Renewable electricity

Electricity accounts for about 50 percent of the energy used in Australian households, but creates around 85 percent of the greenhouse gas emissions because most electricity is generated by burning fossil fuels.


'Houses' Magazine, Simon & Freda Thornton Architects / Samu Sawa Photographer

Fossil fuels such as coal, oil and gas are non-renewable energy sources.

Renewable electricity power systems (REPS) use renewable energy sources to produce electricity with very low greenhouse gas emissions.

Renewable energy sources such as the sun, wind and water are continuously replenished from natural sources.

When fossil-fuelled generators are used as back up, some greenhouse gases will be produced.

REPS usually operate at low cost but can be expensive to install. The cost per kWh for the system life includes the installation and maintenance costs and remains unaffected by future energy price rises.

The design and installation of a REPS is a complex task requiring specialist knowledge. The Sustainable Energy Industry Association (SEIA) has a register of accredited designers and installers who can ensure systems comply with the appropriate Australian Standards. The register can be accessed on SEIA's website at www.seia.com.au or by calling (02) 6230 1562.

Rebates may be available to offset the initial cost of installing REPS.

RENEWABLE SOURCES

The most common systems used in Australian homes are photovoltaics, wind turbines and micro hydro generators. These can be used alone or in combination.

Photovoltaic panels

Photovoltaic (PV) modules convert sunlight into electricity. They have no moving parts and are therefore reliable and require little maintenance. PV panels can be expected to last 20 years or more. PVs are suitable for use in urban areas as they take up little space and make no noise.


pvsolar@optusnet.com.au

Solar cells are usually monocrystalline, multicrystalline, or amorphous type. [See: Photovoltaic Systems]

The different module types are suited to different applications. Always seek expert advice before deciding which to use.

Solar modules come in different sizes ranging from two Watts peak (Wp) output up to 300Wp output. The most common modules sold in Australia are in the 60Wp to 80Wp range.

Solar modules can be mounted on a frame (either free standing or on the roof) or incorporated in the building fabric. Building Integrated PVs are more commonly installed in grid-connected systems than stand-alone systems.


AUSMEA and University of Newcastle

Wind generators

Wind generators or turbines use the wind to turn a propeller that drives a generator. They come in many shapes and sizes. The most common is the 'horizontal axis' turbine with blades like an aircraft propeller and a tail or vane to direct it into the wind. Wind generators are more suited to non-urban areas as the turbine needs to be mounted on a tower and makes some noise in operation.

Domestic wind generators are usually used in stand alone power systems and designed to charge a battery bank. [See: Batteries and Inverters]

A wind turbine produces an alternating voltage and current, and these are rectified to provide DC at the correct voltage to charge batteries, similar to the system in a motor vehicle.

Domestic sized wind generators range from 300 Watts to 5kW, but in some instances a 10kW or 20kW turbine could be used.
A typical installation will use a 1kW turbine.

The wind generator must be installed on the highest tower that is practical and cost effective for the site. The typical tower used in domestic wind generator systems is between ten and twenty metres tall. [See: Wind Systems]

MICRO HYDRO GENERATORS

Micro hydro generators convert the mechanical energy of flowing water into electrical energy. With a suitable water supply, micro hydro generators can produce energy more reliably than solar or wind generators.

Domestic micro hydro generators are usually used in stand alone power systems and can be either a DC unit, designed to charge a battery bank or an AC unit designed to supply the household loads directly.

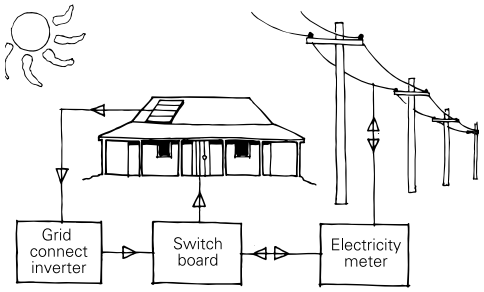
Domestic micro hydros are installed beside existing streams, at sites with a natural spring on a hill, or at artesian bores with suitable pressure.

DC micro hydro generators are generally in the 100 Watt to 3kW range, and AC units range from 300 Watts to 5kW. In some instances a 10kW or 20kW AC turbine could be used.
[See: Micro Hydro Systems]

With a suitable water supply a micro hydro unit can be the most cost effective form of renewable electricity.

SYSTEM TYPES

Most renewable systems are unable to provide electricity at all times as there may be insufficient sunlight, wind or water available. To fill the gaps, electricity can be supplied from storage batteries or generators in stand alone systems or from the electricity grid in grid connected systems.



Grid connected system

Grid connected systems

Grid connected systems interact with the electricity supply grid. Grid connected systems are generally located in urban areas and PVs are the usual energy source. The main components of the system are the renewable energy source and a grid interactive inverter.

The inverter converts the low DC voltage generated by the system to the normal 240V AC household supply. It also monitors the operation of the system to control how much electricity is drawn from or fed to the grid.

If the household uses more energy than the renewable sources can supply, the shortfall is provided by the grid so power is always available.

If the system is supplying more energy than is needed, the excess is fed into the grid. Often the meter just "runs backwards" when electricity is going into the grid, so the household only pays for the difference between what is imported and what is exported. Different suppliers have different buy-back rates and metering arrangements. Check with your electricity supplier for precise details.

System sizing is not critical as the grid is used for backup when the system output is insufficient for household needs.

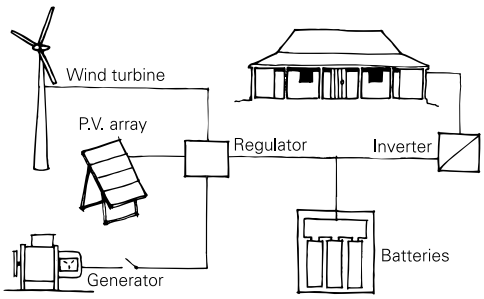
As a rule of thumb, a one kWp monocrystalline array will produce about 1,500kWh of electrical energy per year and will require nine square metres of space. An amorphous system will require more space. The system designer will specify and size it accurately for your particular location and load.

As the peak output of the system is determined by the size of the inverter, it can be useful to install a larger inverter than initially required. The excess capacity will allow additional modules to be added later. The size of the inverter will depend on your budget.

Grid connected systems do not have storage batteries and do not provide a guaranteed continuous power supply. If the grid goes down the inverter will cut out for safety reasons and there will be no electricity available.

Stand alone power systems (saps)

Sometimes known as Remote Area Power Supplies (RAPS), these systems are becoming more common in less remote areas. They are more complex and expensive than grid connected systems because they need to be self-sufficient.



Stand alone power system

The main components of a stand-alone system include:

> A renewable energy source.

> Control equipment for battery charging and backup power source operation.

> Storage batteries.

> An inverter. This is not required if the home runs 12 and 24V DC appliances. Although DC appliances are usually more energy efficient than their AC counterparts, they are more expensive and the range is limited. DC systems also need larger capacity and more expensive wiring. Some SAPS systems use a combination of AC and DC appliances.

A generator set for emergency backup. These are generally installed in PV and wind systems, but not micro-hydro. They are used for:

> Charging the batteries.

> Supplying specific high power loads.

> Emergency back-up in periods of unfavourable weather or when loads are larger than the original design.

It is generally recommended that the system includes a generator for battery charge equalisation. [See: Batteries and Inverters]

Your SAPS system should be designed to meet the required household load. Excess energy generated is stored in batteries for use when the renewable source is not available. The battery bank should be sufficient to provide power for several days.

SAPS systems are usually installed where electricity supply is not available or connection costs are high. However, some people install SAPS to be independent from the mains supply or to have reliable power in areas where blackouts are common.

In some cases it may be appropriate to use more than one type of renewable energy source, such as a photovoltaic system with a wind system.

REBATE SCHEMES

Under the Photovoltaic Rebate Program (PVRP), and the Renewable Remote Power Generation Program (RRPGP), cash rebates are now available from the Australian Greenhouse Office (AGO) to householders who install grid-connected or stand-alone photovoltaic systems. The rebate covers about one third to half of the price of the system excluding fossil fuel back-up generators. For more information call 1300 138 122 or see the AGO's website at www.greenhouse.gov.au. Some state governments provide additional rebates.

REDUCING ELECTRICITY CONSUMPTION

Investing in energy efficiency will avoid unnecessary expenditure on system capacity.

Before installing a renewable electricity system, your electricity usage needs to be calculated and minimised through energy efficiency or use of alternate fuels to reduce the size and cost of the system.

This is particularly important for systems that must be self-sufficient. They do not have access to the electricity supply grid for back-up and you may have to resort to using expensive fuels such as diesel. For grid connected systems, using less electricity reduces the amount purchased from the grid or increases the amount that can be sold back to the grid. This saves you money.

General rules

Use energy sources other than electricity where possible, e.g. solar for hot water. If solar is not suitable consider an efficient heat pump system. [See: Hot Water Service; Solar Hot Water]

Limit the use of high power demand electrical appliances such as cookers, microwave ovens, water heaters, room heaters, clothes dryers, air conditioners, vacuum cleaners and hair dryers.

Buy energy efficient appliances, especially fridges and freezers.

Use externally heated water from solar systems for clothes and dishwashers – do not let them heat their own water.

Use passive design building principles to reduce the need for heating and cooling.

Use natural lighting and energy efficient fluorescent lighting.

Be aware that many appliances use stand-by energy when not actually being used. Televisions, videos, clocks, computers, faxes, battery chargers, power packs, etc. still use power when they are "switched off". These small loads may be enough to switch on the inverter, and inverters are often very inefficient at low load. Turn appliances off at the wall switch when not in use and buy Energy Star approved models. [See: Energy Use Introduction]

ADDITIONAL KEY REFERENCES

The Australian Renewable Energy Website
www.renewable.greenhouse.gov.au

Sustainable Energy Development Authority, NSW
www.seda.nsw.gov.au/

Sustainable Energy Authority, Victoria
www.seav.vic.gov.au/renewable_energy.htm

Sustainable Energy Industry Association
www.seia.com.au/

SEIA, Introduction to Remote Area Power Supply Systems

Harris, M and Hutchinson,
A Build Your Own Green Technology Alternative Technology Association, Melbourne

Principal authors:
Geoff Stapleton, Global Sustainable Energy Solutions and Geoff Milne

Contributing author:
Chris Riedy