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Meta Description: Want to make sure your solar panels are up to the task? Learn how to calculate solar panel output in real-world conditions to ensure you are covered.



How To Calculate Solar Panel Output

Calculating the output of your solar panels isn't as simple as you might think.

While the rated power (e.g., 100W or 400W) indicates the *maximum* amount of electricity a PV panel can generate per hour, many factors come into play that affect how much power output you'll actually get.

The truth is, there are so many variables involved in how much electricity a solar panel produces hour by hour that there's no way to predict *exactly* how many watts a PV panel will produce. Even panels from the same manufacturer, with the same rated power, on the same rooftop will generate slightly different amounts of electricity.

However, once you understand the various factors that impact a solar panel's performance, you can come up with a reasonably accurate estimate of the average amount of electricity each PV panel should produce per day.

If you're considering switching to solar and shopping for a PV panel array, a rough estimate of real-world electricity production in your location is essential — and much more likely to be accurate than simply adding up the rated power of each panel.

Here's what you need to know to estimate solar panel output in real-world conditions.



Factors to Consider When Calculating Real-World Solar Output

The benefits of solar energy are numerous, but building your own solar power system requires advanced planning to ensure it meets your family's unique electricity consumption needs.

One of the most crucial factors to consider when planning a switch to solar is also one of the least understood: **The difference between a solar panel's rated power wattage and its real-world electricity output.**

Every PV panel comes with a rated power wattage. Likely, this is between 100W and 400W per panel. Rated power indicates the maximum amount of electricity your panels can produce (in watts) under *ideal* or Standard Test Conditions.

However, in the real world, conditions are rarely perfect, and numerous factors affect how much electricity a PV panel will actually produce. And it's never a constant. The wattage your solar panels generate will vary from hour to hour — even minute to minute.

For example, EcoFlow's 400W Rigid Solar Panel has a rated power spec of 400W. But you're more likely to produce an average of 300W of electricity per hour over the course of a day.

On average, you'll get about 75% of the rated power in actual output with EcoFlow's rigid, portable, and flexible PV panel options.

Keep in mind, that's a daily average. Some hours, your panel might produce close to 100% of its rated power — other hours, it might produce 60%, all on the same day.

Here are the crucial factors that impact the real-world output of your solar panel array.

Solar Panel Efficiency

Solar panel efficiency measures the percentage of direct sunlight a PV panel receives that gets converted into electricity. Again, the listed specification is calculated based on ideal conditions — rare in practice.

Factors that impact the real-world efficiency of your solar panels include temperature, panel age, and cleanliness.

Having said that, a brand-new PV panel's efficiency should not vary much from its listed rating.

The higher a solar panel's efficiency, the more electricity you will generate from available sunlight.

Understanding what "efficiency" measures as a PV panel spec helps you make a more informed purchase decision.

High-quality monocrystalline PV panels typically average around 20% efficiency. EcoFlow's solar panels, like the 400W Rigid Solar Panel, the 220W Bifacial Portable Solar Panel, and even the 100W Flexible Solar Panel, achieve 23% efficiency — an industry best.

Polycrystalline PV panels are a cheaper option and tend to achieve between 10-15% efficiency. Thin-film panels can fall between 7-18% efficiency.

The lower the efficiency rating, the less electricity you'll generate from the sunlight your location receives.

Orientation and Location

What direction are your PV panels facing? The orientation relative to your geographic location significantly impacts your solar array's energy production. You want your solar panels to be facing the equator for maximum output.

Tilt also matters when positioning panels to receive the maximum amount of sunlight. The best way to get the most output out of your panels is to set the tilt of your panels at an angle equal to the latitude of your location. You can leave your panels at this angle year-round or adjust them for maximum optimization a few times each year.

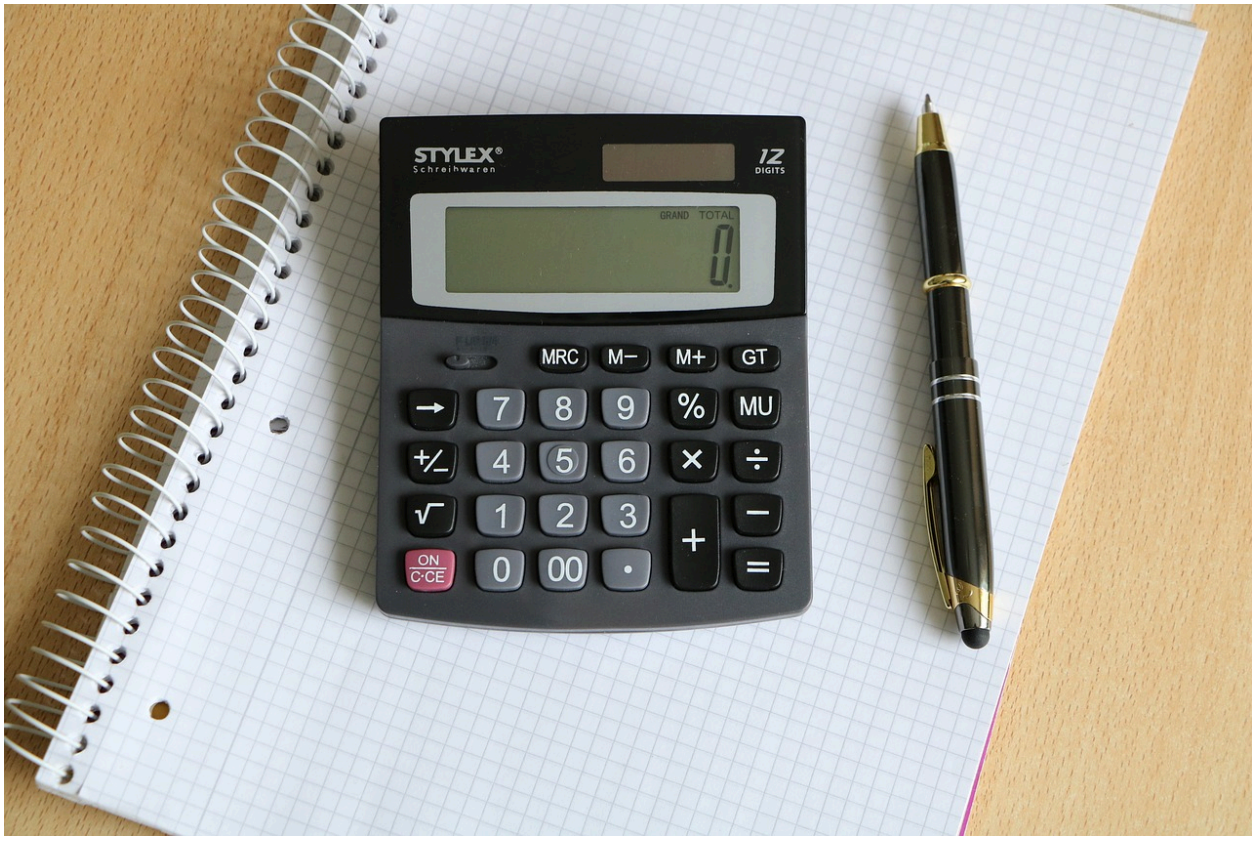
The goal is to position your panels to receive maximum sunlight. Of course, the ideal tilt varies over the course of a day as the Earth orbits the sun. To get the most out of your solar panel array, consider a solar tracker so your panels can follow the sun automatically.

Degradation Rate

Like everything else, photovoltaic panels degrade over time. You'll find that your solar panel loses around 0.5-1% of its rated output with each passing year.

Half a percent is not a significant amount. At that rate, you can still expect your solar panels to work at 90% capacity even two decades later. Still, the degradation rate is worth remembering because it will eventually reduce overall output and affect how long your solar panels last.

You can extend the lifespan of your panels by keeping them clean and free of dirt and debris. Routine maintenance and cleaning help ensure you get the most juice out of your PV panels.



Solar Panel Output Calculations

Now, it's time to combine everything you've learned to estimate how much power your solar power array can generate.

The formula to estimate your solar panel output is below:

> *Output = STC Rating (rated power under Standard Test Conditions, in watts) x Peak Daily Sunlight Hours x .75*

To calculate your solar panel output, take the power rating and multiply it by the peak hours of sunlight and multiply by .75.

Why .75? That’s to help account for all of the factors we discussed above that can decrease your solar panel’s electricity output.

Here's an example. The EcoFlow 400W Rigid Solar Panel has a 400W rated power output. Let's say you get an average of 5 hours of daily peak sunlight where you live.

If you enter that into the formula, you get the following:

Output = 400W rated power x 5 Peak Daily Sunlight Hours x .75 = 1,500Wh

You can estimate that a 400W panel will produce 1,500 watt-hours per day, or 1.5 kWh, under those real-world conditions.



Why Is Solar Panel Output Important

Understanding the output of your panels is essential for calculating energy production in real-world conditions. It will only ever be an estimate. But still, it enables you to plan for how much power you can rely on your panels to produce on average — and if that's enough for what you want them to power.

Suppose you're trying to power a refrigerator using your solar panels. You'll want it running around the clock to keep perishable items stored at a safe temperature. In this case, understanding the output of your panels lets you determine whether your setup can meet the electricity consumption demands of your refrigerator.

Remember, solar panels don't work on their own. You'll need a portable power station or other balance of system to convert and store the solar energy your panels capture into household (AC) electricity.

Determining your PV panel output lets you estimate how long it will take to charge your portable power station with solar power.



What Are the Standard Test Conditions for Solar Panels?

As discussed above, the rated power wattage of PV is determined in a laboratory under Standard Test Conditions. It indicates the maximum amount of electricity a solar panel can produce under ideal circumstances.

So what are the “ideal conditions” for maximum electricity output (wattage) from a solar panel?

Here are the most critical conditions that testers rely on to determine rated power:

- Operating temperature of 25°C (77°F)
- Full solar noon sunshine (irradiance) of 1000 W/m2 (1 kW/m2). (Basically, the irradiance used for testing is the equivalent of direct sunlight at the brightest time of day, completely free of obstructions like clouds or shade.)
- Sea level air mass (AM) of 1.5 (1 sun)

Unsurprisingly, these conditions rarely exist all at the same time in the real world.

Understanding rated power is crucial to ensuring your solar panel array meets your electricity consumption needs.

Final Thoughts

Now, you should have all the information necessary to estimate the average amount of electricity your panels should produce per day. From there, you can determine how many PV panels you need to accommodate your desired electricity consumption.

Other crucial things to keep in mind when purchasing solar panels and a balance of system include:

- Maximum AC power output (Running AND starting watts)
- Electricity storage (battery) capacity
- Solar charging/input capacity (This determines how many panels you can connect to your system)
- Compatibility between the solar panels and all balance of system components (This is particularly crucial if you're attempting a DIY solar build instead of an all-in-one solution)

EcoFlow has a wide range of award-winning plug-and-play solar power solutions for almost any use case — from backpacking to whole home generators.

Check out EcoFlow today to meet your off-grid electricity needs.