ANNEXE 1

Waverley BOROUGH COUNCIL

Van Zyl and de Villiers Consulting Engineers

PROPOSED REDEVELOPMENT OF GODALMING SWIMMING POOL

FOR

Waverley BOROUGH COUNCIL

Energy Strategy

Project Revision Sheet

Revision	Date	Changes	Author
Rev 0	26/04/2010	Draft for comment	Rod Warren
Rev 1	10/05/2010	Comments from DC Leisure & WBC	Rod Warren
Rev 2	17/05/2010	Comments from meeting 11/05/2010 at WBC	Rod Warren

Executive Summary

This report summarises the energy strategy and CO_2 reductions required for the proposed redevelopment of Godalming Swimming Pool.

The approach to this report has been to estimate the annual energy consumption using suitable benchmark figures from CIBSE Guide F, apply passive energy efficient means and then implement low / zero carbon technologies to reduce the carbon footprint of the development as a whole. The CIBSE Guide F benchmarks for leisure centres are obtained from *Sports and Recreation Buildings: Energy Consumption Guide 78 (ECG78)*. The Guide provides benchmarks for seven different types of sports and recreation buildings. The proposed Godalming Swimming Pool is best represented by the Type 4: Combined Centre within ECG78.

The low / zero carbon technologies considered are recognised by the Department for Business Enterprise and Regulatory Reform (BERR) Low Carbon Buildings Programme. The forms of low and zero carbon (LZCs) technologies considered are listed as follows:

- Gas fired combined heat and power (CHP) unit
- Wind turbines
- Solar heating
- Photovoltaic (PV) power generation
- Photovoltaic thermal (PVT) panels
- Biomass heating
- Biodiesel fired CHP
- Ground source heating / Air source heating

The preferred energy strategy for this particular development is a combination of the following:

1. **Energy efficient means**
   - High performance thermal envelope. The design and construction will work to the following improved factors:

Element	Part L2A Minimum Standards	Recommended Standards for Pool Hall	% Improve - ment	Recommended Standards for Building (Weighted Average)	% Improve - ment
Roof	0.25 W/m^2K	0.14 W/m^2K	36	0.18 W/m^2K	28
Walls	0.35 W/m^2K	0.25 W/m^2K	29	0.28 W/m^2K	20
Floor	0.25 W/m^2K	0.20 W/m^2K	20	0.20 W/m^2K	20
Windows	2.20 W/m^2K	1.4 W/m^2K	36	1.8 W/m^2K	18
Air perm - eability	$10m^3/h/m^2$	$5m^3/h/m^2$	50	$7.5m^3/h/m^2$	25

Table 6: Enhanced building envelope values

- Insulation of pool tank 0.25 W/m^2K
- High efficiency boilers with minimum gross efficiency of 95% at 80/60°C

- Use of natural light; main pool (5% average daylighting with minimum of 1.4), Fitness Suite (2% average daylighting with minimum of 1.4), Studios (2% average daylighting with minimum of 1.4), Reception/Cafe (2% average daylighting with minimum of 0.9), circulation spaces on first floor.
- In order to avoid glare within the pool hall the pool hall glazing should be north facing and provision should be made for rooflights over the pool and spectator areas
- To avoid excessive solar gains to areas that are comfort cooled:
    - Glazing should be north facing
    - If not north facing provision should be made for external shading elements
    - If external shading cannot be provided, glazing should have g-value of no more than 0.4, but with good light transmittance
- Digital central and automatic light switching for all areas
- Movement sensors to all areas of intermittent use; stores, offices, small change rooms, toilets, studios.
- Day light control of lights in all areas where there is natural daylight
- Use of Low energy metal halide/fluorescent/LED lights throughout (max 2.7watts/m^2/100lux)
- Variable speed drives on all pumps (modulation of pump speed to match demand)
- Variable speed drives on all pool filtration pumps to match demand
- Automatic control on ultraviolet pool water treatment plant to suit water quality
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- Heating controls to optimize boiler efficiency
- Natural ventilation where possible
- Heat recovery on ventilation plant (>60%)
- Grey water harvesting from pool water sampling to flush toilets
- Building Management System which will ensure optimum control of plant and monitor energy consumption
- All meters to be recorded on BMS
- Small power and lighting to be separately metered in all areas
- Water saving devices to be included in taps, toilets and showers.
- Physical pool cover to be deployed daily when the pool is not in use.
- IP based energy display wall as described below
- The building is to achieve an EPC of B or better
- Building orientation and solar shading design to be optimised and sun track analysis to be provided to demonstrate that it has been optimised.
- IP based energy wall (with graphics) summarising energy usage and benefits of low and zero carbon technologies

2. Low & Zero Carbon Technologies

The contents of the report were discussed at a meeting with Waverley Borough Council on 11/05/2010. It was agreed that the following 4 options were to be considered further at tender stage:

(i) CHP_{gas} (50kWe)
(ii) CHP_{gas}(50kWe) & PV (34,000kWh)
(iii) Biomass (70kW)
(iv) Biomass (70kW) & PV (34,000kWh)

The carbon benefit from the low carbon technologies is summarised below:

	Carbon Emissions ($kgCO_2$/annum)	% Reduction CO_2	Estimated Annual Reduction in Energy Costs (£/annum)
Reduction from CHP_{gas}	44,090	11.06%	£5,126.52
Reduction CHP_{gas} & PV	64,184	16.10%	£18,413.45
Reduction from Biomass	66,950	16.79%	£15,513.41*
Reduction from Biomass & PV	87,044	21.83%	£28,800.34*

Table 2: Carbon reduction summary
**assumes proposed HiTs included*

The Contractors will be requested to cost each of these 4 options separately for both site locations.

Glossary

AD	Approved Document
ADL1A	Approved Document Part L1A
ADL2A	Approved Document Part L2A
BER	Building emission rate
BREEAM	Building Research Establishment Energy Assessment Method
CHP	Combined Heat and Power
CIBSE	Chartered Institute of Building Services Engineers
CO_2	Carbon Dioxide
COP	Coefficient of Performance
DER	Dwelling Emissions Rate
LZC	Low or Zero Carbon
NHER	National Homes Energy Rating
SAP	Standard Assessment Procedure
TER	Target Emissions Rate

Caveat

"This document has been prepared for the titled project, or named part thereof, and should not be relied upon or used for any other project or part as the case may be, without an independent check being made on it. Appendix A lists the tariffs and assumptions used in this report for the purpose of demonstrating reduction in CO_2 emissions. Any energy figures or energy costs are estimates only for the purposes of this report only and should not be used for any other purposes. Van Zyl & de Villiers Consulting Engineers will not be liable for the consequences of using this document other than for the purpose for which it was commissioned, and any user and any other person using or relying on this document for such other purpose, agrees and will be such use or reliance be taken to confirm this agreement to indemnify Van Zyl & de Villiers Consulting Engineers for all loss or damage resulting there from".

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1 Introduction

The aim of this report is to detail the preferred energy strategy for the proposed redevelopment of Godalming Swimming Pool to ensure that the new building is designed, constructed and operated in an energy efficient and sustainable way.

The report demonstrates how the design intends to significantly reduce the carbon emissions of the development through the use of developed technologies and considered design and quantifies the benefit of the low and zero carbon technologies that are proposed.

The development consists of a main pool, reception/cafe area, wet and dry change (including village and group change), fitness area and a dance studio.

For the purposes of this report it has been assumed that the gross internal floor area will be:

Building Type	Floor Area (m^2)
Wet and dry leisure centre	**1,935**

Table 3: Area Schedule of the Proposed Development

Any reference to costs in this report should be considered preliminary only for comparison purposes and is subject to design development and confirmation by the specialist contractors and cost consultants.

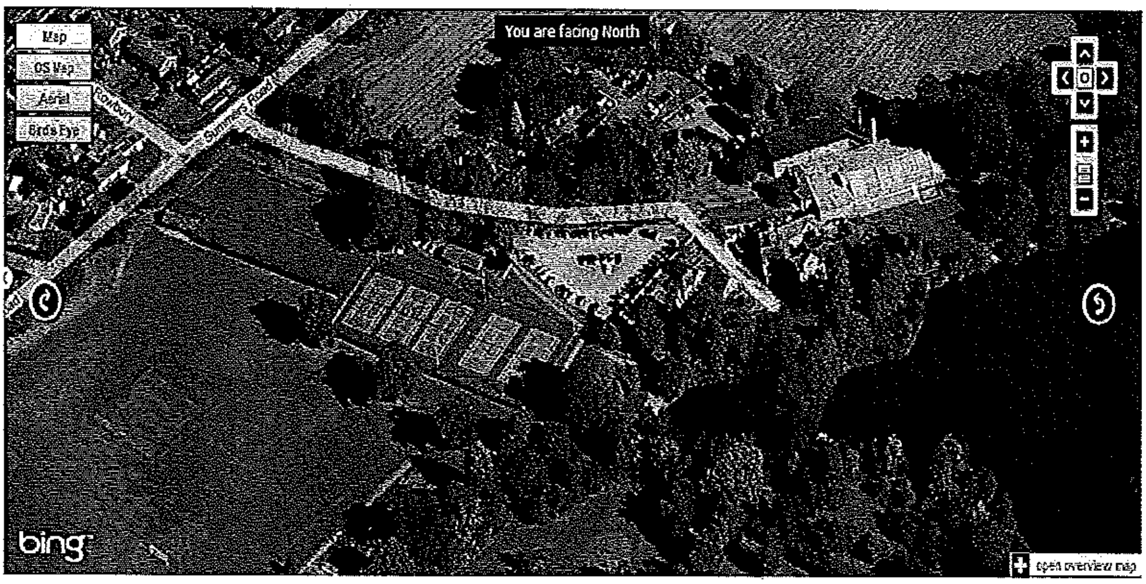

Image of current site to be redeveloped

2 Calculating the Baseline Carbon Footprint of the Development

In order to comply with Part L of the Building Regulations any building's Building Emissions Rate (BER) has to be lower than the same building's Target Emissions Rate (TER). The TER therefore sets the benchmark against which the building's performance will be measured. As the building design and Part L calculations and hence the calculation of the building's TER will only be concluded at a later date during the design development process, it is proposed that for the purpose of this report the building's carbon footprint should be calculated by using energy benchmarks from CIBSE Guide F.

The CIBSE Guide F benchmarks for leisure centres are obtained from *Sports and Recreation Buildings: Energy Consumption Guide 78 (ECG78).* The Guide provides benchmarks for seven different types of sports and recreation buildings. The proposed Godalming Swimming Pool is best represented by the Type 4: Combined Centre within ECG78. The energy benchmark has subsequently been adjusted to make allowance for pool filtration equipment. The energy benchmark with typical energy benchmarks as below:

Predicted Annual Energy Demand		Predicted Annual Carbon Emissions		Total Carbon Emissions
Gas ($kWh/m^2/year$)	Electricity ($kWh/m^2/year$)	Gas ($kgCO_2/m^2/year$)	Electricity ($kgCO_2/m^2/year$)	$kgCO_2/m^2/year$
297	186	61	145	206

Table 4: Energy and carbon benchmarks for Type 4: Combined Centre as per ECG78 (adjusted)

ECG78 also advises that these benchmarks could be adjusted based on certain site specific factors. For the purpose of this report the annual gas demand has been reduced by 104 $kWh/m^2/year$ based on the following adjustments within ECG78:

- Building fabric improved with high insulation levels and detailing to avoid air leakage: reduction of 39 $kWh/m^2/year$
- Southern Location – Thames Valley, Avon Valley or further south: reduction of 65 $kWh/m^2/year$

With these reductions energy benchmarks for the leisure centre component are:

	Predicted Annual Energy Demand		Predicted Annual Carbon Emissions		Total Carbon Emissions
	Gas (kWh/year)	Electricity (kWh/year)	Gas ($kgCO_2/year$)	Electricity ($kgCO_2/year$)	$kgCO_2/year$
Baseline	574,695	474,420	118,387	280,382	398,769

Carbon intensity of natural gas ($kgCO_2/kWh$)	**0.206**
Carbon intensity of grid generated electricity ($kgCO_2/kWh$)	**0.591**

Table 5: Calculated site baseline CO_2 emissions

3 Waverley Borough Council Requirements

3.1 Waverley Borough Council guidelines refer to Policy SE2

'Policy SE2 looks at four main areas, not just renewable energy. Those are:

- stand alone renewable energy systems
- the requirement for 10% renewable energy in all new developments
- an expectation that Combined Heat Power (CHP) is incorporated into schemes of over 5,000 sq m floor space; and that
- new developments should be energy efficient.

However, for new developments the most appropriate sequence of consideration should be:

- be lean: Improved energy efficiency (beyond the minimum requirements of Building Regulations 2006 - to at least good practice, best practice or ideally advanced practice). In essence this will reduce the energy consumption of the development
- be green: Requirement that 10% of the total energy consumption of the site is to be designed to come from renewable energy technologies
- be clean: Where expected, CHP should be incorporated into the scheme

If this approach is followed, then it will be cheaper in the long run.'

3.2 Waverley Borough Council Carbon management Plan (CMP) 2010 – 2015

Extract from document:

Ref	Project	Lead officer	Cost	Payback period (years)	CO_2 savings (tonnes)	% of target	Project Start Year
LC 1	Replace Godalming Leisure Centre[1]	Kelvin Mills		-	46 - 91	2.9 – 5.8	2011

Utility costs assumed:
Gas 3.2p/kWh
Electricity 8p/kWh

[1] Reduction is based on a preliminary assessment of between 15-30% reduction in energy use.

4 Energy Efficient Measures

The first stage in reducing the development's carbon footprint is to use energy efficient measures that will exceed the requirements of the Building Regulations. The energy efficient measures proposed for this development include:

- High performance thermal envelope. The design and construction will work to the following improved factors:

Element	Part L2A Minimum Standards	Recommended Standards for Pool Hall	% Improvement	Recommended Standards for Building (Weighted Average)	% Improvement
Roof	0.25 W/m^{2}K	0.14 W/m^{2}K	36	0.18 W/m^{2}K	28
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5 Low and Zero Carbon Technologies Considered

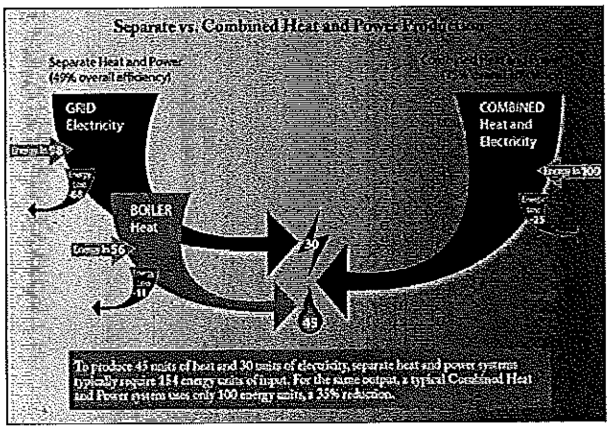
The use of Low and Zero Carbon (LZC) technologies should form an integral part of any new development with the potential to make significant carbon reductions. Consideration has been given to the following LZC technologies with a view to reducing energy and/or CO_2 emissions.

The technologies considered below are recognised by the Department for Business Enterprise and Regulatory Reform (BERR) Low Carbon Buildings Programme (LCBP):

- Gas fired combined heat and power (CHP) unit
- Wind turbines
- Solar heating
- Photovoltaic (PV) power generation
- Biomass heating
- Biodiesel fired CHP
- Ground source heating / Air source heating

The results of the feasibility study are summarised in Appendix A of this report, and each technology has been considered as follows:

5.1 Gas fired combined heat and power unit (CHP_{gas}): Combined Heat and Power Units (CHP_{gas}) are not unlike electrical generators as they burn fuel to generate electricity. They differ from a standard generator in that the water used to cool the engine is made available for heating. CHP_{gas} is ideally suited to applications where there is a proportionate electrical and heat demand. It is however important to ensure a suitable load balance of electricity and heat demand from the building to match that generated by the CHP. The CHPs controls are to be designed to modulate (thermally and electrically) with the site load.



This building has a large annual heat and electricity load which does lend itself to the application CHP_{gas} . The calculations in Appendix A shows that the CHP_{gas} produces a significant reduction in CO_2, and is commercially viable in terms of running costs and payback of investment.

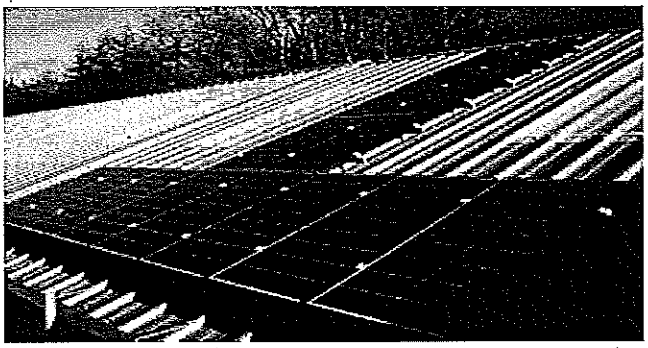
5.2 Wind turbines: This technology uses wind power to generate electricity. The effectiveness of such a scheme will depend on the annual average wind speed to which the generator will be subjected. This will depend on planning constraints (noise, visual impact etc), the permissible size of the wind turbine as well as its location.

The calculations have been based on two 2.5kW wind turbines (3.5m rotor with a minimum hub height of 6.5 to 11m). Other configurations would be possible depending on the location.

5.3 Solar heating: Solar heating is a proven technology and has been around for many years. Although less popular in the UK in the past, its popularity is growing with more emphasis on the use of renewable energy sources and is likely to grow further with the introduction of Heating Tariffs (HiTs) scheduled to be introduced in April 2011.

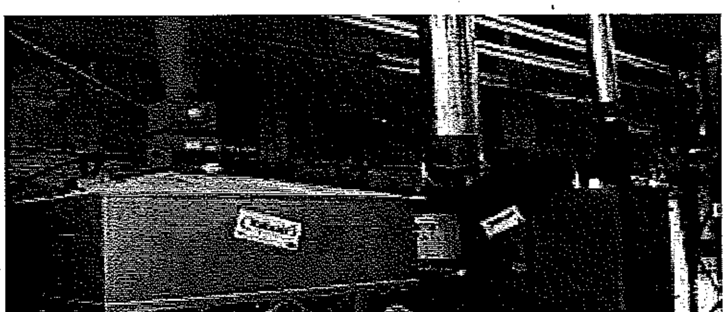
Solar thermal heating is ideally suited to this type of development due to the high base load heat demand all year round. This technology is suited to a leisure centre however its application is limited for two reasons; firstly the panels produce the most heat during in summer when the heat load is the smallest, and secondly the application of this technology is limited by the amount of south facing roof area. The size of this solar thermal array is limited by the annual domestic hot water usage. Appendix A shows that the reduction of CO_2 is limited however the reduction in energy costs is good with a payback less than 10 years. Note that HiTs have been factored into these calculations based on current information; these incentives are due to be introduced in April 2011, however are yet to be confirmed. Note that this technology is heat based and is not necessarily suited to work in conjunction with other heat generating technologies.

5.4 'Photovoltaic panels: This technology generates electricity from exposure of photovoltaic panels to solar radiation. It is a proven technology that has been around for many years.



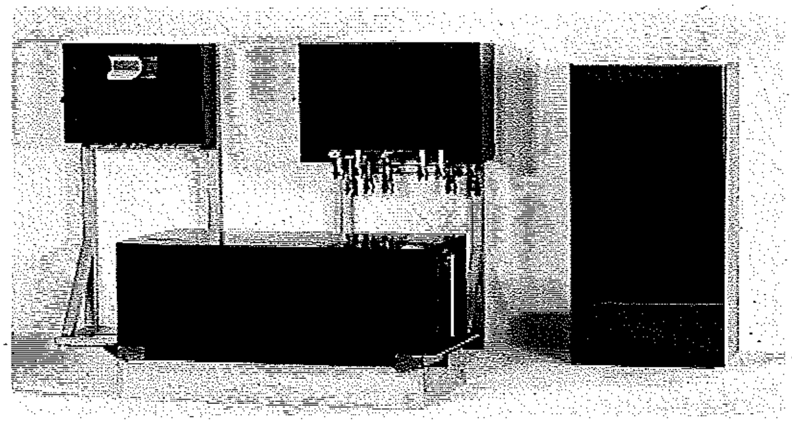
This technology is suited to a leisure centre and whilst its application is not limited by base heat load like solar panels, it is limited in a similar fashion by suitable south facing roof area. Appendix A shows good reductions in CO_2 and with the benefit of the newly introduced FiTs (April 2010) the payback is close to 10 years. One of the benefits of this technology is that it can easily be combined with other technologies.

5.5 Biomass boiler (wood chip): The burning of wood is considered as a renewable energy source since the wood chips are manufactured from sustainable forests and provided the source is within approximately 35 miles of the site, it can be considered carbon neutral.



Biomass plant requires considerable space for the boiler and adequate biomass storage facility. Biomass delivery vehicles also require good road and site access as well as turning circles. The cost of biomass varies considerably and is often affected by the storage / vehicle delivery constraints. This technology is largely dependent on a reliable local wood chip supplier. Initial enquiries suggest that wood chip is available locally and the cost of woodchip used in the calculations is conservative however is based on a minimum fuel delivery size of $40m^3$. The sizing of the biomass boiler is critical and is best sized as a base load unit. A biomass boiler which is designed to modulate should be used to allow a high load factor to be utilised. In this instance a 70kW base load unit has been proposed. Appendix A shows that the reduction of CO_2 is relatively high; the energy costs can increase/decrease depending on the relative cost of gas and biomass, however with the expected introduction of HiTs in April 2011 the cost benefits are increased with an annual payback of well below 10 years. Note that the HiTs are 'draft' only and subject to government legislation. In order for biomass to work in practice, a large amount of thought and design has to be placed on the logistics of delivery of fuel and operation of the plant. These should be agreed up front with the end user. Note that wood chip is specified, not wood pellet.

5.6 Biodiesel combined heat and power unit ($CHP_{biodiesel}$): Fuels made from cellulosic biomass resources. Biofuels include ethanol, biodiesel, and methanol and are regarded as renewable and a low carbon form of energy. Biofuel could be used as a renewable energy source to power for example, a $CHP_{biodiesel}$.

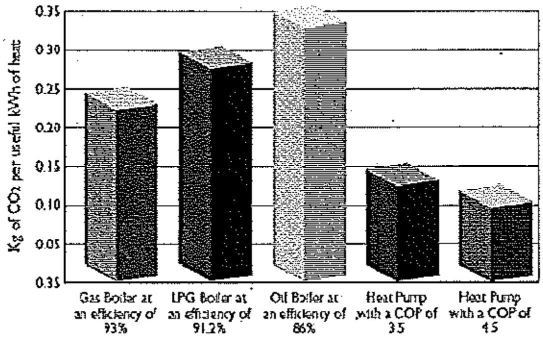


This technology is similar to gas fired CHP and is ideally suited to wet leisure centres. The difficulty with the use of this technology is the availability of biodiesel CHPs and the supply of biodiesel which is truly renewable and eligible for tariff incentives.

The calculations in Appendix A show that a biodiesel CHP would yield high CO_2 savings with an excellent payback. The calculations are based on the assumption that the biodiesel would be eligible for HiTs to be introduced in April 2011. The eligibility of biodiesel as a renewable fuel has come under scrutiny recently by Ofgem and it would appear that there are limited sources of eligible biodiesel at present. There is undoubtedly a large risk associated with the sourcing of biodiesel at the present time, and until such time as there is certainty in the market place for the supply of biodiesel, this technology has limited options.

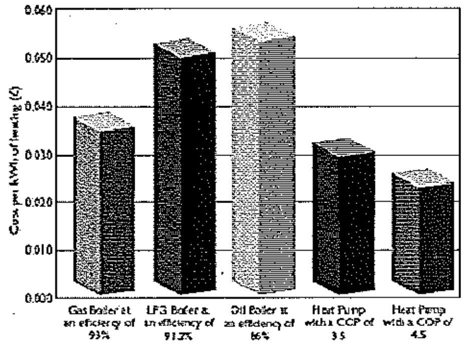
5.7 Ground source heat pumps (GSHP) and Air source heat pumps (ASHP): Air / ground source heat pumps upgrade naturally occurring low temperature heat into useful high temperature heat and vice versa to provide cooling. This technology is already well known in the air conditioning market and has proved very efficient when used for cooling and heating. However, in other countries, such as Sweden and Switzerland, heat pumps are often used as a primary source for heating and hot water. Change in legislation in the UK and a drive to more sustainable solutions has seen heat pumps becoming more popular in commercial applications. Heat pump technology is very flexible, with excellent energy efficiency and CO_2 reduction potential.

CO_2 Emissions for various heating systems



There is **57% less carbon emissions** when comparing a gas boiler with a heat pump of a COP of 4.5.

Running costs for various systems



There is a **34%** reduction in running costs when using a heat pump with a COP 4.5 when compared to a gas boiler.

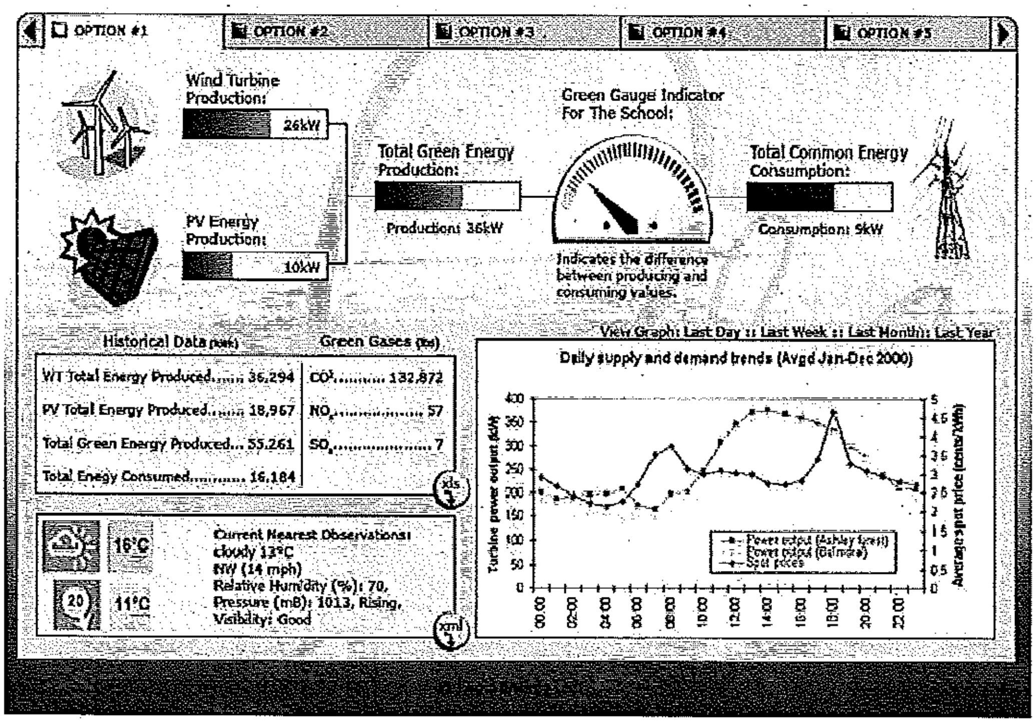
The operational characteristics of a heat pump are totally different to an electric or gas boiler. With a conventional boiler, one kilowatt of energy in gives less than 1 kilowatt of heat to the building. With a typical electrically driven heat pump, one kilowatt of energy in gives a heat output in excess of 2.5 kilowatts. Outputs of 3kW (as shown in the figure below) or more are not uncommon. This ratio is known as the Coefficient of Performance (COP); which can vary from 3 to 4.5.

Due to the low grade heat from ground/water source heating the application of this technology in this instance is limited. Due to the relatively high capital cost and limited application the payback is in excess of 20 years. Air source heat pumps should be used to provide the local space heating and cooling to areas such as the Fitness Suite and Studios. The reduction in CO_2 is small but has zero capital cost and should be used.

6 Energy Wall

The yield from the various renewable technologies is to be displayed on a user friendly energy wall which will be used for educational purposes. The energy wall will be displayed on a large LCD TV in the reception area, but will have the facility to be dialled in to by any computer on a secure connection using a unique IP address and password.

The display will integrate wind, PV, solar thermal and rainwater harvesting technologies alongside inputs from the fiscal energy and water meters and a small weather station. The results from energy, carbon and water savings will be available in real time data behind the main display screen. The results will be displayed in a child friendly manner in a similar format to the example below:



7 Summary

It is proposed to significantly reduce the carbon footprint of the development by a combination of:

1. Energy efficient means

- High performance thermal envelope as summarised in Table 6 above.
  - Insulation of pool tank 0.25 W/m^{2}K
  - High efficiency boilers with minimum gross efficiency of 95% at 80/60°C
  - Use of natural light; main pool (5% average daylighting with minimum of 1.4), Fitness Suite (2% average daylighting with minimum of 1.4), Studios (2% average daylighting with minimum of 1.4), Reception/Cafe (2% average daylighting with minimum of 0.9), circulation spaces on first floor.
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  - IP based energy wall (with graphics) summarising energy usage and benefits of low and zero carbon technologies

It is not possible at this stage to accurately determine the energy CO2 benefits of the 'energy efficient means'. This will have to be calculated at a later stage when the footprint of the building is identified and the benefits can be calculated by means of recognised energy modelling software.

2. Low & Zero Carbon Technologies

The contents of the report were discussed at a meeting with Waverley Borough Council on 11/05/2010. It was agreed that the following 4 options were to be considered further at tender stage:

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	Carbon Emissions ($kgCO_2$/annum)	% Reduction CO_2	Estimated Annual Reduction in Energy Costs (£/annum)
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*Table 7: Carbon reduction summary (*assumes proposed HiTs included)*

The Contractors will be requested to cost each of these 4 options separately for both site locations.

8 Appendix A – Summary of Low / Zero Carbon technologies

GODALMING LEISURE CENTRE

FOR

WAVERLEY
BOROUGH COUNCIL

ENERGY SAVING AND LOW CARBON ENERGY SOURCES

Item	Sustainable Technology	Annual Electrical Output (kWh)	Annual Cooling Output (kWh)	Annual Heat Output (kWh)	Annual CO_2 Savings ($kgCO_2$)	Annual % reduction in CO_2 Emissions	Annual Energy Savings (excl FIT/HIT benefit or CRC)	Annual FIT/HIT benefit	Annual CRC benefit	Annual Maintenance Costs
1a	30kW Gas fired CHP (Capital Purchase)	151,787	0	252,945	30,114	7.6%	£5,544	£0	£361	£2,468
1b	50kW Gas fired CHP (Capital Purchase)	234,549	0	332,048	44,090	11.1%	£8,234	£0	£529	£3,637
2	Wind turbines	19,710	0	0	11,649	2.9%	£1,374	£4,750	£140	£500
[redacted]										
5	70kW Biomass Boiler (40m³ biomass storage)	0	0	339,850	66,950	16.8%	-£4,880	£22,090	£803	£2,500
6a	34kW Biodiesel CHP	156,366	0	239,148	152,195	38.2%	-£7,778	£8,600	£1,826	£6,000
6b	51kW Biodiesel CHP	234,549	0	340,786	223,674	56.1%	-£12,130	£0	£2,684	£7,500
7a	Ground/water source heating and cooling to fitness suite and studios	0	36,000	17,400	2,905	0.7%	£472	£957	£35	£0
7b	Ground/water source heat pump heating to DHW and pool	0	0	36,780	2,984	0.7%	£203	£2,023	£36	£0
8	Air source heating and cooling (compared with air cooled chiller and boiler)	0	36,000	17,400	1,669	0.4%	£129	£348	£20	£0

Assumptions:		
1	CO_2 emission factor of natural gas ($kgCO_2$/kWh):	0.200
2	CO_2 emission factor of grid supplied electricity ($kgCO_2$/kWh):	0.591
3	CO_2 emission factor of grid displaced electricity ($kgCO_2$/kWh):	0.591
4	CO_2 emission factor of woodchip ($kgCO_2$/kWh)	0.000
5	CO_2 emission factor of biodiesel from cooking oil ($kgCO_2$/kWh)	0.004
6	Annual CHP running hours after 90% availability:	4590
7	Annual Biodiesel CHP running hours after 90% availability:	4590
8	30kW Thermal CHP heat utilization:	100%
9	50kW Thermal CHP heat utilization:	95%
10	70kW Thermal CHP heat utilization:	90%
11	Cost of electricity - day (p/kWh)	6.5
12	FIT for PV panels	31.4
13	FIT for wind turbines	24.1
14	CRC benefit (£/tCO_2)	12
15	Cost of natural gas (p/kWh)	1.9
16	HIT for solar thermal (p/kWh)	17
17	HIT for biomass boiler (p/kWh)	6.5
18	HIT for ground source heat pump (p/kWh)	5.5
19	HIT for air source heat pump (p/kWh)	2
20	HIT for biodiesel CHP (p/kWh)	6.5
21	Climate Change Levy on electricity (p/kWh):	0.47
22	Climate Change Levy on gas (p/kWh):	0.164
23	Cost of woodchip (p/kWh)	3.50
24	Cost of Biofuel (p/kWh)	5.63
25	Estimated total annual kg CO_2 emissions for building	398769
26	Estimated total annual heating demand for building (kWh)	574695
27	Estimated total annual DHW demand for building (kWh)	91051
28	output from	000
29	Annual biomass boiler running hours after 95% availability:	4855
30	EER of air source heat pump plant	3.3
31	COP of air source heat pump plant	3.5
32	EER of ground source heat pump plant	3.8
33	COP of ground source heat pumps	4
34	EER of air cooled chiller plant plant	3
35	Annual cooling demand (kWh)	36000
36	Annual heating demand to areas comfort cooled (kWh)	17400
37	Grant for PVs for local authority (maximum of 50kWp = £145,000)	0%
38	Costs provided	
39	Payback calculated without CRC benefit.	
40	Carbon intensity figures are based on Part L 2010 consultation paper	
41	Annual CO_2 footprint is based on 1950m² floor area and energy benchmarks for leisure centres	
40	All costs exclude VAT.	

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