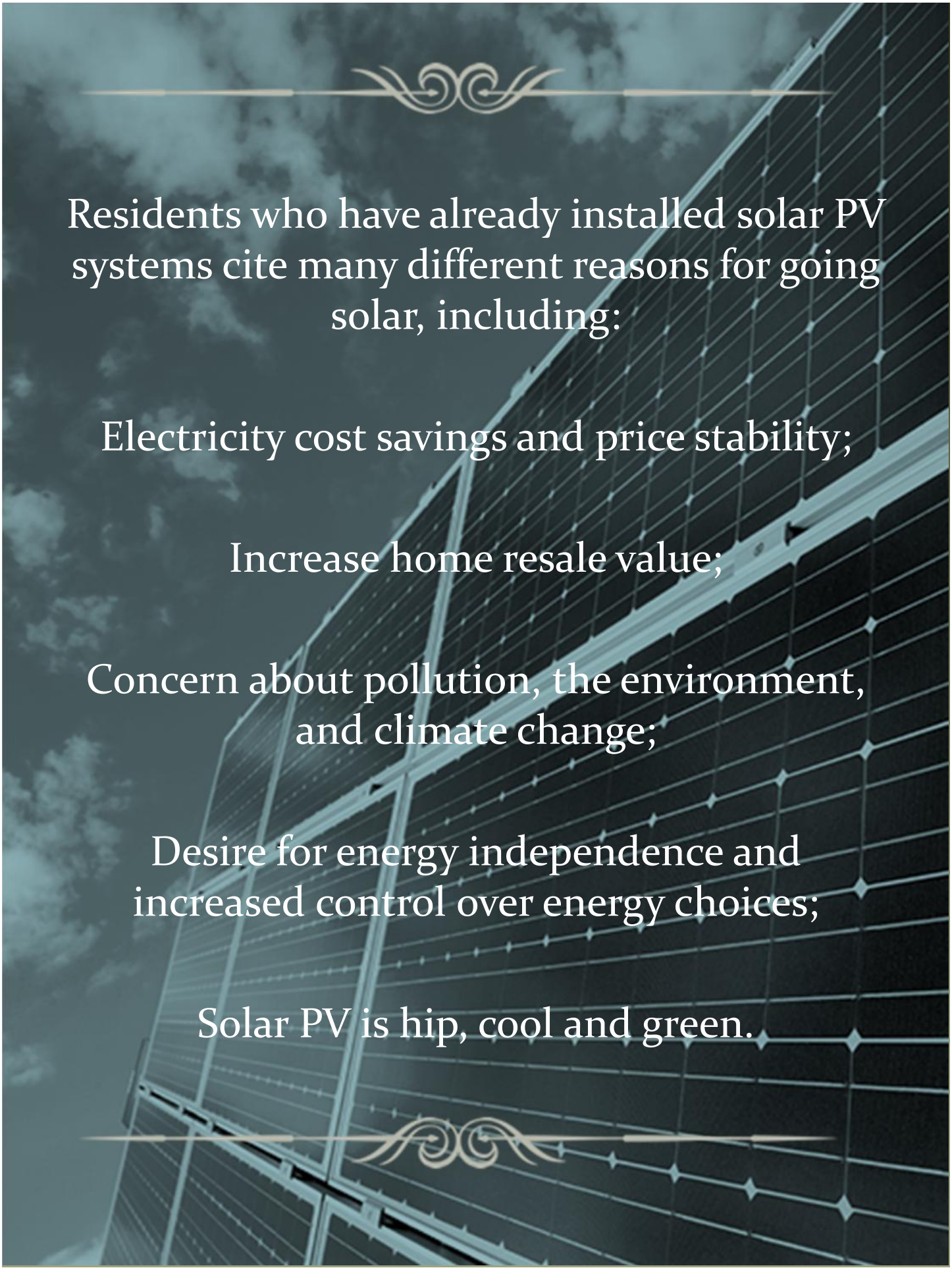
ESTATES
ECO International

Net Zero Energy
Custom Homes Builder

How Much Solar Do I Need?

Solar Energy 103


Residents who have already installed solar PV systems cite many different reasons for going solar, including:
Electricity cost savings and price stability;
Increase home resale value;
Concern about pollution, the environment, and climate change;
Desire for energy independence and increased control over energy choices;
Solar PV is hip, cool and green.

How Much Solar Power Do I Need?

Step #1: First things first, CONSERVATION.

Before you begin to "size" a solar system for your existing home, we recommends that you implement several energy management and conservation techniques in order to reduce your overall need for energy:

 Change all incandescent and halogen light sources to compact fluorescent lighting (CFLs). Home Depot is a great source for these indoor or outdoor lamps and fixtures. Most compact fluorescent lamps will fit into existing lamp sockets. This will result in double savings – fewer watts used to light a space AND less A/C used to cool down the air around those little heat lamps!
 Wherever possible, add additional insulation to your attic walls and floors. Use pipe insulation on heated water pipes. Insulate your hot water heater.
 Add shading devices and/or solar screens to your east, south, and west-facing windows. However, during winter months, you may want to take off the south-facing screens in order to *gain* solar heat.
 If you have old appliances, consider upgrading. Today's appliances are *much* more energy efficient than those made as few as 5 years ago. We highly recommend that you purchase only Energy Star rated appliances and air conditioning equipment.
 Use natural gas or propane appliances where possible for cooking, central heating, water heating, and for your clothes dryer. Better yet, dry your clothes via solar (clothesline)!

Step #2: What do you want to do with the power?

If you are already served by a power company, it is considerably cheaper to purchase a "grid-tie" system. If you want to be totally independent of your energy company and/or you need electricity in a location that is not yet served by your energy company and it would be very expensive to connect, you will want to consider a "Battery Stand-Alone" system. A "Battery Back-up" system is a combination of the two systems, where batteries are used as a back up for a power outage in an emergency situation.

Grid-tie: You generate power during the day (while the sun is out) so if you're producing more than you're using, your meter will run backwards. Your energy company supplies the power you use at night, so your meter will run forwards. This push-pull will "net" at the end of the month with a balance either in the customer's favor or in the electric company's favor. In this dynamic, the power company acts as a huge energy storage device/battery.

Battery Stand-Alone: Along with the solar panels and support system, you will need to purchase batteries. Your solar panels charge the batteries and you then draw energy needed for your house from the batteries. You would need to determine all energy needs and make sure your system is large enough to acquire and store enough energy.

Battery Back-Up: This is a hybrid system that is useful when power goes out. You can pre-determine which appliances should never be without energy, and then store that needed power. For example, you might have emergency back up for your refrigerator, computer, and 4 lights.

Step #3: Consider how much power you actually use.

Realistically, you will probably look to *supplement* your power needs via solar ("grid-tie" as described above) rather than use a Battery Stand-Alone system. If you want more information about battery back up and true system sizing, please let us know – we have an overview you can use to determine your full power needs. However, if you simply want an understanding of how much electricity you use and how much a solar system will produce, follow the steps below.

One way to look at the math:

1. Solar systems are generally sized in 1 kW – 6 kW (and larger) systems. A typical size is 3 kW.
2. 3 kW, or 3 kilowatts = 3,000 watts
3. A 3 kW system will generate around 3,000 DC watts per hour
4. Multiply the per hour generation by 5.4 which is an average number of sun hours in a day (3,000 x 5.4 = 16,200)
5. Multiply the new total by the average number of days in a month (16,200 x 30.5 = 487,620)
6. Multiply the new total by .77. This is the "derating" factor, or the amount of energy lost when DC current is turned into AC current. (487,620 x .77 = 375,467)
7. So, a 3 kW system will generate about 375,467 watt-hours per month, or about 375 kWh.
8. Now compare this number with the kWh usage noted in your electric bill. How many kWh do you use in a typical month? Twice this amount? Then you would save roughly ½ your electric bill if you installed a 3 kW system.
9. Consider how much money you save per month to figure out how long it will take to pay off your system.

Another way to look at the math – in reverse:

If you want to get all of your energy needs met through solar power (and get a "0" bill from your electric company) calculate how large a system you will need by following the steps below. Before you start, choose an average electric bill. Look for how many "kilowatt hours" you consumed. This is generally expressed as "kWh".

Direction	***Example***	***YOUR info***
Note the average number of kWh you use per month	550	
kWh X 1000 = total AC Watts used per month	550,000	
Total AC Watts / 30.5 (days in a month) = AC Watts used per day	18,033	
AC Watts used per day / Sun Hours per day (Central Texas = 5.4)	3339	
AC Watts needed per hour per day X 1.29 (AC to DC conversion factor)	4307	
Solar array in DC Watts to reach a Zero electric bill	4307	
Solar array in kilowatts, or kW	4.3	

Step #4: Information to keep in mind when considering a solar system.

- Review your electric bill. Some power companies charge a higher rate the more energy you consume (i.e. Tiered Pricing). Solar will impact the most expensive rate of charge for consumption, thus having the potential to "shave off" the highest tier.
- Up to 30% of the total cost of installation can be taken as a federal tax credit. Previous versions of this credit had a cap of $2,000; there is no longer a cap.
- The most productive system is located on a South- or West-facing roof (or area) that is shade-free from 9 am – 3 pm every day of the year.
- Generally speaking, you will need ~ 1 square foot of space for every 10 watts. So a 3 kW system would take ~ 300 square feet; a 4 kW system would take ~ 400 square feet.
- You do not need to size a system to meet all your energy needs. You will remain a customer of your electric company, so you can use more (or less) power as needed.
- When considering "payback" time, think about the price of electricity per kWh. Has it increased in the past? Will it increase in the future? By how much? We do not know the answer either, but the question should be factored in to your decision-making.
- All energy providers are obligated to allow "net-metering" which means that the electric meter must be able to run backwards (i.e. when you are generating electricity). However, they are not obligated to pay you a set $ amount, or anything at all, if you generate more energy than you use in a month. Check with your energy provider to find out their particular "Tariff Agreement".
- Be sure to check with your Homeowners' Association before committing to a solar PV installation. For some odd reason that we simply cannot imagine, some are opposed to the "look" of solar.

A Performance Calculator for Grid-Connected PV Systems

NREL's PV Watts™ calculator determines the energy production and cost savings of grid-connected photovoltaic (PV) energy systems throughout the world. It allows homeowners, installers, manufacturers, and researchers to easily develop estimates of the performance of hypothetical PV installations.

The PV Watts calculator works by creating hour-by-hour performance simulations that provide estimated monthly and annual energy production in kilowatts and energy value. Users can select a location and choose to use default values or their own system parameters for size, electric cost, array type, tilt angle, and azimuth angle. In addition, the PV Watts calculator can provide hourly performance data for the selected location.

Using typical meteorological year weather data for the selected location, the PVWatts calculator determines the solar radiation incident of the PV array and the PV cell temperature for each hour of the year. The DC energy for each hour is calculated from the PV system DC rating and the incident solar radiation and then corrected for the PV cell temperature. The AC energy for each hour is calculated by multiplying the DC energy by the overall DC-to-AC derate factor and adjusting for inverter efficiency as a function of load. Hourly values of AC energy are then summed to calculate monthly and annual AC energy production.

The PV Watts calculator is available in two versions. Version 1 allows users to select a location from a map or text list of pre-determined locations throughout the world. Version 2 allows users to select any location in the United States.

The PV Watts calculator was developed by NREL's Electric Systems Center Resource Integration Section.

http://pvwatts.nrel.gov/

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PVWatts * * * **AC Energy & Cost Savings**

Station Identification	
City:	Austin
State:	Texas
Latitude:	30.30° N
Longitude:	97.70° W
Elevation:	189 m
PV System Specifications	
DC Rating:	3.8 kW
DC to AC Derate Factor:	0.770
AC Rating:	3.0 kW
Array Type:	Fixed Tilt
Array Tilt:	30.3°
Array Azimuth:	180.0°
Energy Specifications	
Cost of Electricity:	10.6 ¢/kWh

Results			
Month	Solar Radiation ($kWh/m^2/day$)	AC Energy (kWh)	Energy Value ($)
1	4.32	381	40.39
2	4.96	388	41.13
3	5.47	469	49.71
4	5.52	446	47.28
5	5.54	454	48.12
6	5.93	465	49.29
7	6.21	495	52.47
8	6.22	497	52.68
9	5.77	459	48.65
10	5.65	467	49.50
11	4.60	377	39.96
12	3.96	347	36.78
Year	5.35	5246	556.08

Output Hourly Performance Data

Output Results as Text

EXAMPLE

"When there's a huge solar energy spill, it's just called a 'nice day' " Vote Solar billboard, 2012

"The use of solar energy has not been opened up because the oil industry does not own the sun." Ralph Nader

"I have no doubt that we will be successful in harnessing the sun's energy. If sunbeams were weapons of war, we would have had solar energy centuries ago." George Porter, Nobel Prize winner in Chemistry, 1967

"I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait until oil and coal run out before we tackle that." Thomas Edison, 1931

"Texas has the potential to be a MASSIVE solar market. To put it into perspective, the sunshine that falls on Texas each month has more energy than all of the oil that has ever been pumped out of this state. If you think oil made Texas great, just wait till you see what they do with solar." Rhone Resch, president and CEO of the Solar Energy Industries Association (SEIA), 2011

"It's really kind of cool to have solar panels on your roof." Bill Gates

"Build Net Zero Energy homes – Good planets are hardto find" David Pham