

# **How To Estimate How Many Solar Panels Your Solar Electric System Will Need**

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# How To Estimate How Many Solar Panels Your Solar Electric System Will Need

## Introduction

If you are interested in solar energy and are wondering whether or not you can afford to install a solar electric (or photovoltaic, PV) system in your home, you will need to know how many solar panels it will take to deliver the electricity you need. The reality is that there are several variables that affect the size of the solar electric system you will need. Each system has site-specific requirements, and there is no one-size-fits-all answer. It is much more complicated than it seems, especially if you are planning a system that will provide 100 percent of your electrical energy needs.

But if you have just started your exploration into the possibilities of adding solar panels to your home, you probably would like to have at least a ballpark estimate of how many panels your project would need. So here is a way to calculate a very rough estimate (emphasis on "very rough") of the wattage that your solar array will need to deliver using a few basic numbers.

This is a basic and rough formula you can use to estimate the number of solar panels your house would need, based on your family's history of energy consumption.

Detailed explanations follow, and there is a blank worksheet you can print out at the end of this report:

## Formula to Estimate How Many Solar Panels Your Solar Electric System Will Need

- 1 Average daily kilowatts of electricity used (from utility bills)
- 2 Multiply by 1000 (kilowatts x 1000 = watts)
- 3 Multiply by percentage to be provided by solar
- 4 Divide by solar insolation value
- 5 Multiply by 120% (to allow for normal energy loss within system)
- 6 Divide by solar panel peak wattage (per manufacturer)
- 7 Equals Number of solar panels needed (round up to next whole Number)

## Examples

The Grid below provides examples, and compares the difference in the number of solar panels you would need in different cities. Notice that in Sacramento you would need more solar panels (based on December sunlight hours) than you would in Denver, even though Denver has colder temperatures. This is because winters in Sacramento can be very foggy, even though temperatures rarely dip below freezing. But Denver winters are typically very sunny, even though temperatures often dip below freezing. This is a good example of why you need accurate solar insolation numbers for your site.

	Worksheet to Estimate How Many Solar Panels Your Solar Electric System Will Need	Example Variables		Example Variables	
		Denver	Results	Sacramento	Results
1	Average daily kilowatts of electricity used (from utility bills)	25	25	25	25
2	Multiply by 1000 (kilowatts x 1000 = watts)	x 1,000	25,000	x 1,000	25,000
3	Multiply by percentage to be provided by solar	say 75%, so x .75	18,750	say 75%, so x .75	18,750
4	Divide by solar insolation value	December = 6	3,125	December = 3	6,250
5	Multiply by 120% (to allow for normal energy loss within system)	x 1.2	3,750	x 1.2	7,500
6	Divide by solar panel peak wattage (per manufacturer)	say 120	31	say 120	63
7	Equals <b>Number of solar panels needed</b> (round up to next whole Number)		<b>32</b>		<b>63</b>

### Step 1 – How Much Electricity Do You Use?

First, you will need to know how much energy your household currently consumes or plans to consume. You can get that number the hard way or the easy way.

The hard way is to take an inventory of the wattage requirements of all of your electrical lighting, appliances, tools and equipment and multiply by the number of hours you use each of them. The easy way, which is highly recommended, is to use copies of your electric bills for the past 12 months.

Add up the number of kilowatts your family used each month, or simply use the most recent cumulative year end total. If you don't have copies of your bills, usually you can make a phone call to your utility company, and they will provide you with the numbers.

Divide total kilowatts used during the year by 365 to get average daily kilowatts used.

#### Step 2 – Convert Kilowatts To Watts

Then multiply the daily kilowatts used by 1,000 to convert the number into watts. Now you have the average number of watts your family uses every day.

#### Step 3 - How Much Electricity Do You Want From Solar?

Multiply the daily watts used by your household by the percentage of total electricity that you want to replace with solar. For example, if you want to supply 25% of your electrical needs with solar, then multiply by 0.25. If you want to be able to supply 100%, so that you use grid electricity only for backup, then multiply by 1.00. This number is the average daily total watts of electricity to want your solar energy system to deliver.

#### Step 4 – Adjust For Solar Insolation To Your Site

Divide by solar insolation value. You will need to find the “solar insolation values” for your geographical location. The “solar insolation value” is a measure of the amount of sunlight that actually reaches your site. The angle of the sun's rays hitting Seattle at noon are different from their angles hitting San Diego at noon, and the sun delivers different amounts of solar energy at each location.

To find insolation values for the United States, use the [maps provided by the National Renewable Energy Laboratory](http://www.nrel.gov/gis/solar.html) at <http://www.nrel.gov/gis/solar.html> (look for the PV Solar Radiation Static Maps that show monthly averages. Using a yearly average will give you incorrect values for the summer and winter extreme temperatures.) For other countries, search for "solar maps", "insolation maps", or "solar radiation maps" + the country's name.

Use the minimum insolation value, which is December for the United States. That way your estimate will be based on the least amount of the sun's energy available for your location, and your solar electricity system will be able to handle your family's energy needs even when the sun's energy is at its weakest.

Now divide the average daily total watts of electricity to want your solar energy system to deliver (the number from step 1) by the solar insolation value for your site. This is your preliminary estimate of the number of watts of electricity your solar panels will need to generate.

#### Step 5 – Adjust For System Inefficiencies

Now multiply the number of watts from the last step (step 2) by 120%, or (1.2) . This will give you a 20% allowance for power loss which will occur as the electricity from your solar panels makes its way down the wires, through the inverter and into your appliances. (No system is 100% efficient). This number is your final estimate of the total amount of energy (in watts) that your solar electric system will need to deliver.

#### Step 6 – Adjust For Your Solar Panel Specs

Now divide your final wattage requirements (from step 3) by the peak wattage of the solar panel you plan to buy. You can get this number from the solar panel manufacturer. If you are shopping online, look for a spec labeled "maximum power" or something similar, and express in watts. Small 10 or 20 watt panels would only be useful for powering a few lights or a TV. Larger solar panels which deliver power in the 100s of watts are more efficient for powering a whole house.

## Step 7 – Round Up For Total

Round the result to the next highest number (for example, round 5.3 to 6 solar panels) to get the approximate number of solar panels you will need to buy.

### Tips For Estimating

Remember that this number is useful only as a rough estimate. Since each installation is unique, there are just too many variables to cover all of them in an article or report. But here are a few things to keep in mind as you run your calculations.

---Using the daily average number of watts of electricity that your family uses will not give you a number that is sufficient to cover peak load times. For example if your family is in the habit of running the washer, dryer, air conditioner, two or three computers, and a couple of television sets (and more) at the same time, your energy needs will be higher than your daily average indicates. So you will either need to calculate your peak load needs and take them into consideration when you design your solar energy system, or you will need to change your family's energy use habits to bring down that peak usage number.

---If you are estimating for an off grid system, you will need to look for your highest seasonal energy usage, which is usually during the summer or winter, depending on the climate you live in. Unless you plan on using your backup generator during spells of extreme heat or cold, you will probably want your solar electrical system to be able to provide enough energy during those times. So even though you won't need that much on a average ongoing basis, you will need to design your system to handle the extreme loads.

---To calculate the most conservative estimate (or highest number of solar panels), divide the highest number of Kilowatt hours that your household consumes (peak usage) by the lowest (winter) insolation values for your area.

---Remember that the solar insolation numbers provided in the map will only be a very rough estimate of the actual amount of solar

radiation your site will receive. The placement and orientation of your solar array, whether or not it is shaded for part of the day, and the direction your panels will be able to face after they are installed will all affect the amount of electricity your system will be able to generate. You really need to do a full blown professional site analysis to be accurate. But at least these calculations will give you a ball park number to use for preliminary budgeting and planning purposes.

---For an off grid system, you will need to plan for the additional cost of your storage batteries. So your calculations will need to factor in the highest number of days you anticipate needing to use battery power. Usually you will be using your batteries for power at night, but you will want the extra capacity available for a long spell of bad weather if it occurs.

---Keep in mind that you can start small and scale up whenever your electrical needs or your budget expands. For example, if you are currently receiving your electricity from the grid, but want to experiment with solar energy, you could easily start small and install a small solar panel on your garage to run the lighting. You would not have to tie this into the grid in order to use it, and it would give you some experience with how solar panels operate in your location and on your site. You could get a feel for how complex (or easy) the project really would be for you. It's an easy way to find out whether or not you would want to tackle taking on the time commitment and expense of a larger scale solar panel installation, or whether you would rather hire a professional. Either way, the lessons you would learn about solar energy for your home will be invaluable.

---When it's time to get an accurate calculation for your PV system, consult with a few different suppliers and have them run calculations to double check your numbers before you buy or build. There are many solar suppliers online that will provide free quotes. (And this is also a good way to find out how good their customer service is, and how capable their staff is.) You should consider buying your supplies from someone knowledgeable and helpful enough to provide support for you when you run into the need for troubleshooting.

## Tips For Pricing Solar Panels

--When you are researching which solar panels to buy, it is tempting to look for the lowest price. EBay can be a good source for surplus solar panels and used solar panels. Just be sure to exercise caution to make sure the seller is someone who has an established business, will take proper precautions for safe shipping and handling and will follow through with any customer service needs.

--Cheaper is not always better. As with any construction project, unexpected issues will pop up during your solar panel project. And unless you have a lot of construction experience with electrical projects (and more specifically with solar electric installations), you will be doing yourself a big favor by having knowledgeable and experienced solar professionals available for support. One of the easiest ways to have access to solar professionals is to buy your project materials through them. Access to their knowledgebase may turn out to be worth much more than the extra cost of their products.

## Blank Worksheet to Estimate How Many Solar Panels Your Solar Electric System Will Need

	Example Variables Denver	Results	Variables For Your Site	Your Results
1	Average daily kilowatts of electricity used (from utility bills)	25		
2	Multiply by 1000 (kilowatts x 1000 = watts)	x 1,000 25,000	x 1,000	
3	Multiply by percentage to be provided by solar	say 75%, so x .75 18,750		
4	Divide by solar insolation value	December = 6 3,125		
5	Multiply by 120% (to allow for normal energy loss within system)	x 1.2 3,750	x 1.2	
6	Divide by solar panel peak wattage (per manufacturer)	say 120 31.25		
7	Equals Number of solar panels needed (round up to next whole Number)	32		

## More Resources

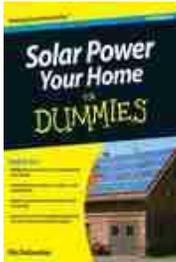
### [Got Sun? Go Solar: Get Free Renewable Energy to Power Your Grid-Tied Home](#) By Rex Ewing and Doug Pratt

This is my solar panel bible! It's the first book I read that really made the concept of how solar panels work crystal clear. I highly recommend it.

### [Photovoltaics: Design and Installation Manual](#) By Solar Energy International

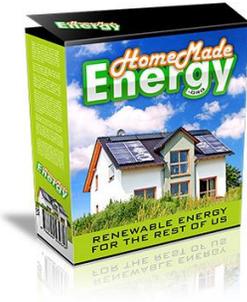
This is a textbook published by a non-profit organization based on Colorado (which is the epicenter for solar energy technology in the US, as far as I'm concerned. Lots of research going on there.) This is the next solar energy book on my list to buy.

### [Solar Power Your Home For Dummies](#) By Rik De Gunther



One of this book's strong points is that it digs pretty deeply into things you can do to reduce energy consumption, which means you can install a smaller and less expensive solar electric system.

### [How to Build Solar Panels and Save](#)



If you want to learn about solar panels, then there is no better way than to build some yourself while also saving money along the way. In this guide you will learn how to build your own solar panel and discover this one little trick that could save you tons of cash each month!

[Solar Living Institute](#) Online classes, live workshops, green jobs, internships...lots of great information about living with solar energy.

[Real Goods Solar](#) They have an online store where you can price solar panels, and an 800 phone number you can call to ask questions about your project specs and brands.

[Real Goods Solar Installation](#) Because installation must be done on-site and is subject to local codes, you have to find a local vendor. If Real Goods does not install where you live, call them and ask if they can refer someone.

[Tips For Living Green](#) You can cut down on the cost of your solar panel installation by reducing the amount of energy your household uses. Little things like wrapping your hot water heater, changing your furnace filter regularly and unplugging computers when they're not in use can save a lot in energy costs.

[Solar Panels on EBay](#)

[Evergreen Solar Panels](#)

[Sharp Solar Panels](#)

[Kyocera Solar Panels](#)

