Further Information ...

Electricity from the sun

Solar PV systems explained

SECTION C

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Further Information ...

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What is Renewable Energy ?

It is energy from a source that is regularly replenished – renewed – by natural processes.

RE Resources

Renewable Energy (RE) is provided, in human terms, from a near infinite source – the Sun.

Almost all forms of RE are derived from solar energy.

- Solar hot water (SHW) systems use the heat energy of the sun.
- Solar electric (photovoltaic - PV) modules use the energy of light itself to produce d.c. electrical power from the sun.
- Wind energy conversion systems (wind turbines) derive their energy from the sun. *The earth rotates, night turns to day,*
  the land and the sea heat up and cool down at different rates producing high and low pressure regions in the atmosphere.
  Air flows at different rates between these areas, creating wind that is used to turn wind turbines.
- Hydro power system also derive their energy from the sun.
  The sun heats the oceans, evaporating water to form water-vapour and clouds. The clouds retain their moisture until its weight is great enough to cause rain. When the rain falls over higher elevations of the land it collects into streams and rivers which provide a source of energy that can be tapped by hydro generators.

Of the forms of RE mentioned above, the first, SHW is ideal for domestic water heating but the others are most commonly used to provide electrical power for domestic and commercial systems.

There are other RE sources that are normally applicable to large scale generation only,
for example, tidal (using energy from the moon and sun) & wave (uses wind energy)

and there are carbon-based fuels …

These are solar energy stored as plant matter. When these fuels are burnt the carbon dioxide - CO_2 - is released, along with the energy. Where timber is grown locally and sustainably it can be used for heating with near zero net carbon dioxide emissions - the CO_2 released is equal to the CO_2 stored during the growth process.

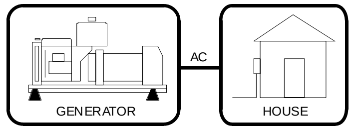
then there are fossil fuels, with which we have become very familiar during the last century.
Coal, oil and gas are forms of solar energy but they are not replenished regularly. They are also carbon-based fuels that derive from plants and release a large amount of CO_2 when burnt, but require geologic forces and time (millions of years) to form.
They are convenient and cost less, in dollar terms, to produce than most other forms of energy but they are also the most polluting forms of energy we could use.

Fossil fuels are NOT sustainable.

While at the current time fossil fuel reserves are still being found, most estimates reveal that within 50 to 100 years, other energy sources will be needed for the majority of our requirements.
If growth in the use of these fuels does not slow, then there will soon be no alternative but the use of ‘alternative’ energy sources.

What is a stand-alone power system ?

Genset only

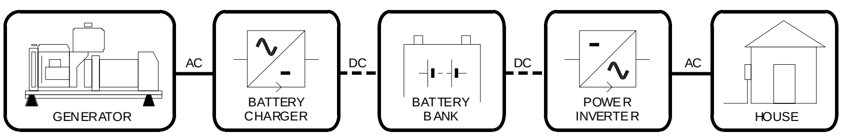


In its simplest form a SPS may comprise only a genset (petrol, diesel or LG) to provide electrical power.
Electricity is produced whenever the genset is running BUT this is often not the best solution as there are a number of disadvantages …

COST	The fuel and maintenance costs are high.
EFFICIENCY	The genset is often running very lightly loaded which leads to increased fuel and maintenance costs (and more frequent genset replacement)
INCONVENIENCE	Starting / stopping the genset, maintenance, Refuelling and noise produced.

Genset – Battery charger – Battery – Inverter

A typical SPS will use a battery bank for energy storage.



The power for your house is provided from the battery bank via a power inverter, which converts the d.c. power to 240V a.c suitable to run standard lights and appliances.

This is the same quality of power that is provided to your appliances by the grid.

BUT if the battery bank is not recharged and goes flat, you will have no power. It must be charged by some source. In this case, the genset will charge the battery bank through the battery charger.

The advantages over the genset only are …

COST	The genset is required for battery charging only - fuel and maintenance costs are reduced.
EFFICIENCY	The genset operates with a higher load which increases the genset life
CONVENIENCE	You can operate your lights and appliances without having to start the genset

The main disadvantage is higher capital cost for the battery charger, batteries and inverter.

Another option is to provide an alternate battery charging source. The majority of stand-alone power systems use solar energy for battery charging.

SPS configurations

A stand-alone power system can be provided in a number of configurations …

1. Genset input only, with energy storage (battery bank) and a.c. (inverter) supply. No renewable energy input. This option reduces genset runtime and hence fuel and maintenance costs.

2. A hybrid power system where renewable input provides the smaller portion of the energy requirement and the rest is sourced from regular, short genset run-times.

3. Smaller power systems where the majority of the energy required is provided from a renewable resource and where the genset input is minimised.

   A. Inverter and genset can act in parallel to supply large electrical loads
   B. Genset supplies all loads and charges the battery bank while it is running, with the inverter supplying the power to the loads for the rest of the time.
   C. Inverter supplies all loads with the genset used for battery charging only.

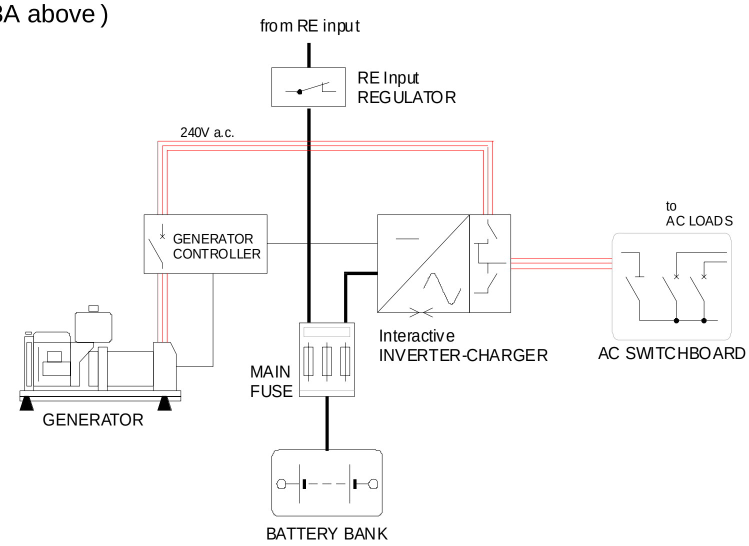
4. Small power systems where all energy is provided from renewable sources only. This option can be used when energy usage can be reduced during periods of reduced renewable input.

Configurations 1 and 2 above are most often used for larger domestic or commercial power systems.

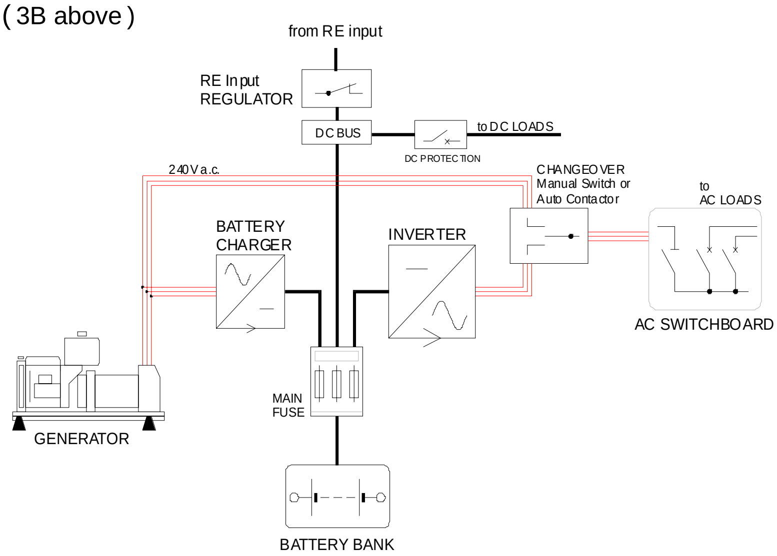
For most household power systems, for example, up to 20kWh energy use per day OR less than 10kW power requirement the configurations included in 3 above are the most likely power system solutions.

The following diagrams show the basic connection of …

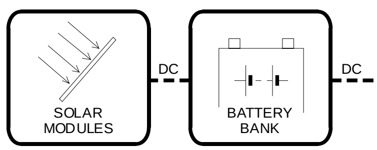
PARALLEL SPS with auto-start genset
(3A above)



SWITCHED SPS with manual genset start
(3B above)



Solar modules



Solar energy is one RE source that is commonly used.
Solar modules convert power from sunlight into d.c. electricity that can be used to recharge your battery bank.

Solar electricity is produced only when the modules are exposed to sunlight.

The stronger the solar radiation, the more power is produced.
The longer the day (e.g. summer days) the more energy is produced.
Cloudy or rainy weather will reduce both the power and energy.
Shading (from trees or other obstructions) will also reduce both the power and energy produced.
[Refer to SECTION C Power and Energy]

Since there are often longer periods of bad weather, for SPS, the size of your battery bank can be increased to extend the period before the batteries go flat. A system will typically be supplied with a genset and a battery charger as a back-up to recharge the battery bank 'on demand'.

Solar (photovoltaic - PV) modules convert sunlight directly into d.c. electrical power.
The modules are manufactured from a number of 'solar cells' connected in series to provide a suitable output voltage e.g. 12 or 24 volts.

The energy produced during the day is directly proportional to the amount of sunlight to which the modules are exposed.

This varies between locations and over a 12 month cycle
- more energy is produced during summer (or dry season) and less during winter (or wet season). PV modules produce less power as their temperature increases.

There are several types commercially available and others under development in labs around the world. The commercially available types fall into two categories …

1. Crystalline
These are modules with cells cut from pure silicon crystals. There are two types available :
Mono-crystalline solar cells manufactured from a single crystal
- the square cells are a uniform dark purple to black colour
and
Poly or Multi-crystalline solar cells are cut from a cast silicon block.
- the square cells are blue with individual crystal boundaries visible
The cells are normally encapsulated between glass and a sealed backing.
They can provide around 150 watts per square metre in full sun.

2. Thin Film or Amorphous
These are modules with cells deposited on a stainless steel substrate - the narrow cells are a uniform dark purple to black colour
The cells are normally encapsulated without a glass cover.
They can provide 100 to 120 watts per square metre in full sun.
- a slightly greater area is required, for the same power as crystalline modules

Other technologies
A range of other technologies like
concentrators (high temperature cells),
titanium oxide, organic dyes, ???
are currently in the lab or available in limited production quantities.
The PV industry is constantly looking for improvements in solar energy collection.

Batteries for stand-alone power systems

Batteries are the heart of any SPS.
They provide the energy storage necessary to ensure the availability of consistent power to the loads, from variable RE sources.

The main battery type used is lead-acid, either …
flooded - liquid electrolyte
or valve-regulated - sealed AGM or gel.
They can operate reliably for many years provided they are kept as cool as possible and are NOT deeply discharged too often.

Battery life is maximized by keeping the daily discharge below 20% of the battery capacity and ensuring that they are fully charged on a regular basis.

Because of the high discharge currents available and
hydrogen production in flooded batteries
- when the batteries approach full charge

BATTERIES CAN BE DANGEROUS

There are some safety requirements.
[Refer to SECTION C Australian Standards]

Inverters for stand-alone power systems

An inverter provides a 240V a.c. output to run standard appliances from the d.c. power from the battery bank. A modern sine-wave inverter can produce a better quality power than that provided from the power utility grid
- you are not connected to supply surges created by other power users.

There are 3 main types …

Inverters
These are the mainstay of modern power systems.
They provide high quality a.c. power with features such as, low battery disconnect and over-temperature / overload shutdown.

Inverter-Chargers
As well as providing high quality a.c. power, these can also provide battery charging from a connected genset. When the genset is running the inverter will switch from supplying power to the a.c. loads and charge the battery bank.

They can also have a range of monitoring and control functions such as,
Amp-hour logging and battery state of charge estimation
Genset control
Computer control and data download (direct or through a modem)

The a.c. supply will not be interrupted where the inverter controls the start-up and shutdown of the genset. Where the genset is started (and stopped) manually there may be a brief interruption of supply, most often during genset shutdown.

Interactive Inverters
Share all the features and functions of inverter-chargers
with the additional advantage that they can operate in parallel with the genset to supply a.c. power to large loads, when required. As they 'synchronise' their output with the genset, any change-over between the Inverter and genset is 'transparent'.

Inverters, inverter-chargers and interactive Inverters are available from a number of Australian and overseas manufacturers with a large range of features and functions.

Gensets for Stand-alone Power Systems

240V a.c. gensets of different sizes are available from a wide range of suppliers. The problems that can occur with auxiliary supply gensets for SPS also cover a wide range.
There are two main types of Genset used …
petrol / LPG and diesel powered.

Small 'portable', 3000 rpm, **petrol gensets** can be used
but their output sine wave is often unreliable - suffering from problems like high voltage >250V a.c. or high frequency >55 Hz
or 'spiking' of the waveform, at no load
OR if the genset has been run lightly loaded for extended periods,
it may have low voltage <230V a.c.
or low frequency <45 Hz under load
or even the inability to supply sufficient power for battery charging.

While small petrol gensets are used, they are normally limited to applications where …

the battery charger is a transformer type that is relatively insensitive to a.c. supply variations.
It is only used occasionally, for example -
during bad weather,
for larger loads,
for charging batteries when low,
to provide equalization charge when required.

AND
the genset is only started manually - auto-start is not normally used as small petrol gensets may not start reliably unattended,
even when they are fitted with automatic, or solenoid operated, choke.

Larger LPG gensets

These are still basically a petrol engine modified to run from LPG but where the LPG fuel system is integrated with the engine by the manufacturer, there is usually electronic engine control and reliable automatic voltage regulator (AVR).
They produce a controlled output waveform but they still require the equivalent of a choke - a solenoid controlled fuel purge. Auto-start controllers will operate reliably.

Diesel gensets

These are the preferred choice for auxiliary supply and battery charging on larger power systems, where the genset is required to operate regularly (e.g. daily or at least a few times per week).
Most are low speed (1500 RPM) with reliable AVR control.
Auto-start controllers operate reliably.
They are much more reliable than small petrol gensets.
While diesel fuel is combustible it is much safer that petrol.

Genset installations

There are a number of factors to consider when selecting and installing a genset.

Mounting
The genset must be secured on a stable base and restrained from movement.
Noise control
High frequency engine noise can be reduced with bulk insulation and low frequency exhaust noise by solid barriers. A reduction in noise can be achieved by ensuring that all air flows go through several direction changes before entry or exit.
Ventilation
Separation of air flows is vital. The inlet airflow should be separated from the cooling air and the exhaust outlet. The genset manufacturer's data should be used to determine the volume of air required for inlet and cooling flows.
Temperature
Genset output reduces and maintenance requirements increase with higher operating temperatures. Cooling is vital - a 240V a.c. fan to provide additional cooling while the genset is running, is often necessary.
Fuel storage
AS 4509.1 Safety requirements, provides guidelines on fuel storage. Local government regulations must also be followed.

Maintenance

All maintenance operations should be considered.
Ready access to oil and coolant inlets & drains, oil & air filters and any drive belts is required.

Auto-start

An isolation device to prevent genset start during maintenance operations must be located in close proximity to the genset.
An auto-start warning must be visible on approach.

The genset output should be de-rated for altitude, temperature and humidity.

Battery chargers for stand-alone power systems

Battery charging from an auxiliary, on-demand power source, usually a genset, is necessary during periods of reduced energy input from a RE source, for example

- extended cloudy weather for PV systems
- wind droughts for wind turbines
- or long dry periods for micro-hydro generators

and for periodically, boost or equalize charging a battery bank to maintain reliability.

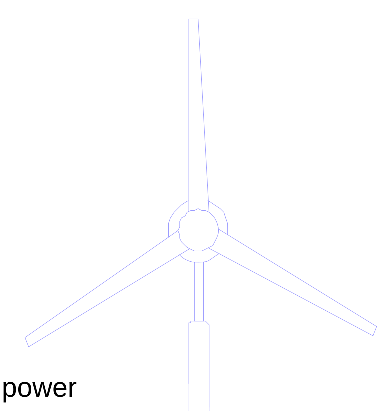
There are two main types of battery charger used …

Transformer type
The main element of this type of charger is a transformer that reduces 240V a.c. to the level required to charge the battery. The a.c. is converted (rectified) to d.c. and a 'constant' voltage is used to provide charge current. As the battery voltage rises the charge current reduces until at full charge only a small charge current flows.

Electronic type
This type uses electronic switching to reduce the 240V a.c. input and provide a 'constant current' to the battery. This continues until the battery is fully charged and the charger switches to a small 'float' charge to maintain the battery voltage.
This is the same charge regime used by inverter-chargers and interactive inverters. This charge method is potentially faster and better for the batteries than the 'constant voltage' method.

To reduce the recharge time (and genset fuel use) the battery charger should provide as large a charging current as possible,
but not above the maximum recommended by the battery manufacturer.

Wind turbines



Wind turbines produce electrical power from the wind.
For small to medium size systems, designed to provide energy to a household, the a.c. power produced is transmitted to a dedicated regulator and converted to d.c. for battery charging.

The energy produced is directly proportional to the power of the wind.
Suitable wind regimes are very site specific and the available wind power usually shows wide variation over a day and a year.

If wind power is to be used as the major energy source, site logging for at least 6 months is recommended. The area around the turbine tower should be free of any obstructions that cause turbulence in the wind flow.
The tower (or mast) should be free-standing and must not be attached to a house or any other occupied building as mechanical vibration can be transmitted through the building.
The turbine often needs to be at least 15 metres above the ground.

There is a large variety of commercially available types

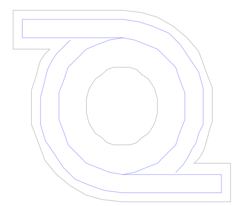
Design and Installation should comply with BCSE Design and Installation guidelines for small wind systems

Pico-hydro generators

Hydro generators produce electrical power from a flow of water. For small to medium size systems, designed to provide energy to a household, the a.c. power produced is transmitted to a dedicated regulator and converted to d.c. for battery charging.

Two types are available.

1. Low head – High flow
   A large volume of water is required to produce energy. The generator is usually in or next to the stream or river.
2. High head
   Energy is extracted from a smaller volume of water flowing from a height (usually greater than 15 metres).
   The generator is most often installed near the power system battery bank with the water piped from its source.



Both require extra civil works for (underground) transmission lines or pipe-work.

The energy produced is directly proportional to the power of the water flow. A suitable water resource is necessary.
If hydro power is to be used as the major energy source, a knowledge of available water flows is also necessary.

Pico-hydro power generation can be the most desirable source of RE given a reliable water resource. Power can be provided 24 hours a day, 7 days a week.

Input regulators and controllers - for stand-alone power systems

The basic function of a regulator is to remove the charging source when the batteries are fully charged. There are two basic types used …

Switched – the RE input is simply disconnected.
These are usually only used for PV arrays.

Shunt – the RE input is diverted to a 'dump' load where the energy produced is dissipated as heat. This type of regulator is required for rotating machines where the input cannot be simply disconnected – Wind turbines and micro-hydro generators.

Maximum Power Point Tracker (MPPT) for PV arrays

A MPPT type regulator is a DC-DC converter that ensures that the connected solar modules can produce more energy (depending on the module temperature) by operating at their maximum power point. They are most useful where the area available for the PV array is limited. Where the PV array is some distance from the battery bank they can also be used to reduce cable losses.

Many regulators provide monitoring facilities for input current flow and battery voltage.
Some have built-in control functions as well. These controllers can monitor power system parameters, such as current flows and battery voltage. They can also provide functions like

- amp-hour logging and battery state of charge estimation
- d.c. load and genset control
- computer control and data download
  (direct or through a modem)

Power and Energy

A quick overview of power and energy, both of which have been mentioned previously.

Power is an instantaneous value and is measured in watts (W).

Energy is a measure of the electrical power consumed.

ie. Energy (Wh) = Power (W) x time (hrs)

One watt, or for that matter 1 watt-hour, are very small measures.

In most cases, power and energy production (and usage) are measured in kW and kWh. 1 kW = 1000W and 1kWh = 1000Wh

for example, a 100W incandescent light globe uses 100W of power.

If the light is left on 24hrs per day the energy consumed is

100W x 24hrs = 2400Wh or 2.4kWh per day

Electricity is a high grade energy because it can be easily converted to other forms, such as …
Light - using a lighting element or fluorescent tube or
Heat - using an electric element or
Mechanical energy - using an electric motor

It is suitable for a wide range of tasks, but in renewable energy systems the capital cost of electricity production is high.

To ensure the best return on your investment, in a solar power system, some thought should be given to energy efficiency measures. Life style and the cost of any changes will also be major considerations.

As appliances require replacement, the most energy efficient types available could be selected, for example,

replace incandescent light globes with compact fluoros, where appropriate.

Using electricity to change the temperature of a space is the most energy intensive use.
Appliances that fall into this category are …

- Cooking - Stoves, ovens, electric jugs and frypans, etc
- Water heating
- Space heating - heaters, reverse cycle air conditioners
- Dish washers with electric heating
- Clothes dryers
- Refrigeration
- Space cooling - air conditioners

Energy Services

The most appropriate energy source should be selected for each task, such as …

Cooking

LPG is often the most appropriate for stoves and ovens. This does not mean that electric jugs, frypans and microwave cookers are off the list if they are used infrequently or for short periods. These loads often have large power requirements and can add significantly to the size and cost of the 240V a.c. inverter.

Water Heating

Solar water heating is the preferred option with instant heat LPG backup.

Space heating

An energy efficient house design is the best option to reduce heating energy needs but again the energy requirement to heat large areas is best left to wood or gas heaters.

Dish washers

Automatic dishwashers with electric water heaters will use a large amount of energy to heat the water. These will usually not be an option for smaller power systems.

Clothes dryers

In some tropical areas, especially during 'the wet', clothes dryers are necessary. Consideration should be given to using a heat source other than electricity, for this purpose. In most areas the sun and wind do a good job, for nothing.

Refrigeration

Gas (LPG) fridges can be used to reduce the initial power system cost but they are quite expensive units and ready availability of LPG is necessary. Where LPG is used for cooking it may not be a problem to provide the extra. The main option is to use the most energy efficient 240V a.c. refrigerators suitable for your home.
DC refrigerators or freezers with thicker insulation may be an alternative.

Space cooling

Again, energy efficient house design with sufficient ventilation (with fans, if necessary) is the best option. Insulation in roof and wall spaces can improve comfort levels significantly. In summer, some east facing and more importantly, west facing areas can become uncomfortably hot. The planting of vegetation or erection of shade structures to the ESE and WSW of these areas can help. The use of window shades or tinting can achieve a similar effect.
Air conditioning with electric motor-compressors use large amounts of electrical energy and are not often used with SPS.

Appliance energy rating

The federal government, through the Australian Greenhouse Office, has updated earlier initiatives in appliance energy labelling.
The relative energy efficiency of a wide range of domestic electrical appliances is available at the AGO web-site.

Again, to maximise return on your investment the use of the most energy efficient appliances, that suit your requirements, is necessary.

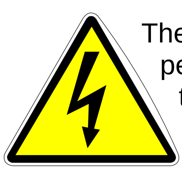
ELV and LV

All States have legislation, in place - the Electricity Act - that requires all work on Low Voltage (LV) must be performed by suitably licensed electrical workers.
e.g. electricians or electrical Contractors. NOTE : normal household 240V a.c is LV

Extra Low Voltage (ELV) – NOT above 50V a.c. or 120V d.c. These voltages are not considered lethal but due to the higher current flows required, can be dangerous.
AS 4509.1 – Safety, requires that any installation or maintenance work on an SPS is performed by 'competent person'.

A person is considered to be competent where that person
" … has acquired through training, qualifications, experience, or a combination of these, knowledge and skill enabling that person to correctly perform the task required."
BCSE installation accreditation is one form of qualification that complies with this requirement.

In practice, for ELV power systems with a solar (photovoltaic) input, the highest voltage battery bank that can be installed by a non-licenced person is 60V d.c.
Power systems with nominal battery voltage above this are considered to be LV with a requirement for suitably qualified installation and maintenance workers.



The above information is important as, at ELV levels, work on the power system can be performed by a 'suitably trained and experienced' person. If a system owner decides to take on any maintenance tasks, they must ensure that they have been trained in both the task itself and general & personal safety requirements.

It is usually the responsibility of the system installer to provide instruction for the system owner in all maintenance tasks required. For example, any work on battery banks …

- the use of gloves, safety glasses and the ready availability of a water supply and/or eyewash equipment is required
- Insulated tools should always be used and
- Metal watches or the like, must not be worn.
- A safe work method must be used with an awareness of the dangers of hydrogen build-up and the handling of battery acid.

Safety equipment for work on 'flooded' battery banks, should be provided as part of the power system
In addition, the system manual should provide detail on all maintenance requirements.

There are additional requirements for low voltage installations.

All work on LV systems must be carried out by appropriately licensed electrical workers.

Power System Quotes for stand-alone power systems

An independent electrical power system is not an unlimited supply. This means that you must take control of energy supply and use. There is additional work required for power system and genset maintenance.

It is sometimes difficult to decide between competing offers for the supply and installation of a power system. The following may help …

While cost is always a major factor, it is necessary to determine what you are getting for your money. It is important to understand the implications of your decisions as you are the one who must live with the results.

The design of your power system is very important as it impacts on issues such as …

Capital cost
Genset runtime - ongoing fuel and maintenance costs
Functionality – the level of user intervention required
Reliability

The first point of contact with a system designer is when you decide to get a power system quote. The first question will be:

“ How much electrical energy do you need? “

To answer this question a load assessment survey must be completed.

Appliance description	Qty	Power watts	Daily Usage hrs	Time of use

NOTE : for larger power system it may be necessary to determine the time of use of your appliances. This enables daily load profile to be established.

This requires careful consideration but the system designer can provide assistance.

Each electrical appliance you use is listed, with its power requirement and an estimate of its average daily use.
This is the information used to determine the size or capacity of all major system components. The designer may make some suggestions on energy efficiency or recommend strategies for reducing your energy and power usage.
Recommendations can often include limitations on the use of some high power loads, i.e. ensuring that high power loads are NOT in operation at the same time.

For larger power systems it may be necessary to provide information on the time of use of appliances and any other electrical loads, enabling a closer investigation of your total power requirement by compiling a daily power profile.

After determining your requirements for system functionality and genset use, the designer can provide details of the power system. It will normally be necessary to work with the designer to ensure suitable areas are available for the RE equipment, battery enclosure and other components.

At this point a quotation for the supply and installation can be delivered.

Once you have several quotes the next task is deciding which is the best for you.
A contract for the power system supply and installation should be included as part of, or in addition to, the quotation documentation.

The quotations should provide …
Specifications, quantity, size, capacity and cost
for the major components, for example

- renewable energy equipment
  PV modules and array, wind turbine, micro-hydro generator,
  mounting frames or structure, tower / mast, civil works,
  regulator / controllers
- batteries
  battery overload protection and isolation
  battery safety equipment and signage
- inverter, Inverter-charger or interactive inverter with continuous, ½ hr maximum and surge ratings
- battery charger – if required
- genset – if supplied
- any additional metering or data-logging
- design, installation, travel and transport costs
- installation and other equipment costs.

System performance estimates such as,

System total load energy,
Renewable Energy input from each source
and Genset runtime estimates,

for at least 2 months of the year (BEST and WORST performance) with load maximum and surge demand, agreed load management strategies, renewable energy resource data used and system voltage.

Other considerations may be …

What are the qualifications and experience of the system designer /installer ?

Are other contractors required for other, related tasks ?
(e.g. electricians, communications installers, civil works,)

What are the installation and equipment warranties ?

Are training and system documentation provided ?

Is a maintenance / service contract offered ?

What is the response time for system problems ?

Australian Standards for stand-alone power systems

The RE Industry recognised the need to define industry best practice and to address safety, design and installation issues. The outcome was a range of Australian Standards.

Secondary batteries for stand-alone power systems – AS 4086
- part 2 Installation and maintenance

Stand-alone power systems – AS 4509
- part 1 Safety requirements
- part 2 System design guidelines
- part 3 Installation and maintenance

Installation of photovoltaic (PV) arrays – AS 5033

All design and installation work must comply with mandatory requirements and best practice recommendations should be followed.

AS 4086.2 Secondary batteries for stand-alone power systems - Installation and maintenance

Covers the following areas for ELV battery installations …

- Battery and inter-cell connections
- Over-current protection
- Battery enclosure layout, location and mechanical considerations
- Ventilation
- Safety signage
- Inspection and maintenance
- Installation and commissioning
- Battery safety

AS 4509.1 SPS Safety requirements

Mandates safety requirements for SPS …

- Wiring and circuit protection Genset Fuel storage
- Towers and freestanding PV mounting structures
- Additional battery requirements and signage
- Mechanical and thermal protection Multiple LV sources
- Shutdown procedure instructions

AS 4509.2 SPS System design guidelines

Addresses a large range of design issues and provides minimum recommendations for the design of renewable energy systems.

The guidelines cover stand-alone power systems with ELV battery banks but the design principles should be applied to larger (LV) commercial and industrial applications.

AS 4509.3 SPS Installation and maintenance
Provides best practice recommendations for SPS installation and maintenance …

Installation and cable protection
Photovoltaic arrays
Wind turbine installation
Micro-hydro installation
Genset installation mandatory requirements
Equipment layout requirements and recommendations
Test and commissioning
System maintenance
System documentation

AS 5033 PV Array Installation
Concentrates on PV array installation electrical safety issues.
LV arrays produce d.c. voltage at dangerous levels. This standard mandates PV array safety and installation requirements and provides best practice recommendations for both ELV and LV levels.

Protection requirements
Wiring requirements
Component requirements
Earthing
Marking requirements and safety signage
Documentation for PV systems

Safety signage
All of the above standards require some safety signs.
All installations must comply and safety signs must be mounted
where they are readily visible, near the specific equipment or hazard.

System Documentation

One important consideration is the provision of suitable safety, commissioning and user documentation …

A professionally installed power system is not complete without …

System equipment descriptions and operating instructions
Performance estimate and guarantee
Safety and maintenance procedures
Commissioning records and checklists
Warranty information
A copy of the original energy use estimate that has been used as the basis of the system design
A simple connection diagram
All the equipment manufacturers' documentation.