1666

Queen Elizabeth Country Park
Petersfield, Hampshire

Report on the use of renewable energy systems

Index

Section 1: Basis of Report

The report is intended to identify the various types of renewable energy that could be considered for use at the Queen Elizabeth Country Park, consider in a simple way, the economics and technical merits of these systems, and make recommendations as to which of these are worth pursuing in the design of the mechanical and electrical services installations. The report will not only consider the economics of the options, but the potential merit as a teaching facility which the Park offers, and how some of these renewable facilities might be used as a training tool.

The economic considerations will take into account the various grants that are available, both for studies and installation works, and how these may impact any decisions made. It will also take into consideration the exiting facilities offered by the Park and the environment, and will consider the management of those resources.

Several of the items considered will be subject to planning restrictions, and overall acceptance by other bodies, and these may have implications which will seriously affect any recommendations made. However, the report is intended to identify which means, if any, are potentially worth considering, and how these should be considered when designing the building itself.

Section 2: Biomass Systems

2a) General Description (i) heating

Biomass systems are heating and process systems which use renewable and commercially available fuel sources. These include timber, straw, reeds, grain and specialist grasses. The way in which these fuel sources are harvested and prepared before use vary, as do the efficiencies of each type of fuel, and they need to be considered very specifically in each case. They have a specific benefit to the environment, in that being products which grow naturally, they absorb carbon dioxide during their normal growth cycle. When they are burned as fuel, they only give off the carbon products that have been absorbed during their lifetime, and this is considered by the environmental agencies as having a zero net emission of carbon products, unlike gas and oil.

As Britain is committed to reducing the amount of carbon emitted into atmosphere under the Kyoto Agreement, the use of biomass products as a fuel source is encouraged by many agencies, both nationally and internationally, and this is reinforced with grants to assist in studies to consider biomass systems, as well as assisting the funding of actual developments.

The specific fuels to be used should ideally be those which are available in sufficient amounts within the locality of the building considered, to reduce transport costs. In some cases, they can involve the use of material which is essentially a waste product, or that can be grown and harvested in sufficient quantities to meet a demand. The latter group involves the use of reeds, grains and specialist grasses, and the former straw and timber. Much timber of low, or non-commercial quality is available on most farms and estates. This can come from routine coppicing and thinning of forests, clearing of ditches and streams and general forest management, and this option which is of particular interest at the Queen Elizabeth Country Park.

From discussions with the Forest District Manager, there are over 1,000 tonnes of hardwood produced each year by routine management of the forests. Timber is a viable biomass fuel, and it could be used to provide all of the heating and hot water for the Country Park with a considerable quantity left over for sale on the market, when processed, as a useful fuel source. The economics are considered in section 2b, and there are variables which need to be quantified, such as labour costs to be attributed to the cutting and chipping of the wood, transport costs etc.

The timber would need to be chipped into manageable sizes, stored, dried and transported to the fuel store, and the equipment for all of this would need to be taken into consideration when considering the economics. However, it would eliminate the dependency on oil or gas as a fuel source, have a realistic payback period, provide a better return on the surplus material than currently available, generate a small cottage industry, and be beneficial to the environment.

The equipment used for wood burning systems has been commercially available for many years now, and has been used in the UK for around 20 years, albeit on a small scale. In Europe, the concept has been much more favourably considered for many years, and wood burning systems, whether for individual homes or district heating systems have been popular for many decades. The plant efficiencies are normally higher than similar gas or oil fired equipment, and the life expectancy of the boilers is similarly longer.

There is space available in the car park compound for a suitable fuel storage area, adjacent to a suitable boilerhouse location, which is currently not designated for other uses. It would be simple to adapt the space under consideration to a fuel store, and transport wood chips from the adjoining estate. With the fuel load assesses at 72 tonnes per annum, this equates to a volume of 288 cubic metres per year. We consider that it would be possible to provide a storage space of around xx cubic metres, which means that the fuel would only need to be delivered x times a year. In addition, fully automatic fuel handling systems and ash handling systems within the boilers, means that little or no work is required to maintain the system, load fuel or clean out ash. The fuel would be delivered to the storage area directly from the trailers, and the ash could be removed once a month, and used as fertiliser.

Whilst timber is available in chips or pellets, only the former has been considered viable, as there are no sawmills currently in use to produce pellets.

2a) General Description (ii) Combined Heat and Power (CHP)

CHP systems are self-contained methods of providing heating and electrical energy from a single machine. Traditionally, an oil or gas fired electrical generator uses reclaimed heat from the waste gases to provide a source of hot water for heating. The overall thermal efficiency of the generator is thereby sufficiently increased to make it a viable option to purchasing energy direct from local utilities.

With biomass systems, the gas is normally produced directly from the timber using a digester or similar means. On larger systems, it would be possible to use a biomass boiler in the same manner as a conventionally fuelled boiler to generate steam, which is used to power an electrical generator, thereby providing heat and electricity from a single source.

It is important when considering CHP systems to have a constant use for the heat energy provided. When there is a heating load, this is usually sufficient, but when this is not required, during warmer months, an alternative demand is required to make the system economically viable, such as domestic hot water or a swimming pool.

2b: Calculations

The energy loads for the QE Country Park are based upon the record drawings available at the time of the report, and our understanding of the way in which the building will be used in the foreseeable future.

Our estimate of the maximum heat loss of the building is 120kW, and this produces an annual energy requirement of 219,000 **kWh** for heating.

The hot water load, has been assessed at an annual figure of **51,000kWh**.

The combined heating and hot water load is therefore assessed as **270,000kWh.**

Using gas as a fuel source, with a cost of **1.5p/kWh**, the annual energy costs for heating and hot water would amount to **£4,050.**

Mains gas is currently used as the primary fuel source. Wood chips bought on the market at a price of around £45 per tonne would give a running cost of **£3,240**, giving a saving on running costs of **£810**. However, the cost available at the QE Country Park is considerably less, as the timber is readily available, and it is only the drying, chipping and transport costs will need to be considered.

We estimate that the timber required for the total energy load at the QE Country Park would be **72 tonnes**, based upon a thermal output of **3.75mWh** per tonne of wood chips at 25% moisture content. This would leave over 900 tonnes for commercial use.

For the purposes of this report, we will assume that the timber is stored off site for drying, chipping, and is then taken to the Park as fuel, with the remainder of the chips sold at source as a fuel. We further assume that the cost of the chipping machines and associated transport costs are offset against the commercial element of the surplus material, the cost of fuel to the Park becomes almost free, and therefore shows an annual saving of **£4,050** compared with gas.

In addition, there remains some **900** tonnes of wood chips, which at **£45 per tonne**, would generate an annual income of **£40,000**. This would have to be offset against the cost of the chipping machine, and labour and transport costs, but we would still expect to see an annual surplus as well as the generation of a small cottage industry. If this activity proved successful, it may be possible to expand the production of wood chips as demand for this fuel source grows, either by harvesting more timber, or buying it in at acceptable prices.

The electricity demand for the site for lighting, small power and fixed equipment is assessed as **57,500 kWh.** Purchasing electricity directly from the local utility company at **7.0p per kWh** would give an annual cost of **£4,025.**

2c: Manufacturers Details

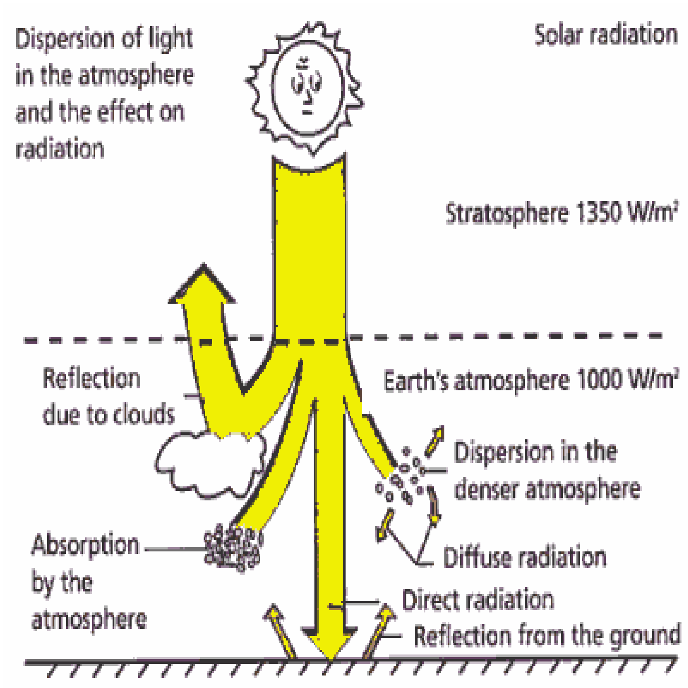
1. Typical boiler details

2. Typical fuel handling system

Section 3: Solar Heating

3.a: General Description

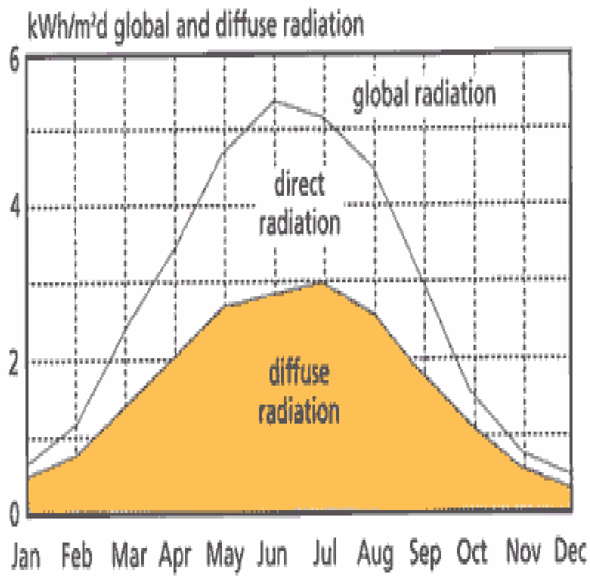
All sources of energy on Earth originate from the sun; fossil fuels are derived from extinct life forms once energised by the sun. Renewables such as wind and wave power result from the sun's radiation driving the climatic forces.
It would make sense to utilise the sun's energy in the most direct way possible because, in harnessing any of these other sources, large inefficiencies are inevitable during their conversion to more useful forms of heat and electricity. Capturing and making use of the sun's energy "as it arrives" not only greatly reduces these conversions losses but avoid the production of harmful pollutants too.



Over 7 million households already use solar hot water systems in Europe and the installed collector surface area should reach 80 million square metres by 2010. The future of thermal solar energy definitively looks bright.

Which are the advantages of thermal solar energy ?

- no damage to the environment
- free energy and with minimum maintenance costs..
- endless energy resource
- energy production on site profitable and competitive
- saves conventional energy
- safe without risk.



-

The market of thermal solar energy has reached maturity. Reliable products with an optimum efficiency are now available.

In our study for the QE Country Park, we are considering the possibility of producing hot water for sanitary and personal use by means of high efficiency solar collectors. The best location of the solar collectors for this element of the work would appear to be the south facing roof overlooking the central courtyard..

3.b: Heat transfer

The solar energy, collected by the solar collector heats a liquid solution of water/glycol circulating in the collector plates and is transferred to a conventional heat exchanger integrated in the tank/boiler located in the building. Headers, piping and a pump are specially installed to circulate the liquid in the most efficient manner.
The building conventional heating systems the can be connected to this tank or employ a unique tank/boiler. An electronic control panel regulates the entire system.

Several types of panels are available, and we propose using two different types on this project to demonstrate their respective capabilities. One will be a conventional flat plate system, and the other will be an evacuated tube system. The flat plate system will have a collector area of approx.3.2m^2 and the evacuated tube system will have a collector area of approx. 1.6m$^{2.}$

These systems will be connected to a real time output monitor, in conjunction with the PV panel display, to demonstrate the energy being provided from both PV displays and both solar panel systems.

Section 3B: Calculations

The solar energy available in a particular site is directly related to the latitude of the site and the average solar days during the year.

It is estimated that the average annual energy that can be collected is **1200 kWh/m^2** of collector.

For a roof of **3.2 m^2** the collected energy is roughly **3,840 kWh**.
For a roof of **1.6 m^2** the collected energy is roughly **1,920 kWh**.

Detailed calculations shall be carried out depending on the collector's orientation and their inclination.

The cost of the panels is in the region of £ 9,000.

Section 3.C : Manufacturers Details

Section 4: Heat Pumps

4a) General Description

This is the generic term given to a range of machines, which convert virtually unlimited quantities of low grade energy in the atmosphere or surrounding environment, into high grade energy suitable for use in heating systems. Therefore "air to water" heat pumps take energy from the air, and use that to heat water, whereas " ground to water" heat pumps take energy from pipes buried in the ground, and heat water to a level suitable for heating buildings.

The machines work on the opposite principle to air conditioning units, in that instead of taking heat from a space, and rejecting that to the atmosphere, they take energy from the atmosphere or ground, and reject that into the space.

The machines use fluids which have a boiling point below 0 ^{0}C, so that there is sufficient energy in the atmosphere, even at low temperatures to boil the refrigerant, and create the heating process. Similarly with pipes buried in the ground, where temperatures several metres down are at a constant temperature of around 10 ^{0}C throughout the year.

The efficiency of the machines is called the "Coefficient of Performance" (COP), and is the energy output of the machine, divided by the electrical energy required to operate it. Typically, ground source heat pumps have COP's around 5.0, which means for every kW of electrical motor power used, 5kW of heat are produced. This means than running costs are 20% of a straight forward electrical system at around 1.4p/kWh, which makes them cheaper than oil or LPG to operate.

When using ground source systems, care needs to be taken when the system is used for heating or cooling only, to avoid sub-cooling the ground. Test holes would need to be drilled to assess the thermal characteristics of the ground, to confirm the number of boreholes required. Boreholes would normally be 100m deep and 120mm diameter, and each borehole with have a "U" tube inserted. This is filled with water and a monopropylene solution, and then the borehole is backfilled, and the pipes connected to a common header.

Air source systems are less complicated, but as their output is directly related to external air temperatures, they are less effective as it gets colder, which makes them much larger than ground source machines for the same heat output. They can be useful when air conditioning is required, when the same machine can be used for cooling in the summer, and heating in the winter. As no air conditioning has been considered for this scheme, we have focussed on ground source heat pumps only.

The machine can be located virtually anywhere with reasonable distance from the Visitor Centre, so that noise and visual impact can be minimised.

4b): Calculations

Using the ground as a heat source, heat is transferred at the rate of about 40w/metre run. Using boreholes 100m deep, each with a closed circuit “U” tube, around 15 boreholes would be required to produce the 120kW heating output required.

The capital cost of the boreholes and pipework would be around **£40,000**, and the cost of the machine itself a further **£20,000** with **£3,000** to test and commission the plant. However, the potential savings on running costs would be nominal, and could not be justified against the considerable capital expenditure required.

We would only consider heat pumps to be viable if some form of cooling system were required in any area.

4c: Manufacturers Details

1) Literature on heat pumps

Section 5: Wind Turbines

5.a: General Description

5.1: General

Electricity produced by wind generators can be used directly, as in water pumping applications, or it can be stored in batteries for household usage. Wind generators can be used alone, or they may be used as part of a hybrid system, in which their output is combined with that of solar panels, and /or a fossil fuel generator. Hybrid systems are especially useful for winter backup of home systems where cloudy weather and windy conditions occur simultaneously.

The generator can be connected to the grid, providing electricity to the community when not used by the owner. Wind turbines produce no pollution and by using wind power it is possible to offset pollution that would have been generated by the power utility company. Over its life, a small residential wind turbine can offset approximately 1.2 tons of air pollutants and 200 tons of greenhouse gases (carbon dioxide and other gases which cause climate change).

The most important decision when considering wind power is determining whether or not the chosen site has enough wind to generate the power for its needs, whether it is available consistently, and if it is available in the season when it is needed.

5.2: Wind Turbine

Most wind turbines are horizontal-axis propeller type systems. A horizontal-axis wind turbine consists of a rotor, a generator, a mainframe, and, usually, a tail. The rotor captures the kinetic energy of the wind and converts it into rotary motion to drive the generator. The rotor usually consists of two or three blades. A three-blade unit can be a little more efficient and will run smoother than a two-blade rotor, but they also cost more. The blades are usually made from either wood or fibreglass because these materials have the needed combination of strength and flexibility (and they don't interfere with television signals!).

Vertical-axis turbines are also common but less commonly employed.

The generator is usually specifically designed for the wind turbine. Permanent magnet alternators are popular because they eliminate the need for field windings. A low speed direct drive generator is an important feature because systems that use gearboxes or belts have generally not been reliable. The mainframe is the structural backbone of the wind turbine and it includes the "slip-rings" that connect the rotating (as it points itself into changing wind directions) wind turbine and the fixed tower wiring. The tail aligns the rotor into the wind and can be a part of the over-speed protection.

5.3: Towers

A wind turbine must have a clear shot at the wind to perform efficiently. Turbulence, which both reduces performance and "works" the turbine harder than smooth air, is highest close to the ground and diminishes with height. Also, wind speed increases with height above the ground. As a general rule of thumb, a wind turbine should be installed on a tower such that it is at least 10 m above any obstacles within 100 m. Smaller turbines typically go on shorter towers than larger turbines. A 250 watt turbine is often, for example, installed on a 9 to15 m. tower, while a 10 kW turbine will usually need a tower of 25 to 36 m.

It is not recommended to mount wind turbines on small residential buildings because of the inherent problems of turbulence, noise, and vibration.

The least expensive tower type is the guyed-lattice tower, such as those commonly used for ham radio antennas. Smaller guyed towers are sometimes constructed with tubular sections or pipe. Self-supporting towers, either lattice or tubular in construction, take up less room and are more attractive but they are also more expensive. Telephone poles can be used for smaller wind turbines. Towers, particularly guyed towers, can be hinged at their base and suitably equipped to allow them to be tilted up or down using a winch or vehicle. This allows all work to be done at ground level. Some towers and turbines can be easily erected by the purchaser, while others are best left to trained professionals. Anti-fall devices, consisting of a wire with a latching runner, are available and are highly recommended for any tower that will be climbed. Aluminium towers should be avoided because they are prone to developing cracks. Towers are usually offered by wind turbine manufacturers, and purchasing one from them is the best way to ensure proper compatibility.

5.4: Remote Systems Equipment

The balance-of-systems equipment used with a small wind turbine includes a set of batteries, regulators, transformers and electronic controls. If a connection to the grid is planned, suitable interconnection/transformer and metering devices shall be necessary. However, batteries may not be necessary.

5.5: Being Your Own Utility Company

UK legislation allows a wind generator user to interconnect to its house or business to reduce the consumption of utility supplied electricity. This same legislation requires Utilities to purchase any excess electricity production at a price (avoided cost) usually below the retail cost of electricity. Because of the high overhead costs to the utilities for keeping a few special hand-processed customer accounts, net energy billing is actually less expensive for them.

These systems do not use batteries. The output of the wind turbine is made compatible with utility power using either a line-commutated inverter or an induction generator. The output is then connected to the household breaker panel on a dedicated breaker, just like a large appliance. When the wind turbine is not operating, or it is not putting out as much electricity as the user needs, the additional electricity needed is supplied by the utility. Likewise, if the turbine puts out more power than the house needs, the excess is instantaneously "sold" to the utility. In effect, the utility acts as a very big battery bank and the utility "sees" the wind turbine as a negative load.

After over 200 million hours of interconnected operation, it is clear that small utility-interconnected wind turbines are safe, do not interfere with either utility or customer equipment, and do not need any special safety equipment to operate successfully.

5.6 Specific Needs

The location of the wind turbines at Queen Elizabeth Country Park is likely to be sheltered, and not be as effective as located on a more exposed site. However, we consider that the installation of a small free standing model will be a useful training tool, coupled with the other renewable energy systems considered.

5.7: Configurations of wind Power Generators

Various configurations can be established with wind generators. The following drawings show the different solutions. Others can be assessed in function of the local requirements.

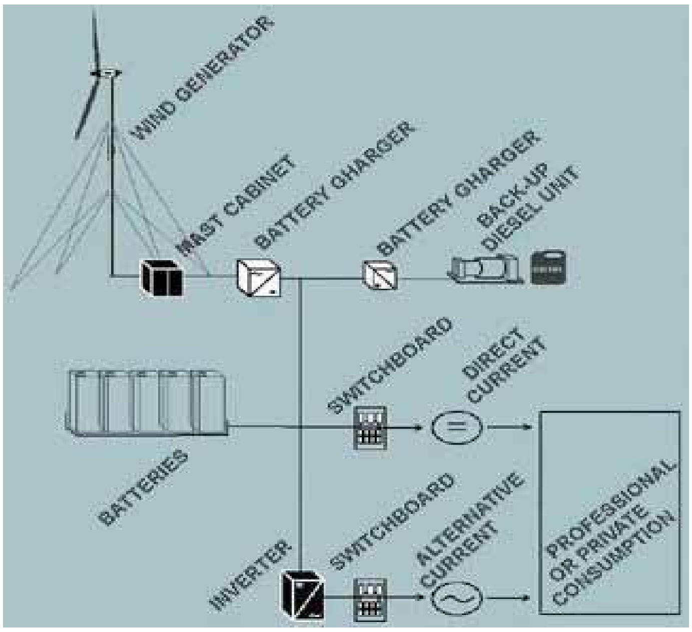


Fig. 1 Stand-alone wind power plant

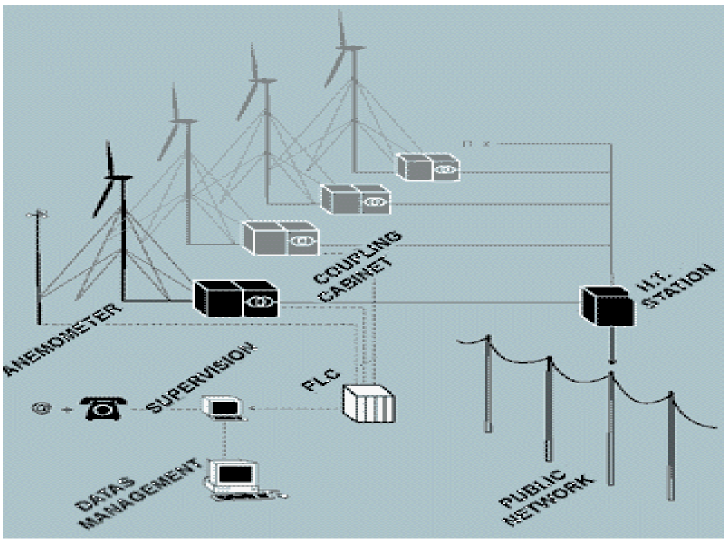


Fig. 2 Grid connected wind generator

5.b: Calculations

In order to identify the site, the capacity and the availability factor of a wind generator, it is necessary to carry out a wind study in the area where a generator is planned. This study is based on the DTI wind speed database. The wind resource data provided can be sufficient for an experienced evaluator to predict wind turbine performance. However some wind speed local measurements may be carried out for a period of two to four months.

The DTI wind speed database has provided the following wind speed parameters in the 1 Km grid square for the QE Country Park:

45 m agl : wind speed 6.1 m/s
25 m agl : wind speed 5.6 m/s
10 m agl : wind speed 4.8 m/s

The data show that at a height of 25 m above ground level (agl), the average wind speed is 5.6m/s.

Measurements carried out locally will confirm the data but also will establish additional parameters such as availability and peak factor.

We estimate that the initial electrical energy load for the QE Country Park will be **57,500kWh.**

We believe that a Generator of capacity of **10 kW** could be suitable for the Park. This machine could produce up to **10,000 kWhr/year** in this location**.** Larger machines or more machines of the same size could be installed should the client wish to develop more wind energy on the estate.

5.C. Manufacturers Details

In Europe and USA a considerable number of manufacturers of wind power generators have been established during the past ten years. We have selected a small number of manufacturers who are well experienced in building highly reliable small generators with size and capacity that could be suitable for an installation at the Park.

The wind system will usually recoup its investment through utility savings within six to ten years and after that the electricity it produces will be virtually free. Over the long term, a wind turbine is a good investment because a well-sited wind system increases property value, similar to any other home improvement. A detailed calculation can be carried out only following a study of the site and the selection of the machine.

5.C.1 North Energy Gazelle 20 kW.

Manufactured by North Energy in United Kingdom. Price between £ 75,000 and £ 80,000 depending on the site

The Gazelle is a three bladed 20kW wind turbine, which enables farms, businesses and schools on windy sites to generate their own clean electricity. The currently available model is suitable for grid-connected sites with a three phase supply.
The turbine is on a tower 14.5 metres high and has blades 5.3 metres long. It has been built to the latest international safety standards.

5.C.2 PW 20/14 20 kW

Manufactured by PitchWind Systems AB in Sweden
Price approx £ 40,000
The Turbine has a two blades variable speed propeller with very low level of noise. The direct-driven generator eliminates the need of a gearbox.

5.C.3 Windside models

Manufactured by Oy Windside Production Ltd in Finland.
All models have vertical axis and a range of power from 10 W to 25 kW.
Advantages include operation at very low wind speed (1-2 m/s up to very high storm conditions). All models have a very low noise level.

Windside WS-030

Section 6: Micro Hydro Generation

There is no running water at the Park, and therefore the option of using this facility is not available.

Section 7: Rain Water re-cycling

7a) General Description

Rain water recycling or harvesting, is a simple way of reducing water consumption for residential properties. A filter unit is installed into a conventional rainwater downpipe. This collects up to 90% of the rainwater passing through the downpipe, and the filter incorporates devices to prevent leaves and other debris passing through. The water is then taken into a storage tank, normally located below ground, from where it is pumped to serve all devices in the house which can operate on non-potable water. This includes toilets, washing machines and gardening uses.

The tank needs to be dark to reduce the possibility of algae and bacterial growth. It incorporates all necessary pumps and control systems to pump stored water to any outlet whenever required. A mains water back up system is normally provided, should the stored water be exhausted when a demand is required.

The system is not to be confused with grey water re-cycling, described later, which recycles water from showers, baths and washing machines, treats it chemically, and recycles it for use with toilets or gardening uses.

Because one system is chemically treated, and one is natural, the two should not be mixed, unless used for gardening uses.

7b) Calculations

The volume of water used for possible rainwater harvesting is as follows:

a) Toilet use @ 45 litres/day/person	66,000 litres
b) Kitchen use @ 20 litres/day/person	30,000 litres
c) Gardening Allow 3 hours use of hose per week @ 500 litres/hour	78,000 litres
Total	**174,000 litres**
Cost from water supply company @ £2/m^3 (1m^3=1000 litres)	**£ 350**
Cost of harvesting equipment	**£2,000**
Cost of pipework modifications to suit	**£1,500**
Total	**£3,500**

Payback period = 3,500/350 = **10 years**

The water flow rates are based upon normal use for a household of 4 people. If this demand is increased, or the gardening use is greater, the payback period will be reduced

7c) Manufacturers Details

1) Rainwater Harvesting literature

Section 8: Grey Water recycling

8a) General Description

Grey water recycling collects water from all household kitchen and bathroom waste systems, except toilets, treats it chemically, discharges the waste products to sewage mains, and recycles the treated water for use in toilets or gardening uses. It is particularly beneficial for the latter option, because some of the particulates which remain have a beneficial effect on plant growth. It is normally treated with a coloured dye to distinguish it from normal mains water, and avoid cross connection between the two systems.

Many people do not like to see coloured water in the toilets, and for this reason are unhappy to use it for this purpose. If it is therefore used solely for gardening uses, it needs to be considered with rainwater harvesting systems, which serve a similar purpose.

Rain water harvesting systems require little or no modifications to the existing drainage system, other than the introduction of the filter into the down pipe, and have no chemical costs. Grey water recycling needs duplicate internal plumbing systems to be set up, to separate waste from toilets and wastes from baths, sinks, basins and washing machines etc. None of these requirements are necessary with rain water harvesting.

We consider that there will be sufficient rainwater available at the Park to meet all normal requirements for toilets, kitchen and gardening, and therefore in this case, it is not worth considering grey water recycling further.

Section 9: Photovoltaics

9a) General Description

Photovoltaic cells convert energy from daylight into useful low voltage electricity. This energy is converted at source, into the voltages used in the UK, and becomes an alternative source of electrical energy. Because energy loads within buildings fluctuate, it is possible for the amount of energy generated through the cells to exceed the demand required on the site. It is therefore common to arrange an agreement with the local supplier of electricity for all of the energy supplied to be sent to the grid, and credited to the supplier at realistic prices, usually the same as those charged by the supply authority to the tenant.

Photovoltaic cells are not cheap, and because the amount required to provide realistic amounts of energy are quite high, they normally need to be built into the overall building design to make them viable. However, there is a large area of roof at the Centre which needs to be replaced, and incorporating photo voltaic cells as part of this process will be more economical.

A cost effective case for considering them solely in terms of electricity generated is difficult, but the benefit to the Centre as a teaching tool makes this an option to be considered on more than simple economics.

The best location is the west facing roof of the Centre. We propose here to install a 15m x 5m area of PV tiles in lieu of conventional roof tiles, which should generate up to 6.9kWp.
A further PV display will be installed on the south facing roof overlooking the Courtyard, and this array should generate 0.9kWp, and contribute 700kWh to the annual energy requirement of the Centre.

The PV display will be connected to a real time output monitor to provide a permanent demonstration of the power being generated at all times. This will be similarly coupled to the outputs from the solar panels to show the output.

9b) Calculations

The output from each tile is 23Wp, and the area of 300 tiles should generate 6.9kWp., which should provide approx 5000kWh per annum, giving a net saving of approx. £300 per annum compared with normal tariff electricity prices.

The cost of the 300 tiles would be £52,500 for the supply of the tiles, plus a further £15,000 for installation. If this is undertaken at the same time as the proposed roof refurbishment, it will save the cost of roofing materials of approx. £3,000.

A smaller PV display is proposed for the south facing roof overlooking the courtyard which will be used largely for demonstration and teaching facilities. This will cost around £7,000 to install, and will generate around 0.9kWp.

Section 10: Grants

10.1: UK Government support to renewable energies

The British Government has established two major funding institutions for renewable energy.

a. The Clear Skies Initiative
b. The Energy Saving Trust

Other initiatives are related to special premium tariffs for electricity produced by renewable energy.
Additional support on the technologies and applying for a grant is available through the Community Renewables Initiative or Renewable Energy Advice Centres

10.2: The Clear Skies Initiative – Building Research Establishment (BRE)

10.2.1 General

The £10 million Clear Skies Initiative aims to give homeowners and communities a chance to become more familiar with renewable energy by providing grants and advice. Homeowners can obtain grants between £500 to £5000 whilst community organisations can receive up to £100,000 for grants and feasibility studies. Clear Skies supports projects in England, Wales and Northern Ireland.

During the past few years, the Government has introduced a number of measures to encourage the uptake of renewable energy and energy efficiency by power generators and businesses.

With the advent of the Clear Skies initiative, the Government is encouraging homeowners and community groups to take an active part in the climate change agenda and reap the benefits of renewable energy.

The different types of renewable energy offer different benefits but they all utilise non-polluting and effectively limitless energy sources.

The technologies supported are:

Solar Water Heating
Wind
Hydro
Ground Source Heat Pumps
Automated Wood Pellet Stoves
Wood fuel boilers

Grants will only be awarded to homeowners where an accredited installer is to be used. These installers will work to a code of practice and be vetted beforehand to ensure that you get the most appropriate system for your needs, correctly installed at the right price.

One of the main benefits of using renewable energy is that it reduces emissions of carbon dioxide. When allied to energy efficiency measures, renewable energy is one of the most effective methods of reducing carbon dioxide emissions. All applicants are to investigate all methods of increasing the overall energy efficiency of their homes. This includes such strategies as maximum insulation, and purchasing household electrical equipment with an 'A' energy rating e.g. fridges, freezers, washing machines and light bulbs.

10.2.2 Technologies and grant size available

For Household grants, the amount of grant is dependent upon the technology installed as detailed below. For community grants, the size of the grant is the lower of 50% of installed cost or £100,000 regardless of the technology.

10.2.3 Solar Thermal Power

Solar panels, also known as "collectors", can be fitted to a building's roof. They use the sun's heat to warm water, or another fluid, which passes through the panel. The fluid is then fed to a heat store (e.g. a hot water tank) and helps provide hot water or central heating for the building (at a higher typical cost than detailed below). The panels work throughout daylight hours, even if the sky is overcast and there is no direct sunshine.

Active solar panels can also be used to heat swimming pools.
Typical System Cost £2000-£4500
Household Grant Offered £500 regardless of system size

10.2.4 Wood Fuelled Boiler Systems

These systems must comprise the main heating system of the house and can be run on logs, wood chips and wood pellets. Log burning stoves, even those used for heating (e.g. AGA), are excluded.
Typical System Cost £4,500 for a 15 kWh system burning logs or pellets. A system burning wood chips might be twice this figure.
Household Grant Offered £50 per kWh installed. Installations larger than 30 kWh are allowable but capacity above that level will not incur a grant.

10.2.5 Room heaters/Stoves with automated wood pellet feed

Wood burning systems, unlike other renewables, do emit carbon dioxide. However, as the wood fuel is cultivated, it absorbs the exact same amount of carbon dioxide as is released when burnt. As such it does not add to the carbon dioxide in the atmosphere.

An eligible system can be used for heating a single room, hot water or a whole house. This excludes the AGA type stove as these are not automated.
Typical System Cost £2400-£2600
Household Grant Offered £600 regardless of system size

10.2.6 Micro-Hydro

Water is used by "hydro turbines" to generate electricity. Water flowing down rivers, for example, turns the turbine round; this movement is used to produce power. Most hydro power is produced in hilly or mountainous areas, or in river valleys.

The amount of electricity that can be produced is determined by how much water is available and how fast it flows. Additionally of all renewable energy technologies, it is the most consistent at providing electricity.

Typical System Cost: Costs for hydro projects depend greatly on the site and can vary considerably.
Household Grant Offered £1000 per kWe installed up to a maximum of £5000. Minimum size of 0.5 kWe. Installations larger than 5 kWe are allowable, but capacity above that level will not incur a grant.

10.2.7 Wind Power

A wind turbine converts wind to electricity. The most common design is for three blades mounted on a horizontal axis, which is free to rotate into the wind on a tall tower. The blades drive a generator either directly or via gearbox (generally for larger machines) to produce electricity. Vertical axis turbines are also available.

The electricity can either link to the grid or charge batteries. Modern designs tend to be very near silent in operation such that the wind in the leaves on trees can be louder.

Typical System Cost £2,500 - £5,000 per kWe installed
Household Grant Offered £1000 per kWe installed up to a maximum of £5000. Minimum size of 0.5 kWe. Installations larger than 5 kWe are allowable but capacity above that level will not incur a grant.

The grant will be based on the turbine rating at a windspeed of 12 m/s
Special premium tariffs can be negotiated with the grid connection operator.

10.2.8 Ground Source Heat Pumps

Ground source heat pumps can be used efficiently to a heat a house by drawing heat from the ground, concentrating it and delivering it to the building. Systems use a pump and compressor to remove heat from one side of the circuit and eject heat to the other side.

Pumps use electricity for their operation and users may consider subscribing to a green tariff scheme, which promote the use of renewables by power generators.
Systems must be non-reversible, closed loop ground source only using either a borehole or trench.
Typical System Cost £4000 - £6000
Household Grant Offered £1200 regardless of system size.

10.3: Household eligibility criteria

Details of the eligibility criteria are listed below. These details may change at any time without notice as the scheme develops. BRE reserve the right to decline an application.

Specific Eligibility Criteria

1. Applicant must be the owner of the property for which grant is applied for.
2. Applicant will be resident of the UK.
3. Property must be located within England, Wales or Northern Ireland. For Scotland, see the link on the home page.
4. System must supply a building (mobile homes, caravans, house boats, etc are not eligible).
5. System must be designed, installed and commissioned by an accredited installer
6. System must use components on the DTI’s recognised product list.
7. Installer will provide an estimate of the annual energy output of the system.
8. Grants must be spent within 1 year of grant offer being made.
9. Maximum of two grants awarded per applicant provided they are for different technologies.

Energy Efficiency First

One of the main benefits of using renewable energy is that it reduces emissions of carbon dioxide. When allied to energy efficiency measures, renewable energy is one of the most effective methods of reducing carbon dioxide emissions. We strongly advise all applicants to investigate all methods of increasing the overall energy efficiency of their homes. This includes such strategies as maximum insulation, and purchasing household electrical equipment with an 'A' energy rating e.g. fridges, freezers, washing machines and light bulbs. You can obtain a simple DIY home energy survey from your local energy efficiency advice centre.

How to apply

An application form can be downloaded from www.clear-skies.org The recognised product list is still under development.
Applications will be assessed against the criteria above, the chosen installers accreditation status is current and that the proposed system is appropriate for the client expectations.

10.4: Community eligibility criteria

Community applications will be assessed on a competitive basis. Four funding rounds will be held each year with a strict deadline for submissions for each round. Applications received will be assessed by BRE's technical team and a selection panel drawn from relevant organisations.

Two general conditions of the scheme apply to applications. DIY installations will not attract a grant and the equipment installed must be new and not refurbished. Properties both on and off the electricity grid are eligible for a grant. Groups are also encouraged to seek at least two estimates before applying.

Non profit organisations eligible for grants under the Community Stream will include:
* Community groups.
* Environmental trusts.
* Housing associations.
* Local authorities.
* Universities, Hospitals and other public service organisations.

Details of the eligibility and assessment criteria are listed below. These details may change at any time without notice as the scheme develops. BRE reserve the right to decline an application.

10.4.1 The following conditions will be applied to community schemes:

1. Grant must be used to support the capital and installation costs of a renewable energy scheme.
2. Applicant is a non profit organisation.
3. Applicant/recipient is a legal entity.
4. Scheme is located within England, Wales and Northern Ireland.
5. Schemes must use components on the DTI's recognised product list.
6. Grant applied for is a maximum of 50% of total capital and installation costs, or £100,000, whichever is smaller.
7. All statutory approvals must be in place.
8. Grant must be spent within 2 years of award being made.
9. Applicant must agree to participate in government case study material.
10. Applicant must agree to monitoring of the scheme by the scheme manager.

10.4.2 Community applications will demonstrate the following essential criteria:

1. Scheme must be technically sound and financially viable, with a good chance of making it to commissioning and operating successfully.
2. Scheme must demonstrate evidence of real community involvement and engagement (i.e. in scheme design and development). This will include, but not be limited to, an effective process of community consultation.
3. Scheme must enhance public awareness and understanding of renewable energy (via visibility, open days, etc).

Community applications will also be scored against the following non-essential criteria:

1. Scheme demonstrates (where relevant) evidence of linking to energy efficiency measures.
2. Scheme demonstrates (where relevant) evidence of linking to wider sustainability issues.
3. Scheme represents value for money (in terms of both kW and kWh) – unless it is very innovative.
4. Applicant can demonstrate presence of match funding:

All other things being equal, preference to be shown for.
a.- Schemes located in area of social need.
b.- Schemes demonstrating cross-community involvement.

10.4.3 Feasibility Studies

Funding support for feasibility studies is available to groups proposing community schemes. They are eligible to receive 75% of costs for studies or £10,000, whichever is the lower, to help address key issues such as technical viability, legal and planning issues, and access to finance. The funds available for feasibility studies are limited.

10.5: Energy Saving Trust

10.5.1 General

The Energy Saving Trust was set up by the UK Government after the 1992 Rio Earth Summit and is one of the UK's leading organisations addressing the damaging effects of climate change. Its goal is to achieve the sustainable and efficient use of energy, to cut the carbon dioxide emissions which are the key contributor to global warming. The EST is a non-profit organisation funded by governments and the private sector.

Working with a range of partners, EST focuses on delivering practical solutions for households, small firms and the road transport sector - solutions which save energy and deliver cleaner air.

10.5.2 Priorities

Current priorities are:

- to stimulate energy efficiency in UK households and achieve social, environmental and economic benefits
- to create a market for clean fuel vehicles which will deliver local and global environmental benefits.
- to stimulate a market for renewable energy which will achieve social, environmental and economic benefits

ESTsupports:

1. Energy Efficiency for homes
2. Solar Photovoltaic Electricity
3. Community heating schemes

These are based around a heat network that supplies more than one building or dwelling and provides significant benefits for customers especially households. A scheme may supply heat to the network from conventional boilers; from renewables-fired boilers; or utilise the waste heat from power generation (Combined Heat and Power, or CHP). In addition a scheme may provide other services for example, electricity (either over the public network or via private wire) or chilled water for air conditioning.

The Government's Community Energy programme has £50 million available for capital expenditure over the next two years for Local Authorities, Registered Social Landlords (RSLs), Hospitals, Universities and other public service organisations. It applies to England, Wales, Scotland and Northern Ireland.
Energy Services aims to stimulate innovative, sustainable projects which help customers use energy more efficiently.

A project can involve partnerships between housing associations, local authorities and energy suppliers.

Section 11: Recommendations

The purpose of the report is to consider those types of renewable energy that can be used in a beneficial way at the Queen Elizabeth Country Park. This is principally based upon economic considerations, where an acceptable pay back period on investment can be identified, or where other benefits can be found. However, because of the possibility of using the Park as a teaching and training location, there are advantages of having systems of renewable energy which may not be cost effective, but which provide a valuable training tool.

We would therefore recommended that a biomass boiler system be installed to provide the basic base heating load for the centre, and coupled with solar panels of 2 types, hot water provision. Photovoltaic cells can be used for generating a percentage of the centre's overall electricity load, coupled with a small wind turbine.

All of these facilities will be monitored constantly to show instantaneous and accumulated energy production.

In addition, rainwater will be harvested and used to reduce potable water consumption, and this too will be monitored.

We do not consider that there is an effective case for heat pumps of any type in this study, as the alternatives are more cost effective, and the capital cost rules out their use for study purposes only.

Gray water recycling is also ruled out on cost grounds, as the potential savings in WC water consumption are too small to be cost effective, and can be replaced by the rainwater harvesting system.

Micro hydro systems cannot be considered without the facility of running water present on site in sufficient quantity.