DLL Woking

Energy Strategy

July 2019

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EXECUTIVE SUMMARY

This report provides an Energy Statement for the new leisure centre in Egley Road, Woking, which addresses the Core Strategy and Development Management Policies.

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 building will be monitored via a building energy management system, to better understand and control energy performance.

These measures will provide a 3.81% improvement on the over 2013 Building Regulations.

Low Carbon Technologies

Following a review of the site 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 25.39% 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 1.22% 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	**3.81%**	**25.39%**	**1.22%**	**30.42%**	**292**

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 30.42% over 2013 Building Regulations, or 292 tonnes of CO2 per annum, which provides a significant carbon dioxide saving from energy efficiency measures, low carbon technology and renewable energy.

1.0 INTRODUCTION

1.1 Background

Hulley and Kirkwood have been appointed to develop an Energy Strategy for the new David Lloyd leisure centre in Egley Road, Woking. This report provides an approach to ensure the new Leisure centre meets compliance with the Woking Council planning policies.

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

CS22: Sustainable Construction

New residential development on previously developed land will be required to meet the energy and Carbon Dioxide (CO^2) and water components of the Code for Sustainable Homes level 3 (or any future national requirement) from now until 31 March 2013, the energy and CO^2 and water components of at least Code level. 4 from 1 April 2013 and the energy and CO^2 and water components of Code level 5 from 1 April 2016. New residential development is encouraged to meet the full requirements of each Code level, with particular encouragement for the material and ecology elements. Where the scale, nature and location of a development would justify a higher Code level, the Council will negotiate with developers to achieve that because of the lower cost of developing such sites.

New residential development on greenfield sites will be required to meet the Code for Sustainable Homes level 5 (or any future national requirement) from now because of the relatively lower cost of developing such sites.

The Council will consider a case based on evidence of viability if an applicant can demonstrate that the requirement for code level 5 cannot be met. This will be considered on a case by case basis.

New non-residential development of 1,000 sq.m or more (gross) floor space is required to comply with BREEAM very good standards (or any future national equivalent).

All new development should consider the integration of Combined Heat and Power (CHP) or other forms of low carbon district heating in the development. All new development in proximity of an existing or proposed CHP station or district heating network will be required to be connected to it unless it can be demonstrated that a better alternative for reducing carbon emissions from the development can be achieved. Details of the zones where connection will be required will be set out in an SPD and will be determined by factors such as the capacity of the existing CHP network, distance from it and physical constraints.

The evidence base15 sets out the locations in the Borough which have significant potential for CHP or other forms of low carbon district heating networks. Subject to technical feasibility and financial viability, all development within these zones will be required to be designed and constructed to enable connection to the future network.

Applications for developments with exceptionally high total energy consumption, such as large leisure facilities with a high heat demand or buildings with exceptionally high power/cooling loads (such as data centres), will be required to reduce the total carbon emissions from the development by 10% through the use of renewable energy measures on site.

Where it can be demonstrated that the standards set out in this policy cannot be met on site, permission will only be granted if the applicant makes provision for compensatory energy and CO^2 and water savings elsewhere in the Borough equivalent to the carbon savings which would have been made by applying this policy.

The Council will encourage proposals for residential extensions and non-residential developments of 1,000 sq.m or less (gross) floorspace to incorporate energy and water efficiency measures.

The standards set out in the policy will be reviewed to reflect any future change in national standards and/or any equivalent standards that might be introduced.

CS23: Renewable and low carbon energy generation

The Council recognises significant progress needs to be made if national targets for the generation of renewable energy are to be met and encourages the development of stand-alone renewable energy installations in the Borough. All proposals will be considered on their individual merits with regard to scale, location, technology type and cumulative impact on the surrounding area.

The Council particularly encourages applications from community-based and community-owned projects.

Applicants should take appropriate steps to mitigate any adverse impacts of proposed development through careful consideration of location, scale, design and other measures. All reasonable steps to minimise noise impacts should be taken.

Applicants should provide sound evidence of the availability of the resource which will be harnessed or the fuel to be used, including details of the adequacy of transport networks where applicable and detailed studies to assess potential adverse impacts such as noise nuisance, flood risk, shadow flicker and interference with telecommunications.

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 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 be designed to achieve an air permeability of 3m^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 0.30.

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	85	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 1.6 W/(l/s), with Class L2 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 73%.

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.

	Part L2a							Non Part L	Total site energy Consumption kWh/m^2	Total Site $C0_2$ kg/m^2	Total Site $C0_2$ (tonnes per annum)	**Total Site $C0_2$ (Percentage)**
	Energy Input kWh/m^2					Total 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	26.2	4.2	13.5	16.9	401.3	462.1		51.9	514.0	171.9	959.0	
Energy Efficiency	24.3	2.5	16.4	14.2	385.7	443.1		51.9	495.0	165.3	922.5	**3.81%**

Table 3 – Energy efficient design summary for new leisure centre

3.0 LOW CARBON TECHNOLOGIES

3.1 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.

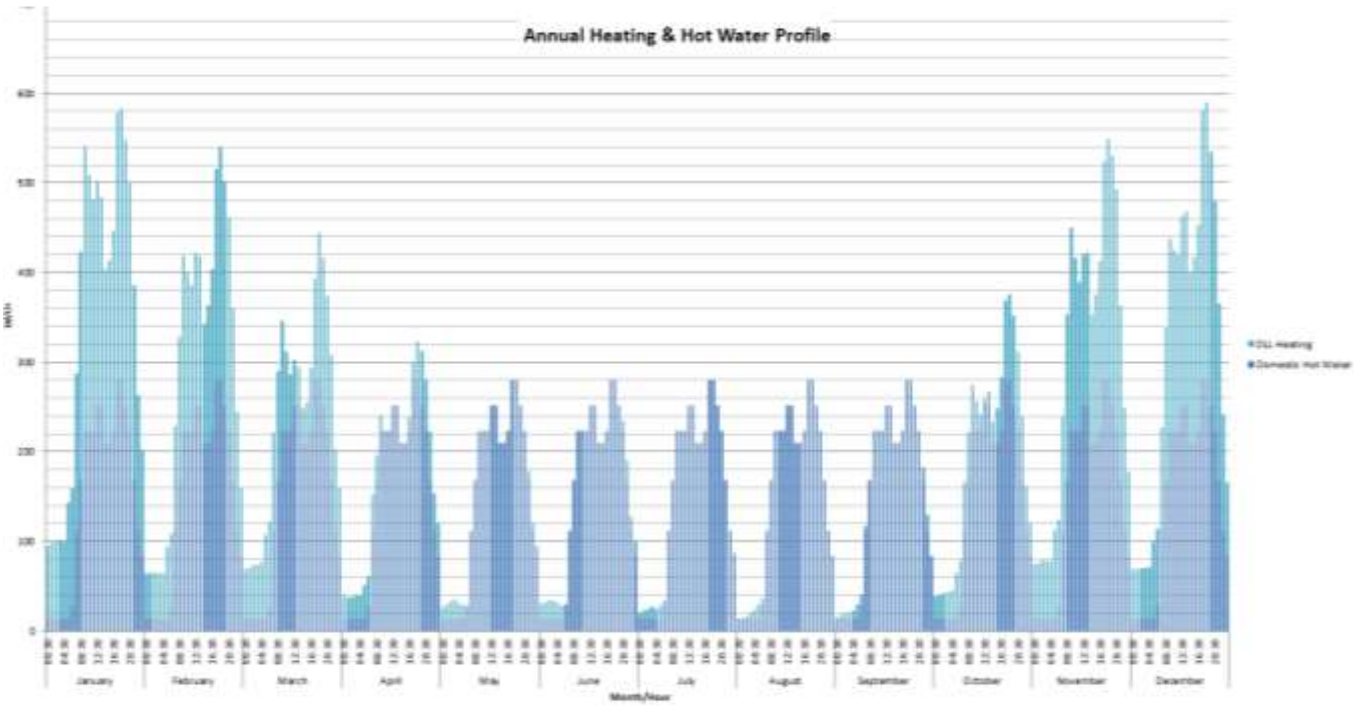

Figure 1 – Annual Heating & Hot Water Profile

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 160kWth will keep the CHP operational for around 6,916 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 243,499 kgCO_2 which is a total site wide saving of 25.39%. Based on the above information and the Core Strategy it is proposed that the heating and hot water based load is generated using a CHP system with boiler backup.

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 gradient of the local landscape, 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.

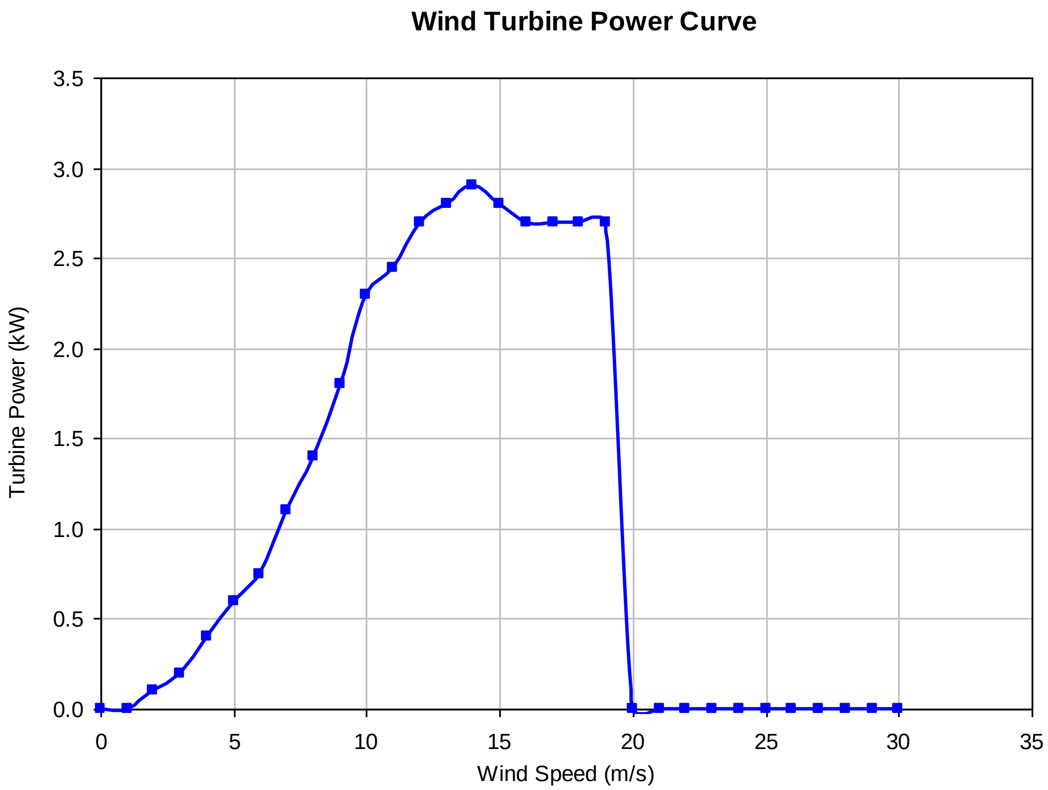

Figure 2 - Wind Turbine Power Curve

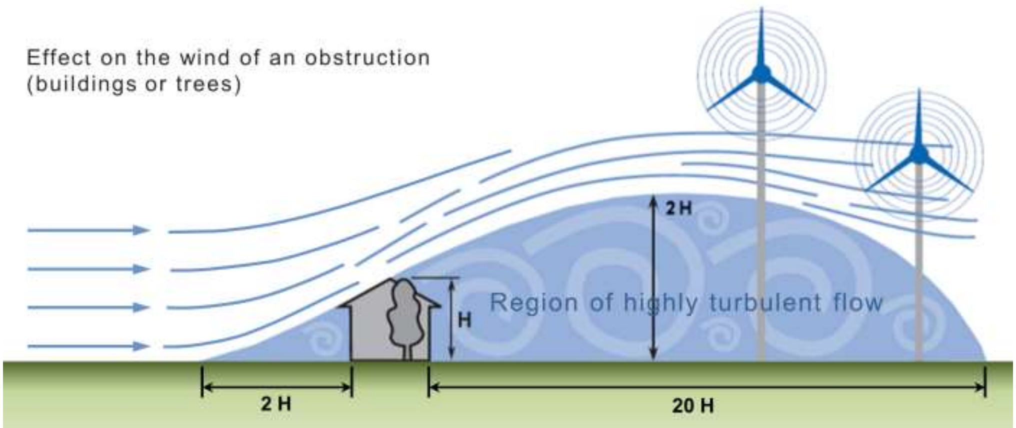

Figure 3 - Effect of Obstructions on Wind Turbines

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	30 m
Capacity	45 kW
Energy Output per year	24,552 kWh
CO_2 Reduction per year	12,742 kgCO_2
CO_2 Savings	1.38%
Turbine Cost	£82,000
Feed In Tariff	8.19p
Export Value	5.24p
Simple Payback	14.25 years

Table 4 – Wind turbine calculation summary

A 45 kW turbine would have a rotor diameter of 30m. It is calculated that this would virtually no effect on the buildings CO_2 emissions and payback period of 14 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.

Typical Solar Water Heating Systems	
 *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	78,120 kWh/annum
CO2 Savings	16,873 tonnes/annum
Reduction in buildings CO2 emissions	1.83%
Renewable Heating Incentive	10.75p
Payback	6.57 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 proposed for use 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. The proposed split systems will provide the lounge, studios and changing rooms heating and cooling requirements. This system 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 1.22% saving to the building compared to natural gas heating.

The renewable contribution made by the Air Source Heat Pumps in the building will be 1.22% CO_2 reduction.

Heat pump technology could be extended to serve the hot water and water based heating demands of the building. However, any additional energy sources for the water heating systems would reduce the operational efficiency of the CHP scheme and will not be pursued.

Calculation Summary

	Data
Heat Pump type	ASHP
System Cost	£52,000
Renewable Energy Output per year	54,126 kWh/annum
CO2 Savings per year	28 tonnes/annum
Reduction in buildings CO_2 emissions	1.22 %
Payback	35 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	18%
System Area	400 m^2
System Cost	£65,000
Energy Output per year	56,470 kWh/annum
CO2 Savings per year	29 tonnes/annum
Reduction in buildings CO_2 emissions	3.18%
Payback	11.5 Years

Table 8 – PV panel requirement for new leisure centre

If a 400 square metre array could be located on this site it will cost in the region of £85,000, this will save 29 tonnes of CO_2 per year which is roughly 3.18% saving of the total carbon produced. It has been confirmed that it is not possible to install a safe access route to the roof for maintenance. The PV array does not provided a sufficiently high carbon saving within a realistic payback period, also due to the CHP plant producing a high carbon saving this option will not be pursued further.

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.

	Part L2a							Non Part L				
	Energy Input kWh/m^2											
	Space Heating	Cooling	Auxiliary	Lighting	Hot Water	Total Site Demand kWh/m^2	Low Carbon & Renewables kWh/m^2	Unregulated Energy Consumption kWh/m^2	Total site energy Consumption kWh/m^2	Total Site CO_2 kg/m^2	Total Site CO_2 (tonnes per annum)	**Total Site CO_2 (Percentage)**
Notional Building	26.2	4.2	13.5	16.9	401.3	462.1		51.9	514.0	171.9	959.0	
Energy Efficiency	24.3	2.5	16.4	14.2	385.7	443.1		51.9	495.0	165.3	922.5	**3.81%**
Low Carbon							202		293.0	121.7	679.0	**25.39%**
Renewable Energy – Air Source Heat Pumps							9.72		283.23	119.6	667.3	**1.22%**
Total Carbon saving												**30.42%**

Table 9 – Renewable technology summary for the new leisure centre

The table above shows that the Air Source Heat Pumps contributing 1.22% CO_2 reduction, the new leisure centre achieves a total CO_2 reduction of 30.42% 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	Local 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 Woking Council Core Strategy.

The proposed strategy minimises energy loss and consumption by improving building fabrics and installing high efficiency equipment. This will provide improvements of 3.81% 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 26.61%.

Overall the new leisure centre will achieve a 30.42% improvement on Part L 2013 Building regulations.

The development as a whole will achieve CO_2 savings of 292 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	**3.81%**	**26.61%**	**1.22%**	**30.42%**	**292**

Table 11 - Summary of CO_2 Reduction in New Leisure Building