TIPS and TECHNIQUES: **SOLAR PANEL DIY** *by George Linardos*

# SETTING UP A SOLAR PANEL/BATTERY AND 12 VOLT FRIDGE SYSTEM

"The milk's gone off, everything frozen has thawed and you guys have been out fishing all day!"

Those words clearly summarized my first attempt in going camping with a 12v fridge and solar panel combination. My wife was clearly not impressed and to be honest, that camping holiday was a disaster. I was ill-informed, ill-equipped and I spent most of the holiday shuttling backwards and forwards to friends with powered sites lugging heavy batteries and chargers.

The setup I had simply did not work- even under the best conditions.

On my return to Melbourne I was determined to investigate this topic further and subsequently spent many hours talking to manufacturers and suppliers of solar panels, fridges and batteries.

This has not made me an "expert' on the subject but with some of my new found technical knowledge behind me and ten or so years camping for a month each year on an un-powered site and conversing with dozens of other campers using solar/12v fridge combinations I may be able to help you avoid my initial mistakes.

I remember a doctor friend who once said that there is a point in medicine where "it's no longer a science but an art form!" to a certain degree the same can be said about this subject. We can control the technical aspect but we can't control the most important element and that is the **SUN**.

**VERY IMPORTANT**
First determine whether you intend to use the fridge occasionally on a short term stay. i.e. long weekends [3-4 days], or for longer stays of a week or more.

**SHORT TERM[3-4 days]**
A 50Lt to 80Lt fridge will require a 100w or preferably a 120w solar panel and a 100AmpHr battery as a minimum.

**LONG TERM [1 week or more]**
A 50Lt to 80Lt fridge will require two 80w solar panels and sufficient batteries to hold 340AmpHrs as a minimum.

Some may argue with the above figures however as I mentioned before we can't control the sunlight, its duration or clarity and we are preparing for the worst case scenario not just hoping for the best.

## DEFINITIONS

**The Solar Panel**
The solar panel simply harnesses the sunlight, converts it into energy or power and stores it into a battery or batteries.

**The Regulator**
The regulator limits the amount of power the solar panel is putting into the batteries. Its function is to stop the solar panel from overcharging and therefore damaging the batteries.

**The Battery**
The battery is the store room of power. It receives power from the solar panel, stores it and disperses it to the fridge as required.

**The Fridge.**
Here we are talking about portable fridges which work on 12v power. Most work on 240v as well but that does not concern us for the purposes of this article.

Some "smart" fridges are designed to work on either 12 or 24v and will automatically adjust to suit. The Waeco-C-F-80 is one of them. However all of our calculations and set-ups will be based on 12V systems.

"Duty cycle", when referring to the fridge, means what % of the the time the motor of the fridge is working over a 24hr. period. Just like your fridge at home the motor only works in order to keep the contents at the desired temperature which you have set.

**NOTE*the bigger the solar panel the more power will go into the battery. The bigger the battery the more power it will store. The bigger the fridge the more power it will draw from the battery.**


TIPS and TECHNIQUES: **SOLAR PANEL DIY** *by George Linardos*

# CHOOSING SOLAR PANELS

The size and power consumption of your fridge will determine the size [measured in watts] of your solar panel or multiple panels and the size of your battery or batteries. **Beware,** there are no short cuts here. Solar panels are not nuclear reactors.

In order to achieve their maximum power out- put they need direct sunlight at 90 degrees, clear non-haze skies, and even dust on them can prevent achieving maximum performance. In other words conditions must be ideal and very often they are not.

As a rule of thumb remember this. A 100W solar panel will deliver a maximum of 6 amps per hour into your battery under perfect conditions. Since we only count the hours of sunlight between 10a.m.to 4p.m.[sunlight before or after is considered too weak] the absolute maximum or "peak" power we can

Solar panels come in different sizes both in dimensions and performance rated in watts.

The polycrystalline 12v solar panels [they are the ones featured in these photos] are compact, powerful and contrary to popular belief extremely tough. They will withstand considerable force and have been known to survive when hail storms have destroyed roof tiles. These panels are available in many sizes and power ratings. When choosing your panels determine whether you will fix them permanently to the roof of your van or whether they will be free- standing

.Large solar panels say 80watt or more are cumbersome and heavy. You may wish to consider the folding type [shown above] particularly if you are going to use the free- standing option.

The other type of solar panel is called "amorphous". In my opinion they are not

## CHOOSING YOUR BATTERIES

I do not intend to delve too deeply into this area. There are enough claims,

counter claims and a plethora of technical information to warrant a separate article. Let's keep it as simple as possible. The main things you need to know is how much power the battery will hold [measured in amps], how many times can

recharge it [described as "cycles"] and its

So you walk into the battery shop and ask a simple question like " How many amps is this battery mate?" and the salesman

replies "800 cold crank". Now that's great! We are working with solar panels in amps, our fridge's drain on power is measured in amps and all of a sudden we've got "cranks" to confuse us totally. It reminds me of that commercial "I just

They tell me there's no formula to convert "cranks" to amps so if the amp rating is not stamped on the battery, don't buy it.

The preferred batteries for this application are called "deep cycle". They are sealed [no spillage of acids] lead acid batteries with thick plates and can withstand many charges and discharges. These are what most people use with their 12v fridges. However be aware that they are Heavy .A 100amp deep cycle battery weighs 33kg. Once you set them up they stay there. There is no maintenance required apart from regular charging.


Remember also that a battery should not as a rule of thumb be drained more than 50% of its capacity. Sealed lead acid batteries like to be kept at full or close to full charge.

A stored, unused battery will continue to gradually discharge without having anything drawing on its power so remember to re-charge batteries every three months or so.

## CHOOSING YOUR REGULATOR

Some solar panels come with the regulator already attached and wired to connect directly to your battery. In the event that your solar panel does not ,then you must buy a regulator to suit..

The formula is simple. Always choose a regulator with an amp rating greater than that of your solar panel or solar panels combined, if you choose to use one regulator for both. For example a solar panel producing 6amps will require a 10amp regulator. A solar panel producing 3 amps will require a 5 amp regulator.

Regulators prevent the battery from overcharge and they also prevent current flowing backwards from the battery to. the panel. **They are essential.**

One other choice you may wish to consider is buying an 'up-market' regulator with automatic LCD read-out.

These regulators [ such as the one featured here] actually show you how many amps your panel is delivering and t the charge state of your battery. The read-out moves automatically and continuously from one reading to another. You always know how much power is going into your battery- unfortunately they don't show how much is going out.

The latter we have to calculate using some information we know and some guess work and some guess work.

**More.....**

TIPS and TECHNIQUES: **SOLAR PANEL DIY** *by George Linardos*

# INSTALLING A SOLAR PANEL FOR A 12 VOLT FRIDGE SYSTEM

The first decision you have to make is whether you will fix your panels permanently to the roof of your van or motor home or whether they will be free-standing. There are advantages and disadvantages with either option.

Fixed roof-top solar panels don't present storage problems. However they cannot possibly face the sun at the optimum angle of 90 degrees. Also in the hot summer months most people choose to camp in the shade therefore further reducing the solar panel's performance.

On the other hand free-standing solar panels can be moved to face the sun whenever possible and within reason be set up away from your shady camping spot. Storage however now becomes a problem.

Also you have consider the amount of wires and cables which you will have around your campsite as well as the security factor re theft.

My choice was easy as my soft top camper trailer left me only with the free-standing option.

What is shown in these pages is a free standing solar panel/12v fridge/battery combination as I would use. There are many combinations of solar panels batteries and fridges. Each is determined by the factors that I mentioned earlier. I will not go into dual battery car systems, wind generators and other "hybrid" back-up combinations.

You can use the following calculations provided by Peter Israel from Solarcharge in Melbourne to determine your own needs and set up accordingly.

On average, the 80W solar panel [twin folding 40W] sitting flat on your roof in full sun will put out about out about 5 Peak Sun hour Equivalents.

.So 5 [amps in full sun] x 5PSE=25Ah a day. The same solar panel in a free-standing configuration and shifted a few times a day to keep aiming at the sun will deliver closer to 40 amp hrs [note the significant difference in flat mounted vs free-standing movable panels!] Note also that Peter is counting only 5 hours of sun each day whereas others count on six.

Therefore, if I am using two 80 watt folding solar panels I can expect [in theory] around 80Ah of power to be delivered to my batteries If I attach to two x 100amp batteries connected in parallel [see photo] I have 'one' 200Ah battery. Is this enough? Well that depends on what appliances we are running at the other end.

Since I have chosen the large Waeco CF-80 I know that it draws 4 amps on average and a total of 62amps over a 24 hour period where the surrounding temperature ranges 24 hour period where the surrounding temperature ranges from 15 to 55 degrees Celsius [from the tests done in the Australian 4WD Monthly]. Now we have to be careful here as the amount of power a fridge draws depends on many variables such as the contents, the ambient temperature around the fridge, the "cold" setting, whether or not it is set on freezer mode, how many times it is opened and so on.

The duty cycle of the fridge is calculated at around 50%.All of the above mentioned variables can change this so some times the draw will be less and at other times more.

Now we are guided by experience [our own and others] some facts and some guess work and this is where science starts to become an art form.

Look at it this way if the fridge draws less than the figures quoted here, consider it a bonus. Always work on the worst case scenario.

My two 80w solar panels will deliver at best 80Amp hrs per day. My fridge will draw 60amps per day and I have 100 amps in reserve in my batteries. I it seems that in theory I will have plenty of power. In reality I might just make it with plenty of clear blue skies! The panels will rarely deliver their full power, there will be power losses in the cables and connections and anyone who thinks campers spend their holidays moving panels around all day just hasn't been camping! [with all due respect to the armchair "experts"].

Why have I got only 100amphrs and not 200? Because you should never flatten batteries less than 50% of their capacity approx 11.5volts.

Peter recommends at least 340amps in batteries "for a rainy day" pardon the pun. Looking at my set-up I think I will connect another 2x100 amp hr batteries to be sure, to be sure. Remember that I camp on an un powered site for a month. There are times when we don't see any sun for weeks. You may be able to do with less.

TIPS and TECHNIQUES: **SOLAR PANEL DIY** *by George Linardos*

# WIRING SOLAR PANELS

You don't have to be a rocket scientist to hook up a system as long as you read instructions and follow some simple rules.

The easiest system is to buy pre-wired panels with regulators built in. Simply connect the red alligator clip to the positive terminal on your battery and the other one to the negative.

Attach a female CIG connector to the battery and plug in you fridge's 12v lead. The more sophisticated set-ups require connecting batteries in parallel, adding a fuse to protect the circuit and ensuring you use the correct size wires. Nothing less than quality 3mm cross-section for short distances say up to 2 metres and 8mm cross section for up to ten metres

The accompanying photos show all the connections you will need.

MAKE SURE YOU CONNECT TO THE RIGHT POLARITIES, otherwise you could cause irreparable damage to your set-up, not to mention the possibility of fire.

**SUMMARY**

When setting up your system give it a chance to work under adverse conditions. If you are going to err do so on the basis of more power rather than less. Why spend thousands of dollars. on a system designed to fail?

In the words of Effie,
"how embarrassment!'

**ACKNOWLEDGEMENTS**

SOTERION PTY LTD.
SOLARCHARGE

**George Linardos**


Solar Panel

Regulator

Cables

Fuse

Back of Solar Panel Connections

Wiring to Batteries

Junction Box at back of Solar Panel


Battery Connection