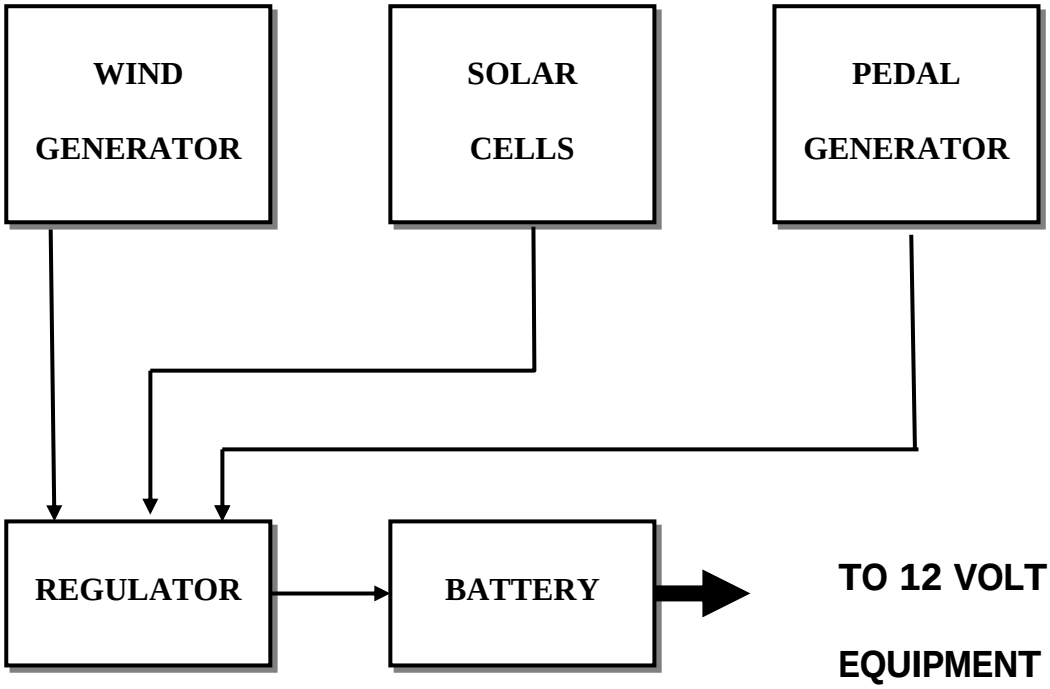
SMALL – SCALE WIND, SOLAR AND PEDAL ENERGY

The aim of this system is to charge a 12 volt battery using alternative energy. It comprises a wind generator, a photovoltaic array (solar cells) and a bicycle-driven generator. The outputs of these are connected to the regulator or charge controller to charge the battery. The maximum total charging current is about 10 amps, about 130 watts of power. In practice far less than this will be realised; it is not always windy or sunny. The pedal generator is very useful for backup charging when there happens to be no wind or sunshine for a time, but takes work to produce a useful charge. The diagram below shows how the system is connected up.



A small-scale system such as this will not power electrical space heaters or cookers. It is suitable for lighting, small sound systems, portable DVD players, etc. Other low-power equipment includes mobile phones and laptop computers with 12 volt adaptors. A small inverter, which converts 12 volts to mains, can be used for low power mains equipment if required. The inverter is connected to the battery and is normally fitted with a standard mains socket. Care has to be taken not to over-drain the battery.

The wind generator converts wind energy to electrical energy. It delivers 5 amps of charge at 40 to 48 k.p.h. (25 to 30 m.p.h.) windspeed. Choice of a site for optimum performance of any wind generator is very important. Ideally it needs to be sited at least 100 metres from, and 10 metres above, any obstruction, preferably on top of a hill. On a poor site with nearby trees and/or buildings a wind generator will spend most of its time swinging about

trying to pick up the various gusts and eddies induced by obstacles rather than providing good steady charging. The taller the pole or tower the better as wind speed increases with height for a given location. In view of these requirements, wind generators mounted on houses will result in very poor performance in over 99% of cases. This has been confirmed by experience. The wind generator was set up in a small, fairly exposed front garden near a bungalow for some weeks. The results were so poor compared with those from better sites that the wind generator was taken down.

Solar cells (photovoltaic or PV arrays) convert sunlight to electrical energy. These are often called solar panels, which can result in confusion with the solar panels used for heating water. The array in this system delivers 2.2 amps of charge in bright sunlight. Solar cells work under light to moderate cloud, but at reduced output. Over the darkest months of Winter they produce very little charge indeed; just a few percent compared with their output in Summer.

There are two basic types of solar cells. One is the "amorphous" array, which is typically dark brown with thin parallel silver lines about 15mm apart. The output from this type of array has been found to fall drastically over a 2 to 3 year period, so they are not a good long-term purchase. The crystalline (mono- or polycrystalline) type has a bluish appearance and is available in larger sizes. They are usually much more rugged, and efficient, than the amorphous type which are usually glass fronted. The array used in this system is over 18 years old and still performs very well.

The bicycle generator converts human energy to electrical energy. Bicycle generators can be a small generator fitted to a frame, which is clamped to the rear wheel spindle of the bicycle, or fitted in the hub of the rear wheel. The generator is driven by the rear wheel, and the frame supports the bicycle. Moderate effort is required to charge at about 2 amps. It's a matter of keeping this up long enough to get a reasonable amount of charge. Provided the frame, front forks and rear wheel are in reasonable condition, an old "scrap" bicycle can be used. The bicycle generator in this system comprises a scrap, overhauled bicycle, a 6 amp home-made generator and frame. Suitable generators can be bought commercially.

The regulator (or charge controller) electronically combines the outputs from the wind generator, solar cells and bicycle generator and regulates the charge to the battery to prevent overcharging. The excess power is dissipated by the regulator. It needs to be rated at more than the maximum total charging current that the system can generate. There are often meters on the regulator which indicate charging current and battery voltage. Switched and fused 12 volt outlets are often added at this point. Regulators are now widely available commercially.

The battery acts as a reservoir in that it stores electrical energy, thus making it available as required. Good quality deep discharge batteries are required; leisure batteries are good, but the best gel batteries have a 10 year guarantee. Car starter batteries are not ideal as they are not designed for deep discharge use. Using old, tired batteries is not advisable as they are inefficient and tend not to hold their charge – in effect the reservoir is leaky. The battery capacity (measured in amp-hours) needed depends on local climate and individual power usage, but one rated at about 100 to 200 amp-hours would be suitable for this system. This specifies the size of the reservoir. No battery should be discharged to below 11.5 volts. This means that the battery is approaching a state of such deep discharge that its service life may be shortened.

For general camping/caravanning, wind and pedal generators are usually impractical. For most purposes, a 40 to 60 peak watt PV panel, a regulator to suit, and a 100 amp hour leisure battery are recommended. Remember to set up the PV panel to face South, and that it is not shaded at any part of the day, if possible.

The pictures below show the bicycle charger, PV panel and wind generator, and a close-up of the home-made bicycle generator.