



THE RV SOLAR REFERENCE GUIDE



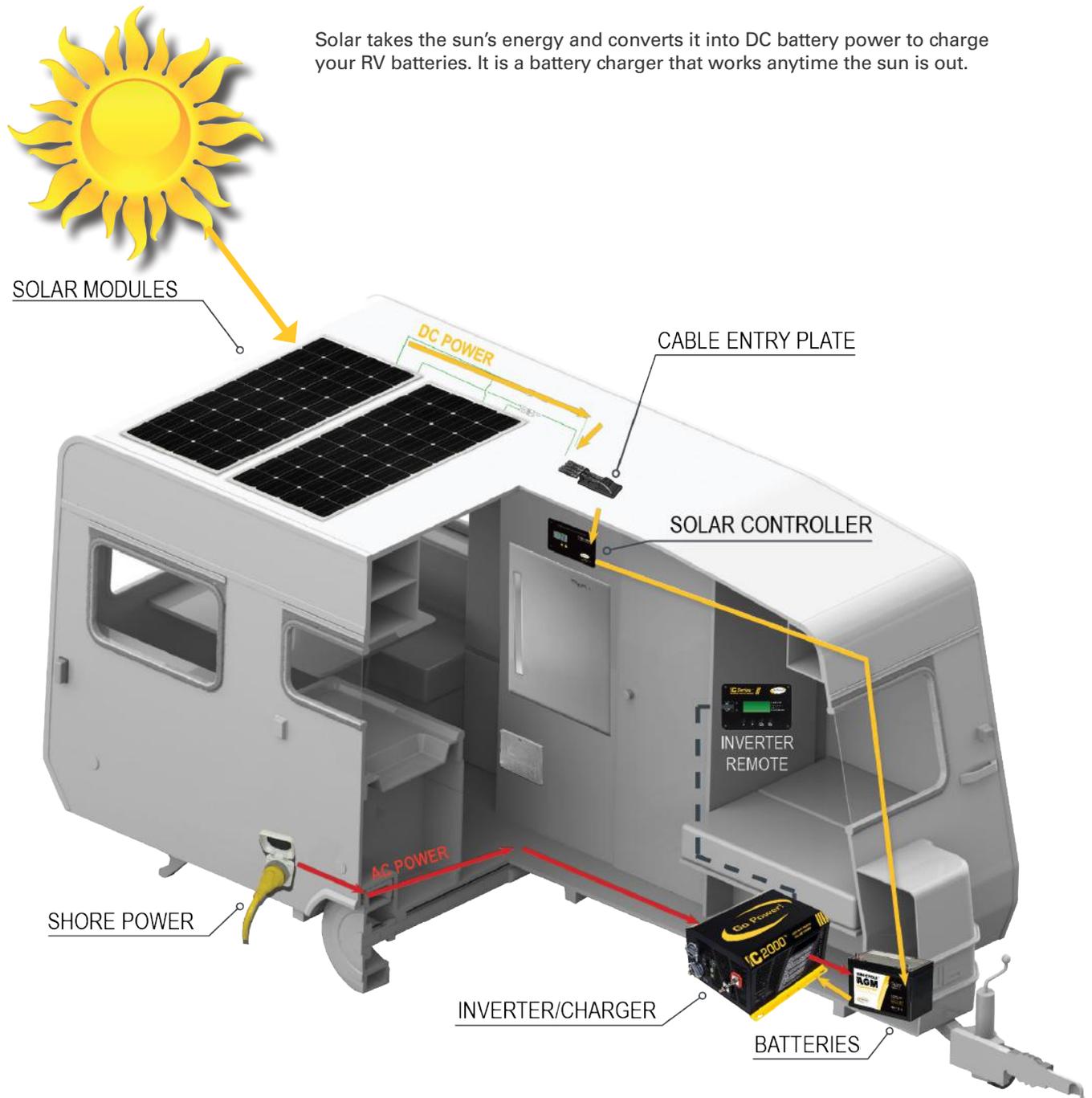
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HOW SOLAR WORKS



But how do these components work together to power your RV's components? Read on to learn more.



RV SOLAR-EXPLAINED

HOW IS YOUR RV SOLAR SYSTEM LIKE THE FUEL SYSTEM IN YOUR CAR?

It helps to think of your RV solar system as your car's fuel system.



The **RV Battery** is like your car's gas tank. A typical RV battery may be rated at 100 amp hours. Those amp hours are like gallons of fuel in your gas tank. Just as you consume gasoline to run your car's engine, you use up amp hours to operate RV appliances like your water pump, refrigerator, or TV. When your battery is depleted, you need to replenish those amp hours; in this case, with energy from your solar panels.

Voltage. Think of voltage as "pump pressure". Using our auto analogy, imagine you pull your car into the gas station to refill your gas tank. If the gas pump doesn't provide enough pressure, it will not completely fill your gas tank and you won't be able to drive as far next time.

The same is true for RV solar charging. Many standard RV solar chargers don't produce enough voltage, only charging your RV battery to 13.7 volts—much less than the 14.4 volts required for a full charge. Without that complete charge, your "gas tank" won't be full. This means you won't be able to stay off-grid and run on battery power for as long as you would with full batteries. That's why Go Power! solar solutions are designed to charge to the right voltage, giving you a 100% charge—every time.



A word about wiring. Think of your RV wiring as the fuel line in your car. If the line is very small, it can't provide enough fuel to that big V8 engine, which will sputter and perhaps even stop altogether. This is the case in your RV. If you use inadequate, thin-gauge wire for your system, those wires won't carry the full amount of power to your batteries or inverter, causing them to not run your appliances properly. This can pose a safety hazard, as the wires may become too hot. Every Go Power! system uses the correct, heavy gauge wire to ensure all components and appliances receive the right amount of power.

SOLAR SYSTEM COMPONENTS

Your RV solar power system is made up of several key components that all work together to collect, regulate, store, and deliver power to your RV appliances. All these components must be compatible in type and capacity to ensure your solar system performs safely and optimally.

Now let's break down the individual components of our RV solar system in this eBook.



Go Power![®]



SOLAR PANELS

DEMYSTIFYING SOLAR PANELS

How they work. Solar panels are made up of individual solar cells that convert sunlight into energy. That energy comes in the form of direct current (DC) electricity, which is used to charge and replenish your RV's batteries. Typically, several panels are joined together, creating a 'solar array.'

What to look for. There are three common types of solar panels: amorphous, monocrystalline, and polycrystalline.

While **amorphous panels** are the least expensive, they are the least efficient and take up the most room. They can also lose up to 30 percent of the power-generating capabilities in their first year—they actually degrade when exposed to sunlight!

Polycrystalline panels take up roughly half the space to produce the same power as their amorphous counterparts, however, they can vary widely in quality. Look for panels with the highest rated wattage for their size. A smaller footprint means a more efficient panel.

While monocrystalline panels are also available with different grades of cells, they are almost always more efficient than poly panels. ***They also typically last longer, making them the wallet-friendly choice.***

RIGID VERSUS FLEXIBLE PANELS

Rigid panels are more commonly used than flexible panels. Rigid panels are made with tempered glass, are very durable, and typically come with much longer warranty periods.

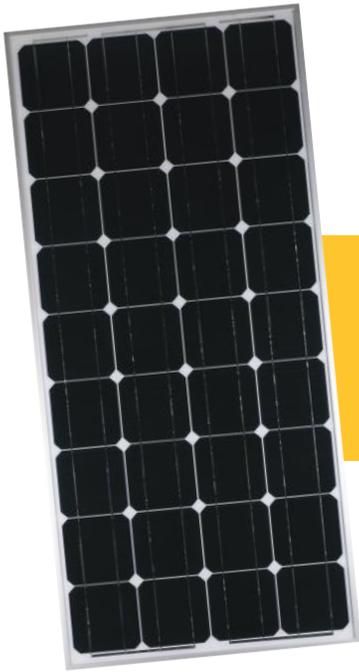
Flexible panels are usually reserved for specialty applications — when the panels need to be molded to curved surfaces, or when where there are height/weight constraints. While flex panels may be up to 80 percent lighter than rigid panels, they are much more susceptible to damage.

For cost, durability, and warranty length, it's tough to beat the value of rigid glass panels.

BUYING TIPS

- Don't be tempted by cheap panels. They are usually made with low-quality, or cut cells— while they may be cheaper, they're far less efficient. Full, complete solar cells perform better, last longer, and are worth the additional cost.
- Watch out for manufacturer claims of wattage output. The best manufacturers will provide a minimum output for their panels, as opposed to maximum output. Always ask your seller to document their panel output range (including a plus/minus percent).

SOLAR PANELS



MONOCRYSTALLINE

- Most efficient, takes up less space
- Look for top grades, full cells and documented minimum output
- Highest efficiency

POLYCRYSTALLINE

- Cost-effective but less efficient
- Quality varies - look for full cells and documented minimum output



AMORPHOUS/THIN FILM



- Inexpensive but inefficient
- Takes up a lot of room
- Degrades and loses capabilities over time



BATTERIES

RVs typically use deep cycle, valve-regulated lead-acid (VRLA) batteries that can be regularly discharged and recharged. There are two types of VRLA batteries— gel and absorbed glass mat (AGM)—with the latter being more popular.

AGM batteries offer many advantages to the RVer. They are sealed, do not spill or vent gas, and require no maintenance. AGM batteries also charge quickly and are more resistant to low temperatures. They are, however, sensitive to overcharging and require the use of a charge controller as a preventative measure.

Gel batteries are also sealed and don't spill, but they are much slower to charge than their AGM counterparts. Based on older technology, they also require a charge controller compatible with Gel batteries.

Lithium-ion batteries. The third option not mentioned above is lithium-ion batteries. They provide high performance and efficient charging in a low-weight package. They are safe, require no maintenance, and offer a long life-cycle. The drawback to lithium-ion batteries is cost—these batteries come with a very high price tag.

How many batteries will I need? This will depend on the energy consumption of your RV. The more appliances you plan to run, the higher your consumption will be. RV batteries can also be wired together to form a 'battery bank,' providing either higher voltage (wired in series) or greater capacity (connected in parallel).

Should I choose 6v or 12v batteries? While 6v batteries offer more amp hours, 12v batteries, in some configurations, can provide more redundancy.

Most of your RV applications require 12v current, so you'll need two 6v batteries connected in series to generate those 12 volts. If one of those 6v batteries go bad, you'll have no usable power.

However, if two 12v batteries are connected and one does not work, you'll still have usable 12v power.

Typically, 6v batteries are used if you're looking for maximum power or are planning to have a large battery bank.

GO POWER! RECOMMENDS



12 VOLT SUN CYCLE AGM SOLAR BATTERY

Features

- 12V, 110AH @ C100 | 100AH @ C20
- Float application: 13.5 – 13.8V
- Cycle application: 14.4 – 15.0V



6 VOLT SUN CYCLE AGM SOLAR BATTERY

Features

- 6V, 224AH @ C20
- Float application: 6.8 – 6.9V
- Cycle application: 7.2 – 7.4V

BUYING TIPS

- For most off-grid applications, high-quality AGM batteries are preferred since they strike the best balance between performance and price.
- With batteries, 'heavier is better.' More lead means more capacity.
- Be sure to check out the manufacturer's battery warranty and ask about their service and support capabilities.

TYPICAL BATTERY BANK SIZING



500+ watts of Solar

- 5x 6volt battery
- 5+ days running only battery power
- Recommended Go Power! Kit - SOLAR EXTREME



300-499 watts of Solar

- 5x 12volt battery
- 3-5 days running only battery power
- Recommended Go Power! Kit - SOLAR ELITE



170-299 watts of Solar

- 2x 6volt OR 2x 12volt battery
- 1-2 days running only battery power
- Recommended Go Power! Kit - WEEKENDER



CHARGE CONTROLLERS

The **solar charge controller** is a critical component in your RV solar system. The controller maintains the life of the battery by preventing overcharging. When your batteries are low, the controller provides a full flow of current from your solar panels to replenish your battery bank. When your batteries achieve a 100% charge, the controller limits the current flowing from your solar panels to the batteries.

There are different types of solar charge controllers. While simple one or two stage controllers will shut off solar current when your battery is full, **Pulse Width Modulated (PWM)** controllers offer more functionality. They provide greater control of the current flowing from your solar panels and better 'trickle charging' of your batteries.

Maximum Power Point Tracking (MPPT) controllers are up to 30% more efficient than PWM controllers and provide even more control, however the high cost of MPPT controllers remains prohibitive. A top-quality PWM controller is recommended for almost all RV applications.

CHARGE CONTROLLERS

PWM Controller



MPPT Controller



BUYING TIPS

- Cheaply made charge controllers can give off a lot of electrical 'noise' and interfere with some electronics like stereos and televisions. Look for a charge controller that has been UL-certified or undergone other independent standards testing.
- Consider emerging features — options such as Bluetooth connectivity that will allow you to monitor and manage your controller remotely.



POWER INVERTERS

While your RV batteries generally provide 12 volt DC power, many of the appliances you run in your RV require 120 volts AC (like in your home). Making this conversion is the primary role of your RV power inverter.

There are several things to consider when choosing your RV power inverter. First, while most older inverters use '**modified sine wave**' technology (to recreate the AC power profile in your home), many appliances and sensitive electronics run better on the power produced by newer, '**pure sine**' inverters. While more expensive, pure sine inverters provide more assurance that all your current and future devices will run optimally.

We recommend choosing an inverter from a company with a proven track record and reliable customer support. Your inverter should have a full range of safety certifications (such as CSA and UL) to ensure safe operation within your RV.

More elaborate converters also give you the capability to charge your batteries when you're plugged into shore power or running a generator. Some even allow you to 'pass through' AC current directly to your appliances when you're plugged into shore power, or to draw shore power and battery power at the same time.

Pure Sine Wave Inverter



Modified Inverter



Appliances and Electronics



= Ideal with pure sine inverter

Appliance	Watts
 Cell Phone	50
Ceiling Fan	75-120
Coffee Maker	800-1200
 DVD Player	35-100
 Gaming Console	100
Hair Dryer	900-1600
Iron	1000
Light Bulb (incandescent)	100
Light Bulb (fluorescent)	25
 Microwave Oven	1500-2000
Mini Christmas Lights (50)	25-75
 Computer + Monitor	125
 Laptop	25-150
 Laser Printer/Fax (printing)	850-1300
 Satellite Receiver	10-25
 Stereo	250
 Tablet (iPad)	100
 TV (Flatscreen)	65
 TV (25")	300
Toaster	800-1500
 Toaster Oven	1500
Toaster Oven (convection)	3000+
Vacuum Cleaner	1225-1500

Common and Commercial Tools



Pure Sine Wave Inverters are ideal for variable speed tools (ie:drills)

Appliance	Watts
 1/4" Drill	250
 1/2" Drill	750
 8" Circular Saw	1800
Air Compressor	2000-3000
 Bucket Heater	1500
 Charger - Battery powered tools	240-500
 Credit Card Machine	100
Electric Chain Saw - (14", 2hp)	1100-3000
Electric Block Heater	750
 Fiber Optic Splicer	1000
Grinder - (4 1/2")	25-75
Halogen Flood Lamp	500-750
 Hammer Drill	1100-1600
Heat Gun	600-1500
High-Pressure Washer - (1hp)	10-25
 Knife Cutter	1100
Reciprocating Saw	1500-1800
 Sewer Camera - lights + crawler	500
Shop Vac - (5hp)	1000
Space Heater	1500
Sump Pump - (1/2hp)	1100-2200
 Table Saw	1800
 Thumper - (electrical fault locator)	1800-2500



POWER CONVERTERS, BATTERY CHARGERS, AND TRANSFER SWITCHES

In RV applications, the terms 'power converter' and 'battery charger' are used interchangeably. The converter takes AC power (from shore power or a generator), converts it to DC, and uses it to charge the RV batteries.



Good converter/chargers are high-performing and will dramatically shorten the time it takes to charge the batteries — kind of like filling your pool with a fire hose instead of a garden hose. A converter charger will provide savings in generator fuel and shore power charges, and minimizing your generator run times is likely to make you more popular in the RV park.

Transfer Switch



Transfer switches provide both safety and convenience—who wants to be manually transferring power sources at night or in the middle of a storm?

Transfer switches automatically switch between two sources of incoming AC power. It's critical that different AC power sources are kept separate from each other—failing to do so can result in damaged electrical equipment or even fire.

Once the different AC power sources are attached to the transfer switch, the switch will select the appropriate power source to use based on your preferences. For example, it can send power to your RV refrigerator when you're driving, allowing you to turn off the fridge's propane source (a safety issue when on the road).





RV COMPONENTS SUMMARY

A well-designed RV solar solution built with quality components will provide you with the ultimate flexibility for going off grid and should give you years of trouble-free service. Here are a few things to keep in mind when choosing your solar set-up:

Understand your current and future requirements. Are you a casual RVer, or a hardcore boondocker? What about in the future—will your needs change? Allowing for future requirements when building out your solar system can help you avoid costly retrofits down the road.

Always choose high-quality components. Check the manufacturer's written specifications, read reviews from other customers and understand your warranty options.

Choose your dealer or installer carefully. Your RV solar dealer should be manufacturer certified and have experience with your applications and vehicle type. A good dealer will help you assess your system requirements, design your system, recommend top quality components, perform expert installations, and provide excellent post-sale service and support.

Get on the road and have fun! It's a big world out there. With a quality RV solar system, you'll be able to see much more of it—even if you choose to go off the beaten path.



SOLAR SIZING FOR YOUR RV

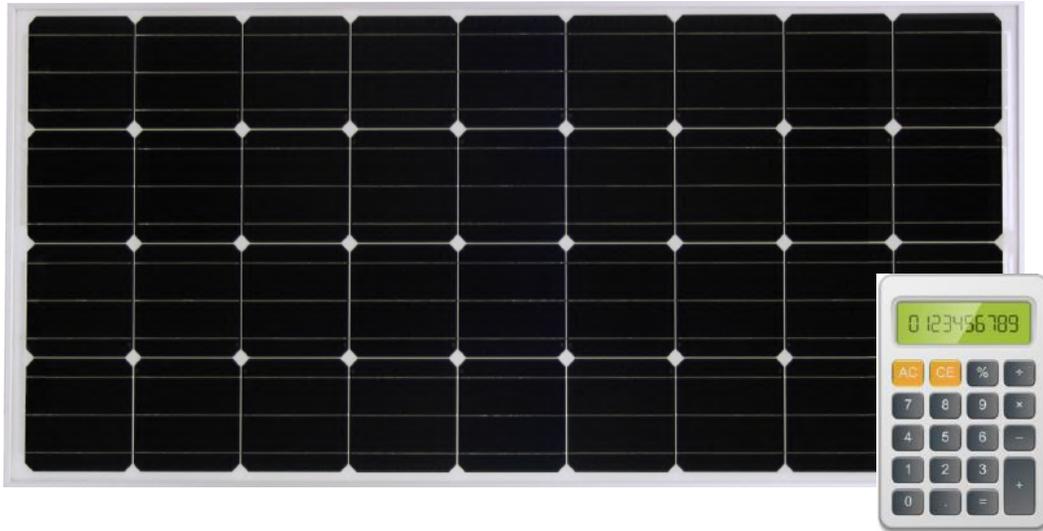
So now that you know all about how solar works, how do you know what size of solar system is right for you? Go Power! has a **number of ways to help you find the right system** for your RV, boat or work truck. Our **Simple Sizing Chart** (page 21) and **Solar Sizing Worksheet** (page 22) will provide you with Go Power! mobile power equipment recommendations based on your RV type and specific power usage.

SIMPLE SOLAR SIZING



Step 1: Use the chart on Page 22 to identify the DC and AC power appliances and # of hours each runs / day.

Using the tables on the Solar Sizing Sheet, start adding up your daily power draws.



SIMPLE SOLAR SIZING

(CONTINUED)

Step 2: Calculate the Total Weekly Amps

Multiply total amp hours per day by the number of days per week (i.e.: weekend camping: multiply total amp hours x 2 days, full-time camping: multiply total amps per day x 7 days).

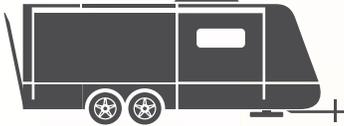
Step 3: Match your Total Weekly Amps with a solar charging kit or complete system

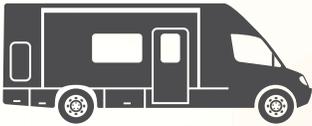
Find your perfect solar solution!

The values on our **Solar Sizing Worksheet** assumes typical power output is based on *6 hours charging per day* and will vary at different times of the year, by location, and with varying weather conditions. For more accurate sizing, including using your location, be sure to visit our online calculator tool (coming soon).

EASY SOLAR SIZING

Use the chart below to find out what solar and inverter kits will work best for an average RV in each class. Visit our website and use our calculator at gpelectric.com/calculator to find the best Go Power! solution for your needs.

	CLASS A (GAS OR DIESEL)		FIFTH WHEEL / TOYHAULER		CLASS C	
						
	1-3 DAYS AWAY	7+ DAYS AWAY	1-3 DAYS AWAY	7+ DAYS AWAY	1-3 DAYS AWAY	7+ DAYS AWAY
SOLAR	300+ watts	600+ watts	300+ watts	600+ watts	150+ watts	300+ watts
INVERTER	2000/3000 watt pure sine	1500/2000 watt pure sine	1500/2000 watt pure sine			
BATTERIES	 x2 to 4	 x4 to 6	 x2 to 4	 x4 to 6	 x2 to 4	 x4 to 6
TRY	Overlander + Expansion kit	Solar AE 4 or Solar AE-6	Overlander + Expansion kit	Solar AE 4 or Solar AE-6	Overlander Kit	Overlander + Expansion kit

	CLASS B		TRAVEL TRAILER		POP-UP OR TRUCK CAMPER	
						
	1-3 DAYS AWAY	7+ DAYS AWAY	1-3 DAYS AWAY	7+ DAYS AWAY	1-3 DAYS AWAY	7+ DAYS AWAY
SOLAR	100 watts	300+ watts	150+ watts	300+ watts	100+ watts	200+ watts
INVERTER	2000 watt pure sine	2000 watt pure sine	2000 watt pure sine	2000 watt pure sine	2000 watt pure sine	2000 watt pure sine
BATTERIES	 x2	 x2 to 4	 x2 to 4	 x2 to 4	 x1	 x2 to 4
TRY	Retreat or Flex-100 kit	Retreat + 2x Retreat-E or Flex-200 kit + Flex-100E	Overlander Kit	Overlander + 1x Expansion kits	Retreat or Flex-100 Kit	Retreat +1 Expansion or Flex-100 kit + 1 Expansion



MOBILE POWER SIZING WORKSHEET

How much power do you need? Consider how many days you'll be off the grid and how much power you'll use. Keep costs down by sizing for just what you need. Most Go Power! solar kits and systems are easily expandable as your power needs grow.

Step 1: Fill in the quantity of items and number of hours each appliance runs per day.

12V, DC Appliances	Amps	X Qty.	X Hours Run/Day	= Total Amp Hours
10 Watt Light	0.08			
15 Watt Light	1.25			
Water Pump	4			
12 Volt TV	3			
SC Fan*	4			
Furnace Fan*	8			
12 Volt Stereo	0.8			
Refrigerator	0.4			
Propane Alarm	0.21	1	24	
Other				

*Fan and furnace are not typically run at the same time.

120V, AC Appliances*				
AC Fridge	10			
TV	4			
DVD	3			
Satellite Dish	4			
Microwave	100			
Toaster	66			
Coffee Maker	60			
Blender	12			
Computer	25			
Laptop Computer	5			
Other				

*All amperage ratings are based on a 12 volt system.

**Fridge amps based on a 4.4 cubic foot fridge, running 12-hours/day.

Total amp hours per day

Step 2: Total Weekly Amps Calculation

Multiply total amp hours per day from Step 1 by the number of days of use per week (i.e.: weekend camping: multiply total amp hours x 2 days).

Amps Per Day:	
x	
# of Days of Use Per Week:	
=	
Amp Hours Per Week	

Step 3: Solar Power Output

Match your power draw from Step 2 to the product listed below:

Amp Hours Per Week	Recommended Solar Kit (DC only)	Suggested # of 12V Batteries
29	10W Eco Kit	1
55	20W Eco Kit	1
71	30W Solar Flex Kit	1
193	90W Portable Solar Kit	2
197	90W Eco Kit	2
228	100W Retreat Kit	2
236	100W Solar Flex Kit	2
290	130W Portable Solar Kit	2
390	190W Overlander Kit	2
470	200W Portable Solar Kit	1
470	200W Solar Flex Kit	4
781	380W Overlander Kit + Overlander Expansion Kit	4-6
1411	500W Solar Flex Kit	4
1172	570W Overlander Kit + 2x Overlander Expansion Kits	4-6
1563	760W Solar All Electric Kit	4-6
2344	1140W Solar All Electric Kit	6-8

MOST POPULAR KIT

Recommended Complete Systems (DC and AC)		
390	190W Weekender System	2
781	380W Solar Elite System	4
1172	570W Solar Extreme System	4-6

Please note: Amp hours based on 6 hours of usable light per day.



A COMPANY YOU CAN TRUST

Since 1996, Go Power! has provided solar power solutions to RVers, campers, and boaters. We have industry-leading warranties and excellent technical support.



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