# Renewable Energy at SCW 2014 – by Merlin Howse

One of our primary aims at Steward Community Woodland is to explore and promote innovative, sustainable practices and ways of living. This includes the use of renewable energy (RE) harvested from nature. Its not uncommon these days for houses to include solar panels but the DIY nature of our RE systems is always of great interest to our visitors. The use of RE has become more and more mainstream in the time we have lived here due to climate change, fuel scarcity and rising fuel prices. There are many people who now have their own RE systems who gained experience of them from visiting and seeing the installations on our site.

A lot of the methods of producing power, especially in the early years, have cost little or nothing to build. This is because we frequently use 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 favouring 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 during the wetter parts of the year. This got us thinking about micro hydro power. Systems of the size we have used are often referred to as pico-hydro.

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. All the micro-hydro systems used throughout our time here have been 'run of the river' systems, which do not require a dam or large reservoir (just enough to house a filter). This means that we can only generate power

from them when there is natural water flowing in the streams and we are unable to store power in a reservoir.

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 could 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 overheating 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 current system has 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 is now approximately 250w.

Current rate of production:

= 3600 x 250w

= **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. They are low maintenance and once the energy cost of production is covered (2-3 years currently) they are a good renewable source of energy. We have had various types of solar panels over the time we have lived here.

They are very convenient 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 forestry work.

PV solar is not uncommon these days but most systems are installed by qualified installers (which is necessary for grid connection and feed in tariffs) and often the consumers understand little about their workings. Our solar panels are a good example of an easy DIY off-grid solution to renewable energy and most visitors are interested to see how this works.

Currently we have 800w of solar on the communal system and some households have independent systems adding up to 2320w. This makes a total of 3.12Kw

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

Current rate of production:

= 3.12 x 750

= **2340Kwh 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.

With the help of a blacksmith we have built a system which has produced wood gas and fueled a converted petrol generator all be it for a small amount of time. It was discovered that further filtration of the gas was required to avoid damage to the engine. Progress and experimentation is ongoing.

This would form 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 building, maintenance and 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.

Conservation is the key however! Because our power is so limited we have learned to conserve electrical power to a large degree. With 13 adults and 8 children on site we use an average of about 360 watts of power (thats about 18w each).