also of value to attribute a level of confidence by which the predicted impact has been assessed. The criteria for these definitions are set out below:

Confidence Level	Description
High	The predicted impact is either certain i.e. a direct impact, or believed to be very likely to occur, based on reliable information or previous experience.
Low	The predicted impact and its levels are best estimates, generally derived from first principles of relevant theory and experience of the assessor. More information may be needed to improve confidence levels.

Table 12.4: Confidence Levels

5. Baseline Information

5.1. The following information was used to develop the baseline carbon emissions for the development :

- Proposed ES Parameters Plans and illustrative Masterplan
- Utility load schedules

5.2. The following process will be followed to establish the Proposed Developments' carbon emissions.

RIBA Stage	Key Activity	Carbon Analysis
1 Appraisal	Brief & Client Aspirations Determine Relevant Legislation/Requirements Initial Site Appraisal Establish Specialist Consultant Input	Initial Benchmark CIBSE TM46, this document offers a comprehensive outline of building energy benchmarks.
2 Strategic Briefing		
3 Outline Proposals	Detailed Site Appraisal Strategic Energy Opportunities (Decentralisation) Passive Design – Shape/Form/Orientation Façade Options – Materials/Mass/Shading Initial Technology Review Low Carbon & Renewables	Refined Benchmarking ↓ Dynamic Energy Simulation
4 Detailed Design	Finalise Renewable & Low Carbon Technologies Establish Sizes, Locations & Renewable & Low Carbon Technologies	↓ Final Dynamic Energy Simulation
5 Final Proposals	Equipment Selection Detailed Design Drawings Small Scale Hydro	**As Built Dynamic Energy Simulation**
6 Production Information		

Table 12.5 : RIBA Stages and Energy Modelling

5.3. Beyond the initial CIBSE TM46 Benchmarking a detailed Energy Model will be developed for a typical Employment Unit using a set of reasonable assumptions and to the future type of employment unit required.

5.4. Although detailed designs are not available for the proposed units and the specific end users are not known at this stage, a series of assumptions have been made to allow an energy model to be developed to assess the overall site Energy Use and Carbon Emissions. It should be noted that these are assumptions, and not proposed design solutions at this stage and should not be adopted on final proposals but offer a reasonable guide to the future energy use. A further consideration is that the model assumes that building is heated whereas the future tenant may use ambient employment units, or cold storage which will impact on the Energy Model. The energy assessment will be based on a mixture of heated and un-heated employment units, therefore the heated buildings will likely be more reliant on fossil fuels such as gas supply whereas a cold storage unit will be more relevant on Electricity use.

5.5. A sample Employment Unit will be modelled to establish typical Energy Use of Carbon Emissions as detailed below.

- It should be noted those are not final detailed inputs but initial elements at this stage to establish energy benchmarking.
- The calculations and modelling will be undertaken to establish compliance with part L2A of the Building Regulations.

5.6. The internal conditions are assigned to the zones as indicated in Table 12.6 below:

Internal Condition Type	Zones assigned to
Indust Circulation	Corridor
Indust_IndProcess	Workshops
Indust_Toilet	WCs

Table 12.6: Internal Conditions

Lighting Efficiencies and Controls

5.7. Lighting

Zone	W/m² 100lux	Presence detection	Daylight-control	Back-space sensor
Office/ corridor	2.50	Auto-on/auto-off	Photo-control	No
Employment Unit	2.67	Auto-on/auto-of	Photo-control	Yes
WC	4.0	Auto-on/auto-of	Manual	N/A

Table 12.7: Lighting

5.8. Air Permeability

An air permeability of 5.0 m3/m2.hr at 50 Pa is assumed.

5.9. Natural Ventilation

To all areas apart from WCs.

5.10. Building Fabric

- External walls:
- Ground floor: Solid concrete, carpet upper (offices), concrete upper (workshop/WC)U-value = 0.20 W/m2K).
- Roof: Lightweight, aluminum outer, plasterboard inner with void above (U-value= 0.20 W/m2K).
- Glazing: SG cool-lite SKN Neutral SKN165 - Total transmittance (g-value) = 0.34, U-value = 1.64 W/m2K
- Frame: U-value = 1.70 W/m2K (15% of rooflights, 50mm wide for non-openable windows and 100mm wide for glazed doors and openable windows)
- Vehicle doors and fire exits:
- U-value = 1.20 W/m2K
- Internal walls: plastered concrete block

5.11. Mechanical Ventilation (extract only)

To WCs:

- Extract fan SFP: 0.4 W/l/s
- Flow rate: 8.0 ach

5.12. Heating

To offices, corridor and WC (LTHW to radiators):

- Fuel: gas
- Seasonal efficiency: 92%
- Distribution efficiency: 90%

5.13. To Employment Unit (Gas fired Radiant Heater or equal)

- Fuel: gas
- Seasonal Efficiency: 88%
- Radiant efficiency: 60%

5.14. Domestic Hot Water

- Fuel: gas
- Efficiency: 92%
- Distribution efficiency: 95%

5.15. Management Features

- Heating, Ventilation and Air Conditioning (HVAC) monitoring with warning for out of range values
- Light metering with warnings for out-of-range values

5.16. Pumps

Variable, with multiple pressure sensors.

5.17. Weather Data

CIBSE Test Reference Year for Manchester (nearest location for data)

5.18. It should be noted the inputs at this stage are not a final design and adopted to establish a quantum of the predicted Energy Use and Carbon Emissions. These inputs will vary throughout the detailed design process.

5.19. Energy Use:

Energy consumption table:

Energy Consumption by End User [kWh/m2] Per Annum		
	Actual	**Notional**
Heating	69.76	52.08
Cooling	0.41	0.73
Auxiliary	0.72	0.39
Lighting	25.33	60.13
Hot water	4.74	5.2
***Energy used by equipment does not count towards the total for calculating emissions. ****Total is net of any electrical energy displaced by CHP generators, if applicable.**		

Table 12.8: Energy Use

5.20. Carbon Emission Results

Carbon Emissions	Kg CO2/m2 Per annum
Heating	12.8
Cooling	0.22
Auxiliary	0.39
Lighting	13.7
Hot water	0.87

Table 12.9: Carbon Emissions

5.21. From the results it is evident that even with a heated employment unit, the highest carbon emissions are attributed from the lighting followed by the heating demand. This is a result of the large extent of artificial lighting required in an employment unit facility.

5.22. The outcome from these results promotes focus in terms of addressing the key areas to reduce energy and subsequent carbon emissions.

5.23. Below is a table with the initial resultant estimated Energy Use and Carbon Emissions based on the site wide parameters plan.

Unit		Elec		Fossil Fuel		Elec		Fossil Fuel		Sub-Total
Plot 1	M^2	$Kwhr/m^2$	Kwhr/ann	$Kwhr/ m^2$	Kwhr/ann	$C0_2/ m^2$	$C0_2$/ann	$C0_2/ m^2$	$C0_2$/ann	
Employment Unit	3,325,000	27	89,777,000	75	249,375,000	11	36,575,000	14	46,550,000	83,125,000
Office	175,000	25	4,375,000	21	3,675,000	10	1,750,000	4	700,000	2,450,000
Total	3,500,000									

Table 12.10: Energy Use & Carbon Emissions

5.24. The overall carbon emissions for the site are based on the criteria set out in the Baseline data that was inputted in to the Energy Model.

5.25. This model is currently based on heated employment units which may not be the case and hence the fossil fuel usage is in the higher end of the calculations.

5.26. The calculations undertaken all demonstrate a betterment of Part L2A of the Building Regulations (2013) and the relevant core strategy policies identified in Section 2 of this paper.

6. Alternatives Considered

6.1. As part of the design development the following has been considered as potential solutions and technologies to be part of the design these are not detailed solutions to be adopted at this stage:

Initial Summary of Technologies Considered, Adopted & Discounted.

6.2. Our initial stage is to discount or consider further particular technologies before detailed analysis is undertaken.

Key: Y – Yes N – No P – Possibly

REDUCE DEMAND	SUITABLE FOR CONSIDERATION	COMMENTARY
Natural ventilation/mixed mode	Y	Site is suitable for natural ventilation solutions.
Natural daylight	Y	As part of the master-planning and individual unit design.
Thermal mass	N	Considered to minimise cyclical energy fluctuations but not conducive to construction methods for Employment Units.
Air tightness	Y	Essential to minimise air leakage and reduce heat losses (improve on Part L)
Solar shading/Solar Glass	P	Yes to mitigate summertime overheating to offices.
Thermal Insulation	Y	Essential to minimise heat losses (improvement on minimum Part L requirements)
Low Energy Fit Out	P	Promoted with future tenants/ occupiers.

Table 12.11: Reducing Demand

ENERGY EFFICIENCY	SUITABLE FOR CONSIDERATION	COMMENTARY
Heat recovery	Y	Could be adopted for particular rooms/ areas.
Low energy lighting	Y	LED fittings important to reduce energy use for artificial lighting
Power management	Y	System can be adopted to limit excessive over voltage and energy use.
DC motors	Y	Can be adopted on specific systems where appropriate.
Variable speed drive	Y	Variable speed drives can be adopted on pumps motors where possible to reduce energy consumption.
Demand Operated Systems	Y	The use of passive infra-red (PIR) for lighting, heating, ventilation is feasible.
De-stratification Fans	Y	Important to adopt in heated environments
Energy Metering	Y	Promotes energy monitoring & out of range energy use.
Lighting Control	Y	Yes to operate in conjunction with daylight sensing

Table 12.12: Energy Efficiency

Key: Y – Yes N – No P – Possibly

RENEWABLE AND LOW CARBON	SUITABLE FOR CONSIDERATION	COMMENTARY
SOLAR		
Solar hot water	P	On the whole, distribution units will not have a high domestic hot water load.

RENEWABLE AND LOW CARBON	SUITABLE FOR CONSIDERATION	COMMENTARY
Photovoltaics (PV's)	Y	Can be used to offset electrical demand subject to financial appraisal.
WATER		
Small scale hydro power	N	Not feasible as no significant water source available
Tidal power	N	Not Applicable
Wave power	N	Not Applicable
WIND		
Wind turbines	N	Impact of building Flicker and noise are key considerations, also visual impact on site, so discounted at this stage of the design.
BIOMASS		
Biomass single room heaters/stoves	N	(relevant to residential buildings only) .
Biomass boilers	N	Peaks & Troughs of hot water demand not conducive to biomass operations if ambient employment unit adopted then large heating demands will not be required.
Biomass community heating schemes	N	Uncertainty of end user not conductive to strategy.
COMBINED HEAT AND POWER (CHP) for use with the following fuels:		
Biofuel	N	Gasification process possible for scale of site, but Biodiesel considered immature feedstock and unreliable.
Natural gas	P	Required baseline heating demand not ideal for uncertainty of end user.
Heat Pumps		
Ground source heat pumps	P	Availability of land makes solution feasible but high capital cost.
Water source heat pumps	N	No significant water sources to reject / absorb heat.
Air source heat pumps	P	Sufficient space available at each unit but may be more appropriate to offices element only.
For heat pumps to comply, the heat source (ground or water) must be from a renewable source, for example soil, outside air, ground water, or a river.		
OTHER		
Fuel cells using hydrogen generated from any of the above 'renewable' sources.	N	Technology not yet mature enough for application.
Rainwater recycling	P	Rainwater collection system, could be adopted to recycle rainwater for toilet flushing purposes for each block.
Green roofs	P	Could promote the site ecology but not specifically adopted at this stage.

Table 12.13: Renewable and Low Carbon Technologies

STAGE 1 - Design Review Reduce Demand

i. Proportion of transparent elements

6.3. The approach to the design will be to carefully consider the balance between transparent elements and opaque elements of the building façade.

6.4. This is important to ensure the avoidance of excess heat losses but at the same time, allowance of good natural daylight. Different approaches will be applied to the offices and other employment units.

ii. Natural Daylighting

6.5. As the Energy model highlighted, the major Carbon emission can be attributed to artificial lighting and hence the ability to reduce the reliance on artificial lighting with good natural daylighting is essential. Typically the employment unit area will have 10-15% of the roof area being roof-lights.

6.6. This percentage of glazing will help to provide a good daylight factor therefore reducing lighting consumption. The proportion of glazing may be locally increased where access to daylight is limited.

iii. Natural Ventilation

6.7. As the site is suitable for natural ventilation menthods, then both the employment unit (B8) element of a typical unit and the office area will be considered for natural ventilation methods.

6.8. It is intended to omit the use of Artificial cooling by the use of passive measures such as:

- Consideration of Building orientation
- Natural ventilation solutions
- Low energy fit out
- High performance glazing where required

iv. Minimise Air Infiltration to Reduce Heat Loss

6.9. In buildings where the fabric allows uncontrolled air movement (higher heating energy is required in winter as a result of the higher heat losses. The building will be designed and built to very high standards in order to reduce air infiltration rates through the incorporation of robust building detailing and high quality construction techniques. The target air permeability rate of 3-5$m^3/h/m^2$ at 50 Pa is considered an aspiration for the future building design (compared to 10 $m^3/h/m^2$ at 50 Pa required by Part L 2013).

STAGE 2 - Design Review Meet Demand Efficiently

i. Once the passive measures have been fully optimised in terms of reducing the initial demand the design solutions will target meeting the demand by energy efficiency measures namely:-

- Mixed Mode Ventilation (offices)
- Low Energy Lighting (LED)
- Daylight Dimming where appropriate
- Occupancy demand systems (such as lighting, heating and ventilation)
- Energy Metering
- Variable Speed Drives on pumps & fan
- Heating set back
- De-stratification fans

ii. Energy Metering

6.10. There is evidence that energy metering will reduce energy by up to 10%, the information provided will allow analysis of energy trends and comparison with benchmark data.

6.11. As a minimum all metering shall fully comply with CIBSE Guide for Energy metering.

iii. Variable Speed Drivers

6.12. These will be adopted on the systems (such as LTHW heating & ventilation systems) to optimise energy use against demand to reduce energy consumption when appropriate

iv. Lighting Control Systems

Low Energy Lighting (LED)

6.13. Low energy lighting will be an essential component in the reduction of the overall energy use of the building coupled with control systems that operate lighting systems on demand (such as PIR systems and due to environmental criteria such a s a daylight Dimming.

v. Destratification fans

6.14. These systems reduce heating demand by recurculating stratifying warm air in tall buildings and hence reduce energy demand.

STAGE 3 - Design Review Renewable & Low Carbon Technologies

6.15. The final element of the design stage is to review the Renewable & Low Carbon Technologies namely:

- Solar Thermal
- Photovoltaics
- Ground Source Heat Pumps (GSHP)
- Air Source Heat Pumps (ASHP)
- Combined Heat & Power CHP
- Biomass

i. Solar Thermal Panels

6.16. The use of solar panels to collect the sun's rays and produce hot water for domestic purposes is extensively used within the UK.

6.17. Panels can be used to offset up to 20-40% of the annual hot water demand dependent on size, orientation etc. While the initial capital cost is relatively high the Government Renewable Heat Incentive of improves the payback and life cycle analysis.

6.18. Invariably employment unit facilities will not have high hot water demands unless due to a specific process which is not possible to predict at this stage. On that basis dedicated Solar thermal panels are not proposed at this stage but roof space on the office area for potential future installation.

ii. Biomass

6.19. Energy from biomass is produced by burning organic matter. Biomass products such as trees, crops or animal dung are harvested and processed to create bio-energy in the form of

electricity, heat, steam and solid fuels. Biomass is the solid form of 'bioenergy', but liquid fuels can also be generated from plant matter and this is referred to as 'biofuel'.

6.20. Biomass is carbon-based so when used as fuel it also generates carbon emissions. However, the carbon that is released during combustion is equivalent to the amount that was absorbed during growth, and so the technology is carbon-neutral (the fuel generally requires treatment and transport, with associated carbon emissions). Unlike fossil fuels, biomass can be replaced relatively quickly.

6.21. At this stage the requirement for heated employment units is unknown and therefore the use of biomass cannot be committed to.

iii. Anaerobic Digestion (AD) at new Wastewater Treatment plant

6.22. The anaerobic decomposition process is a natural process that happens in absence of oxygen. It is a biological process where a biodegradable waste stream is combined with certain types of bacteria to generate biogas. The biogas could be used to power vehicles, or alternatively used in a Combined Heat and Power (CHP) plant to provide the heat needed to warm the digester and/ or to feed into a nearby district heating network and also electricity that can be used in-situ or sold to the grid.

6.23. Suitable waste streams come in the form of organic domestic or commercial waste, sludge form wastewater or farm slurry. The creation of a new wastewater treatment facility for the Denny St Francis development presents an opportunity to consider the possibilities of using the wastewater sludge in an adjacent AD plant. There is also the potential for this to be augmented with organic water or slurry from adjacent farms. Industry precedent indicates that the scale of Denny St Francis puts an AD system designed for wastewater sludge around the borderline of commercial viability, such that more detailed analysis would be required.

6.24. The scale of the development and the potential different uses does not constitute the adoption of this type of technology.

iv. Wind Power

6.25. Wind turbines are essentially tall structures with rotation blades which require sufficient space to operate satisfactorily. The rotating blades operate under wind pressure and generate electricity, which can be used on site by the operator or exported on the electrical grid. The extent of electricity generated will depend on the type of site, the wind speeds experienced and the size of the turbine Typically a 9m high turbine will generate a peak 6kW (KWP) of electricity.

6.26. The extent of electricity generated will depend upon the type of site, the wind speeds experienced and the size of the turbine.

6.27. The principal consideration when assessing wind power are:

- Suitability of site with respect to average wind speeds and surrounding buildings
- Financial viability of wind power
- Aesthetical impact and planning considerations
- Noise generated from Turbine (rule of thumb minimum spacing 5 times rota diameter)
- Space requirement to accommodate the wind turbine

- Electrical transmission systems to connect to electrical grid system.

6.28. Although the site does have favourable wind speeds over 4.5m/s the use of wind power is discounted on the basis of:

- Proximity of existing residential units
- Visual impact on site

v. Photovoltaics

6.29. Photovoltatics convert solar radiation into electricity and must not be confused with solar panels which use the suns energy to heat water usually for domestic hot water purposes or space heating. When PV's are exposed to the Sun's rays they generate a direct current (DC) The DC power is then converted to AC power and is utilised either by the operator of the system and/or converted to the electrical grid and sold/credited to the utility company. Theoretical efficiencies of PV's are around 30% with a further reduction in electrical power when converting to AC alternating power of 15% efficiency.

6.30. The location of PV's is very important they must fully exploit the Sun's rays and hence must be located in un-shaded positions. The exact orientation is not critical but to improve efficiencies then the PV's should tilt to absorb the optimum extent of solar radiation. As a general rule of thumb -1m^2 of PV array at a reasonable tilt, orientation and efficient system will develop about 100-130 (Kilowatt hours per year) in the UK. PV array comes in many different forms from free standing modules located on roof areas to building integrated systems that form part of the building fabric or vertical rain screen type arrangements.

6.31. This technology does offer an attractive method of reducing carbon emissions in the form of electricity production a feature that most occupiers of the employment unit buildings may require.

Decentralised Energy

i. Overview

6.32. This step is the hierarchy relates to this consideration of decentralised energy, such as district heating supplied through energy centre containing centralised boilers or combined heat and power installations.

ii. CHP Technology & District Heating

6.33. Development- size CHP engines tends to be gas- fired and will typically produce heat for domestic hot water and a proportion of electricity supply to the units. CHP systems can supply a single building, small clusters of buildings/ flats or a cluster of many buildings through a heat network. The more units attached to the network, the higher the demand, which would allow a selection from a broader spectrum of CHP technologies. District heating can be applied on a phase by phase network that remain stand alone or connect together in later phases to create a site- wide network. If a district heating system were to be applied at site-wide scale, then this would increase the economies and the efficiencies possible for the overall system.

iii. Decentralised Energy and Viability

6.34. Since the role of decentralised energy in the search for CO2 emissions reduction was first raised, the industry has been gathering knowledge in relation to the financial visibility and delivery implications of such systems.

6.35. Of particular interest has been the financial implications of district heating, given that the UK has little experience or precedent to draw on. It has emerged that the cost of the distribution pipe- work has a significant impact on viability, thus making the concept of heat density an important aspect to consider.

- What constitutes 'business as usual' against what a district system is being compared, i.e. as the policy environment tightens it is no longer possible to compare with conventional energy solutions.
- The ability of the energy sector and finance industry to assist in solving the need for higher upfront capital injection in order to implement district energy schemes.
- The industry uptake of district heating such that monopoly situations don't affect the cost of pipework.
- The ability to streamline groundwork with other trades and how the statutory authorities allow district heating pipe-work to be accommodated in 'adopted standard' roads.
- The emerging design solutions to issues such as distribution losses (which will affect both size and specification of pipe- work components)
- The influence of government incentivisation and cost of compliance burden on viability comparisons and energy strategy selections, particularly with respect to 'on plot' micro based or decentralised approaches.
- How local authorities are facilitating decentralised energy solutions on a local scale such that developers can discharge their compliance burden by connection to an existing system.
- How the tightening of Building Regulations policy, specifically the improvements in fabric energy efficiency which will lead to reduced heat demand, will affect the viability.
- The interplay between the existing building stock, which can provide a good customer base for the heat sales, and the proximity of new build developments that can act as the catalyst for such systems to be implemented.

6.36. Overall it can be concluded that, when accompanied by a suitable level of vision, district heating is often a viable option in areas with heat density and as this cannot be established at this stage, then its adoption cannot be committed to.

7. Potential Environmental Effects

Construction Phase

7.1. The potential environmental effects of the development as a result of the Energy Strategy:

- Increased energy use and carbon emissions as a result of construction activities
- Increased NO_x levels as a result of construction related activities
- Increased water use as a result of construction activities

7.2. A summary of the impacts from construction stage are presented in the Table 12.14 below. The impacts and the significance of these impacts are summarised below using the methodology set out in Section 4 of this Paper:

Nature of Impact	Receptor	Environmental Impact	Significance of Effect	Confidence Level
Increase in CO_2 emissions	Local	Minor Negative	Minor Adverse	High
Increase in NO_x emissions	Local	Minor Negative	Minor Adverse	High
Increase in water consumption	Local	Minor Negative	Minor Adverse	High

Table 12.14: Significance of Effect - Construction Phase

7.3. The potential impacts at construction phase are not significant in the wider context of the Environment in terms of Energy and Water use.

Operational Phase

7.4. The potential environmental effects of the development as a result of the energy strategy:

- Increased CO2 emissions in to the environment from the development
- Increased NOx levels from (burning fossil fuels) such as gas fired boilers into the atmosphere.
- Increased water use for the development

A summary of impacts from the operational stage are presented in Table 12.15 below:

7.5. The impacts and the significance of these impacts are summarised below using the methodology set out in Section 4 of this Paper:

Nature of Impact	Receptor	Environmental Impact	Significance of Effect	Confidence Level
Increase in CO_2 emissions	Local	Minor Negative	Minor Adverse	High
Increase in NO_x emissions	Local	Minor Negative	Minor Adverse	High
Increase in water consumption	Local	Minor Negative	Minor Adverse	High

Table 12.15: Significance of Effect - Operation Phase

7.6. In conclusion, the development will increase the CO_2 and NO_x levels in the local area including the water consumption dependent on the ultimate warehouse usage.

8. Proposed Mitigation

8.1. This section identifies the mitigation measures proposed to manage and/or address the adverse effects of the proposed development at construction and operational stage in relation to the energy strategy.

8.2. The proposed mitigation identified can be controlled by planning conditions imposed on any outline planning permission.

Construction Phase

8.3. During the construction stage of the project number of mitigation measures will be adopted to reduce and manage the environmental impact of the construction activities:

Energy Consumption

- Monitor and record data on principal contractor and subcontractor's energy consumption in kWh (and where relevant, liters of fuel used) as a result of the use of construction plant, equipment (mobile and fixed) and site accommodation.

Water Consumption

- Monitor and record data on principal constructor's and subcontractors' potable water consumption (m^3) arising from the use of construction plant, equipment (mobile and fixed) and site accommodation.
- Using the collated data report the total net water consumption (m^3), 1.e. consumption minus any recycled water use
- The adoption of metering and monitoring technologies of energy use and subsequent carbon emissions against benchmarks will promote mitigation. This could be achieved by the contractor adopting systems such as a low water volume appliances or water recycling systems

Combination of measures will mitigate the energy use and subsequent carbon emissions to meet the Local Plan Core Strategy policies.

Operational Phase

8.4. During the operational phase the development will benefit from the low carbon approach incorporated into the design as set out in Section 6. The low carbon design features will mitigate the Energy consumption with the following strategy adopted:

The following table sets out the strategy that will be adopted to mitigate energy use however the precise details cannot be commented on at this stage. The specific detail and technologies will be established at the detailed design stage once specific end users and operators are known.

Reduce Demand	
Insulation Levels.	Exceed minimum Part L2A Requirements.

Reduce Demand	
Natural Daylight.	Where appropriate for end user brief/use Good levels of natural daylight to promote reduction in the reliance of Artificial Lighting in both offices and warehouse.
Air Tightness.	To meet Part L2A Requirements or better.
Low G' Value Glass.	To Limit Unwanted solar gain & overheating where appropriate.
Natural Air Ventilation.	Consider option to open windows in offices & stack effect in warehouse.
Door Curtains.	Power containment to the future installations of door curtains where appropriate.

Table 12.16: Reducing Demand

Meet Demand Efficiently	
High Efficiency Lighting and Control Systems.	Provided as part of the base build Installation.
Destratification Fans.	Structure designed for future installation Destratification fans.
Demand Operated Systems.	Presence detection control on systems such as toilet extractor fans etc. and lighting controls where appropriate
Mixed Air Ventilation.	Built into base build design for future tenant flexibility.
Heat Recovery.	On ventilation systems where appropriate.
Energy metering.	Sub metering provision built into the base build provision.
Variable Speed Drives on motors.	Adopted on fans and pumps where appropriate to reduce energy consumption.
Lighting Control	Daylight dimming on light systems

Table 12.17: Meeting Demand Efficiently

Meet Demand Efficiently - Technologies	
Photovoltaics & Solar Thermal Panels.	Section of the Roof designed for application of future photovoltaics and for solar thermal panels for future tenant fit out.
Air Source Heat Pumps (ASHP).	Space allocated for Air Source that pumps (ASHP) for future tenant fit out to offer
District Heating.	Space allocation for in-site infrastructure route (Soft dig) for the potential of a future District Heating Systems.

Table 12.18: Meeting Demand efficiently – Technologies

8.5. The combination of these measure will mitigate the energy use and subsequent carbon emissions to meet Warrington BC Core Strategy and Policies and improve on the Part L2A of the Building Regulations

9. Potential Residual Effects

9.1. The following confirms the residual effects of the development after mitigation. The mitigation proposals have been assigned to reduce the carbon emissions from the development for both the construction and operational phases.

Potential Residual Effects – Construction Phase

9.2. The potential environmental effects of the Proposed Development as a result of the construction phase are:

- Increased energy use and carbon emissions as a result of construction activities
- Increased NO_x levels as a result of construction related activities
- Increased water use as a result of construction activities

9.3. The overall impact of the proposal in terms of Energy Use issues during the construction phase is highlighted in table 12.19 below:

Nature of Impact	Receptor	Environmental Impact	Significance of Effect	Confidence Level	Mitigation	Residual Significance of Effect
Increase in CO_2 emissions	Local	Minor Negative	Minor Adverse	High	Adopt systems of metering to monitor the extent of CO_2 emissions.	Minor Adverse
Increase in NO_x emissions	Local	Minor Negative	Minor Adverse	High	Adopt systems of metering to monitor the extent of NO_x emissions.	Minor Adverse
Increase in water consumption	Local	Minor Negative	Minor Adverse	High	Adopt systems of metering to monitor the extent of water use.	Minor Adverse

Table 12.19: Residual Significance of Effect - Construction Phase

9.4. The use of BREEAM credits will be considered at detailed design stage and if implemented has the potential to reduce the effect.

9.5. In conclusion the significance of the residual effects at construction phase will be minor but temporary with the three elements relating to the Energy use monitored and targets set to mitigate the impact in the environment.

Potential Residual Effects – Operational Phase

9.6. The potential environmental effects of the development as a result of the energy strategy:

- Increased load on existing local utility infrastructure
- Increased CO_2 emissions in to the environment from the development
- Increased NO_x levels from (burning fossil fuels) such as gas fired boilers into the atmosphere.

9.7. The overall impact of the proposal in terms of Energy use issues during the operational phase is highlighted in the table below:

Nature of Impact	Receptor	Environmental Impact	Significance of Effect	Confidence Level	Mitigation	Residual Significance of Effect
Increase in CO_2 emissions	Local	Minor Negative	Minor Adverse	High	Adopt strategies to reduce carbon emissions and promote renewable and low carbon technology	Negligible
Increase in NO_x emissions	Local	Minor Negative	Minor Adverse	High	Minimise reliance on fossil fuels and adopt low NO_x appliances	Negligible
Increase in water consumption	Local	Minor Negative	Minor Adverse	High	Adopt water efficient appliances	Negligible

Table 12.20: Residual Significance of Effect - Operation Phase

9.8. The extent and detail of the mitigation is subject to detailed design of the warehouse units one the end users and operators are known.

10. Additive Impacts (Cumulative Impacts and their Effects)

10.1. For the purposes of this ES we define the cumulative effects as:

'Those that result from additive impacts (cumulative) caused by other existing and/or approved projects together with the project itself.'

10.2. All the sites to be considered as part of the cumulative impact assessment are described in the ES Part One Report and illustrated on a geographical basis on the cumulative development plan at Appendix 11 of the ES Part One Report. The projects to be considered in respect of the Energy ES Technical Paper cumulative assessment are listed in the table overleaf:

	Possible Cumulative Development	Details	Status	Justification for Cumulative	To be considered in the CIA (Yes/No)
1	Land bounded by Pewterspear Green Road, Ashford Drive, Stretton, Warrington LPA Ref: 2016/28807 Applicant - HCA	Outline Planning Application for 180 dwellings.	Planning permission granted by WMBC 28-09-2017 (3 years to implement planning permission)	Potential relationship in terms of socio economic.	
2	Land bounded by Green Lane &, Dipping Brook Avenue, Appleton, Warrington, WA4 5NN LPA Ref: 2017/29930 Applicant - HCA	Outline Planning Application for 370 dwellings	Planning permission granted by WMBC 22-01-2018 (3 years to implement planning permission)	It is a committed development and therefore included within the future baseline and assessed within the assessment of the Proposed Development. It does not therefore need reconsidering in the cumulative assessment for traffic and transport, noise and vibration and air quality. Not considered to be a link in respect of any of the other technical areas due to distance and detached nature from the site. **Regarding the Energy strategy there is no specific cumulative impacts envisaged.**	Yes – socio economic
3	Land South of Astor Drive, East of Lichfield Avenue &, South of Witherwin Avenue, Grappenhall Heys, Warrington, WA4 3LG LPA Ref: 2017/29929 Applicant - HCA	Outline Planning Application for 400 dwellings	Planning permission granted by WMBC 22-01-2018 (3 years to implement planning permission)		
4	Land North of Barleycastle Lane, Appleton, Warrington Liberty Properties Development Ltd & Eddie Stobart LPA Ref: 2017/31757	Full Planning application (Major) - Demolition of all existing on-site buildings and structures and construction of a National Distribution Centre building (Use Class B8) with ancillary office accommodation (Class B1(a)), vehicle maintenance unit, vehicle washing area, internal roads, gatehouse, parking areas, perimeter fencing, waste management area, sustainable urban drainage system, landscaping, highways improvements and other associated works. (Gross internal floor space of 56,197m², together with 1,858m² of ancillary office)	Refused Planning Permission by WMBC 14-11-2018	Potential relationship in terms of geology and ground conditions; flood risk and drainage; landscape and visual impact; ecology and nature conservation; socio economic; cultural heritage; utilities; waste; energy; and operational noise. Whilst the planning application has been refused it is still to form part of a sensitivity test for traffic and therefore included within the assessment of the Proposed Development. It does not therefore need reconsidering in the cumulative assessment for traffic and transport; and in terms of traffic generation in respect of noise and vibration; and air quality.	Yes- geology and ground conditions; flood risk and drainage; landscape and visual impact; ecology and nature conservation; socio economic; cultural heritage; utilities; waste; energy; and operational noise
5	Land to the east of Stretton Road, north of Pepper Street, Stretton Road, Appleton Thorn, Warrington LPA Ref: 2017/31848	Full Planning Application for 71 dwellings	Planning permission granted by WMBC 24-10-2018 (3 years to implement planning permission)	Potential relationship in terms of socio economic. It is a committed development and therefore included within the future baseline and assessed within the assessment of the Proposed Development. It does not therefore need reconsidering in the cumulative assessment for traffic and transport, noise and vibration and air quality.	Yes – socio economic

				Not considered to be a link in respect of any of the other technical areas due to distance and detached nature from the site. **Regarding the Energy strategy there is no specific cumulative impacts envisaged.**	
6	Blue Machinery Ltd, Barleycastle Trading Estate, Lyncastle Road, Warrington, WA4 4SY LPA Ref: 2016/28994	Full Planning Application for new industrial warehouse building for storage (replacing smaller storage building), single storey extension to existing building for further storage and two storey extension for additional office space, associated parking provision and landscaping. (1,699m^2 new build, 180m^2 and 265m^2 extensions)	Planning permission granted by WMBC 17-02-2017 (3 years to implement planning permission)	Potential relationship in terms of geology and ground conditions; flood risk and drainage; socio economic; and waste. The traffic generation is not considered to be significant and therefore there is not considered to be a relationship in respect of traffic and transport; noise and vibration; and air quality. Not considered to be a link in respect of landscape and visual impact; ecology and nature conservation; cultural heritage; utilities; and energy due to distance and detached nature from the site.	Yes - geology and ground conditions; flood risk and drainage; socio economic; and waste
7	Land off Lyncastle Way, Barleycastle Lane, Appleton, Warrington, WA4 4SN LPA Ref: 2015/25255 Morley Estates	Full Planning Application for industrial / warehouse development (Sui Generis) to facilitate a plant hire business with elements of vehicle / plant repair, servicing, maintenance and plant storage / distribution / parking and associated offices / welfare facilities, vehicular access via existing service road, acoustic bunding and fencing and other means of enclosure, soft landscaping, 36 car park spaces, fuel pumps (and associated underground tanks), vehicle / plant wash bay and sub-station (Resubmission of 2014/24618) (4,545sqm industrial warehouse building)	Planning permission granted by WMBC 16-10-2015	Potential relationship in terms of geology and ground conditions; flood risk and drainage; and socio economic. The traffic generation is not considered to be significant and therefore there is not considered to be a relationship in respect of traffic and transport; noise and vibration; and air quality. Not considered to be a link in respect of landscape and visual impact; ecology and nature conservation; cultural heritage; utilities; waste and energy due to distance and detached nature from the site. **Regarding the Energy strategy there is no specific cumulative impacts envisaged.**	Yes - geology and ground conditions; flood risk and drainage; and socio economic
8	Former Stretton Airfield, Warrington, WA4 4RG LPA Ref: 2014/2332 Hensmill Property	Proposed construction of subterranean car storage facility (B8 Use Class) with ancillary office development and associated demolition and landscaping accessed from Crowley Lane.	Planning permission granted 23-06-2015	Potential relationship in terms of landscape and visual impact; and socio economic. The traffic generation is not considered to be significant and therefore there is not considered to be a relationship in respect of traffic and transport; noise and vibration; and air quality. Not considered to be a link in respect of geology and ground conditions; flood risk and drainage; ecology and nature conservation; cultural heritage; utilities; waste and energy due to distance and detached nature from the site.	Yes - landscape and visual impact; and socio economic

9*	Warrington Garden Suburb (as identified in the Council's Preferred Development Option Consultation Document (July 2017)	The Warrington Garden Suburb is identified as a Preferred Development Option, which provides the potential development of around 7,000 new homes to be delivered over the full 20 years of the Plan, therefore we have assessed relevant phases with the Cumulative Assessment. Using the Development Trajectory (Table 20 Garden City Suburb Employment Land Trajectory of the Preferred Development Option Consultation Document) we have based the cumulative assessment ONLY on the quantum of development within the Garden Suburb expected to come forward in parallel with the delivery timeframe for the Six 56 Application Proposals. *Due to the limited information available in respect of the Garden Suburb, the Six 56 Warrington Cumulative Assessment will be a non-spatial assessment.		Potential relationship in terms of socio economic. The 1021 dwellings that form part of the Garden Suburb Phase 1 are already assessed as committed development and therefore included within the future baseline and assessed within the assessment of the Proposed Development. It does not therefore need reconsidering in the cumulative assessment for traffic and transport, noise and vibration and air quality. **Regarding the Energy strategy there is no specific cumulative impacts envisaged.** The 15.7ha of employment land at Land North of Barley Castle Lane (Liberty Properties and Stobart) and the additional 1,995 residential units expected to be delivered in Phase 2 of the Garden Suburb will be assessed in the Traffic and Transportation, Noise and Air Quality cumulative assessments based on traffic assessments and Warrington Council's Multi Model Highways Model produced for the emerging Local Plan, which takes account of additional Local Plan Growth in the area. The Cumulative Assessment will be based on the assumptions made within this model in terms of timing of delivery and distribution of traffic on the network. Agricultural Land and Socio Economic cumulative assessments will be based on the residual residential quantum of development (1995 dwellings) identified in the Garden Suburb Phase 2. There is not sufficient information available in terms of spatial delivery for cumulative assessments to be undertaken in respect of the other technical areas, which include Geology and Ground Conditions; Flood Risk and Drainage; Landscape and Visual Impact; Ecology and Nature Conservation; Cultural Heritage and Archaeology; Utilities; Waste; **and Energy**. As such it is not possible to undertake a cumulative assessment in respect of these technical areas.	Yes – socio economic
	Warrington Garden Suburb Phase	**Uses and Quantum identified in Preferred Development Option (July 2017)**	**Uses and Quantum to be identified in Six 56 Cumulative Assessment**		
	Phase 1 0-5 years	406 residential units (non- Green Belt sites)	Six 56 Proposals will be under construction, with		

	Assumed 2020-2025	22ha employment (employment areas include Six 56 Warrington and Land around Barley Castle Lane)	part delivered within Phase 1 of the Garden Suburb. The following form part of the Garden Suburb Phase 1 and will be included within the Cumulative Assessment: • HCA sites (950 dwgs)* • 71 dwgs associated with land to east of Stretton Road* • Land North of Barley Castle Lane (Liberty Properties and Stobart) (LPA Ref: 2017/31757) - 15.7ha* *Note that these sites are already included as part of the Cumulative Assessment and already referenced as sites 1, 2, 3 and 4.		
	Phase 2 6-10 years Assumed 2026-2030	2610 residential units (includes 496 non-Green Belt sites and 2,114 Green Belt sites) 30.3 ha employment (employment areas include Six 56 Warrington and Land around Barley Castle Lane)	Six 56 Proposals will be completed during 2027/2028. The following form part of the Garden Suburb Phase 2 and will be included within the Cumulative Assessment: Garden City Suburb Phase 1 and 2 employment land equates to 52.3ha, beyond the 30 ha referenced in the Phase 1 and Phase 2 employment trajectory set out in the PDO. Six 56 Warrington developable area and planning application for Land North or Barley Castle Lane (LPA Ref: 2017/31757) already equates to 77.52 ha and is already included as part of the Cumulative Assessment. Garden Suburb Phase 1 and 2 residential units equates to a total of 3016 units. The Cumulative Assessment already includes 1,021 residential units. Therefore this Cumulative Assessments should include an **additional 1995 residential units** (i.e. the residual number of units identified in Preferred Development Option that not already included within Six 56 Cumulative Assessment)		
	Phase 3 11-15 years	2,144 ha residential units 45.9 ha employment	The Six 56 Proposals will be fully operational		

	Assumed 2031-2035		Given this Phase of the Garden City Suburb will be beyond the delivery of Six 56 Proposals this phase will not to be included within the Six 56 Cumulative Assessment		
	Phase 4 16-20 years Assumed 2036-2040	2,144 residential units 18.6ha employment	The Six 56 Proposals will be fully operational Given this Phase of the Garden City Suburb will be beyond the delivery of Six 56 Proposals this phase will not to be included within the Six 56 Cumulative Assessment		

Table 12.21: Cumulative Projects

Short Term

10.3. Any future short-term development of the site will have a cumulative impact on the Energy use predicted CO_2 levels and NO_x levels and associated Utility Services demand. This has been considered within spare capacities to mitigate the effects of future development in regard to energy use.

Medium Term

10.4. Any future medium-term development of the site will have a cumulative impact on the Energy use predicted CO_2 levels and NO_x levels and associated Utility Services demand. This has been considered within spare capacities to mitigate the effects of future development in regard to energy use.

Long Term

10.5. The opening and operation of the development and infrastructure will have additional impact on the Energy Strategy subsequent and carbon emissions. Any long term setting cumulative effect will be reduced by the implementation of mitigation measures as set out in section 8.

11. Conclusion

11.1. During the assessment of the Energy Strategy the key focus was to follow a strategic approach to reducing energy and consider how the impacts of energy use will have on Carbon Emissions and NO_x production at both construction and operational phases. Furthermore the use of water at both construction and operational stage has been assessed with mitigation measures adopted and built into the design for future feasibility.

11.2. It has been determined that the Energy Strategy for the Development will promote Low Carbon Design and flexibility in the development of the site. This flexibility will be fundamental in attracting future tenants/end users who will seek to occupy a building with low operating energy use and costs.

11.3. The potential Environmental impacts have been mitigated and has improved to either Minor Adverse or Negligible.

11.4. The key aspects have been to follow a strategic design route to promote

- Passive design and reduce the United Utilities demand on the buildings development
- Energy Efficiency measures to use energy in a more efficient way.
- Design features adopted for the future installations of - Renewable & Low carbon technology

The combination of these measures will mitigate the energy use and subsequent carbon emissions to meet Warrington BC Core Strategy & Policies and improve on the Part L2A of the Building Regulations (as described in Section 8 of this report).

11.5. Final definitive Renewable and low carbon technologies are not be adopted at the stage until the specific requirements of the tenant/end users are known, however the design of the development will promote the potential incorporation of these solutions.

11.6. At the construction stage the impact on the environment will be mitigated by monitoring and measuring CO_2 and NO_x levels promote energy and water use for construction activities.

11.7. The culmination of these measures will mitigate the impact on carbon emissions. NO_x levels water consumption and promote the requirements set out in the Warrington Six 56 local Plan for the overall sustainable design.

12. Reference List

12.1. The following have been used within this report:

- Proposed illustrative Masterplan
- Proposed Utility Load Schedules
- National and Local Authority Planning Documents (NPPF 2018, Core Strategy Local Plan Policies and Specific supplementary Planning Documents)
- ES Parameter Plans.
- Chartered Institute of Building Services (CIBSE) Guide 46
- Utility providers' existing drawings and apparatus details
- Ground conditions report
- Site environmental data

13. Appendices

(None Used)