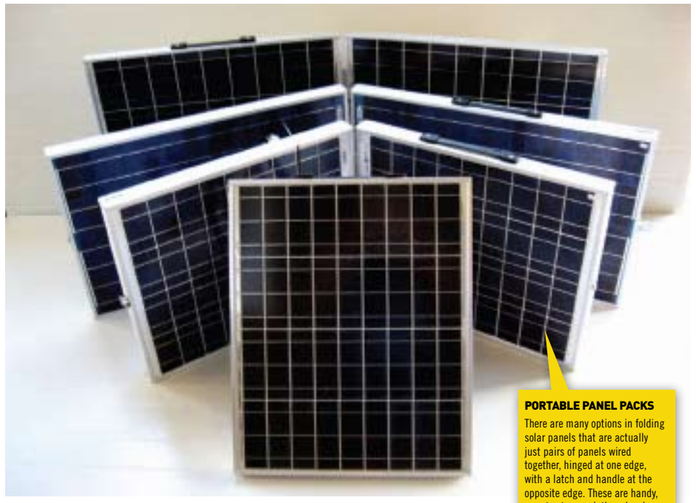
Chase the SUN

Unravelling the mysteries of 12-volt solar power and batteries for your camper

{ WORDS & PHOTOS DAVID COOK }



PORTABLE PANEL PACKS
There are many options in folding solar panels that are actually just pairs of panels wired together, hinged at one edge, with a latch and handle at the opposite edge. These are handy, easy to store and, though solar panels are much tougher than many people think, a good way to protect them when packed for transport. Just be careful of some of the cheaper set-ups on sale as these are often of lower quality.

> First thing to do is sit down and work out the consumption of all the stuff you want to run

Everyone wants to know about solar power and what they can do to create a power-independent RV. The secret is all in the planning.

You need to work out exactly what you want to run off DC power and how many batteries and solar panels you'll need to handle that load. And that stuff ain't cheap.

First thing to do is sit down and work out the consumption of all the stuff you want to run. You can measure this in whichever unit suits you (amps, watts or volts), and virtually all appliances have a plaque stating their consumption. It sounds obvious but add them up using the same unit of measurement. We've decided to go with watts as it's how the output for most panels are measured.

Make yourself a list (called a load chart – see breakout) of what you want to run, writing down their consumption in watts. This will provide you with an accurate and realistic assessment of how much electricity you can expect to consume daily so that you can then determine the size, and nature, of the solar panel(s) you'll need to maintain power supply.

Refrigeration: this can be written out of the electrical equation if you run a three-way fridge, since they run off gas when stationary. A three-way running off 12 volts will consume 140-180 watts per hour. Compressor fridges will consume between 36 and 48 watts per hour for a top-loading unit up to 110 litres, 40-70 watts for small front door opening units, and 70-95 watts for larger units.

If you're in a camper trailer you may get away with gas lighting and/or portable battery-powered units some of the time, but most people require, or desire, more convenient lighting around cooking areas and after dinner. LED lights are much more efficient and use much less power; halogen lights are energy consumptive.

Incidentals: DC water pumps, an inverter to charge mobile phones, portable radios, or run laptop computers. Also, for an inverter, add 15 per cent to the wattage consumption. There are loads of other things you could include besides the above. An LCD TV can easily consume around 60-75 watts. Stereos or videos usually swallow around 20 watts each.
A microwave, on the other hand, can gorge on a massive 1500 watts.

Get the 'rated wattage' of each appliance and work out the length of time each day that they are used. Multiply these numbers together for each item; this gives you the total watts per day for each item. Add all the total watts together for total power consumption per day.

Now divide by 0.7 for panel efficiency and divide by the number of peak sunlight hours for area travelled (about five hours or so median average for Brisbane). This will give you close to the panel size required.

The 'number of peak sun hours per day' is determined, basically, by the latitude and the season, though it's not quite that straight forward. This is not the number of hours between sunrise and sunset, as the earlier and later hours have diminished energy input.
We are talking of peak sun hours, and that can range from as low as three in Tasmania to over six in parts of QLD, NT and northern WA. See breakout for the monthly peak sun hours for various locations in Australia.

ABOVE By remotely locating the panels, this camper is able to best adapt to the sun's motion in the sky and changing circumstances.

ABOVE One option would be to mount your panel on an arm above the draw bar.

SOLAR PANEL CHOICE

Once you've worked out how much juice your appliances will be sucking down, you can then set about choosing the right solar panel.

The glass-based panels are divisible into the newer technology multicrystaline, the older

BOTTOM Even the humble camper trailer can require serious battery storage capacity under the demanding situations at the high dollar end of the market. In such cases, a bank of AGM batteries may be required as shown here.

ABOVE No shadows and a clear view towards the sun ensure this solar panel set-up will generate maximum amounts of power.

LEFT The clear shadow running behind this panel indicates it's properly aligned towards the sun.

polycrystalline and the more expensive monocrystaline. All of these panels are smaller and lighter per unit of power output than the amorphous panels. The downside, however, is that they really struggle to generate anything when there's cloud cover or shadows.

"There are some exceptions to this," says Jamie Hazelden from Dynamic Solar Solutions, in Moffat Beach, Queensland. "For example, the Kyocera glass panels are in the multi-crystalline category and have some shadow tolerance built into them making them the most efficient panel."

The Triple Junction amorphous panels have a textured surface and aren't seriously impacted by shadow; they'll only drop output proportional to the area of the panel covered by shadow. However, the biggest output available in this grouping is 64 watts and at that they are bigger than a 130 watt glass-based panel in physical size. Amorphous panels are more heat tolerant and can be produced in a flexible form to fit a curved surface, but they rarely operate at their full potential when configured this way.

Now, whatever you figured you needed to meet your electrical consumption needs you must be aware that all solar panels will only output around 70% of their 'rated capacity', for reasons which are too detailed to go into here.

ABOVE Some camper trailer manufacturers, such as Trak Shak, offer serious solar arrays with their trailers, although you wouldn't normally align them with a large tree.

LEFT A simple show set-up with a fold-out Kyocera panel running a 12-volt fridge.

Load chart

Work out how much energy your camper uses daily to determine what solar panels you'll need

APPLIANCE	WATTAGE	X	HOURS PER DAY	=	WATT-HOURS PER DAY
FRIDGE	40	x	8	=	320
INTERIOR LIGHT	4	x	3	=	12
READING LIGHTS	10	x	1	=	10
EXTERIOR LIGHT	11	x	2	=	22
PHONE CHARGERS	7 (+15%)	x	2	=	16
LAP TOP	70 (+15%)	x	1	=	81
TOTAL					461
FACTOR (WATT-HOURS/0.7)					658.5 (F)
F/SUN HOURS	ESTIMATE 5.2				126.6

+ Fast Facts

You can convert the different units by applying Ohm's law, which states: Amps X Volts = Watts.

We have allowed for this by dividing our accumulated consumption by a factor of 0.7.

MAKING BEST USE OF YOUR PANELS

Solar panels function at their best when facing directly towards the sun.

That means unless you have an automatic tracking system you are going to have to adjust the panel's position every hour or two if you want to maximise input. For this reason, having panels fixed to the roof of your camper loses you 10-20 per cent of input, but you can compensate by allowing for this when planning for capacity.

You also need to allow that some days will be cloudy or wet, and this will impact upon the efficiency of your system. Most solar panels decline in output once temperatures rise above 25 degrees Celsius so, on a 35 degree Celsius day, you can knock off about 15 per cent from your expected output. On the other hand, amorphous panels actually show a slight increase with rising temperature.

For those seeking flexibility there are some very neat folding packages available today, supplied with a regulator, stands and lengthy cabling which permit you to locate your panel where it will do the best job. Solar panel set-ups are relatively expensive and desirable, so don't leave them unattended.

CONTROLLING THE POWER

You are also going to need a regulator to control the flow of your generated electricity

> Having panels fixed to the roof of your camper loses you 10-20 per cent of input

ABOVE One of the advantages of AGM batteries is that they can be mounted on their side, as in this Aussie Swag camper van.

into your storage battery(s). This is to prevent your solar panel overcharging your battery(s) and, if you choose an appropriate regulator, tapering off the charge rate as your battery approaches full charge.

As with everything in this area, these come in a variety of forms. Forget simple (read cheap) regulators. A recharging battery will take power at the bulk rate until it reaches 70-80 per cent capacity, and then the remaining 20 per cent should take as long to be delivered as the first 80 per cent did.

A quality regulator will give you a range of information on the system and how it's operating, so they are definitely worth spending money on.

To determine the size of regulator you need (in amps) for your chosen system, take your total solar panel wattage and divide this by the voltage of your system at full charge (for a 12-volt system this is effectively 15; for a 24-volt system this will be effectively 30).

It's worth seeking out a professional to make sure you link your batteries correctly.

STORING THAT POWER

Deep-cycle batteries are the only way to go when it comes to storing power – these have the capacity to handle constant discharging and recharging. The less you discharge it before fully recharging it, the longer (in terms of the number of cycles of discharge/recharge) the battery will last.

Storage batteries are designed for slower release of direct current, and starting (cranking) batteries for short sharp discharges. Battery capacity for a storage situation such as we are referring to is measured in amp/hours, the higher the rating the more power you are storing. The idea is to choose the highest storage capacity, taking into account your budget, carrying capacity, ability to recharge in a reasonable time and needs. When choosing a battery, you'll need to take into account factors such as physical storage/mounting space and weight, as storage batteries can be heavy. A 100 amp/hour deep cycle battery will weigh around 35kg, and a suitably strong mount that can restrain such a mass in a moving environment such as a caravan or camper will thus also be heavy.

Deep-cycle batteries can be divided into two camps: wet cell and absorbed glass matt (AGM). I'm going to jump straight to a recommendation and encourage you to buy a sealed battery in most cases.

Though AGM batteries are more expensive, they do not give off excess amounts of highly combustible hydrogen gas, can be mounted in any orientation (even upside down) and in the unlikely event that they may be ruptured, they don't release nasty gases. They will recharge more quickly, are maintenance free, they will self-discharge at a slower rate if in storage and can then be recharged with no loss of efficiency and their robust construction makes them good for rough terrain travelling.

An automotive recharging system is not designed to recharge the battery over 70-80 per cent of a battery's capacity, simply having to top up a relatively small amount of power lost in starting and then keeping up with the demands of running the car.

However, with an appropriately sized solar system with a quality regulator constantly able to top up that last 25-30 percent of capacity, your battery will last much longer and give you more usable power at any time. A well-balanced system will finish charging to 100 per cent capacity by the time the sun goes down in the late afternoon and not go much under 80-85

Peak sun hours

This table (from greenhouse.gov.au) shows the monthly peak sun hours for various locations in Australia.

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	ANNUAL
MELBOURNE	6.9	6.4	5.2	3.8	2.8	2.4	2.7	3.3	4.3	5.3	6.1	6.6	4.6
SYDNEY	6.7	5.8	5.7	4.4	3.6	3.4	3.3	4.4	5.2	5.8	6.3	6.9	5.1
BRISBANE	6.5	6.2	5.7	4.8	4.2	4.1	4.2	5.2	6.0	5.9	6.0	6.3	5.4

MAKE HAY WHILE THE SUN SHINES
The dual panel set-up at left, in shade, will now be dropping off its output, very dramatically if a glass-based unit, while the units in the sun at right will still be drawing the best possible output from the late afternoon sun.

LEFT There is a range of regulators, from the very cheap to quite expensive, all offering different features.

> A quality regulator will give you a range of information on the system and how it's operating...

ABOVE The Unisolar brand amorphous panels are not as heavily impacted by shadow as the crystalline units but they are bigger and bulkier.

With thanks to: Jamie Hazelden at Dynamic Solar Solutions. If you've a 12-volt question, be it about batteries, solar power set-ups, lighting, inverters, accessories or TV set-ups, then give Jamie a bell. Dynamic Solar Solutions' address is: 8B Allen Street, Moffat Beach, Qld 4551,
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