



KIMBERLEY™

Live Life's Adventure Today...in out of the way places!

Offroad Camper Trailer Solar & Battery Size Calculator



How does the Power to Weight Ratio of Super Thin Solar compare with a Porsche Boxster?

The Boxster has three times the power to weight:

The Power to weight ratio of a Standard Porsche Boxster is approx 120 W/kg;
For the Kimberley Super Thin Solar: 37 W/kg

But the Boxster uses carbon based fuel:

The Porsche uses carbon based fuel; the Super Thin Solar uses the renewable power of the Sun!



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Comparison of different technologies.

The Photo on the front cover is a 150W Super Thin Flexible Solar panel popular with camper trailers. It is totally flexible yet can be angled toward the sun for maximum efficiency.

These panels are available from www.eco-camper.com



**This eBook addresses the question:
How much of Australia do you want to experience?**



Solar calculator Assumptions

Rather than start this guide with the differences in solar technologies and technical information, we are going to put this at the end.

You will be able to turn the pages and see different setups. The pages are structured to show a typical setup with 5 hours of solar and AGM then Lithium Batteries.

After this, the solar hours are reduced to 2 hours and a fuel cell introduced.

Where it says “indefinite”; you can read that choosing the smallest solar panel here should do. Where there is a Number, it is the number of days without other charging. Where it says “No”; it is unlikely that you can operate with this configuration.

There are assumptions here to keep things simple. Even though a more accurate calculator like the type we have deployed online will give you exact numbers, travelling doesn't quite work that way. A small layer of dust on the solar panel will reduce efficiency by up to 30%. Cloud cover in the middle of the day will reduce solar capacity by 60%+. There are so many variables here in reality. So going for a system that is a high number of days or “indefinite” should have you covered. However, if it is not critical and you are driving between locations with good charge from the vehicle then the lesser number of days may work for you.

At the bottom of each page is a weight calculation of the glass solar and the super thin solar. When the fuel cell is introduced, the weight of the unit and 10 litres of Methanol is included. The batteries are included in the weight calculation.

There is just One technical point to remember. When charging with a solar controller, the controller HAS to be near the batteries. If you use a system with the controller on the back of the solar panel, it will not fully charge the batteries and efficiencies will be far less. In addition, these controllers are rarely MPPT so the power is considerably less. An MPPT solar controller is used in the calculation.

The amount of power used by the devices listed is the approximate average based on our experience with thousands of systems. It can vary by 100%. If you know you use a lot of power then step up a size or two. If you are frugal, then maybe step down a size. These averages assume average winter weather with typical use.

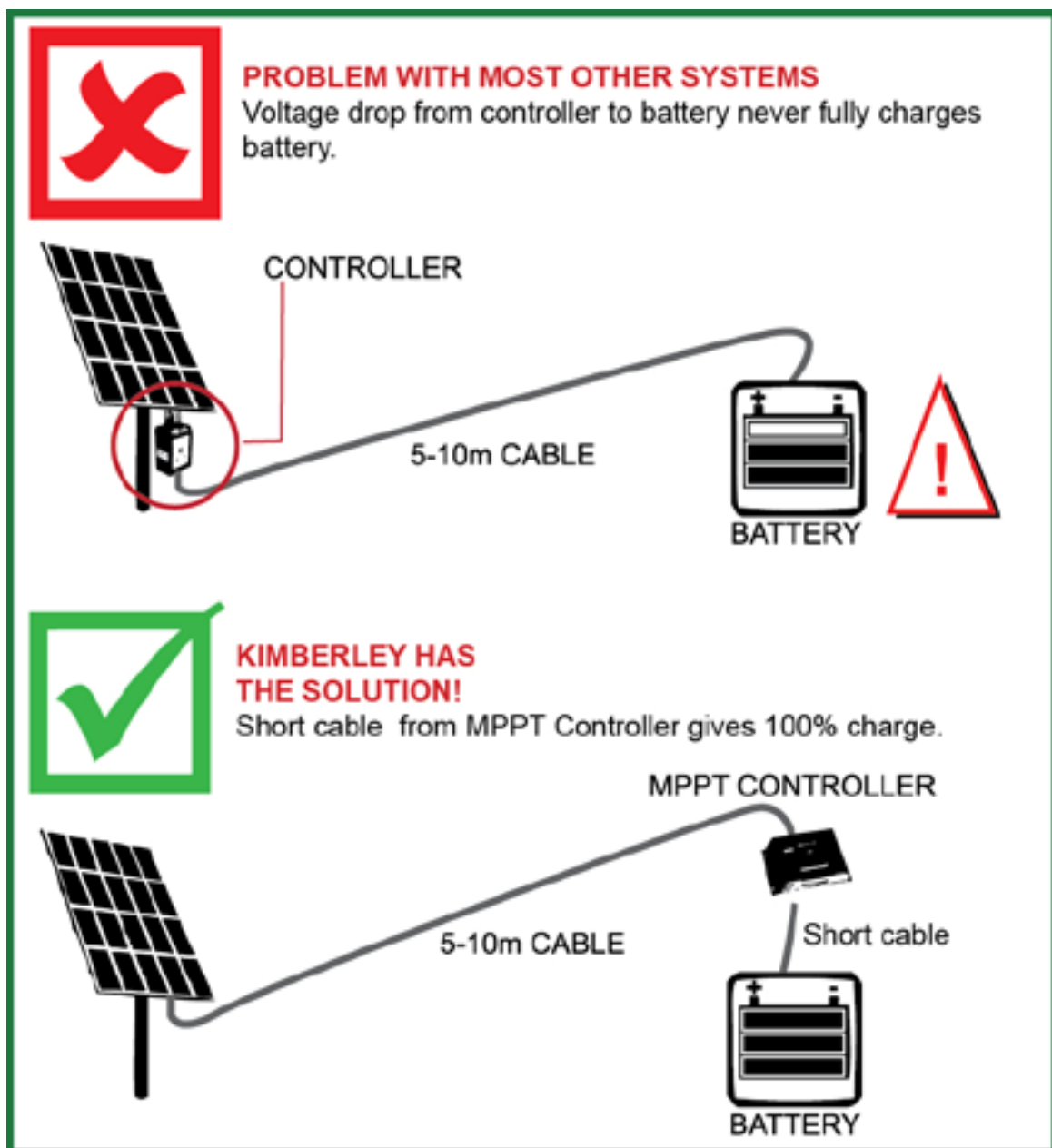
Finally, when you are close, always get the advice for your specific needs from an expert before purchasing. This guide gives you enough information to ask the right questions!



Just ONE golden Rule - there are now several solar system providers who can supply this.

Most solar panels have their controllers mounted to the back of the solar panel for convenience. This causes a voltage DROP from the controller to the battery meaning that the battery never fully charges. With our systems we mount the MPPT controller as close to the batteries as possible to eliminate this voltage loss and allow your batteries to be fully charged.

However, MPPT controllers only work when connected to the battery FIRST. This means any supply with a controller on the back of a panel cannot effectively use an MPPT controller as in this position it is connected to the panel first!



Solar calculator: Panel Size for a given Battery Type and Size

The Table is for **100 Amp Hour AGM Battery** with 5 Hours of good solar charging per day in Middle Australia. We have factored in a 20% efficiency drop through changing sun angle. The Solar controller is MPPT which gives up to 30% more power than regular. The Devices are approx and give you a typical range with increasing usage.

SHOWS NUMBER OF DAYS					
Typical Items Used	75Watt MPPT	150Watt MPPT	225Watt MPPT	300Watt MPPT	375Watt MPPT
LED Lights Water Pump	Indefinite				
LED Lights water pump 40 litre fridge	1	4	Indefinite		
LED Lights water pump 75 litre fridge	No	2	Indefinite		
LED Lights Water Pump 75 Litre Fridge Phone charging	No	2	Indefinite		
LED Lights Water Pump 75 Litre Fridge Phone charging Laptop Charging	No	1	12	Indefinite	
LED Lights Water Pump 75 Litre Fridge Phone charging Laptop Charging Microwave	No	No	1	4	Indefinite
Weight in Kgs					
Weight Battery & Glass Solar in Kgs	42	51	60	69	78
Weight Battery & Super Thin Solar in Kgs	36	38	40	42	44



Solar calculator: Panel Size for a given Battery Type and Size

The Table is for **200 Amp Hour AGM Battery with 5 Hours of good solar** charging per day in Middle Australia. We have factored in a 20% efficiency drop through changing sun angle. The Solar controller is MPPT which gives up to 30% more power than regular. The Devices are approx and give you a typical range with increasing usage.

SHOWS NUMBER OF DAYS					
Typical Items Used	75Watt MPPT	150Watt MPPT	225Watt MPPT	300Watt MPPT	375Watt MPPT
LED Lights Water Pump	Indefinite				
LED Lights water pump 40 litre fridge	2	8	Indefinite		
LED Lights water pump 75 litre fridge	2	4	Indefinite		
LED Lights Water Pump 75 Litre Fridge Phone charging	2	3	Indefinite		
LED Lights Water Pump 75 Litre Fridge Phone charging Laptop Charging	1	3	24	Indefinite	
LED Lights Water Pump 75 Litre Fridge Phone charging Laptop Charging Microwave	No	1	2	7	Indefinite
Weight in Kgs					
Weight Battery & Glass Solar in Kgs	76	85	93	102	111
Weight Battery & Super Thin Solar in Kgs	69	71	73	75	77



Solar calculator: Panel Size for a given Battery Type and Size

The Table is for **200 Amp Hour AGM Battery with 2 Hours of good solar** charging per day in Middle Australia. We have factored in a 20% efficiency drop through changing sun angle. The Solar controller is MPPT which gives up to 30% more power than regular. The Devices are approx and give you a typical range with increasing usage.

SHOWS NUMBER OF DAYS					
Typical Items Used	75Watt MPPT	150Watt MPPT	225Watt MPPT	300Watt MPPT	375Watt MPPT
LED Lights Water Pump	Indefinite				
LED Lights water pump 40 litre fridge	1	2	3	4	7
LED Lights water pump 75 litre fridge	1	1	2	3	4
LED Lights Water Pump 75 Litre Fridge Phone charging	1	1	1	2	3
LED Lights Water Pump 75 Litre Fridge Phone charging Laptop Charging	1	1	1	2	3
LED Lights Water Pump 75 Litre Fridge Phone charging Laptop Charging Microwave	No	No	1	1	1
Weight in Kgs					
Weight Battery & Glass Solar in Kgs	76	85	93	102	111
Weight Battery & Super Thin Solar in Kgs	69	71	73	75	77



Solar calculator: Panel Size for a given Battery Type and Size

The Table is for **120 Amp Hour Lithium Battery** with 5 Hours of good solar charging per day in Middle Australia. We have factored in a 20% efficiency drop through changing sun angle. The Solar controller is MPPT which gives up to 30% more power than regular. The Devices are approx and give you a typical range with increasing usage.

SHOWS NUMBER OF DAYS					
Typical Items Used	75Watt MPPT	150Watt MPPT	225Watt MPPT	300Watt MPPT	375Watt MPPT
LED Lights Water Pump	Indefinite				
LED Lights water pump 40 litre fridge	2	8	Indefinite		
LED Lights water pump 75 litre fridge	2	4	Indefinite		
LED Lights Water Pump 75 Litre Fridge Phone charging	2	4	Indefinite		
LED Lights Water Pump 75 Litre Fridge Phone charging Laptop Charging	2	3	Indefinite		
LED Lights Water Pump 75 Litre Fridge Phone charging Laptop Charging Microwave	1	1	2	8	Indefinite
Weight in Kgs					
Weight Battery & Glass Solar in Kgs	26	35	44	53	62
Weight Battery & Super Thin Solar in Kgs	19	22	24	26	28



Solar calculator: Panel Size for a given Battery Type and Size

The Table is for **250 Amp Hour Lithium Battery** with 5 Hours of good solar charging per day in Middle Australia. We have factored in a 20% efficiency drop through changing sun angle. The Solar controller is MPPT which gives up to 30% more power than regular. The Devices are approx and give you a typical range with increasing usage.

SHOWS NUMBER OF DAYS					
Typical Items Used	75Watt MPPT	150Watt MPPT	225Watt MPPT	300Watt MPPT	375Watt MPPT
LED Lights Water Pump	Indefinite				
LED Lights water pump 40 litre fridge	5	Indefinite			
LED Lights water pump 75 litre fridge	4	18	Indefinite		
LED Lights Water Pump 75 Litre Fridge Phone charging	4	9	Indefinite		
LED Lights Water Pump 75 Litre Fridge Phone charging Laptop Charging	3	7	Indefinite		
LED Lights Water Pump 75 Litre Fridge Phone charging Laptop Charging Microwave	2	6	Indefinite		
Weight in Kgs					
Weight Battery & Glass Solar in Kgs	45	54	63	71	80
Weight Battery & Super Thin Solar in Kgs	38	41	43	45	47



Solar calculator: Panel Size for a given Battery Type and Size

The Table is for **80 Amp Hour Lithium Battery and a 140 Fuel Cell at 30% duty load** with 5 Hours of good solar charging per day in Middle Australia. We have factored in a 20% efficiency drop through changing sun angle. The Solar controller is MPPT which gives up to 30% more power than regular. The Devices are approx and give you a typical range with increasing usage.

SHOWS NUMBER OF DAYS					
Typical Items Used	75Watt MPPT	150Watt MPPT	225Watt MPPT	300Watt MPPT	375Watt MPPT
LED Lights Water Pump	Indefinite				
LED Lights water pump 40 litre fridge	3	9	Indefinite		
LED Lights water pump 75 litre fridge	2	5	Indefinite		
LED Lights Water Pump 75 Litre Fridge Phone charging	2	4	Indefinite		
LED Lights Water Pump 75 Litre Fridge Phone charging Laptop Charging	2	3	27	Indefinite	
LED Lights Water Pump 75 Litre Fridge Phone charging Laptop Charging Microwave	1	1	2	8	Indefinite
Weight in Kgs					
Weight Battery & Glass Solar in Kgs	37	46	55	64	73
Weight Battery & Super Thin Solar in Kgs	31	33	35	37	39



Solar calculator: Panel Size for a given Battery Type and Size

The Table is for **160 Amp Hour Lithium Battery and a 140 Fuel Cell at 10% duty load** with 5 Hours of good solar charging per day in Middle Australia. We have factored in a 20% efficiency drop through changing sun angle. The Solar controller is MPPT which gives up to 30% more power than regular. The Devices are approx and give you a typical range with increasing usage.

SHOWS NUMBER OF DAYS					
Typical Items Used	75Watt MPPT	150Watt MPPT	225Watt MPPT	300Watt MPPT	375Watt MPPT
LED Lights Water Pump	Indefinite				
LED Lights water pump 40 litre fridge	4	13	Indefinite		
LED Lights water pump 75 litre fridge	3	7	Indefinite		
LED Lights Water Pump 75 Litre Fridge Phone charging	2	5	Indefinite		
LED Lights Water Pump 75 Litre Fridge Phone charging Laptop Charging	1	4	Indefinite		
LED Lights Water Pump 75 Litre Fridge Phone charging Laptop Charging Microwave	1	1	2	8	Indefinite
Weight in Kgs					
Weight Battery & Glass Solar in Kgs	49	58	67	76	85
Weight Battery & Super Thin Solar in Kgs	43	45	47	49	51



Solar calculator: Panel Size for a given Battery Type and Size

The Table is for **160 Amp Hour Lithium Battery and a 140 Fuel Cell at 10% duty load with 2 Hours of good solar** charging per day in Middle Australia. We have factored in a 20% efficiency drop through changing sun angle. The Solar controller is MPPT which gives up to 30% more power than regular. The Devices are approx and give you a typical range with increasing usage.

SHOWS NUMBER OF DAYS					
Typical Items Used	75Watt MPPT	150Watt MPPT	225Watt MPPT	300Watt MPPT	375Watt MPPT
LED Lights Water Pump	Indefinite				
LED Lights water pump 40 litre fridge	3	3	5	7	15
LED Lights water pump 75 litre fridge	2	3	4	5	8
LED Lights Water Pump 75 Litre Fridge Phone charging	2	2	3	4	6
LED Lights Water Pump 75 Litre Fridge Phone charging Laptop Charging	2	2	3	4	5
LED Lights Water Pump 75 Litre Fridge Phone charging Laptop Charging Microwave	1	1	2	2	2
Weight in Kgs					
Weight Battery & Glass Solar in Kgs	49	58	67	76	85
Weight Battery & Super Thin Solar in Kgs	43	45	47	49	51



What Super Thin Solar, & Super Light Flexible Solar Panels look like. Perfect for Camper Trailers and Vehicle Storage.



Photo above is a 90W Super Thin solar panel bonded to caravan roof.



Photo on right is 125W Super Thin Flexible panel draped over car but sits easily on camper trailers.



Photo on Left is a 75W Flexible Super Light Panel that can be placed inside a car for security reasons and still provide some charging although it will be significantly reduced!

Photo below is same panel on outside of car window.

Any of these panels are perfect for camper trailers or vehicles as they can be folded up and stored on tight spaces compared to glass solar panels. And they are much harder to damage!



These panels are available from www.eco-camper.com



Fuel Cells.

We have been using them for 4 years with great results!

The principle behind EFOY fuel cells

The EFOY Fuel Cell transforms chemical energy directly into electrical energy. The transformation is highly efficient and involves no moving parts, making it a particularly effective source of power. A lot of patented innovation has gone into our units, making the EFOY fuel cell a marvel of miniaturization, a lightweight but high-powered, long-lasting performer. SFC's home-grown technology has positioned EFOY fuel cells to lead the field in fuel-cell systems for mobile applications.

How does an EFOY fuel cell work?

At the heart of every EFOY fuel cell is the stack. The stack actually consists of several cells: an anode, a cathode and a membrane that acts as an electrolyte, separating the anode and the cathode from each other. Positively charged electrical particles (protons) can permeate the membrane. Methanol and water are introduced on the anode side while ambient oxygen enters the cathode side. H⁺ ions, free electrons and carbon dioxide arise on the anode side. The protons can permeate the membrane while the electrons have to travel an electrical circuit over to the cathode side, thereby producing electrical current. H⁺ ions and water vapor arise on the cathode side, making EFOY fuel cells an extremely environmentally friendly way to generate electricity.

EFOY fuel cells use liquid fuel

Every EFOY fuel cell employs DMFC (Direct Methanol Fuel Cell) technology which transforms methanol directly into electrical current. That's a real advantage, especially for mobile applications, because liquid methanol is easy to transport anywhere in practical EFOY fuel cartridges.

Of course EFOY fuel cells operate in tandem with solar panels. Here, the fuel cell only cuts in if the solar panel can't produce enough power due to poor weather conditions.

The photo on the right is a fuel cell installed in a Kimberley Karavan. It shows the methanol cartridge on the left.

The by-product is pure water which drains into the water tank.

*Fuel Cells are available from
www.eco-camper.com*



Comparison of different solar technologies

For a practical comparison on the Solar Technologies used for portable solar panels, there is only one major thing you have to follow. How many amps will it produce to charge a battery. Then hold the supplier to this number. Don't be bamboozled with watts and other calculations, just ask what the amps of current is. The amps times the number of hours of charge time equals "amp hours" which is a measure of the storage capacity of batteries.

Monocrystalline panels are the most common because they are a very reliable technology and a great watts/square metre. Polycrystalline panels are a cheaper version of crystalline panels, and a little less efficient. We don't sell Polycrystalline panels.

CIS thin-film panels (Typical maximum size sold is 62W, brand Brunskill) are a new technology and performance wise they compare favourably to crystalline panel technologies, with some improved performance in higher heat.

If however, partial shading occurs, an amorphous panel, should be considered, as these panels perform much better in partial shade.

Amorphous panels are a soft flexible lightweight material (we call them our "Superlight" solar panels). They produce a lower amount of power per square meter than crystalline panels BUT the greatest advantage of amorphous panels, when compared to the other types of solar panels, is their shade tolerance. This is due to bypass diodes being integrated into every silicon layer in each cell.

To compare the output of the different types of panels used, the amount of sunshine, temperature, orientation and atmospheric conditions need to be taken into consideration.

We use a third party assessment of the panels in a hot environment like Cairns in North Queensland. As a guide, a [100W] solar panel installed in an unobstructed sunny position in Cairns will produce an average daily output, shown in ascending order of performance:

- o Polycrystalline solar array 0.40kWh/day
- o Monocrystalline solar array 0.42kWh/day
- o Amorphous solar array 0.49kWh/day

So in this practical test, the panel technology with the theoretical lowest efficiency percent produces more power because of the temperature and partial shade from passing cloud cover.



Comparison of different solar technologies

The “thin film” CIGs technology was not tested above but would fall in this range. The one problem with some of the CIGs solar panels is exposure to high heat in a dark environment. It is not uncommon to store a thin-film panel in a dark place such as a protective case, rear of a car, or camper trailer box. Exposure to HIGH HEAT in DARK environments has a short term detrimental impact on the CIGS panel performance. It is typical for a CIGS panel to require “Light Soaking” after dark, hot storage conditions before it can be used. It can often take as much as 72 hours of direct exposure to sunlight for a CIGS panel to regain its rated power generating capabilities.

Unlike CIGS thin film, the amorphous silicon panel will produce its rated power immediately after exposure to high heat and dark conditions. Its ability to operate at rated capacity is NOT degraded after high heat exposure in dark environments. This is a critical factor in most camping applications where power may be demanded at a moment’s notice. For this reason we do not sell the CIGs solar panel technology.

MPPT Controllers

Maximum Power Point Tracking (MPPT) extracts the maximum amount of available power from a Solar Panel (PV) array. A battery-based Solar System normally only extracts about 65% to 95% of the power available from the Solar Panel array.

By using an MPPT-type charge controller almost all of this previously unobtainable power is made available for charging the battery bank.

They are a MUST have. They are rarely used in systems where the controller is located at the back of the solar panels because the MPPT controller MUST be connected to the battery first and then the solar panel second. If it isn’t connected this way, it may not work correctly.



Superthin Solar Panels

The Super-Thin Solar panels are made from Monocrystalline wafers bonded in a unique and proprietary way to Aluminium.

The photo shows the two types of monocrystalline panels.

Monocrystalline silicon solar panels are common in the industry because of reliability and great watts/square metre. However, the traditional glass format is very heavy and fragile. A slight crack can cause the panel to fail!

In 2009, Kimberley started working with a manufacturer to use the Oxide Aluminium back-sheet and Dupont's EVA/ Tedlar products to bond the same monocrystalline wafers.

This produced a highly durable panel less than 2mm thin, and weighing 75% less than glass.

We have now shipped more than 1,000 panels with this technology without one failure! They are virtually unbreakable (No Glass).

