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Living Off Grid - a brief outline by Malcolm Hay (energistar.com)

One of the major considerations when looking at Renewable Energy as a power source is the need to completely review your use of energy and to admit that you are never going to have the unlimited access to energy that you have been used to. Having thrown that bucket of water over you, it is not all bad. By following a few simple recommendations you can be totally self sufficient and have a very comfortable life with most of the facilities that we have become accustomed to.

To start with we have to dispense with all the high power consumption items found in a normal household, meaning anything that produces heat electrically, which includes electric kettles, ovens, hobs, immersion heaters, dish washers etc, however washing machines are a very important aid that cannot easily be replaced and can be used either in hot fill from your water heating system (wood burner etc) or cold fill (with built in heater) subject to rationing its use with regard to your available power. Luckily most modern washing machines will wash at very low temperatures which helps keep energy consumption low. Most of the items mentioned above can be substituted with gas powered equivalents. Although it is obvious it is still worth mentioning that lighting should be low wattage where possible, although some low energy lighting is not compatible with dimmer switches, although this I am sure will change as developments ensue.

Having done a survey of your electrical items to weed out the greedy ones, we now have to consider what power requirements you will need to run your home. Most off grid systems will be battery based, using the renewable sources to keep them charged and an advanced inverter/charger to supply the power you need. It may also be necessary to consider having a diesel generator as a backup for battery charging/supply if required, this can be automatically controlled by the inverter and also in the event of having something like a borehole pump that requires a lot of power on a regular basis, you can set the inverter to start and stop the generator on a suitable timetable.

A "normal" household will use approx 8-15kWh per day, we would expect an off grid system to survive on approx 3 or 4kWh per day, this includes fridge freezer, TV, lights, computer etc. When looking at the size of the battery bank, we would expect it to give you a minimum 2-3 days power from the battery bank alone without any input.

Batteries

We normally recommend using Rolls Deep Cycle Batteries as these are industrial quality (made in Canada) batteries that have been around for a long time and have a good reputation, although if you are looking to save some money it would be worth considering ex fork lift truck batteries if you can find them, check out any fork lift servicing companies in your area... Batteries come in a variety of voltages and amp hours (AH). The amp hours (usually measured over a 20 hr discharge called "c20") give you the storage capacity of the battery at its voltage. The common voltages are 2v, 4v, 6v and 12v, you use a combination of these to arrive at the bank voltage and AH you require*. We would normally recommend a minimum of 400AH @ 48V (8 x 6v/400 AH batteries) giving a bank of 19.2kW, of which we usually allow 50% discharge giving 9.6kW available, which would give you just over 3 days supply at 3kWh per day.

* When working out Amp Hours (AH) for battery banks, if you have a single battery (let's say a 12v one) that is rated at 100AH, then if you have 4 of these in series to make 48v, you will have a bank of 100AH at 48v. But if you had 4 in parallel at 12v, you will then have a bank of 400AH at 12v. If you multiply the volts by the amps, you will notice they provide the same amount of power i.e. 4.8kW, although not all of this is available, as you must never completely drain your batteries.

Renewable Sources

In order to keep your batteries in fine fettle they will need charging at a rate that exceeds the power that you draw from them, this can be accomplished from a number of different renewable sources, three of the main ones being Wind, Solar and Hydro generation. Two of the three sources are usually readily available, Wind and Solar. In the above example of a 48v/400 AH battery bank we would suggest having at least a 1kW Wind Turbine and a 1kW Solar Array

in order to give you a belt and braces approach to your power supply, if the sun isn't shining, the wind is usually blowing! In this instance you should get enough power from the Wind Turbine and the Solar Array to keep your battery bank fully charged. Obviously there will be times when due to our delightful and unpredictable weather the batteries may be a little short changed, but that is when you find out why you bought that generator! It is also worth mentioning that having a generator allows you to maintain your battery bank in top form by allowing the charge routine to be run in equalization mode (a special high voltage charge) periodically which helps keep the cells de-sulphated (the build up of lead sulphate on the battery plates will reduce the efficiency and eventually kill your battery).

Solar Panels are very reliable, require very little maintenance and are quite expensive! They are best mounted on South facing roofs using a special roof mounting kit, an average 245w panel weighs around 20kg each, so bear that in mind when deciding where to put your panels. Panels can also be sited on frames on the ground which can be beneficial as it would allow you to change the pitch angle of the panel to suit the time of year, but you may run into planning problems with ground mounting, check with your local council.

Wind Turbines obviously need to be in an area that is not surrounded by trees and buildings, preferably with a clear view to the south west (or your prevailing wind direction), they do better on a rising hill which tends to accelerate the airflow as it approaches the turbine. We do not recommend mounting turbines on domestic houses as the gable ends of UK houses are notoriously weak and they would also transmit any noise or vibration into the living accommodation. One of the simplest and cheapest mounts for the smaller turbines (1kW) is a guyed scaffold pole (these do not generally need planning permission as they are considered as temporary structures, but if in doubt check it out!) At the moment Wind Power is cheaper per watt than Solar Power, however this is narrowing as Solar manufacturing technology and quantities improve due to the demand for them.

Hydro Power is one of the best sources of renewable energy if you have it available on your land. One of its best properties is that it is usually fairly predictable and you usually have more of it in the winter when you need the power. If you have a stream on your property and the difference in height (head) between the highest and lowest sections of your stream is more than 10ft then you may have a chance of generation, although with such a small head you usually need a high flow rate. It is worth noting that Hydro will produce between 10 and 100 times more power than PV or wind for the same capital investment - if your source is good, it runs 24 hours a day, 7 days a week, providing lots of off-grid energy for as long as the water flows.....

Inverters come in a variety of sizes and usually two types, the cheapest are usually modified sine wave, which will run most items but may cause problems with washing machine motors or microwave ovens depending on the quality of the waveform. The best inverters to use are the pure sine wave type which will give you a wave form as good if not better than a standard grid supply. They do tend to be more expensive but are usually programmable and also parallelable meaning you can add modules for increased power capacity. They come as either inverter only or inverter/chargers, we find the addition of the charger to be very useful in an off grid situation as it allows you to have a generator as a backup if required, which can be autonomously controlled by the inverter. To judge what size of inverter you need, look at what your maximum power demand at any one time is likely to be, we usually recommend a minimum of 3kW to allow for washing machines, however a 5kW would give you a little extra should you ever require it. The modern inverter is very efficient usually in the region 95% and will automatically go into standby if no power is required. I would just mention that all the inverters we recommend are made in Europe or the US (Victron, Studer, SMA and Outback).

Feed in Tariff (in the UK) can be available to you even though you are off grid, as it pays for any power that you produce whether connected to the grid or not and also whether you use it or not! However it is a bit of a minefield as all the items have to be MCS (Microgeneration Certification Scheme) accredited, many of the small turbines (wind/hydro) are not accredited due to the accreditation fee of around £80,000 per model required..... This is just not a viable proposition for the smaller turbine manufacturers as to recoup that amount would price them out of the market. However a solar installation would usually qualify as long as it is installed by an MCS accredited installer, You would need to get advice on this as there are a number of "wrinkles" that need ironing out.

Generators come in all shapes and sizes, a basic rule of thumb is that they should be at least the same capacity as your inverter, they should preferably be diesel (bio-fuel/red diesel) and run at no more than 1500rpm, and as quiet as possible! One other point is that water cooled are usually quieter and you may be able to harvest the heat from the generator to supply your property.

Hope this helps those of you considering dipping your toes into the OFF-GRID renewable energy world, feel free to call if you need any further advice.

Regards

Malcolm Hay