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

Collyn's office

In this series, it seems necessary to continue to stress that, unlike with cars and trucks, where if something does not work it is because a connector has worked loose or a component has failed and needs replacing, this may also occasionally be so with solar but it absolutely cannot be assumed that what you are faced with was designed and/or installed correctly in the first place.

Further cannot be assumed the system is being used as the maker intended (as for example the previous issue's example of RVs with 'converters' being used for free camping).

Another problem is that few owners have any idea of the electrical energy required to run their appliances. It is not uncommon to find owners that seriously expect to be able to run a large TV, lighting and an electric fridge for a single 100 watt solar module.

Also common is that many owner seriously believe that adding more battery capacity (when relying mostly on solar) will somehow result in more energy being available. It may seem obvious but it does not occur to all that more energy is needed to charge that extra battery capacity.

Rather than explaining this in electrical terms, ask the customer what he or she would expect if they opened a second account for the same funds deposited. The losses of that extra battery equate to the bank's charge for that added account.

Essentially, in many instances you are faced with systems that cannot be 'fixed' or 'tweaked'. Sadly, many solar systems are either basically deficient, being used for a purpose for which they were not intended (as in the 'converter systems,' discussed in the previous part of this series, being used for free-camping; and/or grossly optimist owner expectation.

Consider Refusing the Job

In many cases, installation is also inadequate. If so, little can be done without first remedying the basic problems.

One approach in such situations is persuade customers to have you do the job correctly. If they do not accept this (but a growing number reluctantly do) it is best to reject the job. If you attempt to assist, your efforts will inevitably be later blamed as deficient.

Camp sites are sadly full of grey nomads going from one auto electrician after another, attempting to get a $1000 job done for $99.50. They complain about the results and name and shame those who attempt to assist.

Ensuring the Basics

The minimum basics (for most systems) include an alternator charging one or more auxiliary batteries, and the starter battery protected by a voltage sensing relay, and connected to that battery by light starter motor cable. Even this can be problematic as many an owner attempts to charge battery banks of 500 Ah or more that way.

Where, as is common in caravans, an auxiliary battery is located on or within the caravan, the best way to ensure it is fully charged is via a dc-dc alternator charger or battery management system, such as a CETEK, Redarc, Projecta, Sterling Electronics etc *and located close to that caravan battery.*

Use an Anderson plug and connector for that alternator feed. It will assist hugely to run a 13.5 sq mm pair from the alternator to that Anderson socket.

This is because, whilst the dc-dc converters in such systems will produce the optimum voltage for charging, energy lost (as heat) as a result of excess voltage drop along inadequate cable is lost for ever. The dc-dc converter thus draws extra current, and that may not be available from the alternator.

Manufacturers of these units *do* warn of this - but I suspect not sufficiently strongly.

As the solar modules are almost always on the caravan or motor home's roof, it make sense to install a battery management system (as that includes dc-dc alternator charging, plus solar regulation) in that vehicle.

Upgrading Cabling

Almost invariably needing upgrading is the cabling from battery to fridge. Six square mm is far from overkill – but it is common to find 4 mm auto cable

Our previously-owned OKA had lighting, 71 litre litre chest fridge and early satellite telephone (antenna is that dome on the roof), were all run from two 100 watt modules just visible beneath that dome. Pic: top of Cape York 1999.

(typically 1.8-2.0 sq mm). Be aware that the big three-way fridges in many large caravans and motor homes may draw up to 25 amps. For these, I suggest using 10 square mm.

Approximating Solar Output

Previous parts of this series (and my books) show how to assess the solar capacity required. In many instances this will be dictated by the space available for the modules (solar makers call them modules, but your customers call them panels).

As a rough guide the solar module output will be between 100 and 130 watts per square metre of module working area.

The solar module output is about 70% of that seemingly claimed. A '100 watt' solar module is thus highly unlikely to produce more than a maximum of 70 watts.

Estimate average daily input as three times the realistic wattage. For that 100 watt module, this will be: 70 (watts) times 3.0 (hours) = 210 watt hours/day.

Daily output will be much higher on fine midsummer days - but calculating as suggested will result in a system that will still work on all but totally overcast days.

As long as there is enough space for the solar modules this is now feasible as their cost has fallen by 75% since 2010 or so.

You are likely to find that most systems have too much battery capacity to be realistically chargeable by the typically too little solar capacity.

A well-designed solar system should reach float voltage by about midday on most days year round. If it does not, it has no chance of working way up north, nor overcast days.

For all RV purposes the modules can be flat mounted. In most places this results in excellent output in summer – but some loss in winter. They must be securely mounted with an air space of 25 mm or so underneath to allow heat build up to escape.

Many solar regulators and battery management systems accept a range of input voltages. Check this and, if feasible, connect the modules in series or series-parallel such that they operate at the highest allowable voltage (bearing in mind that a typical '12 volt' module can reach 21 volts off load). This ensures low voltage drop without needing heavy cable.

Remember that with voltage drop it is the *percentage* drop of that voltage that matters. Keep most 12 volt RV cabling to 0.2 volt drop end-to-end and 24 volt cabling to 0.4 volt. As the acceptable (say) 0.2 volt drop at 12 volts is 0.4 volt drop at 24 volts, this enables the cable to be only one quarter the size, not just half as some at first assume.

When interconnected in series or parallel, solar modules act much as do batteries. You can series connect modules of any voltage and the result is the sum of the individual voltages, but they must all be of the same current output as the combined output will be limited by that of the least.

Paralleled solar modules must all be of the same voltage, but can have totally different current output. The resultant combined current is the sum of that of each individual solar module.

Keep all solar modules several centimetres away from any hatches etc. Even minor shadowing reduces output out of all proportion to the area shaded. If more than a third is shaded, output is likely to be close to zero.

Many battery management systems require a current shunt. Use only that supplied or recommended by the battery management system supplier as current/voltage relationship varies with the shunt's resistance and current capacity.

Battery Voltage Sensing

Apart from the main heavy cable battery feed, many of these systems also require a light gauge cable from the solar regulator (or battery management system) to the battery.

This cable may appear to duplicate the main battery feed leads so some installers save cable by omitting it. They then parallel connect the main leads to the light gauge cable terminals (of the solar regulator or battery management system.)

This light gauge cable pair is required to enable the regulator to sense the exact battery voltage (needed to optimise charging) and must thus be free of voltage drop. It carries under 1 mA.

Batteries

The longest lasting batteries are still the old wet cells, but they absolutely must be 100% maintained and sanely used. As few RV owners do either, a sealed deep cycle battery or the more costly AGM is likely to a better choice.

Many customers will ask about the optimum depth of discharge. In essence what they are buying is usable amp hours. Batteries do provide a few more amp hours over their life time if discharged less deeply, but by and large it is much like drinking a glass of beer. The faster you drink it, the less time it lasts - and vice versa. Apart from maybe spilling a bit you consume the same quantity of beer.

Learning More Now

Our auto-electricans offer for the 3rd edition of *Solar That Really Works* is extended until further notice. It is also now extended to the all-new *Caravan & Motorhome Electrics* that covers every aspect of that topic. The offer is available to TAFE colleges and their students.

As some companies are ordering them in quantity for their staff we extend a further discount for a total of three copies or more.

We can also offer a full bookseller's discount to those wishing to stock and resell our books (quantities of five or more).

This series will eventually be expanded and totally rewritten - and offered in digital form.