Renewable Energy – by Merlin Howse

A large part of the project at Steward Community Woodland has been to demonstrate and use renewable energy. This is because most electrical power produced world wide is done using fossil fuels thereby releasing ancient carbon into the atmosphere. The other major source of electrical power is nuclear power which has major long term risks involved.

Although I don't see the types of renewable energy we have demonstrated as being a solution to the global issues on their own I do see them as part of the solution along with energy efficient appliances and conservation.

A lot of the methods of producing power, especially in the early years cost little or nothing to build. This is because we have used reclaimed parts from skips and recycling centres. As we all know it is more economic both financially and in terms of our environment to Reduce, Re-use, Repair and Recycle.

Human Power

The first power produced on site was human power in the form of a cycle generator. We cycled to turn a generator that produced electricity that we either used immediately (the most efficient way) or stored in batteries (which is less efficient but can be more convenient). The cycle generators were mostly used to power our laptop computers on which we created and updated the website. We also used the cycle generators at public events to provide educational entertainment.

We have had three different designs of cycle generator all using old reclaimed exercise bikes and permanent magnet (P.M.) motors. The principle of the design is to turn a generator (an old P.M. motor) with the flywheel of the exercise bike. We produced up to 7 amps when charging a 12 volt battery but 4 or 5 amps (50 - 60 watts) is a far more maintainable average output. It was enough to power a laptop computer and a lot of our website was developed whilst cycling like this! See our website for more details. We currently don't use a cycle generator favoring the methods below!

Micro Hydro Power

It didn't take much cycling before we became interested in looking into alternative methods of power production. Fortunately we have a few streams in the woods which flow for the wetter parts of the year. This got us thinking about micro hydro power.

Hydropower is a clean and renewable source of energy that is cheap and reliable compared to solar and wind power. All that is required is a suitable amount of flowing water which our site is fortunate enough to have for some of the year.

Our first hydro system was built at no cost using only reclaimed parts. Drawing less than one litre per second from the stream. This system produced only 12 watts of power at an efficiency of less than 10%. But having spent no money on the project this was a good return and kept us in lighting and some computing over the winter of 2000 without having to pedal our cycle generators.

This worked OK, but we got frustrated with frequent blockages within the casing. We eventually switched to what was basically a four inch diameter plastic paddle wheel. This item was previously the cooling fan on the back of a large induction motor. This is turned with a jet of water from the penstock (pipe). It proved to be slightly more efficient than the pump impeller and blockages were less frequent to due the size of the jet.

Having established that it is perfectly possible to use reused pumps or even a simple paddle wheel - we decided to buy a professionally fabricated pelton wheel so that we can compare the performance differences.

We purchased, with grant funding, a 4" diameter bronze cast pelton wheel and after being unsuccessful at obtaining second hand larger diameter pipe for three years, we decided to buy new 150m x 2.5” plastic pipe with some of the remaining grant money. Still in the spirit of previous designs we used a reclaimed valve and mounting for the jet at the bottom and an old onion bag over an old fan housing in a salvaged plastic bath for the filter at the top. The generator used for this setup was a reclaimed Whirlpool washing machine P.M. motor.

This meant we could double our head (height the water comes down from) and minimise friction losses giving us 35-40 meters of head and a possible flow much greater than previous systems due to the increased diameter of pipe used. As a result, we produced 100 watts without using much more water than on our previous system.

The most we produced from this system was 300w but we had two problems with that, firstly that the generator started over heating and secondly that we weren't using that much power (we're not used to it you see) and the batteries started over charging.

Our most recent system involves the same filter and penstock but uses a pre-built turgo turbine unit that has been lent to us by a friend. This unit produces 200-300w at mains voltage. This higher voltage means less losses in the wires and also that we can use the power directly with mains devices. We also use battery chargers to store power for later use or for when we need to use power tools that require more than 300w. This unit has proved very reliable compared to previous systems with a slightly higher efficiency.

As an average micro hydro electricity production is possible for about 5 months of the year. This equates to 3600 hours of generation. In later years we have improved the efficiency of the water turbine and hence the power output.

2001 – 2004: 20w x 3600 = 72Kwh per year

2004 – 2007: 200w x 3600 = 720Kwh per year

2007 – 2009: 250w x 3600 = 900Kwh per year

Current rate of production = **900Kwh per year**

Solar Power

Photovoltaic solar panels are not something you can easily knock up in the home workshop! They involve a large industrial, chemical manufacturing process, and they are expensive. They are useful however if other sources of power are not available in the area and they are marginally better than nuclear or fossil fuel power.
We have purchased three different brands and types of panels in order to compare them in different conditions. A Kiacira 80w Polycrystalline, a BP 75w, and a 65w amorphous panel. More recently with more members to the project and more power requirements we have also purchased another two 120w polycrystalline panels.
They are very convenient, low mainenance and make up the summer shortfall when the micro hydro is not operational. Of course we use much less power in the summer with longer days and less computing and forestry work.

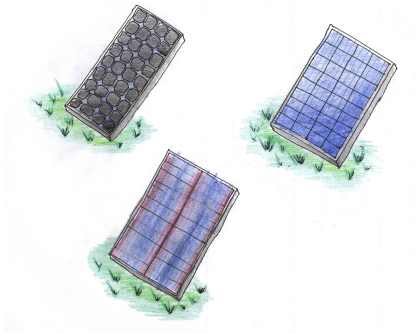
In the UK climate 1KW of PV solar panels will produce approximately 750KWh of electricity over a year.

2002 – 2003: 215w/1000w x 750KWh = 161Kwh per year

2004 – 2007: 340w/1000w x 750KWh = 255Kwh per year

2007 onwards: 400w/100w x 750KWh = 300Kwh per year

Current rate of production = **300Kwh per year**



Wood gasification

Wood gasification is a process where wood is burned in such a way that the flammable gas can be extracted before combustion. This wood gas can then be used either directly for heating or it can be filtered, cooled and fed into a converted petrol engine. This can then be used to drive machinery, a vehicle (as was common during the fuel shortage of the second world war) or a generator.

We are currently researching the possibility of using this technology to generate electricity and power forestry machinery such as a sawmill.

This forms a perfect renewable forestry solution using offcuts of timber to power machinery.

Consumption

The energy generated is used for domestic lighting and computing, and is now of sufficient quantity to power electric tools for forestry work. For mains devices we have got a 2Kw inverter which converts the battery voltage to standard 240v mains power. We received funding from the Woodland Trust for tools equipment, and we used part of this to buy an electric chainsaw for use with our renewable energy. This enables us to demonstrate completely sustainable forestry practice using a combination of hand tools and renewable energy. We have also recently been using an electric band saw on the renewable energy which has enabled us to make better use of timber from the site for building things such as nesting boxes.

Unfortunately we are still victim to the weather and we have found ourselves short of power on occasion. For this reason we do now use a petrol chainsaw if power is not available.

Conservation is the key however! Because our power is so limited we have learned to conserve electrical power to a large degree. With 11 adults and 7 children on site we use no more than 200-300 watts of power (thats about 15w each). 200 watts is the amount used by two standard light bulbs. We have also managed the project and the woodland using mainly this power alone.