Energy Options Report

Hawkesbury Upton Village Hall
High Street
Hawkesbury Upton
South Gloucestershire

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About Encraft

Encraft are independent technical specialists in microgeneration and low carbon technologies. The company operates nationally and employs chartered electrical, mechanical and building services engineers, as well as low carbon consultants accredited by CIBSE. We are accredited by the Renewable Energy Association to provide impartial advice on all types of small scale renewables, and by BRE to act as independent consultants for the Community Sustainable Energy Programme (CSEP). The company has carried out many hundreds of feasibility and design studies since 2003.

Encraft are independent of installers, manufacturers and energy companies and offer impartial professional support to our customers, including:

- Feasibility studies
- System design and specification
- Energy strategy
- Full M&E consultancy services and indemnified designs
- Monitoring and analysis, including wind monitoring
- Passive design, including three dimensional building simulation
- Energy Performance Certificates (EPC)
- Project management

Document history

Date	Version	Author	Checked/comments
16th September 2009	1.0	Jon Garrett	Graham Eastwick

Legal note

The information which we provide is by way of general guidance only to your situation (so for example we do not provide any assurance that particular savings will be realisable, as they are indications only at this stage).

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SUMMARY

This report presents the results of a preliminary assessment of renewable energy technologies and energy saving opportunities at Hawkesbury Upton Village Hall. The study has been funded under the Big Lottery Community Sustainable Energy Programme (CSEP) and will be used in preparing a Project Development Study for potential CSEP capital funding.

The purpose of this study is to i) assess the current energy performance of the existing building and how this might be improved ii) carryout an analysis on different renewable and low carbon technologies to determine their suitability.

The hall's total energy costs over a full year are £3,500 (excluding VAT). This is responsible for emissions of around 20.4 tonnes of carbon dioxide (CO_2).

Energy Efficiency Recommendations

The report detailed a number of insulation measures that you should seriously consider as all other energy projects will be cheaper and easier the more energy efficient the building is. Our recommendations are in order of cost effectiveness are:

(i) Fit insulation above all suspended ceilings
(ii) Install cavity wall insulation in all external walls
(iii) Replace single glazing with modern double glazed units

Carrying out measures (i) and (ii) would reduce the calculated heat load for space heating from 44kW to 36kW and reduce you current oil consumption by around £360p.a.

Heating system

The study looked at the feasibility of using oil or renewable heat to provide heating in the building. The report investigated for each technology the likely installation cost and what the energy costs and CO_2 emissions would be. A summary of these findings are outlined in the following table:

	Indicative capital cost	Estimated running costs p.a.	Estimated CO_2 emissions p.a.
36 kW Oil Condensing Boiler	£4,000	£1,372	10.2 tonnes
26 kW Ground Source Heat Pump	£30,000[1]	£1,608	5.4 tonnes
36 kW Wood Chip Boiler	£31,500	£978	1.1 tonnes

[1] For the heat pump you would need to upgrade the radiators in the building. This is not included in the capital costs as it is not an eligible cost under the grant programme.

36 kW Wood Pellet Boiler	£33,500	£1,761	1 tonne

For the GSHP and biomass boiler options there is grant funding available through the CSEP programme and the governments Low Carbon Buildings Programme Phase 2 (LCBP2). It is likely that planning permission would need to be sought should you decide to proceed with either the GSHP or biomass options.

The report concluded that as you use only small quantities of hot water the savings in using a solar hot water system would be small and for this reason this technology was not recommended.

On site micro-generation

There are a number of technologies that could be used on site to generate electricity for the hall. These are:

- Wind turbines
- Solar photovoltaic (PV) systems

The report concluded that if the modelled wind speed is correct at 6.2m/s at 10m above ground level, a wind turbine would potentially be a very attractive option.

Two small scale turbines were looked at: i) a Proven 6kW turbine and ii) the larger 15kW model by the same manufacturer. The likely capital costs and estimated savings are summarised to be as follows:

	Proven 6kW turbine	**Proven 15kW turbine**
Indicative capital cost	£24,000	£45,000
Estimated annual generation	17,950 kWh	50,000 kWh
Total annual saving	£2,796 - £5,309	£7,199 - £14,200
CO_2 saved p.a.	7.75 tonnes	21.5 tonnes

The turbine would require planning permission and this might be problematic as Hawkesbury is in an Area of Outstanding Natural Beauty

Unfortunately, the south facing roof is not suitable for PV panels due to shading from trees nearby. However, you could install a PV system on the north end of either the west or east facing roof. The output though would be around 20% less compared with the same system on a south roof

The report investigated what the capital costs and potential savings for a 3.9kWp system would be. These are summarised below:

3.9kWp solar PV system covering 31m^2 of roof	Indicative capital cost	£22,000
	Estimated annual generation	2,800kWh

space	Total annual saving	£547 - £1,317
	CO_2 saved p.a.	1.2 tonnes

There is funding available for both of these technologies under the CSEP and LCBP2 programme. The annual saving shown would depend on which government support mechanism the system is entitled to. Unfortunately, the higher figure would not be available were you successful in obtaining LCBP2 funding.

1 INTRODUCTION

Hawkesbury Upton Village Hall is a charitable community hall located in the village of Hawkesbury Upton in South Gloucestershire.

The village hall is a two storey building constructed in 1981 with a total heated floor area of approximately 460m^2. The building consists of a large hall with bar and stage, kitchen, toilets, changing rooms and showers. Upstairs there is a meeting room and a small office.

The hall building is well used by local community groups and organisations. For example, the hall is hired out five mornings per week during school term to a pre-school and toddlers play group. The hall is also used in the afternoons and evenings as a venue for the local badminton, karate, ballet, drama and dance club. At weekends the hall is often hired for private functions such as weddings and birthday parties.

The local parish plan supports the development of a sustainable energy projects in the parish. A local sustainable energy group has been set up to push this idea forward. The village hall has been identified as a suitable building for a potential demonstration energy project on carbon reduction.

The objective of this report is to provide the hall committee with an initial assessment of where the issues are, what the potential approaches to improving energy performance might be, and where effort and resources might most usefully be applied.

The report is based on a visit and survey carried out on 1st September 2009. It is structured as follows:

Section 2 summarises the current energy usage of the building, and the renewable energy resources available on site.

Section 3 sets out a series of approaches to reducing the environmental impact of meeting the site's energy needs, with a discussion of the broad advantages of each option.

Section 4 discusses grants that may be available.

2 COMMUNITY HALL ENERGY NEEDS AND RESOURCES

2.1 Current energy usage

The total energy cost over a full year for the community hall is around £3,500 (based on recent electricity consumption and oil deliveries). The village hall uses oil for all space heating as the village is not on the gas network. The total energy requirement for the building works out to be around 75,000kWh (~64,000 kWh for heating and ~ 11,000kWh for lighting and appliances). This level of energy usage is responsible for carbon dioxide emissions of approximately 20.4 tonnes per year.

The following table shows this energy consumption split between fuels and its associated cost and CO_2 emissions.

Fuel	Total consumption kWh p.a.	£ p.a.	Tonnes CO_2 p.a.
Electricity	10,714 kWh	£1,382[2]	4.6 t p.a.
Oil	64,392 kWh	£2,106[3]	15.8 t p.a.
Total	**75,106 kWh**	**£3,488**	**20.4 t p.a.**

2.2 Baseline theoretical energy demand

To determine what the heat load for the building is we have carried out a heat loss calculation.

To do this we need to evaluate the level of insulation for different elements in the building. For this we use u-values. The u-value is a measure of the energy transmitted by a square meter of material, given a one degree difference in temperature between its two sides. A better insulator will have a lower u-value.

For the baseline case we have assumed that extensions subsequently built comply with the thermal standards set by Building Regulations at the time.

[2] Based on an typical tariff for electricity of 12.9p per kWh for all units

[3] Based on a delivered oil price of 35p per litre

The insulation levels in the baseline case are assumed to be as follows:

	Thermal element	Construction type	Assumed u-value (W/m^2K)
1981 building	Wall	Stone brick cavity – unfilled	1.00
	Floor	Solid floor – no insulation	0.70
	Roof	25mm insulation	1.20
	Windows	Single glazing	4.80
Extensions	Wall	Insulated solid wall	0.45
	Floor	Insulated solid ground floor	0.25
	Roof	Insulated roof	0.25

The calculated heat load for heating the building based on a temperature uplift of 22 degree (that is from -3 degrees to 19 degrees) is calculated to be around 44kW.

Renewable resources

Appendix I summarises the theoretical renewable energy resource available at the hall.

According to the national wind speed database, the wind averages around 6.2 m/s at the hall at 10m above ground level (although this figure can vary by 25% from year to year). The national database is based on a topographical mathematical model of the UK, effectively modelling the wind as fluid flow over a smooth contoured surface driven by known weather patterns. This means it can be wrong, as local trees and buildings and detailed topography can have significant impacts. Taking the actual built environment into account the actual wind speed is therefore likely to be lower than 6.2m/s. However, there is no way of knowing without measuring wind speed at the proposed turbine location over a full year.

Solar energy falling on the hall is relatively predictable month by month, and this is also shown in Appendix I. Over the year as a whole around 1,139 kWh of solar energy will be available per square metre on this site assuming no shading.

However, the challenge for any renewable project is to transform this energy into the right form and deliver it when it is needed. The bulk of solar energy arrives in summer (see Appendix I) when heating is not required. Moreover, the efficiency of solar water heating collectors is around 50%, and the efficiency of solar electrical (photovoltaic) systems is generally lower than 15% (and they are very expensive). The next section discusses ways of rising to this challenge and developing an optimal energy system for the building.

3 APPROACHES TO IMPROVING ENERGY PERFORMANCE

This section discusses different approaches to improving the buildings environmental and energy performance. It is recommended to start with energy efficiency, which we cover in Section 3.1, and then we explore more sustainable approaches to heating, and finally electricity generation.

3.1 Energy Efficiency

It is important to start with energy efficiency, as all other energy projects will be cheaper and easier the more efficient you are in the use of energy.

3.1.1 External Walls

Around 35% of the heat in a building escapes through un-insulated walls. Insulation prevents heat passing through the walls so easily. Buildings built in the early 1980’s are unlikely to have had cavity wall insulation fitted. Retro fitting insulation to existing cavity walls is easy to carry out. The process causes little disruption and can be surprisingly inexpensive and can save much money, reducing heat loss through walls by up to 60%. Insulating material is injected from outside (or inside) into the cavity by drilling small holes in the wall into the gap between the outer and inner layers of brick.

To determine if fitting cavity wall insulation is possible you should approach a professional cavity wall installer to undertake an assessment of the building.

Product type	Blown glass fibre
Specification	Improve u-value to 0.40W/m^{2}K from 1.0W/m^{2}K (a 60% improvement)
Indicative installation cost	£1,500 - £2,000
Estimated annual fuel saving	£170

3.1.2 Roof

Heat loss through the roof can represent more than 20% of the total heat lost from a building.

The village hall doesn’t have a cold attic however there are a number of areas in the building with suspended ceilings (i.e. the main hall and meeting room). It is possible to add insulation fairly easily above the ceiling tiles. There are now products on the market specifically designed for this purpose called insulation pads. These are 200mm thick slabs of fibre glass sealed in polythene that sit directly above the ceiling tile. These typically cost around £6 - £8 per m^2

To insulate sloping roof areas is not that straightforward. If the roof rafters can be accessed then insulation can be applied between them (leaving a wide enough air gap between the insulation and roof felt for ventilation). Otherwise you might consider adding a layer of insulation board below the existing plaster ceiling.

Product type	Suspended ceiling - 200mm insulation pads
Specification	Improve u-value of suspended ceilings to 0.2 W/m^2K (approximately 150m2)
Indicative installation cost	£1,250 - £1,500
Estimated annual fuel saving	£190

3.1.3 Windows

The windows in the building are single glazed and air-leaky around the frames. Ideally they should be replaced with high performance double glazed units. Fitting modern double glazed units with a U-value of 2.0 $W/m^2/K$ or better will reduce the current heat loss by 60%.

Double glazing has other benefits besides saving energy. Condensation on the panes will be reduced, draughts will be eliminated and noise from outside will be less audible.

Product type	U-PVC double glazed units
Specification	Improve u-value of windows from 4.8 $W/m^2/K$ to 2.0 W/m^2K (60% improvement)
Indicative Installation Cost	£4,000 - £5,000
Estimated annual fuel saving	£58

3.1.4 Lighting

The village hall uses a mixture of fluorescent battens (switch control gear with T12 and T8 tubes), and compact fluorescent bulbs.

T12 fluorescent tubes with switch start fittings use more energy and have a shorter life than the more efficient 26mm triphosphor (T8) tubes. Replacing the existing T12 lamps with the slimmer T8 tubes would maintain existing lighting levels whilst reducing energy consumption by around 10%.

Replacing old control gear fittings with modern high frequency ballasted fittings can reduce energy consumption by 25% for better light output. High frequency fittings designed for the slimmer and more efficient slimmer T5 tubes can potentially save an additional 15%.

To avoid the high costs associated in replacing old switch control fittings (typically £100-£150 per fitting) cheaper T5 adaptor kits have been developed. Adaptor kits simply plug into the existing luminaire, transforming it electronically from conventional control gear to high frequency. The adaptor also enables the use of the smaller T5 tubes. Using T5's can cause a reduction in the existing lighting levels may cause them to become too low. We would therefore recommend that a small trial installation is carried out first before any bulk orders are placed.

Typical savings for standard sizes of T8 lamp using conventional control gear

Existing Lamp	New Lamp	Run hours for financial payback*	Expected Energy Savings
6 feet T8 70W	T5 49W	7,450	30%
5 feet T8 58W	T5 35W	6,670	40%
4 feet T8 36W	T5 28W	19,435	22%

* Assumes a £20 installed cost (including new T5 tube) and electricity at 12.9p per kWh

There are several suppliers we are aware of that sell such kits:-

(i) save it easy - www.saveiteasy.co.uk
(ii) 8 to 5 - energy saver- www.8to5energysaver.co.uk
(iii) ecotronic - www.ecotroniclighting.com

3.1.5 Space Heating and Hot Water

The space heating for the community centre is supplied from an IDEAL oil boiler rated at 41kW. The boiler also heats a single coil 300 litre hot water tank which supplies hot water to the kitchen, toilets and showers. Although it wasn't possible to identify the exact age of the boiler (the data badge that could have helped to identify the year of manufacture was missing) it is reasonable to assume that it dates from when the building was built and therefore is over 25 years old. The efficiency of a boiler deteriorates over time and therefore a boiler this old is likely to perform with a seasonal performance of no more than 70%.

It was also observed that the hot water tank is poorly insulated and the pipe work in the plant room is not lagged.

The simple solution would be to replace the existing boiler with a new A-rated condensing oil boiler. These are highly efficient with a stated efficiency of over 90%.

We have re-calculated the heat loss calculation to determine what the energy demand would be for the building if you were to implement the recommended improvements to the building fabric (walls, roof). The required heating load required would fall from around 44kW to about 36kW based on a temperature uplift of 22 degrees.

We have estimated below what the indicative capital costs might be for replacing your current oil boiler for a new model and the likely savings that this will generate.

Product type	36 kW oil condensing boiler with new hot water cylinder
Specification	36kW output
Indicative Installation Cost	£4,000

Energy input p.a.	41,569 kWh
Energy output p.a.	37,412 kWh
System efficiency	90%
Electricity cost p.a.	£1,372 @ 3.3 p/kWh

We have calculated the running costs using an oil price of 35p per litre. However, as you will be aware, the price of oil has fluctuated markedly over the past year. Last summer the delivered price for fuel oil was as high as 60p per litre. Due to the current economic climate it has now dropped back to an average price of around 35p however, energy analysts expect prices to begin increasing once more as we move out of recession.

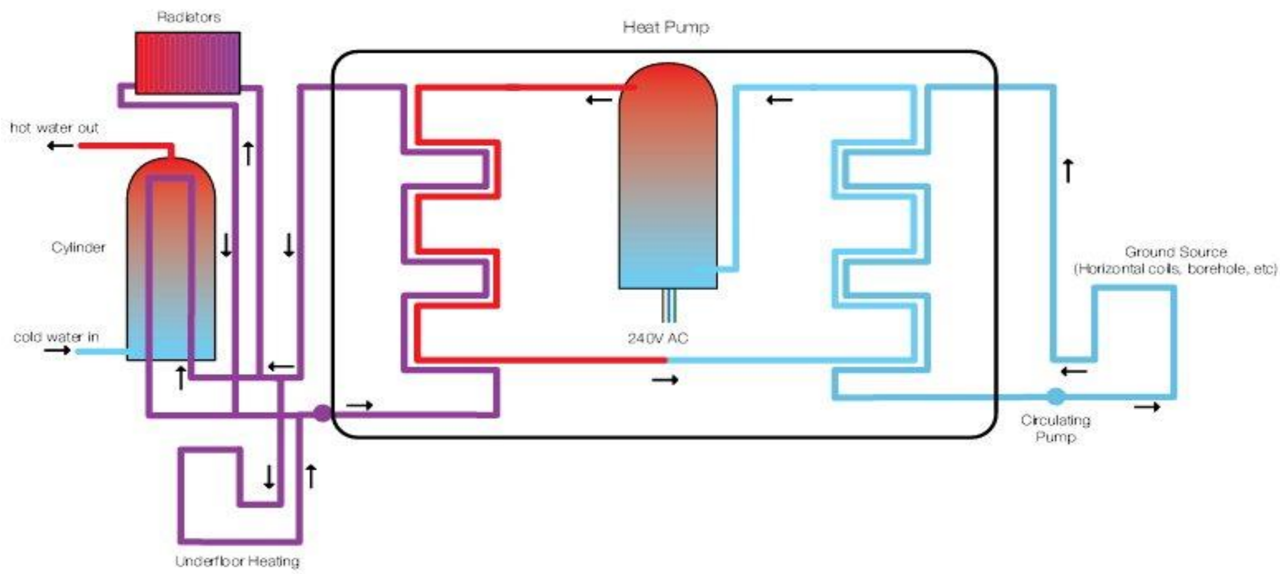
3.2 Renewable Heat

This section discusses options for renewable heat briefly, with a more detailed discussion of solar thermal systems at the end.

3.2.1 Heat Pumps

Technology Overview

Heat pumps use the refrigeration cycle to transfer heat from a source (such as the ground, the ambient air or water) through a heat distribution circuit to an internal space. Heat pumps are like a refrigerator in reverse. A refrigerator removes heat from the icebox making it colder and discards the heat which has been removed as waste into the kitchen. The device is called a heat pump because it takes heat from a low-grade source, a cold place and converts it into a higher-grade form by releasing it into a warmer place. The basic components of a heat pump are shown in the figure below:



The heat pump is powered by electricity but for every one unit of electricity used, 2 - 4 units of heat energy is produced as the total amount of heat energy delivered to the building is equal to the energy input through the compressor plus the energy extracted from the heat source. As heat pumps use electricity they are not CO_2 neutral.

The technology in heat pumps is essentially the same whether the heat source is from the ground, the water or the air. However, as there is an inherent difference in temperature stability between these sources the overall efficiency (commonly described as the coefficient of performance – COP) will tend to vary.

With a ground source heat pump (GSHP) system the earth absorbs a large proportion of the solar radiation that in the UK helps to ensure that the ground stays at a relatively stable 10-12^{o}C all year round. Air source heat pump systems (ASHP) cannot offer the same year round efficiencies since the ambient temperature is far more variable. Efficiencies will drop off as the ambient temperature falls just when there is a demand for heat. Water sourced systems potentially offer the best efficiencies.

The efficiency of a heat pump decreases as the required water temperature increases. Therefore, if the building's heat distribution system can be designed to effectively use water at only 35-40^{o}C then the COP will be significantly better than one that needs to heat the water to 55^{o}C. This is the reason why under floor heating is so desirable when connected to a heat pump: it only needs to be luke-warm to heat the building compared to conventional radiators that require flow temperatures well over 55^{o}C. This is also why it is better to install heat pumps in well-insulated buildings. In a well insulated building the water temperature for the under floor heating might be only 35^{o}C resulting in a COP of 4. However, in a building not so well insulated it might be 55^{o}C resulting in a lower COP of only 3.

Suitability of a GSHP at Hawkesbury Village Hall

A ground source heat pump (GSHP) collects the ambient heat from the ground using either boreholes (50-100m deep) or trenches (1.5-2 m deep and at least 3 meters apart). Due to the expense of drilling boreholes the majority of GSHP systems use pipes laid in shallow trenches. Trenches though require a large amount of land around the building to gather the necessary heat.

To keep capital costs down a GSHP is typically sized to provide around 70% of the maximum heat load for the building. This should cover approximately 95% of the annual heating load with the difference supplied using an electric online heater

To meet a heat load of 26kW would require 1,400m of pipe which would need around 880m^2 of land. This could easily be accommodated using your sports field at the back of the hall.

We have estimated below what the indicative capital costs might be for such a system (including trenching costs) to provide space heating and hot water:

	Capital Cost 26kW
26kW GSHP	£12,000
Ground collector (1,400m circuit)	£14,000
Installation cost and commissioning	£4,000
Total Indicative Cost	**£30,000**

Heat pumps are entitled to grant funding under the government's Low Carbon Building Programme – Phase 2 and the Big Lottery's Community Sustainable Energy Programme. However, neither will cover the cost of replacing the existing radiators with oversized radiators (typically 50% bigger) to ensure the same heat output with a lower flow temperature. You will therefore need to meet this cost yourself (estimated to be around £3,000 - £4,000).

The calculated annual running cost associated with this technology to provide all space heating for the building is shown below. The calculation assumes that the system will operate with high efficiency radiators at a flow temperature of around 50^{o}C.

	Community Hall (with insulation improvements)
Energy input p.a.	12,471 kWh
Energy output p.a.	37,412 kWh
COP	300%
Electricity cost p.a.	£1,608 @ 12.9 p/kWh
CO2 p.a.	5.4 tonnes

3.2.2 Biomass Heating

Technology Overview

Biomass is the name given to fuel derived from plants such as wood, straw and other waste materials. Biomass fuel is considered to be carbon neutral as the carbon dioxide released during its combustion is re-absorbed provided new plants are grown in their place. The common feature with these types of fuels is that their embodied energy is low compared to fossil fuels like coal, oil and gas so more must be burnt for the same energy.

In the UK there are two main types of wood fuel: (i) wood chips and (ii) wood pellets.

Wood chips can either be sourced from specially grown energy crops such as coppiced hazel and willow or from local woodlands using co-products from timber production and harvesting. It is normal practise for the wood to be chipped off site and then transported to the building in containers. Wood chip boilers can be highly mechanised with screw-feds or injectors to enable automated delivery of fuel to the burners. In terms of fuel costs wood chips are comparable to oil or gas but the cost of the equipment is considerably more. Wood chips will require a large area adjacent to the boiler to be put aside for storage purposes. It is important that the chips are kept dry and not allowed to decompose so mechanical turning equipment is often used.

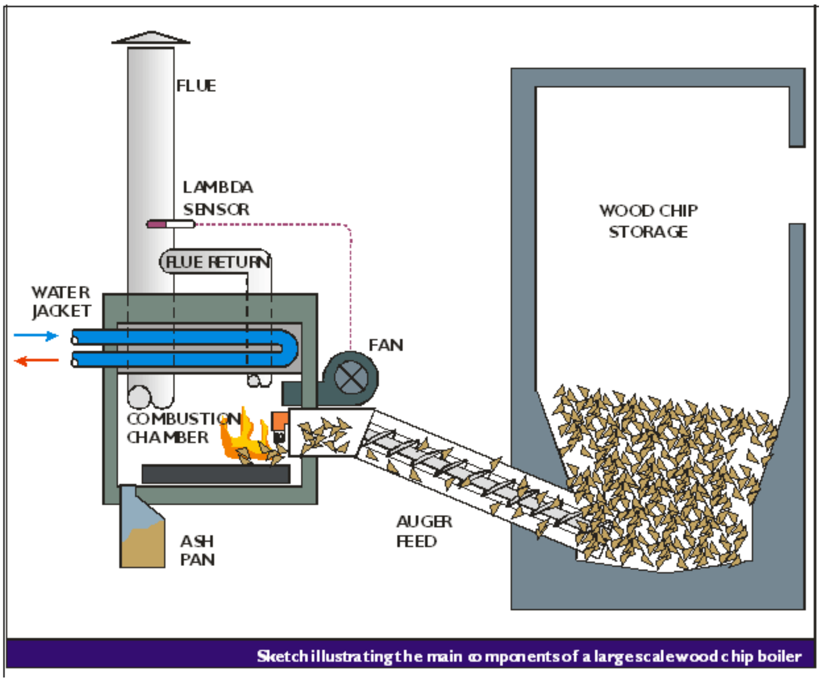


Figure: Typical automated wood chip and store

Wood pellets are a type of reconstituted wood fuel and originate from the by products of the timber industry. They are of a consistent quality and size, have a low moisture content (5 - 10%), and are relatively clean to use. These characteristics make pellets easier to transport, store and more efficient to burn than chips. Pellet boilers, like wood chip boilers, are fully automated with the wood pellets gravity or screw fed into the boiler at a rate that is varied depending upon the desired heat output. Larger wood pellet boilers are usually installed within designated boiler rooms and are screw fed from a covered fuel store located outside of the building. As with wood chips the fuel handling system is essential to the success of a biomass heating installation and will contribute to a high proportion of the overall capital costs.

The processing required to make pellets mean that they are more expensive than wood chips. Typically pellets purchased in bulk at the moment are more expensive than gas but as supply increases prices should fall.

Pellets and chips have various advantages and disadvantages that have to be weighed up. Which fuel is used will depend very much on local conditions and availability.

	Wood chips	**Pellets**
Heating value	3,7 kWh/ kg or 744 kWh/ m^3 @25% moisture content	4,8 kWh/kg or 3,080 kWh/ m^3 @5% moisture content
Density	200 kWh /kg	650 kg /m3
Storage space	Requires more storage space	Less storage space required
Price	Lower fuel costs	Higher fuel costs
Labour demand for plant operation	Higher labour demand for plant operation & maintenance, more ash amount	Less effort for plant operation and maintenance
Fuel quality	High and uniform fuel quality is important but difficult to ensure	Standardised fuel – higher operational reliability

To allow fuel flexibility boilers can be selected, that can be operated both with dry chips and pellets. It is necessary that the feed system is suitable for handling both fuels.

Suitability of Biomass Heating at Hawkesbury Village Hall

Potentially biomass can be very well suited for a community building like yours. Whether it is possible depends on a number of issues. Some of the key ones are listed below:

- Is there enough space for the boiler and an adequately sized fuel store?
- Is there access for delivery vehicles?
- What is the ability to source chips or pellets locally at a cost effective price?
- What level of automation would be necessary?

The existing boiler room is too small to accommodate a biomass boiler and fuel store and therefore an external plant room would be required. This could either be a new building constructed for this specific purpose or you could install a containerised boiler house with an integrated woodchip/wood pellet store.

If you carried out the recommended insulation measurers then for a chip boiler we estimate that you would require about 14 tonnes of wood chip per year. This would need a fuel store with a capacity of between $20m^3$ and $22m^3$ (based on 4 fuel deliveries per year).

Deliveries of wood chip are generally undertaken by tipping lorries where the chips are tipped straight into the fuel store or silo. This wouldn't be a problem provided the fuel store is located on the edge of the car park.

We have estimated below what the indicative capital costs might be for such a system (including trenching costs) to provide space heating and hot water:

	Capital Cost
36 kW wood chip boiler	£7,000
External flue	£3,000
Controls, accumulator tank and other equipment	£6,000
Installation and commissioning	£5,500
Containerised boiler house and fuel store	£10,000
Total Indicative Cost	**£31,500**

The annual running costs associated with the proposed wood chip boiler system for space heating are as follows:-

	Community Hall (with insulation improvements)
Energy input p.a.	46,765 kWh
Energy output p.a.	37,412 kWh
System efficiency	80%
Wood chip cost p.a.	£978 @ £70 per tonne
CO_2 p.a.	1.1 tonne
Fuel required p.a.	14 tonnes
Storage volume p.a.	70 m^3

A wood pellet heating system would need around 8.8 tonnes of pellets and therefore a smaller capacity fuel store with a volume of about $4m^3$ (based on 4 deliveries each year).

We have estimated below what the indicative capital costs might be for such a system (including trenching costs) to provide space heating and hot water. These costs are before any available grants are applied.

	Capital Cost
36 kW pellet boiler	£9,000
External flue	£3,000
Controls, accumulator tank and other equipment	£6,000
Installation and commissioning	£5,500
Containerised boiler house and fuel store	£10,000
Total Indicative Cost	**£33,500**

The estimated annual running costs associated with the proposed wood pellet boiler system are as follows:-

	Community Hall (with insulation improvements)
Energy input p.a.	41,569 kWh
Energy output p.a.	37,412 kWh
System efficiency	90%
Pellet cost p.a.	£1,761 @ £200 per tonne
CO_2 p.a.	1 tonne
Fuel required p.a.	8.8 tonnes
Storage volume p.a.	13.5 m^3

Biomass boilers are entitled to grant funding under the government's Low Carbon Building Programme – Phase 2 and the Big Lottery's Community Sustainable Energy Programme.

3.2.3 Solar Hot Water Heating

Technology Overview

Solar hot water (or solar thermal) is a well established renewable energy technology that can provide hot water heated by the energy from the sun. Solar thermal does not require direct sunlight to work successfully and in the UK they can supply a significant contribution to a building's annual hot water demand.

Solar hot water systems are best suited in buildings that have a consistently high daily hot water demand. In the UK around 50% of the annual energy from the sun falls in the summer months of May, June, July and August. This drops off significantly in the winter such that by December the available solar energy is only around a sixth of that available in June. As a consequence, it is uneconomic to size a solar hot water system to provide full hot water delivery throughout the year. Instead systems are typically sized to meet approximately 55% - 65% of the annual hot water requirement. Most of this will be provided during the summer. However, there will be some contribution even during the winter months.

There are two main parts to the most common type of solar water heating system. The first is the solar collector that traps solar energy and transfers it into the fluid flowing through it. The second is the system that transfers the heat within the collector to the water stored in the hot water storage tank; usually in a closed loop system. The system will not produce 100% of the annual hot water requirement so a top up immersion heater is required within the hot water tank.

Suitability of Solar Water Heating at Hawkesbury Village Hall

A community centre like yours typically does not have a large hot water demand. The main need is in toilets, showers and in the kitchen where small volumes of hot water are required constantly throughout operational hours. Hot water demand is likely to be even lower in July and August when the pre-school club is closed. In the UK a solar heating system is most productive in the summer so if the building is empty for long periods over the summer this free energy will be wasted.

For this reason we do not believe that a solar hot water system would be suitable.

3.3 On-site micro-generation

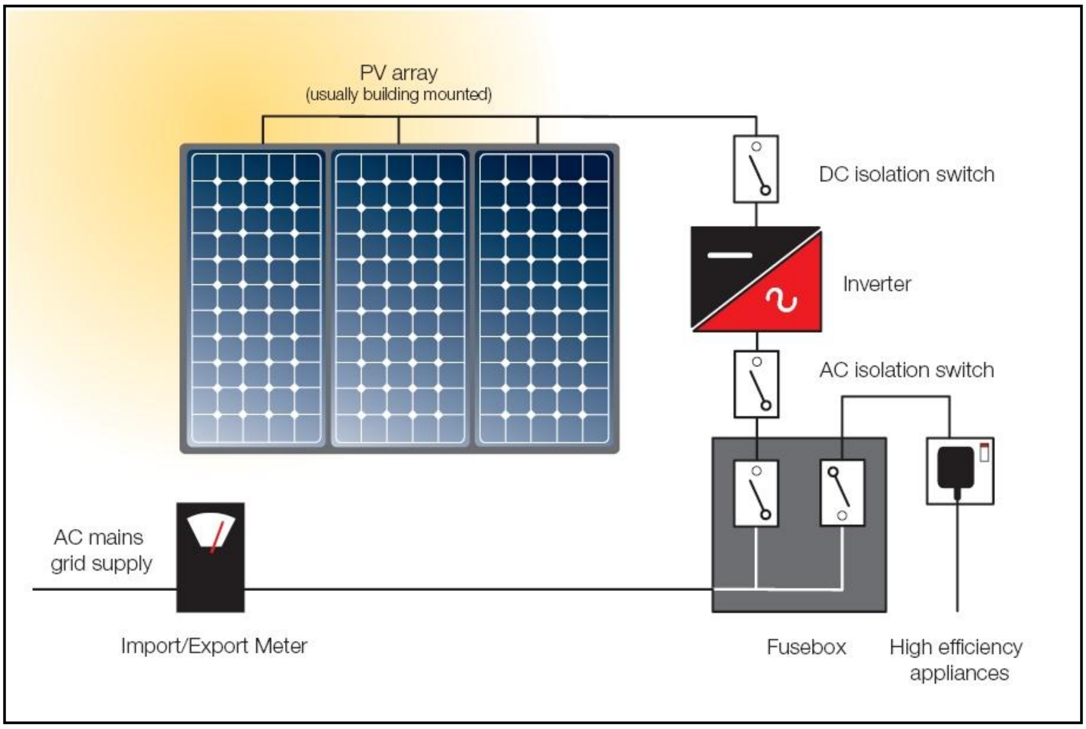
There are a number of technologies in the market that could be installed on site to generate electricity for the hall. These are:

- Solar photovoltaic (PV) systems (a totally different technology to solar water heating)
- Wind turbines

You can in principle generate as much electricity on site as you like as any excess can be sold through the national grid. In practice, however, the best financial returns come from using the electricity on site.

3.3.1 Solar PV

Solar photovoltaic (PV) systems generate electricity directly from sunlight. A typical system consists of an array of PV panels, an inverter, a controller, wiring and an import/export meter.



Photovoltaic modules can be placed on any building surface that receives sunshine for most of the day. The more light a PV array receives the more electricity it will generate. For best performance a solar PV array needs to be inclined at an angle of between 30 and 40 degrees - depending on the latitude of the site - and as near to due south as possible. The system also needs to be away from shadowing from buildings, tress and other structures as all can significantly reduce the performance of the system. Long cable runs from the array to the inverter should also be avoided as this can reduce the system performance due to power cable losses.

The PV system could either be a collection of framed modules that are mounted on the existing roof structure or alternately it could be integrated within any new building structure or replacement roof like a conventional building material. For example, roof tiles could be replaced with solar PV roof tiles that not only produce electricity but also perform all the insulation and waterproofing of a conventional roof.

The total value of the electricity generated consists of three elements:

(i) The value of the electricity used on site that would otherwise have been brought in from the grid.
(ii) The value of any surplus electricity that will be exported back into the supply grid if not used on site.
(iii) An amount paid for the total annual generation. This is currently referred to as a Renewable Obligation Certificate(ROC). A more generous support mechanism called a Feed In Tariff (FIT) will shortly be available. Both are discussed below.

The overall value of (i) and (ii) will depend on the daytime electrical load profile for the hall (which will vary on whether the hall is in use or not) compared to the PV generation profile (which will vary by month).

A Renewables Obligation Certificate (ROC) is a green certificate issued to an accredited generator (the home or business owner) for renewable electricity generated. One ROC is issued for each megawatt hour (MWh) of eligible renewable output generated. This means that you get one ROC for each 1,000kWh of electricity generated. If the electricity companies do not have enough ROCs they have to pay the other suppliers who do have enough. This means that the suppliers want to buy your ROCs to avoid being penalised. The payment depends on the supplier but they currently pay around £35-£45 per ROC.

From April 2010 the government will be introducing a new support mechanism for micro-generation technologies. The proposal is to provide financial support by paying a set 'feed in' tariff (FIT) for the total amount of power generated. The amount paid will depend on the technology type (and size in some instances). For solar PV systems under 4kW the suggested tariff for new installations will be 36.5p per kWh. This will be paid for a set period of 25 years. The same FIT will be paid by all the energy companies and the enrolment process should be relatively straightforward.

Unfortunately, the government's proposals state that installations that have been in receipt of a government capital grant will not be entitled to FIT payments unless the grant is paid back in full however they would still be entitled to receive ROC payments. The government is currently undertaking a consultation on these proposals and this requirement may be changed. A final decision is expected later in the year.

Suitability of Solar PV at Hawkesbury Village Hall

Solar PV is a very popular technology choice for community buildings. It is reliable, with a predictable generation profile that involves little maintenance and can be an excellent community educational resource.

Whether a building is suitable or not and what size of PV system to fit will depend on several key factors. These include (i) the area of suitable roof you have available (ii) whether the building has a three phase electrical supply (iii) the electrical base load of the building and (iv) the size of budget you have to invest.

Unfortunately, the small area of south facing roof on the hall is heavily shaded by a number of mature trees. This would significantly reduce the performance of a PV system should you install it here and is therefore not recommended.

You could however install a PV system on the north end of either the west or east facing roof which are reasonable shade free. The output though would be around 20% less compared with the same system on a south roof.

Fitting solar PV onto non domestic buildings does require planning permission. Locating the system at the back of the building would ensure that it isn't visible from the road and therefore negate any doubts over visual intrusion that planners may have.

The table below summarises the budget economics for a 3.9kWp system, these costs are before any available grants are applied.

		With ROC support	With FIT support	CO_2 p.a.
3.9kWp solar PV system covering 31m^2 of roof space	Capital cost of system	£22,000	£22,000	
	Estimated annual generation	2,800 kWh	2,800 kWh	
	Estimated annual savings from displaced power	£253	£253	0.85 tonnes
	Estimated annual exported power	£42	£42	0.35 tonnes
	Potential value of FIT at 36.5p per kWh	N/A	£1,022	
	Potential value of ROC at 9p per kWh	£252	N/A	
	Total annual saving	£547	£1,317	1.20 tonnes

The calculation assumes that 70% of the total generation is used on site and 30% is exported. Savings are calculated on your electricity tariff of 12.9p per kWh. Carbon dioxide emissions are calculated using a CO_2 emissions factor of 0.43kgCO_2/kWh. The output assumes the panels are south facing and at a tilt angle of 45°.

Because of its lack of moving parts and simple connections a PV system generally requires little maintenance. To avoid any loss in performance the panels should be cleaned periodically to remove any build up of dirt (or bird droppings). However, provided the panels are at a tilt greater than 5% to the horizontal rain should keep the modules clean.

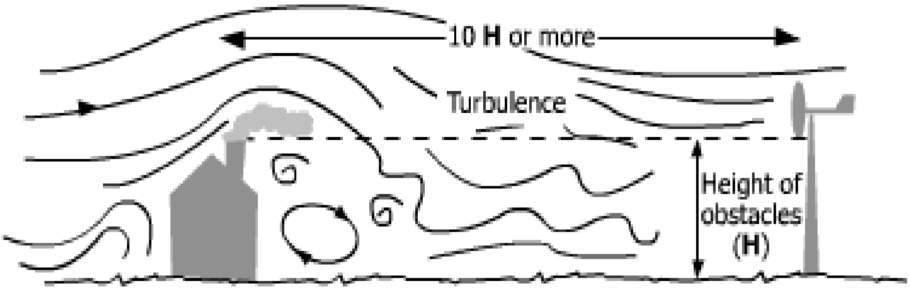
Most solar modules have a design lifetime of around 30-40 years. PV modules of all types usually have a performance warranty of 25 years. After this time the products would be expected to continue to function, but power output may be reduced. These times are only a rough guide and should be checked for each specific product.

3.3.2 Wind turbine

Wind turbines convert energy in the wind into electricity. A typical system consists of a pole mounted turbine, an inverter, a controller, wiring and a meter. It can either be grid connected where surplus electricity is sold to an electricity company, or stand alone where surplus electricity is stored in batteries.

A wind turbine is measured in size by the diameter of its blades and according to the number of electrical units it would produce at a given wind speed (usually 10ms-1). This is known as the rated power and is measured in kilowatts (kW). Turbine manufacturers also publish power curves which give you an indication of how much power may be produced at various wind speeds.

To ensure that a wind turbine operates effectively you need to locate it away from any nearby buildings and trees. Typically the turbine should be located a distance of around 10 times the height of nearby buildings and trees from these obstacles. This is to avoid turbulence. Turbulence has the effect of reducing the energy generated by the turbine and can also put additional mechanical stress on the turbine reducing its life.



Suitability of Solar PV at Hawkesbury Village Hall

If the modelled wind speed is correct, and the actual annual average is 6.2m/s at 10m above ground level, a wind turbine would potentially be an attractive option. However, even on good sites the performance of a wind turbine system is impossible to predict with a high degree of certainty due to the variability in the wind from location to location and from year to year.

Hawkesbury village is in a rural area and therefore as long as the turbine is kept well away from buildings and trees any reduction in wind speed from turbulence should be minimal. The hall has ownership of an area of land at the back of the hall which is used as a sports ground. A good location to site a turbine would be alongside the northern perimeter of the playing field. This backs onto open farm land and looks to be the most exposed. It is also a good distance away from trees, buildings and other obstructions.

A suitable sized turbine for your requirements would have a rated output of between 5-15 kW. In this output range there are now a number of products in the market that are accredited for government grant funding. One such product is the Proven 6kW or the larger Proven 15kW turbine. A cost analysis for both these products is shown below.

Proven 6kW

This type of turbine would be mounted on a 10-15m tower. The rotor diameter is 5.5 m. The tower requires concrete foundations 3m x 3m x 1.2m.

The table below summarises the budget economics for such a system.

<table>
<tr><th></th><th></th><th>With ROC support</th><th>With FIT support</th></tr>
<tr><td rowspan="8">6 kW Proven wind turbine with a rotor diameter of 5.5m mounted on a 10m tower.
</td><td>Installed Cost (including foundations)</td><td>£24 000</td><td>£24 000</td></tr>
<tr><td>Net energy delivered per year</td><td>17,950 kWh</td><td>17,950 kWh</td></tr>
<tr><td>Estimated annual savings from displaced power</td><td>£463</td><td>£463</td></tr>
<tr><td>Estimated annual exported power</td><td>£718</td><td>£718</td></tr>
<tr><td>Potential value of FIT at 23p per kWh</td><td>£4,128</td><td>Nil</td></tr>
<tr><td>Potential value of ROC at 9p per kWh</td><td>Nil</td><td>£1,615</td></tr>
<tr><td>Total annual saving</td><td>£5,309</td><td>£2,796</td></tr>
<tr><td>Total annual carbon dioxide saving</td><td>7.72 tonnes</td><td>7.72 tonnes</td></tr>
</table>

The calculation assumes that 15% of the total generation is used on site and 85% is exported. Savings are calculated on your electricity tariff of 12.9p per kWh. Carbon dioxide emissions are calculated using a CO_2 emissions factor of 0.43kgCO_2/kWh.

Proven 15kW

This type of turbine would be mounted on a 15m tower. The rotor diameter is 9m.

The table below summarises the budget economics for such a system.

		With FIT support	**With ROC support**
15 kW Proven wind turbine with a rotor diameter of 9m mounted on a 15m tower. 	Installed Cost (including foundations)	£45,000	£45,000
	Net energy delivered per year	50,000 kWh	50,000 kWh
	Estimated annual savings from displaced power	£323	£323
	Estimated annual exported power	£2,375	£2,375
	Potential value of FIT at 23p per kWh	£11,502	Nil
	Potential value of ROC at 9p per kWh	Nil	£4,501
	Total annual saving	£14,200	£7,199
	Total annual carbon dioxide saving	21.5 tonnes	21.5 tonnes

The calculation assumes that 5% of the total generation is used on site and 95% is exported. Savings are calculated on your electricity tariff of 12.9p per kWh. Carbon dioxide emissions are calculated using a CO_2 emissions factor of 0.43kgCO_2/kWh.

Planning Policy Statement 22 (PPS22) sets out a clear national policy framework on renewable energy for planning authorities in England to ensure that the Government's renewable energy targets are met. Under PPS22 regional and Local Planning Authorities should recognise the full range of renewable energy sources, their differing characteristics, locational requirements and the potential for exploiting them subject to appropriate environmental safeguards.

Hawkesbury is in an Area of Outstanding Natural Beauty (AONB) so planning permission would be more problematic to obtain. Small scale turbines have been permitted within AONBs provided that it is proven that the visual impact of the development is minimal and that the natural beauty of the AONB will be conserved.

4 POTENTIAL FOR GRANTS

Appendix II summarises currently applicable national grant programmes. In addition, local authorities and development agencies may provide grants if they see projects meeting the objectives of local plans and/or carbon reduction programmes.

APPENDICES

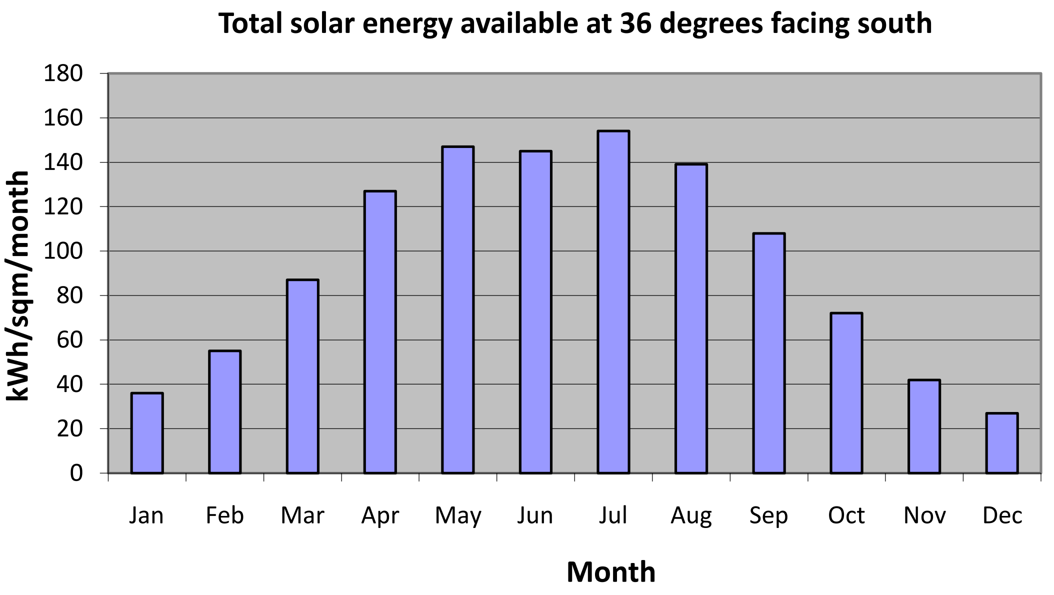
Appendix A Renewable Resources

The table below shows the total annual renewable resources anticipated in a typical year. Data is taken from EU and DTI databases.

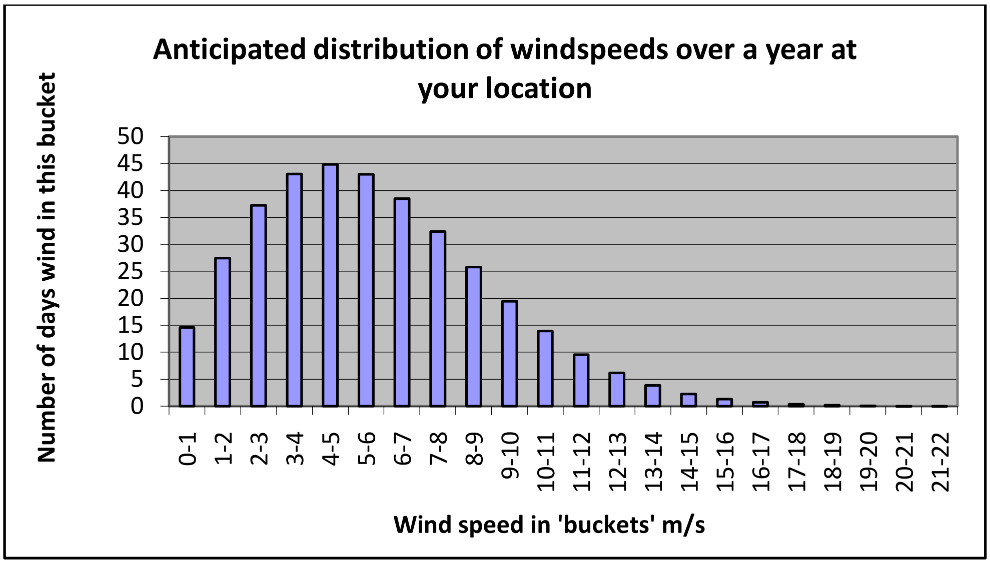
Solar energy (insolation)	1,139	kWh/m^2 at 36 degrees inclination from the horizontal
Average windspeed	6.2	m/s over a full year at 10m above ground level

Variation in renewable energy resources

The charts below show the expected variation in solar radiation and windspeed at this location over a year.



Source: European Union Joint Research Centre



Variation in wind energy

Note that windspeed is somewhat less predictable than sunlight, and the *average* windspeed may also vary by +/-25% from year to year at the same location. The energy available in the wind is also severely limited by local obstacles, such as houses and trees.

Appendix B Grants Available

Low Carbon Buildings Programme Phase 2 (LCBP2)

Phase 2 grants are open to public sector and not-for-profit organisations. The scheme provides capital grant funding for the installation of micro-generational technologies in England, Wales, Scotland and Northern Island. The scheme began in December 2006 and has recently been extended with a further £35 million of government funding. The programme will now run until April 2010 for electricity generation technologies (solar PV and wind) and April 2011 for renewable heat technologies.

Organisations may apply for up to 50% of the cost of installing approved technologies up to a maximum of £200,000. A maximum of three eligible technologies can be applied for at each proposed installation.

The programme is open to all products and installer companies registered on the Micro-generation Certification Scheme (MCS). A full list of these can be found at

www.microgenerationcertification.org.

Eligible micro-generation technologies are:

- Solar photovoltaic's
- Solar thermal for hot water
- Small scale wind turbines
- Ground source heat pumps/Air source heat pumps
- Automated wood pellet stoves
- Wood-fuelled boiler systems
- Micro-hydro Turbines

How to apply

The Building Research Establishment (BRE) has been appointed by the government to manage the scheme on the government's behalf. Applicants can apply either online or by post. Online applications can be made from www.lowcarbonbuildingsphase2.org.uk . Copies of installer quotations and proof of not-for-profit status need to be provided with the application form.

The application will be assessed and the applicant contacted with the decision within 5 – 7 days. The application will be assessed against criteria set out in the application form. A grant offer letter will then be issued to successful applicants. The grant offer letter will specify a deadline, usually 12 months, by which time the installation must be completed. It is a condition of the grant that the system will remain installed and in use for a period of at least 5 years.

Match funding

An applicant is not entitled to receive a grant for the proposed technology if they have or will receive any funding from the national government or devolved administrations in relation to the proposed technology. This includes funding from the Low Carbon Building Programme Phase 1 and the Bio-energy Capital Scheme. However, applicants may receive funding from other public sources (including Big Lottery and Local Government)

Community Sustainable Energy Programme (CSEP)

The Community Sustainable Energy Programme (CSEP), a Big Lottery Fund Scheme, will be launched in April 2008 to offer capital and project development grants to not-for-profit community-based organisations in England to them reduce their energy bills and environmental impact. The grant money can be used for the purchase and installation of renewable technologies along with various efficiency measures.

The programme will provide capital grants of up to £50,000 or 50% of the project cost, whichever is lower, for installing micro-generation technologies and energy efficiency measures. Matched funding can potentially be obtained from the Low Carbon Buildings Programme (LCBP) which may mean that the project receives 100% funding. Eligible micro-generation technologies are:

- Solar photovoltaics
- Solar thermal for hot water
- Small scale wind turbines
- Ground source heat pumps/Air source heat pumps
- Automated wood pellet stoves
- Wood-fuelled boiler systems
- Micro-hydro Turbines
- Energy efficiency measures such s cavity wall and loft insulation, heating and lighting controls

Further details can be found at - www.communitysustainable.org.uk

Scottish Power Green Energy Trust

The trust was established in 1998. Its purpose is to support the development of renewable energy sources across the UK. The trust is funded by the customers of Scottish Power Green Energy Trust and Scottish Power. So far £680k of money has been awarded to around 70 projects.

The trust can provide up to 50% of the capital costs of the project costs up to a maximum of £25,000. The trust supports projects that are shown to i) advance renewable energy and ii) support communities through education and public engagement. Technologies it funds include all of those supported through the low carbon buildings programme. The trust meets three times a year to consider applications. Further information on the Green Energy Trust can be obtained by calling the Secretary of the Trust on 0141 568 3492.

Eon Source Fund

The Eon Source fund offers grants for sustainable energy projects of up to £30,000 to community groups and not for profit organisations located in England, Scotland and Wales. The fund can be used to support energy efficiency measures as well as the installation of micro-generation technologies like heat pumps and solar PV. All applications for funding are assessed by a panel of experts 3 times per year.

The fund is unable to support religious or political bodies.

For further information can be found at www.eon-uk.com/2060.aspx

Esmée Fairbairn Foundation

Esmée Fairbairn Foundation is one of the largest independent grant making foundations in the UK. They make grants to organisations that aim to improve the quality of life for people and communities in the UK, both now and in the future.

In 2007 they expect to make grants totalling £29 million across the UK for charitable purposes in four programme areas: Arts & Heritage, Education, Environment and Social Change: Enterprise and Independence. £5.9 million has been allocated to the environmental programme for this year to fund a number of priority areas one of which is the adoption, on a nationwide basis, of renewable energy. The foundation can be contacted on 020 7297 4700.

Landfill Communities Fund

The Landfill Communities Fund (LCF) enables waste operators to provide funding to organisations through their tax credits for certain types of qualifying environmental projects. Grants awarded are typically in the region of between £5,000 and £50,000. Before an application can be made, a project must be identified which complies with the LCF objectives. These are:

- Reclaiming land, the use of which has been previously prevented by some activity
- To reduce or prevent pollution on land
- To provide or maintain public parks or amenities within 10 miles of a landfill site
- The restoration or repair of buildings for religious worship or architectural or historical interest within 10 miles of a landfill site
- The provision, conservation, restoration or enhancement of a natural habitat.

ENTRUST is the regulator of the landfill tax credit scheme. In order to receive money through the LCF from a landfill operator it is necessary to register with ENTRUST as an environmental body