How to work out the size of solar panel needed

Follow these steps to work out the **best solar panel size** for charging your 12V battery - this is what you need to know and do:

1. What is the nominal terminal voltage, the capacity in amp-hours (**Ah**) and its State of Charge (**SoC**)?
2. Convert the **amp-hours** discharged into energy measured in watt-hours (**Wh**)
3. Calculate **how much energy** solar panels will generate in your location
4. Note **how fast** you want the 12 volt battery to charge, and match the SoC to solar panel output.

Note: The following post assumes lead acid **12 volt** battery at **25°C** (77°F) and solar panel in direct sunlight.

Checking battery discharge voltage

Depth of discharge of a lead-acid battery can be assessed by measuring the terminal voltage with a multi-meter. This should be done:

- At a **stable temperature** preferable 25°C
- When the battery has been dormant for a few hours and **settled**, neither charging or discharging

Convert depth of discharge in amp-hours to energy in watts

Why should we do this?

The battery capacity is measured in **amp-hours** while meaningful solar panel output energy is measured in **watt-hours.**

Battery amp-hour capacity doesn't reflect the **true power** in the battery, because this is dependent on the battery **voltage.**

Converting to watt-hours is the only true way of **comparing the energy** of the battery compare to a solar panel output.

How much power does a solar panel produce?

If you look at the **specification sheet** for a solar panel it will give you the maximum current it can generate.

However, this is in very special **laboratory conditions**. It's quite rare to have sustained **maximum power** from a solar panel.

This is why instantaneous power at any time doesn't really have any meaning. If a cloud passes, or the panel becomes shaded, then the **current will drop**.

By far the most sensible method of sizing solar panels to any application is to calculate **how much energy** it can generate over time in **kWh**, and then match this figure to the battery re-charge capacity needed.

Solar panel energy over time depends on **irradiance**, or peak-sun-hours, and it varies depending on your **location.**

The chart below shows **average irradiance** per day for various locations, but differences between summer and winter will also be significant.

For example, Houston Texas has an irradiance of **5.79 peak sun hours** in June and **2.58** in December, so you would need to take this into account with your calculations.

You can find out the peak-sun-hours for your location on this site. Simply enter your location and read of the **direct sunlight reading** as shown in the image below.

Irradiance is measure in **kWh/m2**/day or year, but the value is also known as peak-sun-hours and is used for **sizing solar systems**.

What size solar panel do you need for your 12V battery?

12 volt lead-acid batteries come in various capacities, from 5 amp-hours up to 200 amp-hours. You need to ask 4 questions before deciding what is the right size solar panel to charge your particular battery:

1. What is your battery **capacity** in Ah?
2. How much is it normally **discharged**?
3. **How fast** do you need it charged?
4. What is your **location**? (to find peak-sun-hours)

Example:

A 12 volt lead-acid battery has a **fully charged** capacity of **60Ah** is discharged **25%**. **8 hours** charge time will be adequate. Location is Houston, Texas. Assume full sunshine.

Energy required = 60Ah x 25% x 12 volts = **180 watt-hours**

Irradiance in Houston, Texas = **4.253** peak-sun-hours

A **80 watts** solar panel will generate 80 x 4.253 peak-sun-hours = **196** watt-hours

So an 80 watt solar panel would be good enough to recharge this battery throughout the day, but it would be prudent to use a **100 watt or 120 watt** rated panel.

Do you need a charge controller?

Solar charge controllers are always recommended for battery charging applications unless the solar panel rating is so low that is cannot **overcharge the battery.**

Such devices are only suitable for trickle charging. A charge controller should be used in any case if using a solar panel over **10 watts.**

Which is better PWM or MPPT?

There are two main types of solar charge controller - **Pulse Width Modulation** (PWM) and **Maximum Power Point Tracking** (MPPT).

The PWM is a dumb device and simply compares the voltage between the panel and the battery, and sets the output current by **chopping up the output** to achieve an average.

It's quite **inefficient**, but adequate for small applications where efficiency is not the prime concern.

Maximum power can only be drawn from a solar panel when the load resistance matches the panel's **Characteristic Resistance**. This is what the MPPT controller does.

An MPPT charge controller adjusts its own **internal resistance** until the panel's voltage and current are at optimum levels. MPPT type charge controllers are up to **40% more efficient** than PWM.