CJ Solar "Quality Systems that last"

ABN 12 446 540 448

Understanding Energy and Power in Solar Systems

Energy and power a are two different concepts often interchanged and confused when getting to grips with understanding solar power .

Power is the rate at which we use **energy**. Say for example we take a fully charged battery and connect it to something. It could be a small clock that will last for a year or it could be a camera which may last a few hours. When the battery is drained, both the clock and the camera have used the same amount of energy. The clock is a low power item as its using the energy slower. The camera is a higher power item.

Power is measured in Watts. Most appliances will have their power rating on the name plate on the appliance. **Energy** is measured in Watt Hours in solar systems.

Energy used by an item is equal to the **power** of an item multiplied by the time the item is on for.
Ie Energy = Power x Time.
Eg a 100 Watt TV on for 4 hours uses 100W x 4 Hours = 400 Watt Hours of energy.

When you get your energy bill, its the energy you pay for, not the power. Its a bit like when hiring a car. You pay for the distance travelled, not the speed at which you travelled when travelling that distance.

We need to balance the energy used in the home by the energy supplied by the solar panels
If we have 1000 Watts of solar panels on the roof and an average of 4 hours a day of winter sun, then we will put in 4000Watt Hours of energy into the batteries. This never really happens in practice as there many losses along the way from the panels to the batteries. Typically only 60% to 80% of this energy can be used due to panel mismatching to the batteries, losses in wiring, battery and inverter inefficiencies.

Energy in solar batteries

Battery energy capacity is measured by the battery Volts and Amp hour rating.
The energy stored in a battery is given by the volts x the amp hours of the battery.
Eg 48 volts x 1400Amp Hours = 67,200 Watt Hours. In a solar system we usually only drain the batteries by 10% to 15% of their capacity per day. In this way they will last much longer and also there is reserve for days when there is no sun. 10% of 67200 Watt Hours = 6700 Watt hours.

Energy budget

To work out how big a system we require, we need to add up all the energy usage of all the appliance in the house. For most items this means, getting its power rating and seeing how long it is on for per day (on average). Items like fridge's and washing machines, we need to measure or look at the manufactures specifications. We generally do this for the winter usage as that's when the sun is less plenty full.
See the table on the last page for some typical household energy usage.

Components of a Stand Alone Solar System

Solar Panels

The panels make electricity from the sun. Panels can be fixed to the roof or be freestanding on the ground. The number of panels required depends on the energy needs of the house. A 2 bedroom house can use more than a 5 bedroom if it has energy inefficient appliances that are left on for long periods

Regulator

The regulator controls the amount of electricity coming from the panels to the batteries. This stops them overcharging. The regulator also typically gives information about the battery voltage and how much daily energy has come in from the panels and is being used by the house

Batteries

Batteries store the energy from the panels for use when the sun is not shining. In a typical 2-3KW system, 6 to 12 batteries are used. Each battery can weigh approximately 120 Kg. Batteries are normally arranged at 24 or 48 volts DC and kept in a locked ventilated area

Inverter/ Charger

The inverter converts the battery voltage to 240V AC so that one can use normal household appliances. The charger is used with a generator in prolonged periods of cloudy weather so as to charge the batteries if they get a bit low.

Fuse Box

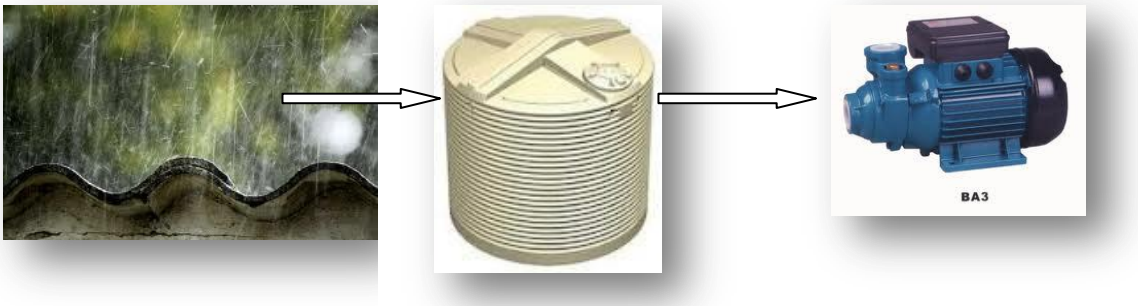
The output of the inverter is then wired up as a normal house

Power Points

Most normal appliances can be used. However the total appliances on at any one time should not exceed the rating of the inverter as it may shut down due to overload

The water tank analogy.

How a roof, rainwater tank and pump can be compared to a Stand Alone Solar System.



Rain falls on the roof and gets piped to a water tank (Like sun on solar panels). The more roof area, the more rain gets collected.

The water tank stores rain water, like a battery stores electricity. We need to only use the water tank at about 10% a day in case we have periods without rain.

On the output the tank a pump pushes out water, like an inverter pumps out power. The size of the pump is dependent on the number of taps that are on at one time.

Then we use water in different ways much like we uses electrical appliances in the house. For example:

		
Constant but not too fast . Like a fridge, often the biggest user of energy in a solar system	Dripping tap. Like a TV on Standby. This may drain the tank more than a power tool thats on for a short while.	Fast but short bursts. Like power tools. If on for a short time, it may not drain the tank much at all

Below is a table of typical energy usage in the house

Item	Power (Watts)	Hours per day	Watt Hours Per Day
Lights Kitchen	11	8.00	88
Lights Bathroom	11	1.00	11
Lights Bed 1	11	1.00	11
Lights Outside	11	1.00	11
Lights Bed 2	11	1.00	11
Lights Bath 2	11	1.00	11
Lights Living room	22	8.00	176
Lights Play room	11	4.00	44
TV 1	100	10.00	1,000
Play station	30	2.00	60
Hi Fi	40	4.00	160
PC (laptop)	35	10.00	350
Printer	25	0.20	5
Austar	12	3.00	36
DVD	10	2.00	20
Vacuum	1800	0.10	180
Washing Machine	350	1.00	350
Dishwasher (eg F&P DS603)	500	1.00	500
Toaster	1274	0.10	127
Water Pump	350	0.40	140
Fridge	40	24.00	960
Freezer	40	24.00	960
Charger	10	24.00	240
Iron	2000	0.10	200
Inverter Standby	10	24.00	240
TV Standby	1	24.00	24
Phone Standby	1	24.00	24
PC Standby	1	24.00	24
Hair Dryer	500	0.10	50
MicroWave	1000	0.30	300.0
Total daily Watt Hours			**6,313.4**

And below, some typical system sizes

Watt Hours per day in winter With 12% battery discharge per day	Panel array Size	Batteries size (Smaller for Gel batteries)
2400	1.2kw	24 volts 900 amp hours
4400	2.4kw	24 volts 1660 amp hours
7200	3.6kw	48 volts 1380 amp hours

The **inverter** in a solar system is the bit of electronics that converts battery power into 240 volt mains power. Inverters come in different capacities. Stand alone systems typically use inverters rated from 1 Kilo Watt to 5 Kilo Watt. ***The size of the inverter is determined by what appliance is going to be turned on at the same time.***