Sustainability Victoria

Renewable Energy Power Systems

It is possible to use renewable sources such as solar, wind and micro-hydro power for your domestic energy needs.

Today, renewable energy power systems can be a cost effective alternative for areas with high electricity connection fees.

It is also possible to connect renewable energy power systems to the grid, reducing the amount of electricity you need to purchase, or in some cases, allowing you to export surplus power into the grid.

This fact sheet provides a guide to the installation, workings and typical costs of renewable energy power systems.

About renewable energy power systems

Renewable energy is energy produced from sources which can be replenished or replaced from natural sources.

The most common forms of renewable energy used include:

> photovoltaic (PV) modules (solar electricity);

> wind turbines; and

> micro-hydro (water) generators.

Your home, holiday home or caravan can be supplied with electricity from any of these generating sources instead of, or in combination with, mains power.

Grid-interactive vs. stand-alone power supplies

Since renewable energy sources are often intermittent, (e.g. solar modules only work during daylight and give the best results during sunny periods) a method of storing the energy is needed. In Australia, the most common solution is to use storage batteries. Power from the PV array is used to charge batteries for later use. Because these systems work independently from the electricity grid, they are called Stand-Alone Power Supplies (SAPS). In situations where the cost of connecting to the mains grid is expensive, a stand-alone system can be a cost effective alternative. Many stand-alone systems use a diesel or petrol generator to charge the batteries during extended sunless periods or to run high-powered appliances.

An alternative is to use the electricity grid to store the energy. These systems are known as grid-interactive systems. The renewable energy is converted to electricity for use in the household and any surplus power is fed into the grid. Power is drawn from the grid when the renewable energy is insufficient to meet the homes electricity needs, so the home operates like any other. Some electricity companies prefer that all of the power from the PV array is fed directly into the grid and is separately metered, which means that all the power to the household comes from the grid like a conventional home.

Components and features of stand-alone power systems

Stand-alone power systems consist of several basic components and key features which are briefly described and shown in figure 1, below.

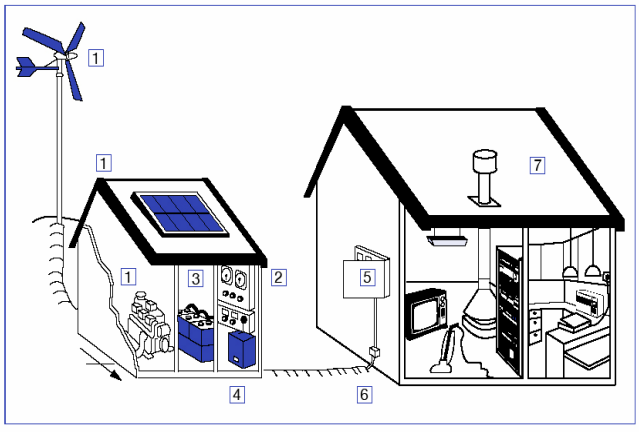

Figure 1

1. Generation equipment

PV modules, a wind turbine, a micro-hydro generator, or a petrol or diesel generator can provide electricity either on their own or in combination.

2. Control and regulation equipment

Regulators, controllers, meters and circuit breakers may be required to control such things as battery charging and to protect circuitry.

3. Energy storage

Specialised large capacity batteries are most commonly used to store energy so that a reliable source of electricity is always available.

4. Inverters

These convert the electricity from the batteries or renewable energy source to the electricity used by household appliances (240 V AC). Specialised "grid-interactive" inverters are able to feed electricity produced by renewable sources into the electricity grid without disruption to the household electricity supply.

5. Control Box

6. Wiring and electrical accessories

A well-designed system should include wiring that is large enough to keep energy losses to a minimum. Adequate fusing, earthing, lightning and other protection measures should be incorporated in the system.

7. Home design, lights and appliances

The design of any new home should incorporate energy efficient design features. Additionally, high efficiency lights and appliances should be chosen to keep the energy load on the REPS to a minimum, thus helping to reduce systems costs.

Grid-interactive renewable energy power systems

In addition to stand-alone systems, which require batteries to store energy, REPS can operate in conjunction with the mains electricity system. These are known as grid-interactive or grid-connected systems.

How do they work?

In grid-interactive systems electricity is still generated from a renewable energy source in the same way as a stand-alone system. The electricity generated then passes through an approved grid-interactive inverter, which converts the electricity into conventional 240V AC to be used by household appliances and equipment. If there is surplus power generated, this will feed back through the inverter and into the electricity grid. Conversely, if the building uses more power than your system is generating, the electricity grid automatically supplies the balance of the energy required without disruption to appliances (see figure 2).

Your electricity meter is used to measure the amount of ingoing and outgoing power, providing a net usage figure for your household. In most cases, surplus power fed into the electricity grid is credited to you, with the net consumption being charged at the end of each billing period. The electricity meter can effectively 'spin backwards' when excess power is being produced by the system. Specialised electronic (or 'smart') meters are sometimes used where more detailed power monitoring is required. As there are variations to this process, check with your electricity supplier for more information on equipment and metering details for your property.

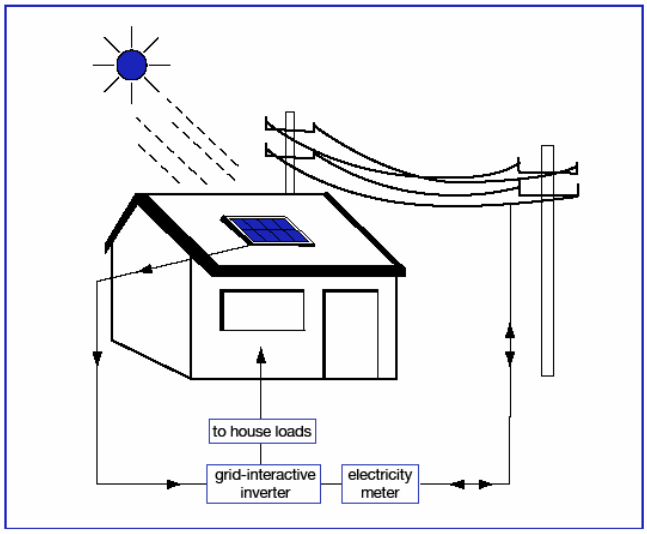

Figure 2

What are the benefits?

The major benefit of grid-interactive systems is that they produce power from clean, renewable solar energy, allowing householders to reduce greenhouse gas emissions and improve our environment.

As systems use the main electricity grid as a back-up, power is always available and systems can be sized according to the customer's requirements and budget.

Systems can be sized to provide a proportion of your power requirements if desired.

Another benefit of grid-interactive systems is that they generate most of their electricity during the day, when the state-wide demand for electricity from power stations is highest. Excess power generated therefore assists during times of peak demand.

System size

REPS must be designed and sized around your own specific needs for electricity. An undersized REPS will leave you less than satisfied, whilst an oversized system will involve unnecessary expense.

In establishing the size requirements of a REPS, you first need to analyse your household's electricity load requirements. This is done by finding the wattage of each appliance and estimating the time that each appliance is used. Multiplying these two figures will give you the energy used by the appliance over that time. Totalling this for all appliances will give you an indication of the electricity load requirements of your household (an example is given in table 1). It is important for this to be done accurately for every appliance - your REPS supplier can help you with this. To reduce the size, and hence cost, of the total system, energy efficiency measures will have great benefit in reducing both storage and generation requirements.

Appliance	Power required (Watts)	Number of hours used	Number of Watt hours (Wh)
KITCHEN			
Fluorescent light	20	3.00	60
Microwave	1700	0.25	425
Toaster	600	0.08	48
LIVING ROOM			
TV	200	4.00	800
Light	60	4.00	240
Stereo	60	2.50	150
	Total daily load		**1,723 Wh**

Table 1: Load calculation

Variations in daily and seasonal conditions, as well as site conditions, will determine your choice in generating equipment. It is recommended that you obtain quotes from a number of suppliers and compare components and warranties before purchasing a system.

System design and safety

Design and installation of a REPS should be supervised by a licensed electrical contractor.

The Australian Business Council for Sustainable Energy (BCSE) has accredited designers and installers who can install REPS according to the appropriate Australian Standards. It is vital that all safety regulations and instructions are followed. Contact the Sustainable Energy Authority for a list of BCSE accredited installers.

Minimising the size and cost of your system

The following general rules will help you to reduce the size and hence capital cost of your REPS. In the case of grid-connected systems, following these energy saving guidelines will reduce the amount of energy you need to purchase from the grid.

Avoid electrical appliances where bulk heating or cooling is involved, such as in cooking, hot water heating, space heating, clothes dryers or air conditioning. These functions use a lot of energy.

Refrigerators and freezers also have high energy use, so energy efficient LPG models should be considered. Choose whitegoods with as high an Energy Rating as possible. See www.energyrating.gov.au for the current list of the most efficient models.

Be aware also of the continuous energy requirements of clocks, including those on videos and microwave ovens. Wherever possible use battery operated clocks or disconnect appliances when not in use.

Consider alternatives such as those listed below.

> Heating - natural gas, LPG or solid fuel heaters combined with passive solar house design if possible.

> Hot water - solar, natural gas,

> LPG or solid fuel hot water services.

> Clothes drying - clothes lines.

> Cooking - natural gas, LPG or solid fuel stoves and microwave ovens (but be aware that microwave ovens only operate at full power when linked with a sine wave inverter, and that the power used is approximately twice the power output rating).

Examples of REPS

Described below are some typical home systems and their approximate costs.

These systems have been designed for particular energy needs and will only be relevant if your requirements are exactly the same. Daily energy output (watt-hours) is given for each system as a guide only. Obviously, the actual energy output will vary with location and the season.

System 1
Small system—suitable for a caravan or weekend house (average output 230 Wh)
(12V DC only)
1 x PV module of 90W output
1 x 200 Ah 12V battery
1 x regulator
Approximate cost $1500 (excluding wiring and installation).

System 2
Medium system (average output 2250 Wh)
(24V DC/240V AC)
14 x PV modules of 75W output
12 x 1000 Ah batteries
1 x regulator
1 x control board
1 x battery charger
1 x sine wave inverter with a rated output of 1200W or larger
Approximate cost—$15 000 (excluding wiring and installation).

System 3
Large system (average daily output 4500 Wh)
(48V DC/240V AC)
24 x PV modules of 83W output
24 x 1000 Ah batteries
Mounting equipment
1 x control board (with suitable meters, fuses and regulation)
1 x sine wave inverter with a rated output of 2250W or larger
Approximate cost—$35 000 (excluding wiring and installation).

The battery capacity has been calculated for five days autonomy with a maximum discharge limit of 50%. A minimum recommended storage time is two days but in this case a petrol or diesel generator would be required to backup the system.

System 4
Grid-connected system
(average daily output 3750 Wh)
13 x PV modules of 80W output
1 x 1500W grid interactive inverter
Mounting equipment
Approximate cost—$14 000 plus accessories and installation (excluding wiring, installation or meter upgrades if required).

Note: It must be emphasised that homes cannot be placed in rigid categories because electricity use can vary widely. The majority of households using stand-alone systems are small and the owners practise energy conservation within their own homes.

It is important for all systems that the correct cables, switches and fuses are used and that installation conforms to appropriate Australian Standards.

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Energy efficient house design

The design of the home itself is the critical starting point for reducing energy needs. Attention to features such as building orientation, insulation, shading, windows and building materials will result in an energy efficient design.

Photovoltaic Rebate program

A rebate is now available to householders who install grid-connected and stand-alone photovoltaic systems. Contact the Sustainability Victoria on 1300 363 744 for an information kit.

Green Power

If you are connected to the 'grid' you can buy electricity generated from clean, renewable energy sources. Green Power is a national program to promote electricity generated from renewable sources.

You can simply choose to buy Green Power from an accredited electricity retailer without the expense of setting up your own REPS - no up-front investment, no maintenance, just payment of a small additional amount on the regular electricity bill.

When you buy Green Power from your electricity supplier, renewable energy is purchased on your behalf from sources such as solar, wind, biomass, wave and hydro.

Visit www.sustainability .vic.gov.au for more details on Green Power products. For additional information on the Green Power accreditation process see www.greenpower.com.au for an up-to-date list of retailers providing Green Power.

Green Power
GOVERNMENT APPROVED

Further information

Visit the Sustainability Victoria website for more information and advice on:

> reducing your energy bills
> energy efficient house design
> hot water systems and usage
> renewable energy options.

www.sustainability .vic.gov.au

The Sustainability Victoria

The Sustainability Victoria was established in 2000 by the Victorian Government to provide a focus for sustainable energy in Victoria.

The Authority's objective is to accelerate progress towards a sustainable energy future by bringing together the best available knowledge and expertise to stimulate innovation and provide Victorians with greater choice in how they can take action to significantly improve energy sustainability.

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