



# TOOLS & RESOURCES

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## Solar 101

### What is solar power?

Solar power is energy derived from the sun's radiation. The amount of available solar energy is incredible -- 10,000 times more than the entire world can consume presently. Merely 0.02% of incoming solar captured would replace every other fuel source presently used. The sun provides the Earth with as much energy every hour as we collectively use in a year worldwide. Furthermore, it is reliable. According to the US National Renewable Energy Laboratory (NREL), its output will remain fairly consistent for the next 50,000 years.

As the global demand for energy grows and conventional energy resources become increasingly costly to extract as well as the increasing risk of energy dependence on foreign oil and natural gas production, people are turning to solar energy. Though the mainstream media has barely mentioned this trend, for those reading solar news, solar installations (both commercial and residential) has been growing exponentially for the last two decades, while the price of photovoltaic (PV) cells has dropped dramatically over the last decade. PV cell prices are 99% lower now than they were in 1976 making it no longer the cost-prohibitive energy source it once was.

### What is distributed solar?

You have probably seen pictures of giant solar farms -- rows and rows of solar panels in the middle of nowhere. Distributed solar is different and much closer to home. Distributed solar energy can be located on rooftops or ground-mounted, and is typically connected to the local utility distribution grid.

### How do I get electricity from the grid?

Electricity comes into a home from the utility via a transformer. The transformer lowers the voltage from thousands of volts down to 240 volts before it enters the home. In the home, it passes through the main circuit breaker and is distributed through branch circuit breakers to various appliances and convenience outlets.

In the United States, the typical small appliance is between 110 - 120 volts. Nominally, the voltage provided is 120 volts but due to transmission losses, it can drop to as low as 110 volts. The maximum amperage is between 15 - 20 amps. Some larger appliance outlets for electric ranges or electric dryers supply 240 volts at 30, 40 or even 50 amperes. In Europe and most of the rest of the world, the voltage is at 220 volts.

### How much electricity does the average US home use per month?

The US Energy Information Administration estimates that the average home in the United States uses ~900 kWh a month, or the amount of electricity 25-30 solar panels provide. Louisiana had the highest annual consumption at 15,046 kWh and Maine the lowest at 6,367 kWh. Take a look at your electric bill for the last year. Understanding your current electricity usage is a necessary step to understand how much energy you consume.

### What are the types of solar uses?

There are three basic types of solar PV generation systems for use in small and residential applications: autonomous, hybrid, and grid-connected. Each system is unique in how it applies solar power to the application it's intended for, but each has the common

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characteristic of using solar PV systems to generate the electricity.

The Autonomous System of solar PV is used as the only means of generating electrical power for the application. This is often the choice when powering a specific appliance or process that does not need to be active 100% of the time, such as night lights, road signs, water pumps, etc. Autonomous systems are used in everything from the simple LED patio lights you buy at your local store to automatic livestock water trough pumps and electric fencing. This is one of the cheapest and fastest ways to set up a solar PV system.

The Hybrid System is a system that relies on solar PV generation as the primary means of generating electricity for the application, but has a backup generator for ensuring the system is powered as close to 100% of the time as possible. This is usually the setup for remote cabins, recreational vehicles, and some security applications. The backup generator is usually gasoline or diesel fuel powered and will automatically start up whenever the power in the system reaches a specified low point or when a bank of batteries for power storage reaches a low charge.

Finally, the grid-connected system is the most commonly used in residential solar PV. **This is the use which you may be most interested in to cut down your utility bills.** In this application, the house or building to be powered by solar is also connected to the utility power grid, which supplies the electricity not supplied by the PV system. In most residential applications, the solar PV does not supply enough power to run the entire home, but instead provides a noticeable supplement to the power purchased from the local utility. In times of peak production, extra power from the solar panels not being used by the home can be returned to the power grid and credited, while in times of low production [such as at night], power is mainly derived from the grid while the PV system lies dormant. Grid-connected systems do not need batteries to store excess power for later use. Since batteries can often make up nearly half the cost of the solar PV system itself, it's no wonder they are left out when they aren't really required.

### How much can I save on my energy bills with a residential solar PV system?

This really depends on your home's consumption information as every home is fundamentally different, however, the average Solar PV system can save between 20-30% on your energy bills. Depending on your roof size and availability, you could potentially install a system that would off-set your entire home's energy consumption.

### When will I start saving money on my electric bill?

Immediately! As soon as your system is installed and hooked up to the grid, you will immediately begin off-setting your home's consumption which means saving money on your electric bill!

### Can I go completely off the grid?

Yes, but we don't recommend it for most people because batteries drastically increase the cost of the system and more maintenance is required than a regular grid-tied system. Until battery prices come down in the coming few years, a grid-tied system is the best way to go solar.

### What happens when it's cloudy?

As long as there is light, your panels will still be producing power, albeit at a fraction of their peak capacity.

### What happens if it hails?

Solar panels need to be able to withstand whatever Mother Nature throws at them. In fact, most manufacturers put their panels through rigorous testing, shooting 1" metal balls at high speeds at the panels to simulate severe hail conditions. Anything more, and your insurance would have to cover the damages; but it's safe to say that at that point, your house would probably have bigger issues than just the condition of the solar panels!

### Do I need to get insurance on my system? How much would it be?

Just as with any other additions to your house, like a pool or a deck, as long as you don't exceed your coverage, your premium should not increase much, if at all. However, every insurance plan is different and we encourage you to find out the details for your policy before going solar. Solar panels usually have warranty up to 25 years.

### Do I need to get approval from my Home Owner's Association?

While a Home Owner's Association cannot "prohibit or restrict homeowners from installing a solar energy device," they can stipulate "where the solar device should be located on a roof." Every HOA is different, so please contact your Association before making a solar purchase.

### How often do I need to clean my panels?

You can thank Mother Nature as rain takes care of most of the required cleaning, but we do recommend that to keep your panels producing at their peak capacity, you rinse them at least once a year to clear any dust (or bird droppings) which might have accumulated.

## Frequently Asked Questions

### Isn't solar expensive?

You're not alone in thinking that solar is expensive. In fact, from our experience in talking to people, most people assume solar panels for their average-sized home (think 5 kW or 20 panels) would cost over \$20,000. The reality is closer to \$10,000, less than half of most people's guess. The combination of the sharp drop in solar panel prices and government tax credit of 30% has made installing solar to be a rational investment for many. In fact, the payback period in Hawaii is just 5 years, California 6 years, and Texas 8 years. Any electricity generated after that is free energy.

### Isn't solar hard to maintain?

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Exactly the opposite! Solar panels require almost no maintenance. The only part is cleaning at most once a year.

### What about batteries to backup power?

Nearly all modern solar panel systems are grid tied which means they're connected to the conventional electricity grid. When you use more than your panels can provide, you draw power from the grid like you have done. Batteries are an option for those who really want them, but they're expensive, bulky, and have to be replaced every five to ten years. From an economic perspective, we do not recommend going with battery backup unless you're really concerned about having backup power

### How many solar panels do I need for my house?

A small home of about 1500 square feet needs 4 kilowatts [kW] which is 16 panels to offset up to 50% of electricity usage. Each panel can provide about 250 watts [W]. An average-sized home can require 6 - 8 kW which are 24 - 32 panels. We do not anticipate most homes to have enough roof space to support 10 kW which is 40 panels. Here at Simplify Solar we provide solutions up to 10 kW.

### What's the installation warranty cost beyond 5 years?

There is no correct answer, as it depends on the installer. \$200/year is very fair and would be what Simplify Solar may charge in the future for offering this warranty / peace-of-mind to you.

### What does the installation warranty cover?

It covers all workmanship warranty - so any roof leaks, electrical/wiring problems, etc. Basically anything not related to the package materials as this would be covered by the respective manufacturer warranties.

### How large are the average solar panel size?

65 " x 39 " within 2 inches error. In other words, about 5' x 3'. The area is roughly 17.5 square feet.

### If there's damage to the house due to faulty wiring of solar panels, who pays for it?

Your home insurance should cover this.

### Will my property tax go up with solar panels?

In 29 states including California and Texas, solar installations are property-tax exempt. This means that installing solar panels will increase the resale value of your house without costing you an extra dime in property taxes. The same cannot be said for other home investments such as swimming pools, a new deck, etc. For a full list, take a look at the [Database of State Incentives for Renewables and Efficiency \[DSIRE\]](#).

## Technical Details: Physics

### What is the difference between energy and power?

Energy is the capacity to cause anything to happen. Power is the measure of energy consumed in a certain amount of time. A watt [W] is a measure of power, while a watt-hour [Wh] is a measure of power over a period of time, or energy. For example, a 60 watt light bulb that stays on for 12 hours would consume  $60W \times 12hr = 720$  watt-hours [or 0.72 kilowatt-hours] of energy. Consider a 600 watt microwave that is used for 15 minutes a day. It would consume  $600W \times 1/4hr = 150$  watt-hours [or 0.15kWh] of energy.

### How is voltage and current related to power?

Another way to think of power is the voltage [V] multiplied by current [I]. Voltage is measured in volts [V] while current is measured in amperes [Amps or A]. Let's take a physical analogy of water flowing downhill through a pipe to explain these two concepts.

Think of electrons flowing through a wire as water flowing downhill through a pipe. The voltage of an electrical circuit can be thought of as the height difference between the water at the highest point in the pipe and the water at the lowest point in the pipe. The greater the vertical distance, the greater the voltage. The current of an electrical circuit can be thought of as the amount of water flowing through a cross section of the pipe in a second. The wider the pipe and the faster the water flows, the greater the current.

### What is the theory behind solar energy?

When one thinks of solar power, solar photovoltaics [PV] or solar panels come to mind. Even within the category of PV there are many applications and variants of the technology, but fundamentally, PV enables us to directly convert sunlight into electricity. The fundamental physics was worked out by Albert Einstein in the early 20th century for which he obtained a Nobel Prize in Physics. The photoelectric effect explains how certain energetic photons [particles of light] has enough energy to knock out electrons from materials. These free electrons moving is what we call electricity.

PV arrays consist of solar cells that can come in a variety of shapes and sizes. The PV array on a house generating electricity is likely made of crystalline silicon. Silicon has been used in computers and other electronics for a long time and is a class of material known as semiconductors which are unique materials that directs these electrons in a controlled direction. You might have wondered why we don't use copper since copper is commonly used to carry electricity in wires. Copper is a class of materials known as conductors which even though it can carry electrons easily, it does not have the control to direct the electrons in a particular direction. Copper wires work in carrying electrons since there is already a push from one end and a pull to the other end. In a solar panel with electrons being generated all over the place on the solar panel surface, there needs to be a semiconductor such as silicon to direct all of the electrons in the same direction.

Since only photons with enough energy can knock out electrons, the efficiency of solar cells are limited. Efficiency is defined as the ratio of the useful energy [converted electricity] to the total amount of light energy hitting the solar panel. Typical solar cells have an efficiency of around 15% although there are models that reach up to 21% in efficiency. Two physicists named William Shockley and Hans Queisser

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around 15%, although there are models that reach up to 21% in efficiency. Two physicists named William Shockley and Hans Queisser developed a theory in 1961 which sets the fundamental limit of solar panel efficiency to be 29% for silicon. Using other materials, laboratory prototypes have reached over 40% in efficiency.

## Technical Details: Components

### Are solar panels all I need?

A typical grid-tied solar PV system includes the solar panels, an inverter (to convert direct current generated by the solar panels into the alternating current that your house uses), a racking system (to attach the panels to your roof without causing leaks), an AC disconnect (a safety measure to ensure that when the power goes out so the system will not backfeed into the grid), the wiring, the maintenance and other smaller components. These other components are called the balance of system (BOS).

### What's the difference between monocrystalline and polycrystalline panels?

The typical monocrystalline solar cell is a dark black color, and the corners of cells are usually missing as a result of the production process. Polycrystalline, on the other hand, is identifiable by its signature light or dark blue color. Historically, monocrystalline solar cells have historically had a higher peak efficiency, and were more readily available than polycrystalline solar cells. The blanket statement that monocrystalline panels are better than polycrystalline cells, however, is not accurate. Each panel and its manufacturer should be considered on a case-by-case basis.

### What direction do my panels need to be facing?

In the northern hemisphere, the highest energy production comes from panels which face south. Any roof face extending up to due east or west would also yield good production due to higher peak demands in the mornings and evenings, but anything north of east or west is not recommended. [Consider reading our blog entry Should My Solar Panels Always Face South for more information.](#)

### What happens when the power goes out?

Unfortunately, even if your panels are producing energy, you will not be able to use it. Your system would get disconnected from the grid so that any energy that is produced does not backfeed into the transmission lines and put utility workers at risk. Backfeeding is when power runs in reverse. The solar panel distributes the power to the rest of the house but it also feeds power out through the main breaker to the transformer, which then converts it back to thousand of volts and attempts to energize all neighborhood utility lines.

**Energizing the utility lines in this fashion is dangerous and illegal!** Workers attempting to restore power to the neighborhood may unexpectedly encounter high voltage on the utility lines and suffer a fatal shock. This is why an AC disconnect is needed so that in case of power outages, your system does not backfeed.

## Technical Details: Design

### Why do you need pictures of my attic?

These will help us determine how the panels will be attached to your roof, while making sure that we maintain the structural integrity of the roof and meet wind load requirements. Most jurisdictions also require a structural engineer's stamp of approval to be able to install solar and these pictures will help speed up the process in which we can get approved.

### Why do you need pictures of my meter and electric panel?

These will help us get a better idea of how to tie in the solar panels to your current electric system. Based on these pictures, we can design a full electrical diagram to gain utility interconnection approval, pull electrical permits from your local jurisdiction and make sure the installer understands the full scope of the installation before bidding for a project.

## Technical Details: Installation

### When is my installation & how long will it take?

The installation date is set by your chosen installer and normally takes between 30-45 days to install. This includes the design and permitting process.

### Who will be here? Can I trust the people who come to do the work?

All Simplify Solar partner installers have been through an intense vetting process so you can be confident that your install team not only has the experience, but they also have the know-how to get the job right on the first try. All our affiliated installers have at least five years of solar PV installation experience and are certified and insured to complete the job.

### Will they leave everything as clean and intact as they found it?

Absolutely. We take pride in providing a clean and aesthetically pleasing install. With Simplify Solar, you can be sure that we will leave your roof and home just the way we found it!

### Will they leave with a to-do list that will stretch on for months?

Your install should not take more than 2-3 days to complete. The packaged system will arrive to your home a few days before the scheduled install, your installer will arrive, begin the installation process and upon completion, will submit an interconnection agreement with your local utility. Once the connection is online, your panels will begin producing power and Simplify Solar will follow up to make sure that you are a 100% satisfied with your equipment and install.

## Solar Finance

## Is it better to own or lease a solar system?

While many homeowners were able to go solar because of the no-upfront-costs and limited liability benefits of leasing a system, the national trends are going away from leasing to owning. This is because owning a solar system has gotten more affordable, and the long-term benefits are passed on to the homeowner instead of the installer or financier.

## How much does my property value go up with a solar PV system installed?

A good rule of thumb is that every \$1,000 saved in annual energy expenditures increases a home's value by \$20,000. For most homes, this is about 50-75% of the system cost before incentives!

## Difference With Simplify Solar

Simplify Solar simplifies the process of going solar.

### How is Simplify Solar different?

Simplify Solar seeks to simplify the process of installing a Solar PV System on your home. Traditional methods require an invasive sales process that has an auditor come to your home for a site survey in order to estimate and quote out a system. If you want multiple offers, you have to contact different solar companies in your area and repeat this same lengthy and intrusive process all over again. Then you end up with a solar PV system they pick where you pay exuberant amounts and wait months for the installation to take place. This is where Simplify Solar helps make your life well...simple. We cut out the middleman and have installers compete for your business. This is where you, the consumer wins! We make solar simple and the best part...we pass the savings on to you! The average Simplify Solar PV installed system is 30% less than the competition. By taking advantage of the savings our cloud platform offers, you eliminate all the overheads and work directly with an installer of your choice to mount and balance your PV system. By providing some basic information and a few pictures of your home, Simplify Solar will design your packaged PV system and work with an installer of your choice to complete setup and connection.

### What is the average savings for a Simplify Solar System as compared to the competition?

The average packaged system from Simplify Solar is 30% less than the competition. Some Simplify Solar PV systems have been installed for less than half of what our competitors offer. By eliminating unnecessary overheads and the need for a physical site survey, Simplify Solar reduces the costs of providing solar and passes the savings on to you!

## Did You Know?

### 1. Solar photovoltaic systems are not expensive!

Much of the cost of solar PV systems are due to the balance of system (BOS) and not the solar panels themselves. This BOS not only includes physical components such as inverters and racking systems but also includes installation costs, permitting, zoning, and connecting the system to the grid. The Energy Department SunShot Initiative works to aggressively drive down these soft costs – making it faster and cheaper for families and businesses to go solar.

Simplify Solar simplifies the entire process for you by providing an unique turnkey solution which no other company provides. We can provide a 5 kW system (an average house) to you for less than \$10,000 even without federal incentives!

### 2. Solar photovoltaic systems have been around for a long time.

The solar photovoltaic system is NOT a new technology! They were first invented in 1954 by scientists at Bell Labs for satellites in space. In fact, on the front page of the April 26, 1954 edition, The New York Times proclaimed the milestone, "the beginning of a new era, leading eventually to the realization of one of mankind's most cherished dreams -- the harnessing of the almost limitless energy of the sun for the uses of civilization."

Solar photovoltaic (PV) panels constitute a mature technology. Today, over 60 years later, not only are they still the most reliable power source in space, they are now widely used on Earth. Just in the US, solar panels have been installed at over 500,000 homes. More than 100,000 homeowners installed solar panels in 2013 alone.

### 3. Solar panels are growing tremendously everywhere, even in the United States.

Green Tech Media research shows that there's a residential solar system installed every 4 minutes in the US. If trends continue, the United States will have 1 million residential solar installations by 2016, which is 10 times the number of installs that existed in 2010.

Germany leads in solar energy though it has the same sun potential as Alaska -- not much. Germany is smaller than Texas but produces more than four times as much solar power as the United States. In terms of solar energy output, Germany currently produces 34,558 megawatts of solar power, while the U.S. currently produces just 7,962 megawatts.

In terms of total solar power capacity per capita, Germany crushes every other country. At the end of 2012, it had approximately 400 MW of solar power capacity per million people, considerably more than #2 Italy at 267 MW per million people, #3 Belgium at 254 MW per million people, #4 Czech Republic at 204 MW per million, and #5 Greece at 143 MW per million people. The US came it at #20 with about 25 MW per million people (quite pitiful when put into this perspective). The top solar state (per capita) in the US at the end of 2012 was Arizona, which had about 167 MW of solar power per capita (and would have ranked #5 if it were a country).

### 4. Solar panels are much more ecologically friendly than fossil fuels.

Solar panels produce no pollution, although they impose environmental costs through manufacture and construction. These environmental tolls are negligible, however, when compared with the damage inflicted by conventional energy sources; the burning of fossil fuels releases roughly 21.3 billion metric tons of carbon dioxide into the atmosphere annually.

A 10 kw solar panel installation (under certain conditions) is estimated to generate about 17,000 kwh in a year. In environmental terms, this is equivalent to avoiding the emission of 11.7 metric tons of Carbon Dioxide (CO2) into the atmosphere. This is equivalent to the greenhouse gas emissions of approximately 2.3 cars in a year or burning 27.3 barrels of oil.

#### 5. Solar panels may be suitable for you even if you don't receive much sunlight.

Many people wonder if where they live is sunny enough for solar. This really isn't an issue. Most places in the U.S. that aren't particularly sunny are still just fine for installing solar panels. It's true that the more sunlight there is, the more electricity the solar panels will produce.

But, residential solar is really about saving money and the sunniest places don't always have the highest savings levels. How much money you will save is largely dependent on how high your electric rates are and what kind of rebates and incentives are available to you. This is why consumers located in northeastern U.S. can have significantly higher savings from solar power systems than consumers in sunnier states such as Florida.

#### 6. Solar panels can also be used to power boats and airplanes.

A solar powered catamaran called PlanetSolar has just finished traveling around the world on clean solar power, while also performing scientific research on the ocean's Gulf Stream current. This 9,000 kilometer trip, spread out over 5 months of navigation, featured stops in Atalayoun (Morocco), Monaco, and then Greece, where the ship transformed into a scientific platform as part of the "TerraSubmersa" archeological expedition, led by the University of Geneva (UNIGE). Once again, the largest solar-powered ship ever built showed she could be used for concrete goals, and thus reaffirmed her position as a multi-functional tool and formidable communication platform.

Another Swiss company is focusing on a solar powered plane called Solar Impulse that will require zero fuel. Masdar, Abu Dhabi's renewable energy company, is the host partner of Solar Impulse. The team will be hosted by Masdar and Abu Dhabi at the start of January for testing and training before the start of the first solar-powered flight around the world. Si2 will be delivered to Abu Dhabi by cargo plane from the Payerne aerodrome in Switzerland towards the end of the year and will be showcased during the World Future Energy Summit as part of the Abu Dhabi Sustainability Week, which is hosted by Masdar between 17 and 22 January 2015.

