DLL Bicester

Energy Strategy

March 2020

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EXECUTIVE SUMMARY

This report provides an Energy Statement for the new leisure centre near Bicester which addresses the Cherwell Local Plan 2011-2031.

To help in the decision making process the report follows the following format;

Energy Efficient Design

Low Carbon Technologies

Renewable Energy Technologies

Energy Efficient Design

A series of passive and active energy efficient measures have been reviewed and adopted for the new building. The key measures for the development are the usage of high performance facades, LED lighting, heat recovery and natural ventilation where possible, taking into account the way the building is utilised. In addition to this, the effect of these measures on the new build will be monitored via a building energy management system, to better understand and control energy performance.

These measures will provide a 1.7% improvement on the NCM building.

Low Carbon Technologies

Following a review of the sites base load it has been possible to ascertain that a combine heat and power unit used for the heating and hot water systems will provide a 35.8% CO_2 saving. Following this the new leisure centre will incorporate this technology in the proposed design.

Renewable Energy Technologies

A number of renewable systems have been considered for the development and are reviewed later in this report. It has been decided that a high efficiency air source heat pump system shall be utilised as it provides 1.6% carbon saving for the development.

Improvement on 2013 Building Regulations

By incorporating the energy efficiency savings, low carbon and renewable technologies mentioned within this report the carbon dioxide emissions improvement over Building Regulation 2013 for the new leisure centre is illustrated in Table 1 below.

	Energy Efficient Design	Low Carbon Technologies	Renewable Energy Technologies	Total	Tonnes CO2 savings per annum
New Leisure Centre	1.7%	35.8%	1.6%	39%	159

Table 1 - CO_2 emission reduction summary

Based on Table 1, the total carbon saving that can be achieved for the new leisure centre is 39% over 2013 Building Regulations, or 159 tonnes of CO2 per annum.

1.0 INTRODUCTION

1.1 Background

Hulley and Kirkwood have been appointed to develop an Energy Strategy for DLL Bicester. This report provides an approach to ensure the new Leisure centre meets compliance with the Cherwell Local Plan 2011-2031.

The energy strategy reviews the new building's energy performance and energy generation via the use of thermal modelling software (IES VE). The building regulation simulations were run using a level 5 assessment.

1.2 Planning Policies

1.2.1 National Policy

The Paris agreement has now been adopted by the UK government and includes a total of 197 parties, the aims of this agreement are as follows;

Mitigation: Reducing Emissions;

- A long-term goal of keeping the increase in global average temperature to well below 2°C above pre-industrial levels;
- To aim to limit the increase to 1.5°C, since this would significantly reduce risks and the impacts of climate change;
- On the need for global emissions to peak as soon as possible, recognising that this will take longer for developing countries;
- To undertake rapid reductions thereafter in accordance with the best available science.

Transparency and global stock take;

- Come together every 5 years to set more ambitious targets as required by science;
- Report to each other and the public on how well they are doing to implement their targets;
- Track progress towards the long-term goal through a robust transparency and accountability system.

Adaptation;

- Strengthen societies' ability to deal with the impacts of climate change;
- Provide continued and enhanced international support for adaptation to developing countries.

Loss and damage;

- Recognises the importance of averting, minimising and addressing loss and damage associated with the adverse effects of climate change;
- Acknowledges the need to cooperate and enhance the understanding, action and support in different areas such as early warning systems, emergency preparedness and risk insurance.

Role of cities, regions and local authorities

The agreement recognises the role of non-Party stakeholders in addressing climate change, including cities, other subnational authorities, civil society, the private sector and others.

They are invited to;

- Scale up their efforts and support actions to reduce emissions;
- Build resilience and decrease vulnerability to the adverse effects of climate change;
- Uphold and promote regional and international cooperation.

Support;

- The EU and other developed countries will continue to support climate action to reduce emissions and build resilience to climate change impacts in developing countries**.**
- Other countries are encouraged to provide or continue to provide such support voluntarily.
- Developed countries intend to continue their existing collective goal to mobilise USD 100 billion per year by 2020 and extend this until 2025. A new and higher goal will be set for after this period.

With the Paris agreement now in place the 2008 climate change Act is due to be re-visited, this is expected to be carried out in 2018 and continue to be reviewed every 5 years after. At this stage the climate change Act 2008 is still a legally binding target within the UK and abroad of a least 80% cut in greenhouse gas emissions by 2050, with a reduction of at least 34% by 2020.

The UK government has committed to achieving the EU Directive 2009/28/EC to generate 15% of UK electricity from renewable sources by 2020. With all of the countries commitments the EU as a whole shall achieve at least 20% of energy from renewable sources.

The National Planning Policy Framework now replaces all planning policy statements (PPS) so that it all comes under a single document. Section 10 "*Meeting the challenge of climate change, flooding and coastal change*" identifies the key areas that local and regional policy makers must encourage in their policies.

1.2.2 Local Policy

The following text has been extracted from the Local Plan 2011-2031 which sets out the planning strategy.

Policy ESD 1: Mitigating and Adapting to Climate Change

Measures will be taken to mitigate the impact of development within the District on climate change. At a strategic level, this will include:

- Distributing growth to the most sustainable locations as defined in this Local Plan
- Delivering development that seeks to reduce the need to travel and which encourages sustainable travel options including walking, cycling and public transport to reduce dependence on private cars
- Designing developments to reduce carbon emissions and use resources more efficiently, including water (see Policy ESD 3 Sustainable Construction)

- Promoting the use of decentralised and renewable or low carbon energy where appropriate (see Policies ESD 4 Decentralised Energy Systems and ESD 5 Renewable Energy).

The incorporation of suitable adaptation measures in new development to ensure that development is more resilient to climate change impacts will include consideration of the following:

- Taking into account the known physical and environmental constraints when identifying locations for development

- Demonstration of design approaches that are resilient to climate change impacts including the use of passive solar design for heating and cooling

- Minimising the risk of flooding and making use of sustainable drainage methods, and

- Reducing the effects of development on the microclimate (through the provision of green infrastructure including open space and water, planting, and green roofs).

Adaptation through design approaches will be considered in more locally specific detail in the Sustainable Buildings in Cherwell Supplementary Planning Document (SPD).

Policy ESD 2: Energy Hierarchy and Allowable Solutions

- In seeking to achieve carbon emissions reductions, we will promote an 'energy hierarchy' as follows:

- Reducing energy use, in particular by the use of sustainable design and construction measures

- Supplying energy efficiently and giving priority to decentralised energy supply

- Making use of renewable energy

- Making use of allowable solutions.

Policy ESD 3: Sustainable Construction

All new residential development will be expected to incorporate sustainable design and construction technology to achieve zero carbon development through a combination of fabric energy efficiency, carbon compliance and allowable solutions in line with Government policy.

Cherwell District is in an area of water stress and as such the Council will seek a higher level of water efficiency than required in the Building Regulations, with developments achieving a limit of 110 litres/person/day.

All new non-residential development will be expected to meet at least BREEAM ‘Very Good’ with immediate effect, subject to review over the plan period to ensure the target remains relevant. The demonstration of the achievement of this standard should be set out in the Energy Statement.

The strategic site allocations identified in this Local Plan are expected to provide contributions to carbon emissions reductions and to wider sustainability.

All development proposals will be encouraged to reflect high quality design and high environmental standards, demonstrating sustainable construction methods including but not limited to:

- Minimising both energy demands and energy loss

- Maximising passive solar lighting and natural ventilation
- Maximising resource efficiency
- Incorporating the use of recycled and energy efficient materials
- Incorporating the use of locally sourced building materials
- Reducing waste and pollution and making adequate provision for the recycling of waste
- Making use of sustainable drainage methods
- Reducing the impact on the external environment and maximising opportunities for cooling and shading (by the provision of open space and water, planting, and green roofs, for example); and
- Making use of the embodied energy within buildings wherever possible and re-using materials where proposals involve demolition or redevelopment.

Should the promoters of development consider that individual proposals would be unviable with the above requirements, 'open-book' financial analysis of proposed developments will be expected so that an independent economic viability assessment can be undertaken. Where it is agreed that an economic viability assessment is required, the cost shall be met by the promoter.

Policy ESD 4: Decentralised Energy Systems

The use of decentralised energy systems, providing either heating (District Heating (DH)) or heating and power (Combined Heat and Power (CHP)) will be encouraged in all new developments.

A feasibility assessment for DH/CHP, including consideration of biomass fuelled CHP, will be required for:

- All residential developments for 100 dwellings or more
- All residential developments in off-gas areas for 50 dwellings or more
- All applicationsfornon-domesticdevelopmentsabove1000m2 floor space.

The feasibility assessment should be informed by there new able energy map at Appendix5'Maps'andthenationalmappingofheatdemanddensities undertaken by the Department for Energy and Climate Change(DECC)(see Appendix 3:EvidenceBase).

Where feasibility assessments demonstrate that decentralised energy systems are deliverable and viable, such systems will be required as part of the development unless an alternative solution would deliver the same or increased benefit.

Policy ESD 5: Renewable Energy

The Council supports renewable and low carbon energy provision wherever any adverse impacts can be addressed satisfactorily. The potential local environmental, economic and community benefits of renewable energy schemes will be a material consideration in determining planning applications.

Planning applications involving renewable energy development will be encouraged provided that there is no unacceptable adverse impact, including cumulative impact, on the following issues, which are considered to be of particular local significance in Cherwell:

- Landscape and biodiversity including designations, protected habitats and species, and Conservation Target Areas

- Visual impacts on local landscapes

- The historic environment including designated and non designated assets and their settings

- The Green Belt, particularly visual impacts on openness
- Aviation activities
- Highways and access issues, and
- Residential amenity.

A feasibility assessment of the potential for significant on site renewable energy provision (above any provision required to meet national building standards) will be required for:

- All residential developments for 100 dwellings or more
- All residential developments in off-gas areas for 50 dwellings or more
- All applicationsfornon-domesticdevelopmentsabove1000m2 floorspace.

Where feasibility assessments demonstrate that on site renewable energy provision is deliverable and viable, this will be required as part of the development unless an alternative solution would deliver the same or increased benefit. This may include consideration of allowable solutions as Government Policy evolves.

2.0 ENERGY EFFICIENT DESIGN

2.1 Passive Measures

2.1.1 Heat Loss

The improved building fabric for the proposed development will generally reduce the heat loss during the winter months, and is a low risk, cost effective measure which in terms of money invested per kg of CO_2 saved is usually one of the most effective measures which can be taken.

However in some cases there may be a year-round cooling demand and care must be taken to improve the thermal insulation without retaining unwanted low grade heat, which could otherwise result in higher cooling loads.

The proposal is to improve the u-values beyond the NCM values required by Building Regulations in order to reduce the heat loss from the building.

The average U-values for all elements of the new leisure centre will follow the values below:

Glazing	U value = 1.6 W/m^{2}K
External Doors	U value = 1.6 W/m^{2}K
External Walls:	U value = 0.26 W/m^{2}K
Ground Floor	U value = 0.16 W/m^{2}K
Roof:	U value = 0.18 W/m^{2}K

2.1.2 Reduction of infiltration Losses

Building air leakage or ‘infiltration’ can create further heat losses via cold draughts into the building. The Building Regulations outlines the test requirements for air permeability, and calls for a minimum of 10m^3 / m^2 / hour at a pressure differential of 50Pa. The notional model calls for 3m^3/ m^2 / hour @ 50Pa.

The new leisure centre will achieve an air permeability of 5m^3 / m^2 / hour @ 50Pa.

2.1.3 Solar Shading and Daylighting

Solar shading to windows will reduce the solar gains to the building, which can reduce or potentially eliminate the requirement for comfort cooling.

Passive solar shading typically comprises of awnings or brise soleil. As an alternative the windows solar performance can be improved, this is represented as the g-value.

The windows through the new Leisure centre will utilise high performance glazing to reduce the solar gain entering the rooms. The g-values of the glazing are proposed to be set at 0.35.

This has been selected as it provides the best compromise between solar gain and the daylighting level within the room.

2.1.4 Natural Ventilation

Natural ventilation uses either the natural buoyancy of warm air – known as the stack effect or the prevailing wind to create air flow within occupied spaces. The ventilation openings can be in the form of suitably designed windows or low and high level louvered openings.

When designed and constructed properly the natural ventilation can provide “fresh” air to the room occupants and avoid summer overheating without the need for mechanical ventilation.

However uncontrolled natural ventilation can result in high ventilation rates during the winter months, which will result in higher heating costs.

Natural ventilation will be maximised wherever practically possible, however, in areas such as toilets, showers, kitchens, internal rooms, deep plan rooms and densely occupied rooms where natural ventilation cannot guarantee the required ventilation rates, mechanical ventilation will be employed.

2.2 Active Measures

2.2.1 Lighting Efficiencies

Light Emitting Diode (LED) technology is the most significant recent development in terms of achieving high lumens per Watt.

It is proposed that for the lighting LED’s will be utilised throughout the new leisure centre. The proposed average lighting efficacy will be as described by the table below, the figures represent a significant increase in efficiency over building regulation standard.

Where appropriate such as storage room, WC’s, offices etc., occupancy and daylight sensors will be used to reduce the lighting load, this can provide significant saving in CO_2 emissions.

Proposed Lighting Efficiencies		
	General Lighting (lm/W)	**Display Lighting (lm/W)**
Leisure Centre	100	60

Table 2 - Proposed Lighting Efficiencies

2.2.2 Mechanical Ventilation

Mechanical ventilation will be required where natural ventilation cannot be achieved. To reduce the amount of energy used, the fan efficiencies will be designed in accordance with the current Energy-related Product (ErP) Directive.

Where required the new building shall be ventilated using air handling units (AHU). It shall be a requirement of the contractor that all fans installed will operate efficiently and all AHU’s achieve a SFP of not more than 1.8 W/(l/s), with Class L1 leakage levels.

The ductwork sizing will be consistent with optimising the fan efficiencies so that the installation complies with the requirements of Building Regulations and DW144.

In addition to the above it is proposed to make extensive use of heat recovery in the ventilation systems. Where appropriate this will take the form of either thermal wheel, flat plate heat exchangers or, if space limitations dictate, run-around coils. The heat recovery efficiency will not be less than 75%.

2.2.3 Variable Speed Drives

It is proposed to make extensive use of variable speed drive (VSD) technologies for any fans or pumps installed within the building. Variable speed pumps can provide significant savings, but can also provide improved reliability, performance and reduced life cycle cost.

2.2.4 Building Management System

Mechanical services will be designed and installed to match the occupancy and level of operation in the areas being served with service zone designed to match the activity zone.

The new leisure centre will adopt a Building Management System to control and monitor all the installed services.

The following sets out the minimum requirements for the Central Building/Energy Management System (BMS) which will continuously monitor and control the main mechanical plant and electrical system functions within the project to reduce energy consumption and assist effective maintenance while ensuring patient comfort.

Energy metering systems are to be installed that enable at least 90% of the estimated annual energy consumption of each fuel to be assigned to the various end-use categories of energy consuming systems.

The energy consuming systems in the building will be metered using an appropriate energy monitoring and management system that will provide ongoing feed back to the building operators.

2.2.5 High Efficiency Cooling Units

To reduce the overall energy usage of any cooling system installed, a high SEER will be required. In addition to this low GWP refrigerants will be used where possible.

2.3 Energy Efficient Design Summary

By integrating the measures described in this section into the dynamic simulation software (IES VE), the following energy savings can be expected.

Energy Efficient Results												
	Part L2a							Non Part L				
	Energy Input kWh/m^2											
	Space Heating	Cooling	Auxiliary	Lighting	Hot Water	Total Regulated Site Demand kWh/m^2	Low Carbon & Renewables kWh/m^2	Unregulated Energy Consumption kWh/m^2	Total Regulated site energy Consumption kWh/m^2	Total Regulated Site CO_2 kg/m^2	Total Regulated Site CO_2 (tonnes per annum)	Regulated Non-Domestic Carbon Dioxide Saving
Notional Building	27	3	17	17	388	452		50	452	96	408	
Be Lean	26	1	23	13	381	445		50	445	94	401	1.7%

Table 3 – Energy Efficient Design Summary for the New Leisure Centre

3.0 LOW CARBON TECHNOLOGIES

3.1 District Heating Scheme

No other energy centres are operational in the vicinity of the proposed works. Therefore taking the above into account we cannot connect to a districting heating system but will allow for the facility to do so if one becomes available in the future.

3.2 Low Carbon Solutions

Combined Heat and Power

A CHP plant is an installation where there is simultaneous generation of usable heat and power (usually electricity) in a single process. The basic elements of a CHP plant comprise one or more prime movers usually driving electrical generators, where the heat generated in the process is utilised via suitable heat recovery equipment for a variety of purposes including: industrial processes, community heating and space heating.

Due to the utilisation of heat from electricity generation and the avoidance of transmission losses because electricity is generated on site, CHP typically achieves a 35 per cent reduction in primary energy usage compared with power stations and heat only boilers. This can allow the host organisation to make economic savings where there is a suitable balance between the heat and power loads. The current mix of CHP installations achieves a reduction of over 30 per cent in CO_2 emissions in comparison with generation from coal-fired power stations, and over 10 per cent in comparison with gas fired combined cycle gas turbines. The newest installations achieve a reduction of over 50 per cent compared with generation from coal-fired power stations.

A contributory factor in the economic viability of CHP is the difference between the cost of electricity and gas, referred to as the "spark gap". The greater the cost of electricity over gas is the more likely a CHP installation is to be viable.

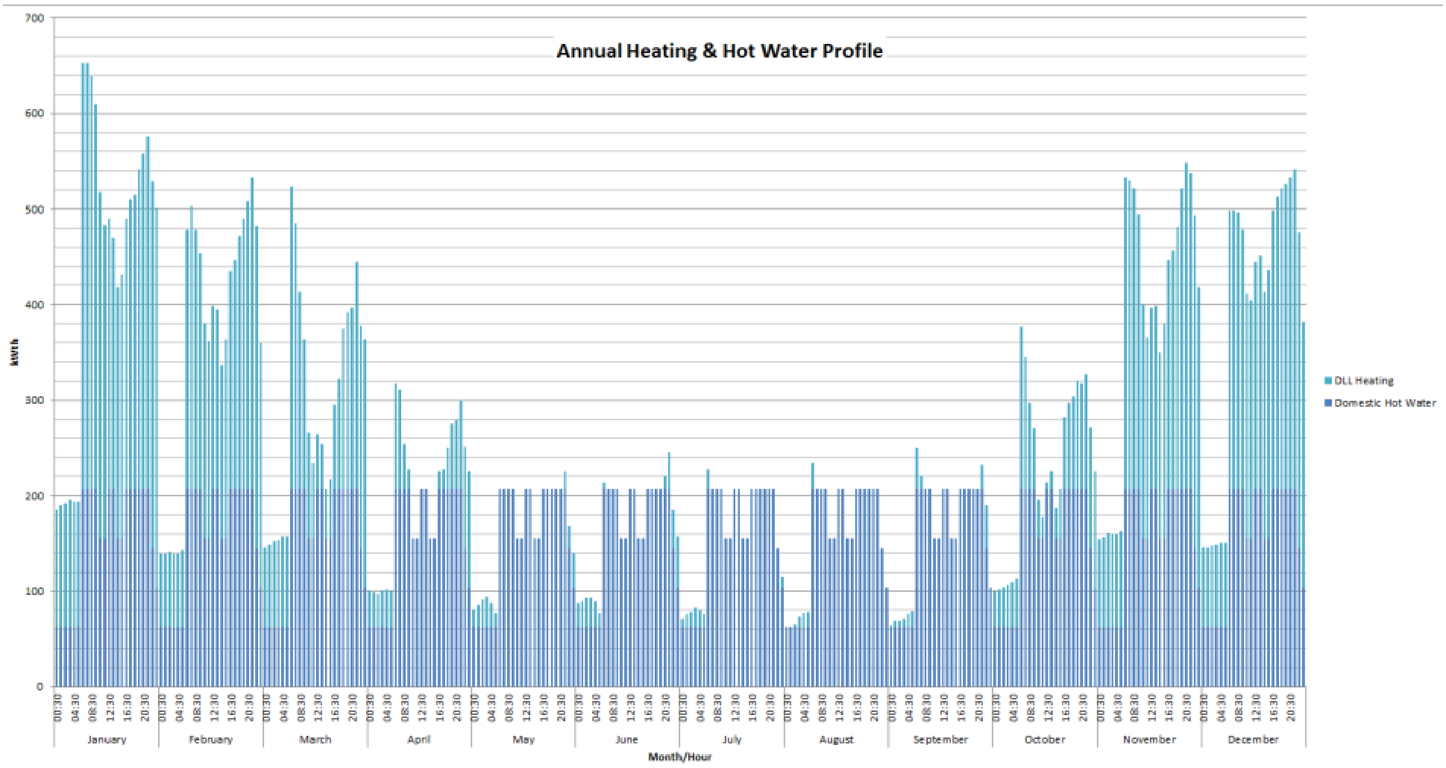


Figure 1 – Annual Heating & Hot Water Profile

Another factor to assess a CHP's economic viability is based on its running hours. It is generally accepted that in order to achieve the economic return of a CHP installation, the operating threshold is 5,000 hours per year.

It can be establish from the figure above that a 140kWth will keep the CHP operational for about 6,054 hours per annum.

Ener-g produces a CHP plant that is able to operate at the above loads and has been considered by the design team. The total carbon dioxide savings from the plant would be 146 Tonnes of CO_2 which is a total site wide saving of 35.8%. Based on the above information and the local planning policy it is proposed that the heating and hot water based load is generated using a CHP system with boiler backup.

Low Carbon Results												
	Part L2a							Non Part L	Total Regulated site energy Consumption kWh/m^2	Total Regulated Site CO_2 kg/m^2	Total Regulated Site CO_2 (tonnes per annum)	Regulated Non-Domestic Carbon Dioxide Saving
	Energy Input kWh/m^2					Total Regulated Site Demand kWh/m^2	Low Carbon & Renewables kWh.m^2	Unregulated Energy Consumption kWh/m^2				
	Space Heating	Cooling	Auxiliary	Lighting	Hot Water							
Notional Building	27	3	17	17	388	452		50	452	96	408	
Be Lean	26	1	23	13	381	445		50	445	94	401	1.7%
Be Clean							203		242	60	255	35.8%

Table 4 – Low Carbon Technology Summary for the New Leisure Centre

4.0 RENEWABLES

This section assesses the feasibility of different types of renewable technologies available for on-site installations and their effectiveness for carbon reduction.

4.1 Wind Energy

The annual average wind speed will be around 4.6m/s. This is the average wind speed for a wind turbine at 10 metres above ground level according to the NOABL wind data base available on the Department of Trade and Industries website. The power generated by the wind turbine is proportional to the wind speed cubed. This is illustrated in the below figure, which shows the power curve of a 2.5 kW turbine.

In most cases the average wind speed of a site is the defining factor on whether or not a site is suitable for generating electricity from wind energy. An average wind speed of 4.6m/s for a site is too low for any considerable electricity to be generated.

Obstructions to the wind path should also be evaluated. The wind to this site is obstructed by the surrounding buildings, creating highly turbulent air flows which would greatly reduce the energy generation.

Wind turbines will also require noise surveys as this could cause potential issues with the residents.

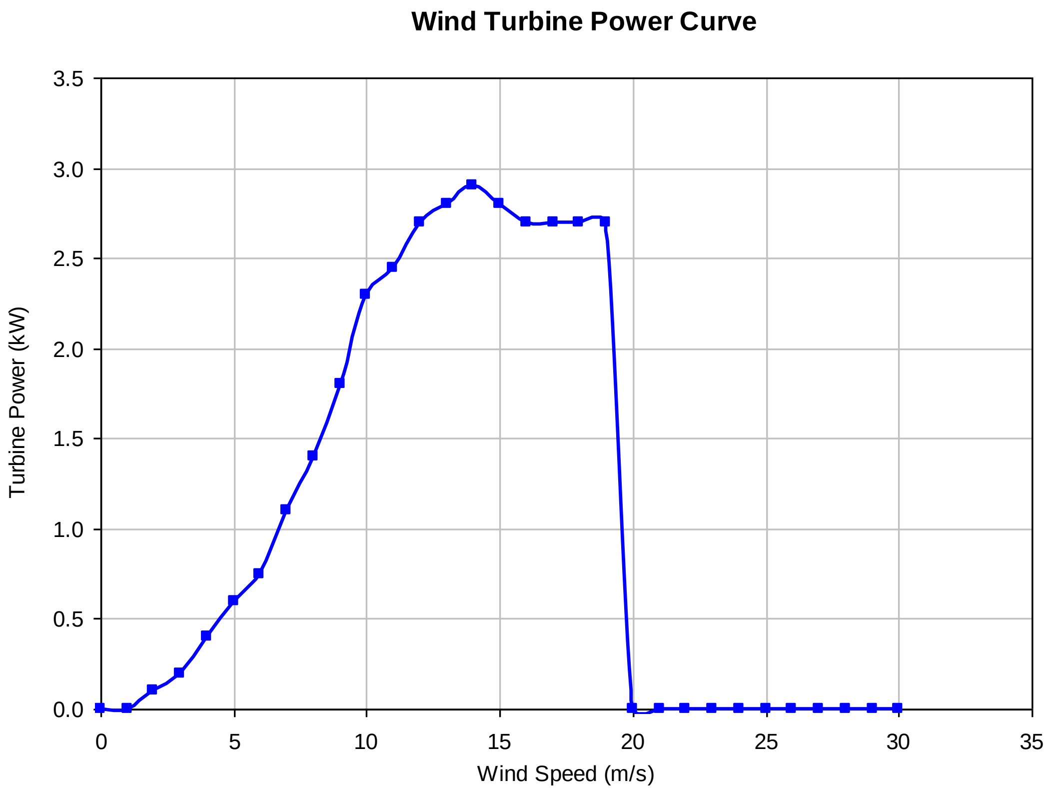


Figure 2 - Wind Turbine Power Curve

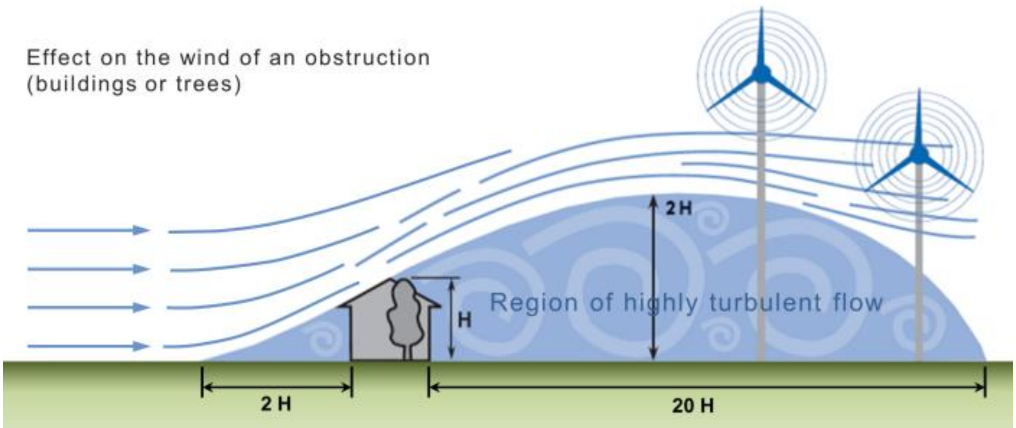


Figure 3 - Effect of Obstructions on Wind Turbines

The site does not have sufficient space for mounting of wind turbines. With the proposed density of buildings, the CO_2 emission reduction could be further lessened if turbulent air flow is experienced. The technology has therefore been discounted.

	Data
Rotor diameter	3.5 m
Capacity	2.5 kW
Energy Output per year	562.17 kWh
CO_2 Reduction per year	290.6 kgCO_2
CO_2 Savings	0.00061%
Turbine Cost	£15,000
Feed In Tariff	8.33p
Export Value	4.5p
Simple Payback	117 years

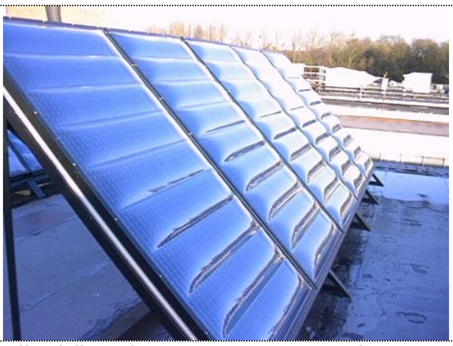
Table 4 – Wind turbine Calculation Summary

A 2.5 kW turbine would have a rotor diameter of 3.5m. It is calculated that this would virtually no effect on the buildings CO_2 emissions and payback period of 117 years.

4.2 Solar Water Heating Systems

Solar water heating systems use the energy from the sun to heat water, most commonly in the UK for hot water needs. The systems use a heat collector, generally mounted on the roof or a south facing façade in which a fluid is heated by the sun. This fluid is used to heat up water that is stored in either a separate hot water cylinder or more commonly a twin coil hot water cylinder with the second coil providing top up to heating from a conventional boiler. Ideally the collectors should be mounted in a south-facing location, although south-east/south-west will also function successfully. The panels can be bolted onto the roof or walls or integrated into the roof.

There are two standard types of collectors used - flat plate collectors and evacuated tube collectors. The flat plate collector is the predominant type used in solar domestic hot water systems, as they tend to have a lower cost for each unit of energy saved. Evacuated tube collectors are generally more expensive due to a more complex manufacturing process (to achieve the vacuum) but manufacturers generally claim better winter performance.



Filsol flat plate system on Wedgewood Visitor Centre (photo courtesy of John Blower), serving washrooms

Viessmann evacuated tube system, London Borough Of Camden (photo courtesy of LB Camden), serving washrooms for office accommodation, library and health centre.

Figure 4 - Typical Solar Thermal Collectors

Calculation Summary

	Data
Collector type	Flat Plate
System Area	150 m2
System Cost	£58,000
Energy Output	49,416 kWh/annum
CO2 Savings	2.7 tonnes/annum
Reduction in buildings CO2 emissions	2.82%
Payback	39.1 Years

Table 5 – Solar Thermal energy calculation summary

While this technology does provide some energy savings, they are small when compared with the savings that can be achieved via the CHP unit. As such, the use of CHP will be most beneficial to the project. Additionally, using solar thermal panels with CHP technology creates a conflict and reduces the efficiency of the system. As this is the case it is proposed that solar thermal collectors are not used on this project.

4.3 Biomass

Biomass is normally considered a carbon neutral fuel, as the carbon dioxide emitted during burning has been (relatively) recently absorbed from the atmosphere by photosynthesis and no fossil fuel is involved. The wood is normally seen as a by-product of other industries and the small quantity of energy for drying, sawing, pelleting and delivery are discounted. Biomass from coppicing is likely to have some external energy inputs, for fertiliser, cutting, drying etc. and these may need to be considered in the future.

Wood from forests, urban tree pruning, farmed coppices or farm and factory waste can be burnt directly to provide heat in buildings, although nowadays most of these wood sources are commercially available in the form of wood chips or pellets, which makes transport and handling on site easier.

Modern systems can be fed automatically by screw drives from fuel hoppers. This typically involves daily addition of bagged fuel to the hopper, although this process can also be automated with use of augers, conveyors or walking floors. Electric firing and automatic de-ashing are also available and systems are designed to burn smokeless to comply with the Clean Air Act.

The most common application of biomass heating is as one or more boilers in a sequenced (multi-boiler) installation where there is a communal i.e. block or district heating system.

Biomass is not thought to be feasible for this development for a number of reasons including:

- On site access problems for large vehicles delivering wood chip.
- Lack of space for a large fuel storage area.
- It's effect on the local air quality.
- Lack of an adequate supply chain in place currently to provide a regular and cheap biomass supply.

4.4 Heat Pumps

Heat pumps use the refrigeration cycle to take low grade heat from the air, water or the ground (a renewable resource) and deliver it as higher grade heat to a building.

Heat pumps take in heat at a certain temperature and release it at a higher temperature, using the same thermodynamic process as a chiller.

The technology is very efficient. Depending on the source of fuel, heat pumps can generate higher output than the input. Whilst a heat pump is clearly not a wholly renewable energy source as it requires some form of input, the renewable component is considered as the heat extracted from the air, water or ground, measured as the difference between the heat outputs, less the primary energy input and plus the primary energy losses.

Heat Pumps can produce significant savings on the entire site energy requirements by means of a renewable source.

Whilst a heat pump is clearly not a wholly renewable energy source as it uses electricity, the renewable component is considered as the heat extracted from the air, water or ground, measured as the difference between the heat outputs, less the primary electrical energy input.

The heat pump system generates CO_2 and cost savings as its efficiency is often multiple times of its input energy. Heat pumps will provide the lounge, studios and changing rooms heating and cooling requirements. The heat pumps will provide only a small amount of the heating to the space as the CHP will be providing the majority, but they still manage to add an addition 1.6% saving to the building compared to the notional building.

The renewable contribution made by the Air Source Heat Pumps in the building will be 1.6% CO_2 reduction.

Calculation Summary

	Data
Heat Pump type	ASHP
System Cost	£46,000
Renewable Energy Output per year	30,237 kWh/annum
CO2 Savings per year	6.4 tonnes/annum
Reduction in buildings CO_2 emissions	1.6 %
Payback	11.1 years

Table 6 – Air Source Heat Pump Energy Calculation Summary

4.5 Photovoltaics

Photovoltaic (PV) systems convert energy from the sun into electricity through semi-conductor cells. Systems consist of semi-conductor cells connected together and mounted into modules. Modules are connected to an inverter to turn their direct current (DC) in to alternating current (AC), which is usable in buildings. PV can supply electricity either to the buildings they are attached to, or when the building demand is insufficient electricity can be exported to the electricity grid.

For PV to work effectively it should ideally face south and at an incline of 30º to the horizontal, although orientations within 45º of south are acceptable. It is essential that the system is unshaded, as even a small shadow may significantly reduce output. On average UK conditions, a 1 kWp PV system can generate between 700-900kWh annually.

PVs are available in a number of forms including monocrystalline, polycrystalline, amorphous silicon (thin film) panels that are mounted on or integrated into the roof or facades of buildings. The table below shows the efficiency values for all the various forms, which is useful for comparing the various PV technologies currently available.

Type	Thin Film	Polycrystalline	Monocrystalline
Appearance			
Description	A thin-film panel is comprised of a thin layer of silicone laid on a straight surface	Solar panels made of polycrystalline cells. The silicon is not grown as a single cell but as a block of crystals. These blocks are then cut into wafers to produce individual solar cells.	These panels are manufactured from very pure silicon. A crystal of this type of silicon is grown in a complex process to produce a long rod. The rod is then cut into wafers to make the solar cells.
Efficiency	7%-12%	10%-18%	14%-22%
Efficiency in overcast conditions	Excellent	Good	Good

Table 7 - PV Types

Calculation Summary

PV Requirement	Data
Collector type	Monocrystalline
PV Panel efficiency	15%
System Area	150 m^2
System Cost	£42,000
Energy Output per year	25,134 kWh/annum
CO2 Savings per year	5.96 tonnes/annum
Reduction in buildings CO_2 emissions	1.42%
Payback	11.6 Years

Table 8 – PV Panel Requirement For New Leisure Centre

A 150 square metre array could be located on this site at roof level, it will cost in the region of £42,000, this will save 5.96 tonnes of CO_2 per year which is roughly 1.42% saving of the total carbon produced. However, it has also been confirmed that it is not possible to install a safe access route to the roof for maintenance. The PV array does not provide a high enough carbon saving within a realistic payback period to be considered further.

It should also be considered that this technology will affect the CHP plant operation and reduce the high carbon savings.

As photovoltaics are not being utilised we will not be undertaking a fight path study as this is considered irrelevant.

4.6 Summary of Renewable Savings

The tables below outlines the CO_2 savings achieved through applying the renewable technologies measures mentioned in the above section.

Energy Calc												
	Part L2a							Non Part L	Total Regulated site energy Consumption kWh/m^2	Total Regulated Site CO_2 kg/m^2	Total Regulated Site CO_2 (tonnes per annum)	Regulated Non-Domestic Carbon Dioxide Saving
	Energy Input kWh/m^2					Total Regulated Site Demand kWh/m^2	Low Carbon & Renewables kWh.m^2	Unregulated Energy Consumption kWh/m^2				
	Space Heating	Cooling	Auxiliary	Lighting	Hot Water							
Notional Building	27	3	17	17	388	452		50	452	96	408	
Be Lean	26	1	23	13	381	445		50	445	94	401	1.7%
Be Clean							203		242	60	255	35.8%
Be Green - Renewable Energy							7		235	58	249	1.6%
Total Savings											**159**	**39%**

Table 9 – Renewable Technology Summary For The New Leisure Centre

The table above shows that the Air Source Heat Pumps contributing 1.6% CO_2 reduction, the new leisure centre achieves a total CO_2 reduction of 39% against the notional building.

5.0 WATER EFFICIENCY

With the onset of climate change and increasing water extraction from rivers and underground supplies the UK's water resources are coming under increasing pressure. This could lead to environmental damage and degradation. So it is vitally important that the water efficiency of the installed appliances and irrigation systems provide the best efficiency levels possible. To achieve this, the following strategy must be implemented;

- Assess the current market for water efficient fittings and engage the design team, suppliers and contractors to pursue the most appropriate solutions.
- Specify performance and flow rates, rather than percentage reductions. This provides greater clarity to the contractor throughout design and procurement and reduces the ambiguity of targets.
- There is a practical limit to water efficiency; the building must reduce consumption as far as possible without compromising performance or placing onerous maintenance burdens on facility managers.
- Produce a Water Efficiency Plan with clear specifications for water efficient fittings.

The table below has been put together to set water efficiency limits for sanitaryware likely to be used throughout the development.

Water Efficiency Minimum Requirements		
	Flow Rate	Fitting
Urinals	1l/flush	Low flush urinal with individual PIR controls
Toilets	4l/flush	Cistern valve flush with spring mechanism or delay valve siphon flush mechanism
Wash Hand Basin Taps	4l/m	Sensor control with aerated flow
Sink Taps	5l/m	Aerated flow
Showers	8l/m	Push controls with aerated flow

Table 10 – Water Efficiency Minimum Requirements

Any irrigation system used internally or externally must be designed to use the least amount of water possible. This system must include the following features;

- Drip feeders
- Water zones based on plant type
- Automatic timers
- Soil moisture sensors linked to automatic controller

6.0 CONCLUSION

The client and design team are committed to achieving the carbon savings set out in the energy strategy for the proposed development.

Having taken into account all the options for reducing the energy in the development, it is clear that incorporating the energy efficiency measures mentioned in this report the development achieves the reduction targets set out by the Cherwell Local Plan 2011-2031.

The proposed strategy minimises energy loss and consumption by improving building fabrics and installing high efficiency equipment. This will provide improvements of 1.7% for the new leisure centre against Part L 2013 notional targets.

The CHP and Air Source Heat Pumps that will be installed in the new leisure centre will provide a low carbon and renewable energy saving of 35.8%.

Overall the new leisure centre will achieve a 39% improvement on Part L 2013 Building regulations, thus significantly exceeding the nation target.

The development as a whole will achieve CO_2 savings of 159 tonnes per annum.

Details of the above is summarised in the table below.

	Energy Efficient Design	Low Carbon Technologies	Renewable Energy Technologies	Total	Tonnes CO2 savings per annum
New Leisure Centre	**1.7%**	**35.8%**	**1.6%**	**39%**	**159**

Table 11 - Summary Of CO_2 Reduction In the New Leisure Building