An Auto-electricians Guide to Installing Solar – an ongoing series

Collyn's office.

Until 1980 or so, most caravans and motor homes had basic auxiliary electrics whereby the alternator not that effectively charged a wet deep-cycle battery. That battery powered a few 12 volt incandescent globes, often a 14 inch TV and a water pump. By and large most used the then only partially effective three-way fridges that, as still now, draw far too much energy to run except from the alternator whilst driving and gas at all other times.

Then, and progressively, owners began to add more, and often high energy using electrical devices such as electric blankets, larger TVs, CD players, early mobile phone chargers, and electric-only fridges. None was a major problem - except when owners stayed away from mains power for days on end.

Many owners attempted to fix their problems by adding more batteries - but that's like opening a second bank account for the money paid in: all it does is attract higher bank fees. Some attempted to get around it by increasing alternator voltage (to a typical 12.7 volts) - and some still do - often by using a so-called alternator fuse/diode.

Solar started to be used around 1990 (and our own 1974 Kombi was, in 1993, so equipped) but the cost was so high that few could afford to do it properly. But for simple systems, it worked well.

By 2000-2002, many RV makers started to include solar, but the typical one or two 80 watt solar modules were more a marketing device than of any practical use - especially where a microwave oven would (and still does) draw about 120 amps (about 1500 watts via the inverter).

Up until then, most charging systems remained unchanged (except for adding a voltage sensitive relay to protect the starter battery from accidental discharge).

With rare exceptions, alternator voltage was too low to charge an auxiliary battery much beyond 70-75% - and excess voltage drop often precluded caravan batteries even reaching that.

A few companies however had long realised there were better ways of charging batteries than from constant voltage - and that multi-stage charging (more next issue as used also in solar) does the job faster and deeper as long as the connecting cabling is big enough to allow it to work.

But mostly it is not, and only too many try to pull 20-30 amps through several metres of 2.0 mm auto cable.

Typical consumption - in watts

Coffee grinder	75
Computer (laptop)	20-30
Computer printer	70
DVD	30
Fans (12/24 volt)	10-25
Fridges (to be covered later)	
Lights 12-volt LED	2-5
Lights 12-volt halogen (each)	10-20
Lights - 240-volt fluoro (each)	8-18
Macerator	300-350
Microwave oven ('800 watt')	* 1400
Mobile phone charger	10
TV (25-35 cm)	20-40
TV (64-80 cm)	60-100
Washing machine (on cold water)	200
Water pump (12/24-volt)	50

The above is in watts. For amps, divide by 12 or 24 for 12 or 24 volts respectively.
** A microwave's draw is about 50%-60% than its rating. See main text.*

Computer Complications

Meanwhile computer technology began to be used for engine management and vehicle functions. Add-on charging devices may or may not affect its operation, but it tends to be blamed for any problems that arise.

The dc-dc alternator chargers (described in my previous article) effectively isolated the alternator from the alleged or actual effects of auxiliary charging - but, as this series will cover later, that may change after 2013 and more so in 2016.

Author's OKA, seen here crossing a river up in Cape York in 1998 - driven by Collyn's wife (Maarit), ran a huge early satphone plus all lights, water pumps etc from solar. The dome is the satphone's satellite tracking antenna. Pic: Author.

In essence, dc-dc alternator charging provide the needs of many RV systems, but not for those that rarely use caravan parks. For these, solar is invaluable, but far from all of their systems work well.

Appliance Reality

By and large solar works fine for most things that, as their main job, do not generate heat. Lights (ideally LEDs), 14 inch LED TVs, lap-top computers, modems and iPods, mobile phones etc are fine; and fridges up to about 220 litres likewise. Microwave ovens

are a special case and, as with fridges, are covered later, but *no* form of electric cooking/water heating is feasible. Use 12 volt LED lights and water pumps, but 230 volt ac appliances are often better and cheaper. Use a full sine wave inverter to drive them.

Peak Sun Hours

The amount of input, on average, from solar is shown below. It is the minimum that is likely anywhere in Australia in mid winter. The units are a solar industry invention - called Peak Sun Hours PSH) that average out the irradiation as the sun seemingly moves from East to West. One PSH is like a 'bucket being filled with averaged sunlight'. In a Hobart winter that may take several hours, in Broome it takes about two hours in mid-winter and about one hour in mid-summer.
The PSH map shown here is the most probable daily PSH *in mid-winter*. In other words it is the *worst* the owner may expect. (The maps are based on the previous average over ten years so may vary from year to year). In the southerly parts of Australia the PSH tends to double by mid-summer. Up north however it is only about 20% more (and that is rarely understood by RV owners).

In technical terms 1 PSH is the equivalent of about 1000 watts/square metre of anything flat - like a solar module that's more or less facing the sun (again more on this later).

Solar Module Reality

Monocrystalline modules (use these for RVs) are 16%-18.5% efficient so in theory we should expect to have about 160-185 watts per square metre of solar real estate - in practice it's typically 70% of that.

So what we realistically have is the PSH x 140 watts per square metre. A typical 100 watt module is about 0.7 square metres and puts out about 70 watts.

Armed with the above, you can almost instantly estimate how much solar you need to provide 'n' watts - or how much owner now has. Thus, young Brendan or Greg up in Broome, know that if a local client has (say) 240 nominal watts of solar then the daily input (in winter is about 70% of 240 watts (about 170 watts x 5 PSH) - that's about 850 watts/day.

Some 10% is lost in charging the now typical AGM battery so that available is 765 watts/day. If the RV uses less, all is well. If it uses more, all is not well. If you see there's a 220 litre electric fridge (about 1000 watts/day) - you instantly know there's a problem).

Assume Nothing

When seeking to fix problems, many auto electricians assume the installation once worked correctly. This cannot be assumed with solar, unless specified and installed by one of the few companies who do it well. Nor, even if they had, that owners then use it sanely.
The starting point, both for fault finding and original installation is to know what is possible and what is not. This is essential, or you'll spend hours seeking faults on a system that cannot *possibly* well anyway. Or trying to cost a new job - that is fundamentally not practical with solar.

One needs to know what an owner hopes/hoped to run, where and for how long. Then, how much solar input is realistically possible from solar.

If the energy coming in exceeds the daily load but battery goes flat, you find out why and fix it (usually because some turkey has wired the fridge via twelve metres of 2 mm auto cable [about 0.7 sq mm] plus a corroded fuse holder - and has the better part of one volt drop).

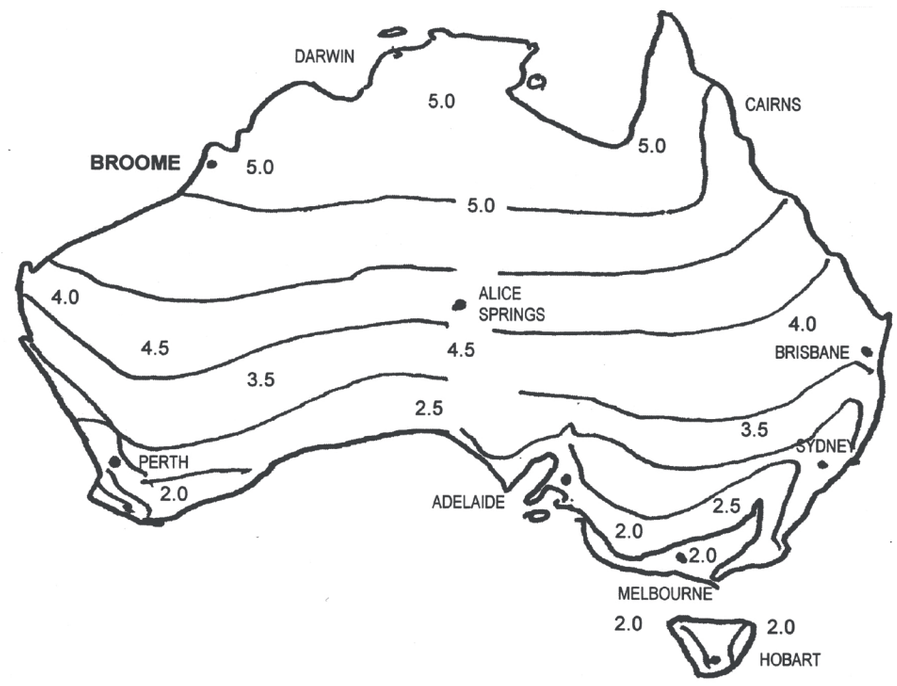
If the energy coming in is less than out, the customer needs more solar - or less load. That may seem almost blindingly obvious - but you'll be surprised how many people think that's fixed by adding one of more batteries. But, as noted earlier, adding more battery capacity *increases* the losses!

Knowing More Right Now

For those seeking to know more right now, please see our special auto-electricians offer for the author's just released 3rd Edition of *Solar That Really Works*.

It is written with RV owners as its intended readership and thus has material readers here will already know - but it is very thorough in its 100 pages of superbly printed content.

On its conclusion the content of this approximately 12 month series will be expanded and produced in both print and eBook form.



This is the minimum average daily amount of sun that your customers are likely to have anywhere in Australia. The units are 'Peak Sun Hours' - a term used only by the solar industry. See the main text for explanation of these units. Drawing© Caravan & Motorhome Books.