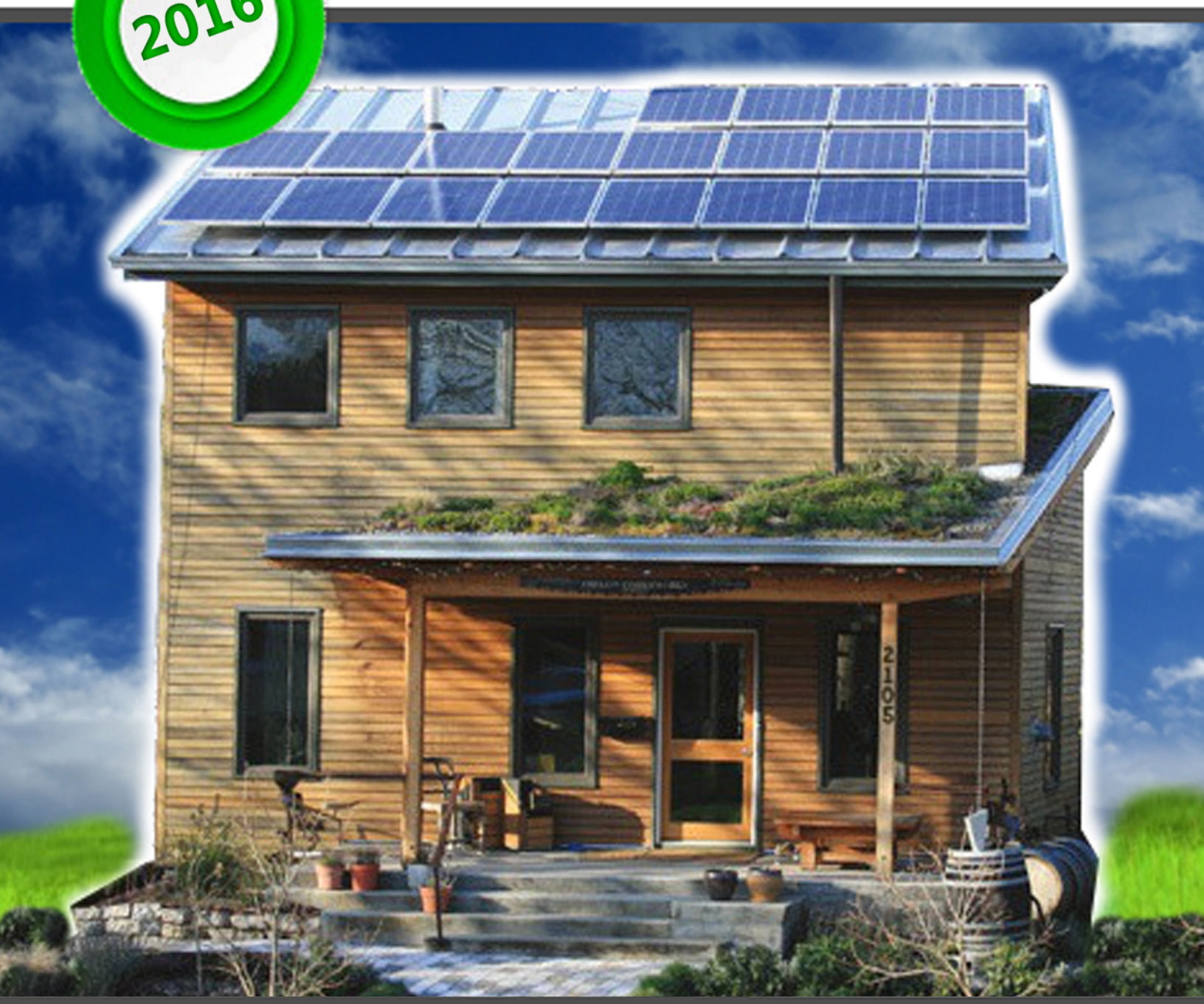
Solar Power Rocks.com

The Ultimate Guide to Powering Your Home with Solar

2016



By the researchers at SolarPowerRocks.com!

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Introduction

Welcome to the Solar Power Rocks Ultimate Guide to Powering Your Home with Solar. We've compiled this document as a comprehensive guide to the process of installing solar on a home in the United States of America. It is a companion to our website, http://solarpowerrocks.com, the best place on the web for people who are considering solar. While this guide has a lot of helpful information, the site is updated regularly with the most current information about state solar policy and incentives and helpful tips for homeowners who want to know if solar can work for them.

This guide explains the whole process of going solar and contains information about topics as broad as what a kilowatt is and how solar panels work and as specific as how to work with a Homeowners' Association to get approval for your solar project. Because of its comprehensive nature, readers should feel free to skip to sections that are applicable to their unique situation, but it might be a good decision to read it cover-to-cover, to ensure you know what to look for and what to expect.

Since you've chosen to receive this document, you're probably interested in seeing how solar power can work for you. You might be an environmentally-minded person looking to do good for the planet by offsetting your usage of fossil fuels, or you might be a money-minded person who's interested in solar as an investment vehicle. No matter what your reasons, solar is a good choice for a lot of people, and a good investment in almost any state in the union.

If you feel lost at any point during reading this book, a glossary of terms is provided at the end for your convenience. Please enjoy, and welcome to the world of solar!

Let's take a look at a case study to see how solar can work:

Case Study: Cayenne Engel, Henderson Nevada

Cayenne Engel wasn't sure if she could afford to install solar, but she was really interested, so she began to do some research, which led her to Solar Power Rocks. When she found out that there were companies interested in installing solar on her home for free, her initial doubts about affordability were erased. As she dug deeper though, she came to the realization that purchasing a system outright was better for her than leasing.

For Cayenne, going solar was an ethical decision. She didn't need it to save her a ton of money, though it's estimated that she'll see a profit once the loan she took out to pay for the system is paid off. "I was interested primarily for environmental reasons," she told us. "I just needed it to be something that didn't cost a lot more than what I was currently paying."

That ended up being more feasible for Cayenne than she expected. Though she'd initially looked at leasing options, owning soon began to look like the best way for her to go solar. "Due to how many people were going with the leasing option, I kept reading about customer service issues and backups due to high demand."

Cayenne strongly preferred choosing a local installer rather than a national leasing company, and after getting several free quotes for system installation, she selected Robco Electric because they featured a good balance between strong customer service and cost. She emphasized she

took the time to do the research, because she wanted to get it right. And though it hasn't been long since her panels were installed, Cayenne is happy with her choice, saying, "The customer service is excellent and I was surprised at how fast everything moved."

Once Cayenne selected an installer and arranged for financing, her next potential roadblock was her HOA. She wondered if they would have an issue with her slapping solar panels on her roof. Fortunately, Cayenne's fears were quickly dispelled. After getting word from her neighbors that they had no issue with Cayenne's choice to go solar, she moved forward with the process. In fact, her neighbors, even those she doesn't know well, are asking about her solar experience.

Cayenne's story shows that it's possible for a homeowner to start producing their own energy from the sun without breaking the bank or trying to save up until a magic number is reached. Despite her initial doubts about affordability, Cayenne took the time to see if she could make it work and now she's producing clean energy that reduces her electric bill and will make her money in the long term.

Cayenne's story has it all—a challenge to overcome, a dashing heroine to overcome it, and a happy ending. She's just one of the millions of Americans whose lives have been improved because they embraced solar. Sometimes, it's just that easy.

If you'd like to see whether you can be the next happy American on that list, read on to find everything you ever wanted to know about solar, and then some.

Chapter 1: Why do people go solar?

Solar power is not just for treehuggers and back-to-the-landers anymore.

For many years after commercially-produced solar panels became available, they were accessible only to very wealthy environmentalists and survivalists or very willing-to-spend-their-life's-savings environmentalists and survivalists. But with modern technological advancements in the design and manufacturing of solar panels, equipment costs have come way down.

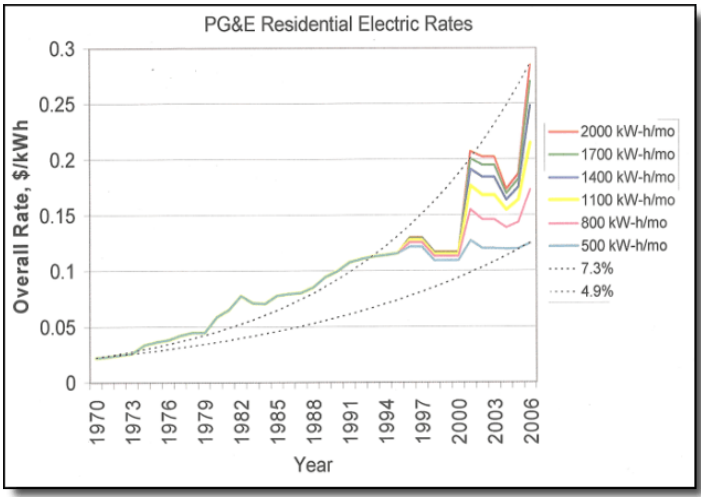
Some of those old treehuggers even ran for office, and now the federal government and state legislatures have also recognized the benefits of solar power by offering some helpful rebates and tax incentives. With lower materials costs and the aforementioned incentives, solar has become a great investment all across the United States, often outperforming the major stock indices. Here are the reasons people go solar today:

I. Financial Benefits

It's a pretty simple calculation: solar panels have come down in price while utility rates have gone up. Here's how financial benefits add up to big returns for solar investors:

Solar stabilizes energy costs over time

Current utility rates are just that. They are *current* – meaning they have been a lot lower in the past and there is no reason to believe they will be decreasing any time in the near future, unless you start generating some of your own power. Below, you can see the average cost of energy per kilowatt-hour in California. Over the past 30 years, this rate has increased at 6.7% per year. Look for this number to increase all over the U.S. in the coming years because of higher coal and natural gas prices and legislation to tax or penalize carbon emissions, among other things.



By getting ahead of the curve and going solar, you can lock in future energy costs over several decades that are significantly lower than you are currently paying. Here's a more practical example of why going solar for this reason makes a lot of sense. As you probably know, airlines have had problems maintaining their profitability after fuel hikes early in the new millennium. Many are charging for additional bags, and some are now charging for water. Water! Well, in the mid-2000s, United filed for bankruptcy, Delta almost tanked, and others like American and US Airways had to merge with each other to stay afloat.

Southwest was the only airline that made it through this continuing price surge. While other airlines were failing, they consistently reported their high profits. Why? They locked in the price of fuel years ahead of time at a good rate by buying fuel futures.

Sunshine is free. Installing solar panels you purchase with cash is like buying fuel futures for the next 25-plus years. Don't be the next United Airlines. Even if you don't have pensions to sever, the money you save can be used for other things—like your bottom line, groceries, or your next tank of gas.

Solar adds value to your home

Having solar equipment on your home increases its value. How much? Appraisers are still getting their act together on this one and they may vary a bit from one to another, but according to The Appraisal Journal, solar energy adds $15-$20 times yearly energy savings to resale value. Let's say you own a home in Pennsylvania and you install a solar power system on your roof, and it ends up saving you $1,000/year in electricity bills. That means your home would increase in value $15,000-$20,000. That's as much as the system will cost, so your initial investment is recouped immediately and pays a $1,000 dividend the first year. Instead of getting upset every time your utility raises power rates, you get a raise instead!

And we aren't just blowing smoke, here. Long-term studies of home sales in California and Colorado have shown strong correlations between solar installations and increases in home value. Homes with solar even sell faster than those without. Thanks for doing all that hard work, government researchers!

Solar adds credit to your utility account for future use

Many states have net metering guidelines they must follow when home or business owners install energy-producing equipment. Net-metering does not involve people from the public works department in orange hard hats coming to measure the height of your basketball hoop net with meter sticks. Instead, your power company is obliged to purchase power you generate back from you at a wholesale rate.

So, let's say you've got some solar panels up on your roof for the summer but you decide to go on and take a vacation for a month or so. All the power that is being generated gets credited to your account. At the end of the year, if you use as much power as you feed back into the grid, your power bill is almost nothing.

Going solar now (rather than later) leverages financial incentives and tax credits

Incentives and tax credits for solar are made available to homeowners in many states (check your state's page at our site, http://solarpowerrocks.com for further details). In some areas, you can deduct up to 50% of the cost of your solar power system (including installation!). But these tax credits are not permanent. In fact, some states are phasing out the rebates and credits they offer because they've already helped so many people get solar on their roofs. In almost all states, incentives will be stepped down over the next several years until they expire—now's the time to lock them in.

Even after electric rate prices make solar more cost effective on its own, people who buy now will have purchased the same technology as the latecomers, but the government will have paid up to half the price. These rebates are already paid for out of your taxes and utility bills… TAKE THEM BACK!

The available rebates and tax credits are the main reason that going solar makes so much sense financially. In some states, the payback time for a new solar power system is as little as 4 to 6 years. Since a system is expected to function at a high level of performance for at least 25 years, the energy savings over that time add up to thousands and thousands of dollars, representing internal rates of return (IRRs) of 15% or more, double that of a long-term investment in the stock market.

II. Environmental Benefits

Solar power is emissions/pollution free

Unlike burning coal, oil, or even wood, solar power is clean. That is to say, there are no residual accumulating pollutants after a day's worth of energy generation. Whether you are an eco-cognizant carbon warrior, or someone who does not know the difference between a carbon footprint and a criminal fingerprint, you'll be glad to know installing solar equipment on your property lessens the detrimental impact you have on our environment.

There are some curmudgeons out there that will argue the carbon cost of producing the panels outstrips the advantage of them, but they are flatly wrong. According to the folks at the National

Renewable Energy Laboratory, who do complex carbon footprint calculations for a living, those panels have a net-zero carbon footprint after only 1-4 years on your roof, and that number is decreasing with new production methods. After that, you'll be consuming significantly less energy produced by processes which release CO2 into the atmosphere, thereby doing your part to ameliorate our global warming and pollution problems. Go you!

Solar power provides clean energy for the next generation

Your home or business will probably be around for some years to come; even after you pass on to whatever you believe lies ahead. The equipment you install now has long-term warranties on it—many solar panel companies provide insurance-backed warranties of up to 25 years. There are solar panels installed 50 years ago that still produce. The people who inhabit your home or work in your buildings in 2050 will be thankful you installed this equipment.

And won't somebody think of the children!? You might be interested in solar because you realize that the past few generations have made a big, dirty, industrial-polluted mess of things, and you want to do something to change it. The incentives are out there to help you realize that dream, and you can make quite a few bucks on the deal, too.

By conserving and installing solar power, you provide a model for others in your community to follow. You will be AMAZED at how much more receptive people are to solar when someone on their block has panels on their roof. It's also a great way to teach your children or those in the neighborhood about energy, electrical engineering, and the awesome power of the sun.

Chapter 2: How Does Solar Work?

Solar power seems almost magical, but rest assured there isn't a bunch of little sparky demons running around inside your wires when their tails get too hot from the sun shining on them—there is seriously science-y science to deal with here, people. This section is a helpful guide that will tell you all you need to know about what happens from sunshine to panel lifespan, and what to look for and expect in a solar installation, too.

I. How light becomes electricity

Light comes to earth from the sun as tiny particles of energy called photons. Photons have the ability to excite atoms by bumping up the energy level of their electrons. For most substances on earth, the absorbed energy makes the atoms move faster resulting in heat. But in some minerals, like the modified silicon crystal that a solar cell is made of, only the electrons move.

The energy that is generated by a solar panel is called photovoltaic (PV), coming from the ancient Greek "photos," meaning "light," and the inventor of the first chemical battery, Andrew Volta.

Electricity, in general, is the flow of electrons from a negatively-charged pole (lots of electrons) to a positively-charged pole (fewer electrons). A standard-type solar cell contains two layers of silicon that have each been adulterated to be either negatively or positively-charged. When sunlight hits the negatively-charged silicon, the extra electrons begin to flow toward the positively-charged section, creating a current. That current is directed across a wire that carries the energy contained in those electrons as electricity.

The electricity that comes from a solar cell is known as Direct Current (DC) electricity, but the appliances in our homes use Alternating Current (AC) electricity. Therefore, the power from a solar panel system is directed first to an inverter, which converts the electricity from DC into AC.

The current generated by the system is usually used to power appliances and lights within the home first, with the excess being sent to the electric utility company for use by other customers. This requires the installation of a new, bi-directional meter that allows the power to flow both ways—in if your panels aren't producing enough to cover your usage, and out when they produce more.

In some systems, power generated by the panels is sent directly to the utility company, creating a credit with the company, and the home where the panels are located still receives power directly from the utility. In either case, the power produced by solar panels offsets the home's usage.

II. Watts, kilowatts, and kilowatt-hours

A watt (W) is a standard unit of measurement that refers to how much power a generator produces or an electrical circuit requires. The technical definition of a watt is "one joule per second," but that isn't very important. It's better to think of it as "the power produced (or required) at any given moment." So a lamp with a 100-watt light bulb needs 100 watts of power to function.

Solar panels are rated by the number of watts they produce at any given time in good sun conditions. Arrays of many solar panels are usually rated in thousands of watts, also known as kilowatts (kW). The utility company measures the energy they sell you by the kilowatt-hour (kWh), meaning how many kilowatts of power you use for the number of hours you need it.

If you look at your monthly electric bill, you'll see how many kWh you used, what the cost-per-kWh was, and how much your total bill is. Often, the cost-per-kWh includes separate rates for energy and various other charges, such as line maintenance, each multiplied by your kWh usage.

III. AC and DC Watts

OK, now we've done it. We've been talking about how many watts a solar panel will produce, but can a 100-watt solar panel really power a lamp with a 100-watt light bulb? Not exactly. The measurement of the solar panel in is direct-current (DC) watts, but like we mentioned above, the electricity produced by a solar panel needs to be converted to alternating current (AC) watts by an inverter, and that process removes a little bit of the power.

For solar panels, there are two ways to quote DC watts. One is called Standard Test Conditions (STC), also known as "nameplate rating." This is the simplest way to quote, because you just take the wattage of the panel and multiply it times the number of panels. For example, if you had 10 230-watt panels, you would have a 2.3-kW DC STC-sized system.

The other way is Performance Test Conditions (PTC). This number will be slightly less than STC. What PTC means is they put the panels under outside test conditions and see what they actually pump out. A 200-watt Panel may actually produce only 180 Watts. PTC ratings take into account everything in the real world, including energy lost during transmission, etc.

When we calculate how much energy a homeowner can expect from his or her panels, we need to know how many AC watts it will produce, so we take the PTC number and multiply it by the inverter efficiency. When all is said and done, that 100-watt AC lightbulb is actually going to need a panel that can produce about 128 watts of DC electricity.

If you're getting your own quotes for solar, make sure that each company provides you with a quote based on the same kind of output. It doesn't matter if it's DC STC watts, or AC watts or anything else, as long as you're comparing apples to apples.

IV. What are the components of a solar power system?

A solar power system isn't just a bunch of panels on the roof—there are many other components that can affect how well the system functions and how much it costs. These components include:

- The panels
- The mounting hardware for the panels
- Racks to hold the panels at the proper angle
- A DC-to-AC inverter or microinverters
- An electricity meter
- Performance-monitoring equipment (optional)

A good installer should provide you with an itemized quote that outlines all the necessary components and installation costs. Let's run down each type of component and what you should look for:

The panels

The panels are where most of the action happens. Modern solar panels from reputable suppliers are high-quality, high-efficiency workhorses designed to keep kicking amps for decades into the

future. A typical solar panel should be rated to produce between 200 and 325 watts, and weigh about 2-4 lbs. per square foot.

Left: Traditional silicon-based panels on a house. Right: Thin-film solar cells applied in sheets.

The information above is generally true for traditional crystalline silicon solar panels, which have been the standard of the industry for decades. You may have heard about thin-film solar cells and how cheap they are compared to traditional ones. Here are some facts about both kinds of panels to help you understand the differences:

Silicon

- Their technology is based on silicon, similar to computer chips. Silicon prices can go up and down, but the prices for panels have been falling for years based on increased production and the parts of the world where most solar panels are made.
- These are the most common type of solar panels.
- They're the most efficient. In other words, they convert more sunlight into electricity than thin film panels do.
- They're more expensive per panel, but not necessarily per watt of power produced.
- They are inflexible and only come in solar panel form, although not necessarily as a rectangle shape. These are most common, however.

Thin Film

- Thin film can be made from a variety of different chemical compounds, including cadmium telluride (CdTe), copper indium gallium diselenide (CIGS), and amorphous

silicon (a-Si). Because cadmium is a toxic chemical, thin film manufacturers have addressed this drawback by providing free recycling of panels at the end of their life.

- Because Cadmium is cheap, thin film is cheap too. Hooray! But…

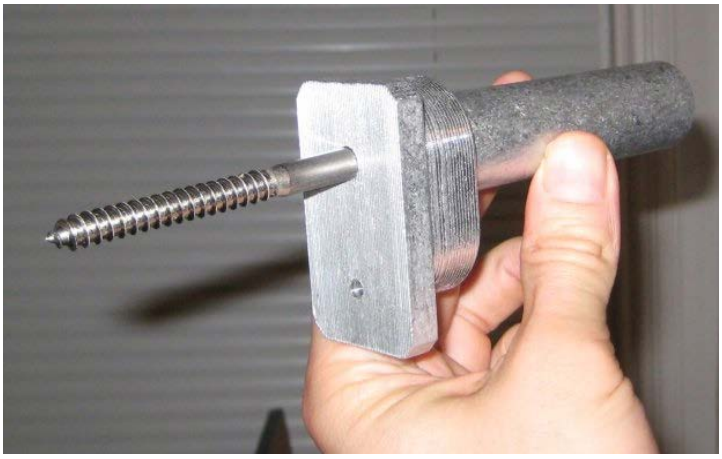
- Thin film is not as efficient as silicon panels. That means you need more panels on your roof to produce the same amount of energy as silicon panels. So, if you have only a little roof space, you're better off with silicon panels.

- On the other hand, thin film technology is more flexible. "Panels" can look like regular roofing shingles. Some can be installed through a "peel and stick" tin roof system or even sprayed on windows and walls.

- You'll pay a lot more for Thin Film "shingles" than square panels. Known as "Building-Integrated Photovoltaic" (BIPV) products, it's meant for people who don't like the look of solar panels on their roof.

Mounting hardware for the panels

Yes, Virginia, the workers on your roof are drilling holes and sticking giant lag bolts (like the one below) into your roof beams. But that shouldn't worry you if you've picked a good installer—the workers will seal the holes thoroughly once they've attached the hardware, and the installation should be warrantied against unfortunate problems like roof leaking.



A typical roof mount for solar

It's very rare that a roof will leak based on the installation of solar panels. And panels can be installed on just about every roof type, including typical asphalt shingles, Spanish tile, wood shake, and tar-and-gravel roofs. Spanish tile roofs are the most expensive to install panels on, because a few the tiles will inevitable be broken when the workers walk on the roof, so you'll need to have extra tiles on hand before the installation can begin.

The bolts that are used by the installer will be strong enough to hold the panels on the roof of your house for the life of the system, and beyond. The panels themselves aren't that heavy. Most of the coding requirements come from "upforce." Basically there is more danger of the panels catching air like a sail and ripping off your roof than there is of them weighing too much and pushing through your roof. If they are bolted to the rafters then they are attached to the infrastructure of your house and not the roof, and there are no worries.

By the way, don't worry about solar panels making it more difficult to fix or replace your roofing material. It shouldn't cost more than about $1,000 for the company to come out and remove the panels so roofers can do their thing, then replace them once the roof is done.

Racks to hold the panels at the proper angle

Once the mounting hardware has been placed on the roof, metal racks are constructed to hold the panels. The racks are designed to hold the panels at the proper angle to the ground (tilt) and pointed toward the south (in the USA) so that they collect the most sun possible (azimuth).

Workers install panels on ground-mounted racks

If a solar power system will be mostly responsible running refrigeration and air conditioning equipment in a hot climate, the panels should be tilted to your latitude minus about 10 degrees. If the system will be used mostly for running heaters in cooler climates, the best angle is your latitude plus about 15 degrees.

In a fixed system, your installer will do all this for you, and they will be the expert, since they install systems on homes all over your area. There are other options that can make a solar panel installation more efficient, but the price goes up as they get more complex, and they're often not cost-effective for homeowners.

The simplest way of increasing the amount of sun your panels get all year round is by installing manually-adjustable racks. These racks can be raised or lowered by hand based on the time of year and the height of the sun in the sky, and adjusted as often as you like.

Another method involves installing automatic sun-tracking panels. Often simply called "tracking," these racks can be designed to both raise and lower themselves using small motors, or turn side-to-side as the earth rotates on its axis, or both. It is useful in areas that have tiered rates for electricity in which the price gets very high in the afternoon, when the sun is in the west instead of the south. Tracking is often quite expensive, and is mostly used in large solar installations.

A DC-to-AC inverter or microinverters

As we mentioned above in the "how solar works" section, the DC energy produced by your panels needs to be turned in to AC electricity to be used by your home or served to the electric company. This conversion is done with an inverter.

A typical DC-to-AC inverter

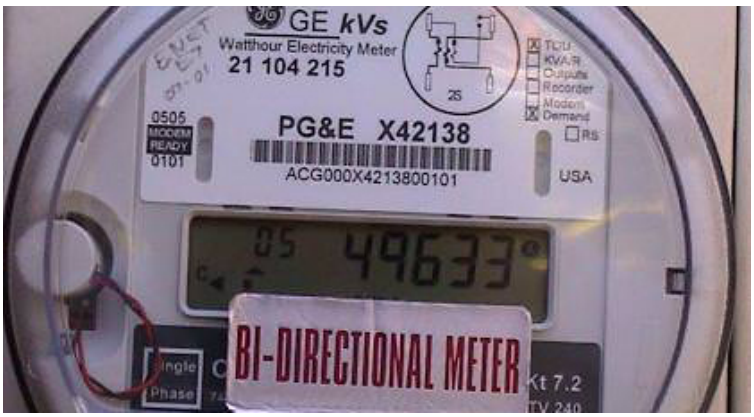
A single, large inverter has long been the most popular method of performing the DC/AC switch. In a system with a single inverter, electricity from all of the panels in directed to a large box mounted on a wall inside the house. Inverters generally last between 10 and 15 years (panel life is at least 25 years) and cost about $1,500 to replace when they fail. If they fail, the whole system goes down.

Recent advancements have led to low-cost microinverters that are designed to take power from each panel and invert it before it is sent along. Microinverters are individually inexpensive, but for a whole system's worth, they cost more than a single large inverter. There are several advantages to using microinverters, including the following:

- A single microinverter is not expensive to replace when it fails
- If a microinverter fails, electricity stops flowing only from the panel (or series of panels) it's attached to—the rest of the panels continue to transmit electricity
- With each panel having its own microinverter, failing panels are easier to detect
- Microinverter lifespan is longer than a single large inverter—some microinverter manufacturers offer 25-year warranties, which match panel warranties

Whether you have a single inverter or many microinverters, they will likely someday need to be replaced. This replacement cost should be included in any estimate you get from an installer, but don't worry too much about it—with the savings you'll see from solar, the cost of an inverter will be a negligible expense in the big picture, and in the next ten or fifteen years, inverter technology is bound to improve a great deal, with lower prices than ever.

An electricity meter

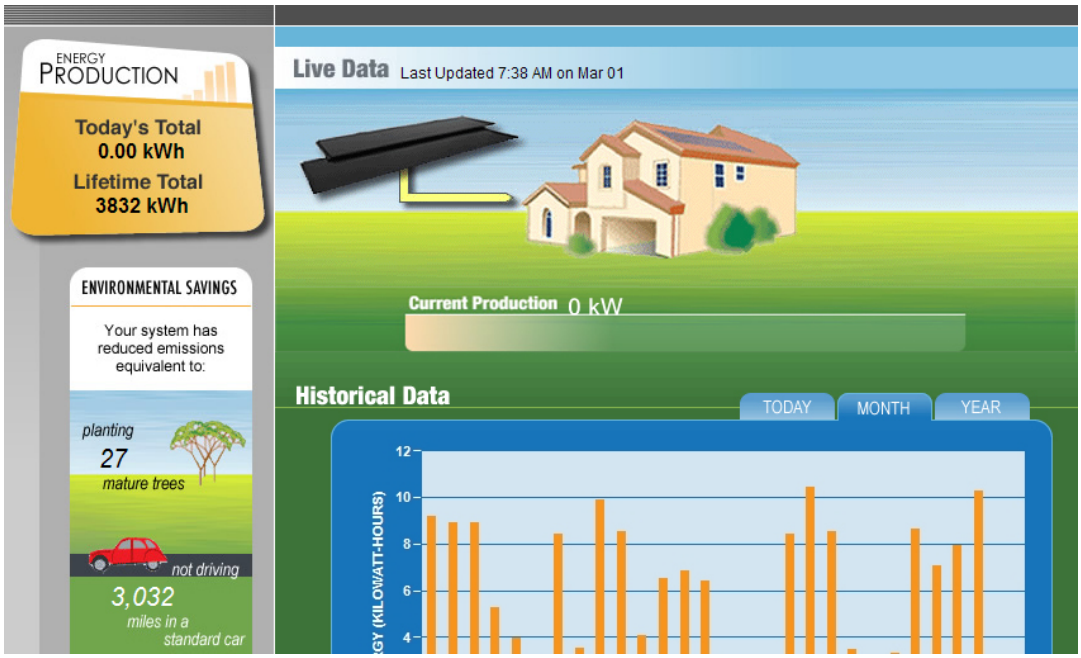


A bi-directional meter on a solar customer's home

When a new solar panel system is installed, the electric utility needs a new way to meter the net usage or surplus each month. Depending on a state's interconnection and net metering policies, the company may simply install a bi-directional meter for you and be done with it. In states without good rules, however, the utility company can force you to buy an expensive secondary meter and redundant external disconnect switch for your system.

Performance-monitoring equipment

Performance-monitoring is often a built-in function of a system when you use a reputable installer, especially if you're getting a solar lease or power-purchase agreement from a nationwide company. The best performance monitor systems are internet-based applications that take data from your inverter (or microinverters) about how much electricity your system is producing over its lifespan, and correlate that data with information about weather conditions and historical performance.



Screenshot from a performance monitoring system

Monitoring is a helpful way to see that your system is working as expected and can tell you right away when something's not right, this is especially helpful for lease and PPA customers. Because the installer must do all maintenance on the system, it is a homeowner's first indication that a service call is necessary.

That's all for the components of a solar power system! There aren't a lot of moving parts (unless you get two-axis tracking), so there isn't much maintenance to do. Just keep your panels clean by spraying them with water every now and then, and enjoy the sunshine… and the savings!

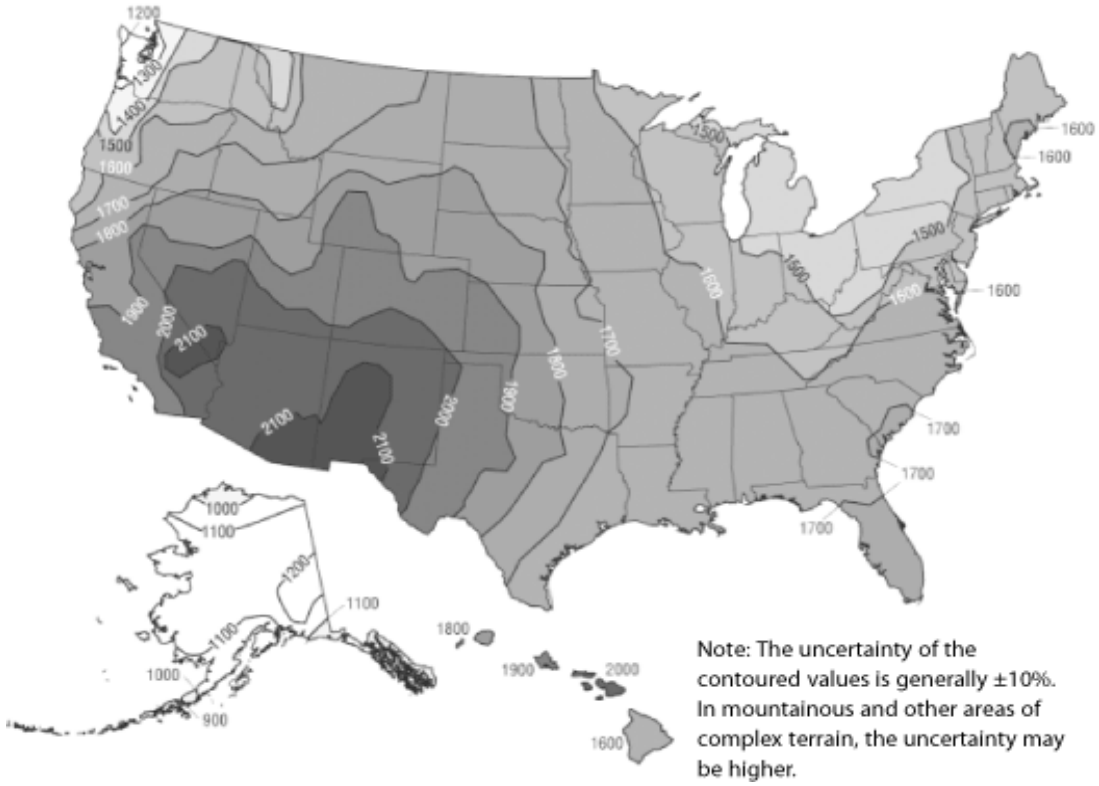
V. How much energy does the sun make?

Every 40 minutes, enough sunlight reaches the earth to power the earth for a year. That fact is staggering, but it's not likely that we're going to cover the every inch of the world in solar panels. And grandiose statements don't do a lot of good in helping explain how solar can help

one family eliminate electricity bills or go carbon neutral, so maybe the real question is: how much energy can the sun make for you?

The answer, of course, is "it depends." But let's run down an example of a house with solar, and go through some of the numbers you can expect to see in that situation. The first step is to see how much sun you can expect to get over a year.

Let's base our example on a person we'll call Sam, in rainy Portland, OR. If you're ready to take the next step and you're curious about your own capacity for production, you can find out how much energy your system will produce by looking at the map below and performing this simple calculation: Solar panel system size in kW x (Map region number x 0.78*). For example, Sam's calculation is 3.5kW x (1300 x 0.78) = 3,549 kWh.



**The map above shows kWh-per year-per kW system size. We multiply that by 0.78 based on the following:*

- *PV Energy delivered as % of manufacturers rating: 95%*
- *Wiring & power point tracking losses: 9% (91% delivered)*
- *Inverter Efficiency: 90%*
- *Total Energy Delivered = 95% x 91% x 90% = 78%*

Sam's 3,549 kWh will offset his usage from Portland's main electric service provider, PGE. If PGE's service price is 12 cents/kWh, Sam is saving about $426 a year on his electric bill. These calculations assume that Sam has a good roof for solar, meaning it's oriented to the south or southwest with little to no shade, so the solar panels can work as well as they're rated.

But it really is as simple as that; find out how much sun you get where you live, decide what sized system you need (more on that later), and run the numbers. Our sample 3.5-kW system is actually a mid-sized system of about 15 panels. Depending on your roof, the amount of sun you get, and how much your utility will pay you for your generation, you might want to think bigger.

VI. Do solar panels work in cloudy weather?

Uh-oh, or OK?

Solar panels work best on clear days with abundant sunshine (not surprisingly). But, do solar panels work in cloudy weather? Yes! On a cloudy day, typical solar panels can produce 10-25% of their rated capacity. The exact amount will vary depending on the density of the clouds, and may also vary by the type of solar panel; some kinds of panels are better at receiving diffuse light. The same thing is true in foggy weather. If you live in a city with frequent fog, like San Francisco, you'll still be able to generate electricity when the fog rolls in.

Ultraviolet light also reaches the earth's surface in abundance during cloudy days (if you've ever gotten a sunburn at the beach when it's cloudy, you've experienced this firsthand). Some solar cells are in development that can capture UV rays, although these are not out on the market yet.

And one cloudy day isn't as important as the amount of sunshine over a full year. As you can see in the example above, even cloudy Portland gets enough sun to make solar work great. Let's not forget about Germany—a country that gets about as much sun as Alaska. On a good day, they get over 40% of their electricity from solar panels. The United States gets about 1%, because we don't have nearly enough installed.

If you have solar panels and keep a close watch on your power output, you may notice a strange phenomenon: on a partly cloudy day, it's possible to exceed your solar system's power rating and produce more power that you could on a sunny day. Known as the "edge of cloud" effect, this happens when the sun passes over the outer edge of a cloud, magnifying the sunlight.

The intense light causes your solar system to boost power output temporarily, which can help balance out losses from full cloud cover. Solar installers typically select system components that can handle temporary power boosts of this nature. If you live in a city with frequent partly-cloudy weather, like Seattle, you may choose to install an over-sized solar inverter to take the best advantage of these power boosts.

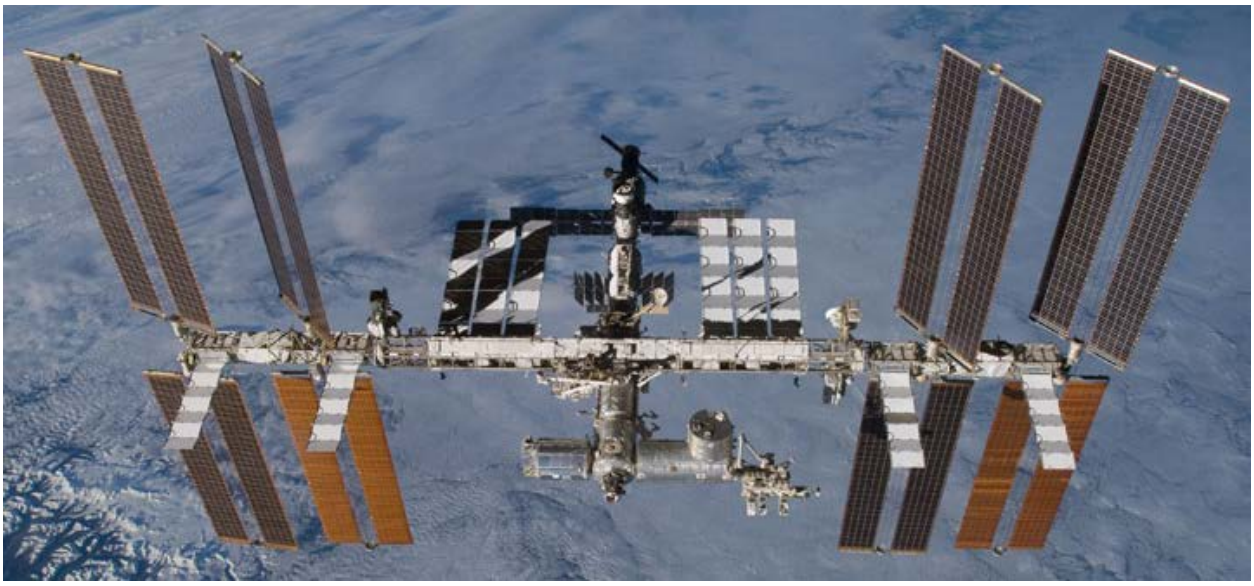
VII. How long do solar panels last?

The solar panels above the door of the Betty Bear Hut were installed in the 1990s, and work as well today as they did then

One of the misconceptions about solar is that it's an untested technology. Skeptics argue there's no way to tell how long the panels will last, or that they will require costly maintenance on a regular basis.

We've done the legwork and determined that there really isn't any data to indicate solar panels won't be the rigorous long-lasting electricity-generating beasts you hoped they would when you first bought them. In fact, evidence from around the world shows that solar panels last for decades and keep producing reliable energy with little degradation.

In fact, solar panels have been used for over 60 years to keep communications and exploration satellites running, and the astronauts on the International Space Station have trusted their lives to solar power for over 13 years. IN THE HARSH ENVIRONMENT OF SPACE.



Solar high-five, ISS!

But anecdotes tell incomplete stories. We looked at some of the data that's out there, and the findings are very promising. For one, even the first solar cells, developed 60 years ago, are still working today!

The most complete review of studies of solar panel efficiency over lifespan, published by the National Renewable Energy Laboratory (NREL) in 2012, looked at degradation rates in nearly 2,000 solar installations. Degradation is basically the gradual decrease in efficiency of a solar panel over time, and it's something of a bogeyman among solar naysayers, who say that solar panel degradation means lower-than-expected earnings over the life of the panel.

Regardless of what solar power's detractors say, nearly all solar panel manufacturers guarantee that the panels they make will maintain above 80% efficiency by the end of a 25-year warranty. But those warranties are based on conservative estimates. The NREL study found that, for traditional silicon-based solar panels, the median reduction in efficiency is about 0.5% per year, which means that the panels operate at 88% efficiency, even after 25 years.

Solar warranties are a pretty safe bet. Many solar panel manufacturers have been in business for decades, and even when they haven't, they're increasingly turning to insurance-backed warranties that guarantee coverage even if they company becomes insolvent in the future.

VIII. What Could Go Wrong With a Solar Installation?

The last thing anybody wants to think about when making a big decision is the multitude of ways everything could go wrong. Yet, the worst case scenario consistently and inevitably becomes one of the biggest factors in any decision making process.

Take travelling for example. You hear about one bombing in Bangkok and suddenly start spreading the word to anyone and everyone about the dangers of Thailand. All the while, the vast majority of tourists go on enjoying Thailand's floating markets and Goong Ten with nary more than a picked pocket and a tummy ache (seriously, look up Goong Ten — it's not for the weak of stomach).

However, in the interest of good reporting and addressing irrational fears, I'm going to list some of the worst things that could go wrong with your residential solar system and what causes them. Then I'm going to tell you why you shouldn't worry about them. Hooray!

All of these concerns fit into three basic categories (production failure, electrical failure, and structural failure) and they all fall into one person's careful hands — your solar designer's! Many states and jurisdictions require a licensed professional engineer to review the structural or electrical portion of a system's design, but more often than not, your system is only being checked by your designer, your local permitting office, and your utility company.

If by some miniscule chance one of these problems does arise with your system, you know who to blame. That's why we put you in contact with trustworthy solar experts. On to the bad news!

Production Failure

With the advent of power purchase agreements and solar loans, production targets have become the primary design goal of many systems. Gone are the days of selling a nice round number of kilowatts to a customer and working out the numbers from there. The creative financing in the modern solar industry relies on accurate production estimates from the day your system is turned on to twenty years in the future. These production estimates are based on a stack of factors ranging from the tilt of your roof to the weather patterns in your local area. The most obvious factor though is shading, either from neighboring houses, trees, or existing obstructions on your roof.

Shade is the output killer

So with all of these complications, it's easy to see how things could go wrong. Though it varies depending upon your exact location, for most areas of the U.S., the best exposure will be seen on south-facing roof planes. The optimal tilt will depend upon your latitude; if your latitude is between 25° and 50° (anywhere in the U.S.), use the latitude, times 0.75 and add 3 degrees. Of course, if you already own a home, knowing the optimal tilt and azimuth (a fancy word for the direction your roof planes face) doesn't help you — you're stuck with what you've got.

However, the emphasis placed upon these factors is well-placed, as inaccuracies in tilt and azimuth can affect the expected production, even in very minor situations, by as much as 5%. Fortunately, during the survey of your home, these factors should be accurately measured on site and used to calculate the exposure of various roof planes to the sun.

The site visit should also include a shade assessment. While there are many different tools used to assess tree shade (Solmetrics, Sprite, Suneye, rusty chainsaw, etc.), care must be taken during the site visit and design process to record and interpret these readings accurately. Shading can have a greater effect on solar arrays than you would expect, as shade in one area of the panel affects the production of the entire panel and shade in one area of the array affects the production of the entire array.

Systems are designed to current shade estimates, so remember that your trees will need to be maintained in order to keep your estimates as accurate as possible. Make sure that your sales

rep understands which trees can stay and which, if any, can go in order to reach your production goals. This will help the design process run smoothly.

Electrical Failure

Another important factor in system design is the sizing of the equipment and stringing (electrical connections) of the modules. Solar panels output DC current which must be converted to AC current for residential applications. This process is carried out by an inverter, more on that here. Under certain weather conditions like extremely sunny days, inverters with a high DC-to-AC ratio may begin to clip power. This sounds bad and will obviously result in a loss of production during that time, but may result in an overall increase in production throughout the year.

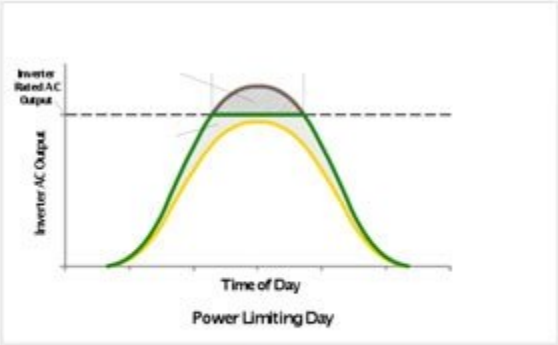


Figure 1a: Daily Production Profile
Power Limiting Day

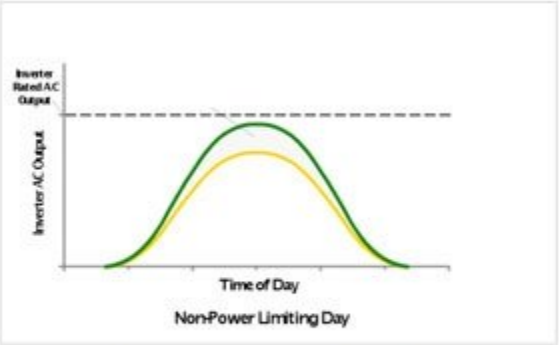


Figure 1b: Daily Production Profile
Non-Power Limiting Day

The graphs above demonstrate the benefit of oversizing the system for the inverter; the green line shows the power output of a system with a high DC-to-AC ratio and the yellow line shows the power output of a system with a lower DC-to-AC ratio. While the green line experiences clipping on very sunny days, it produces more on average days. So while this may seem like an error, it's actually beneficial in many instances.

Actual electrical failure can occur when module stringing is not designed correctly (i.e. not enough panels are producing at the same time to turn on the inverter), wire lengths are not properly accounted for and result in a significant voltage drop, or the method of tying the system into your home's electrical setup does not provide sufficient overcurrent protection.

However, all of this should be totally within the expertise of your solar designer's skill set to size correctly. Basically, as long as you don't let any old shmuck design your system (regardless of whether they stayed in a Holiday Inn last night), you shouldn't have to worry about electrical failure.

Feel free to ask questions when it comes to the equipment selected for your system, but keep in mind that some otherwise desirable manufacturers may not be the best fit for your system due to the stringing or layout of the modules. If your system ever fails to turn on or produce as much as predicted, contact your trusty solar installer and someone will be sent out to check on the inverter outputs.

Structural Failure

While seemingly unlikely, structural failure must be considered in any situation in which additional loads are being attached to a roof. Most solar panels and the required mounting hardware will only add roughly 3-4 PSF to the mounting area. However, additional factors such as snow load, wind speed, and live load (i.e. installers walking around on your roof), must be taken into account as well. Snow load considerations are typically determined by the local permitting authority based on your home's location (e.g. city, county, elevation, etc.). The same goes for wind speed, which will be used in calculations to determine the hardware's suitability.

Once these factors are determined, they must be applied to your home's structure to decide whether it can handle the additional loading. Specific information regarding your home's structure should be documented during the surveyor's visit. Precise roof and attic measurements should be taken to avoid catastrophic failure (see above).

Just kidding – as is the case with all of these types of failure, no reputable solar company would ever risk mounting on a roof with questionable structural integrity. Barring some unforeseeable natural disaster (Sharknado 4 maybe?), anything that goes up on your roof will be accounted for with a sizeable safety factor.

While all of these disasters could occur, especially in instances of DIY solar installations, they are highly unlikely when in the hands of solar professionals. Further, many solar companies offer production guarantees, monitoring, and ongoing maintenance to sooth any irrational fears you may still have.

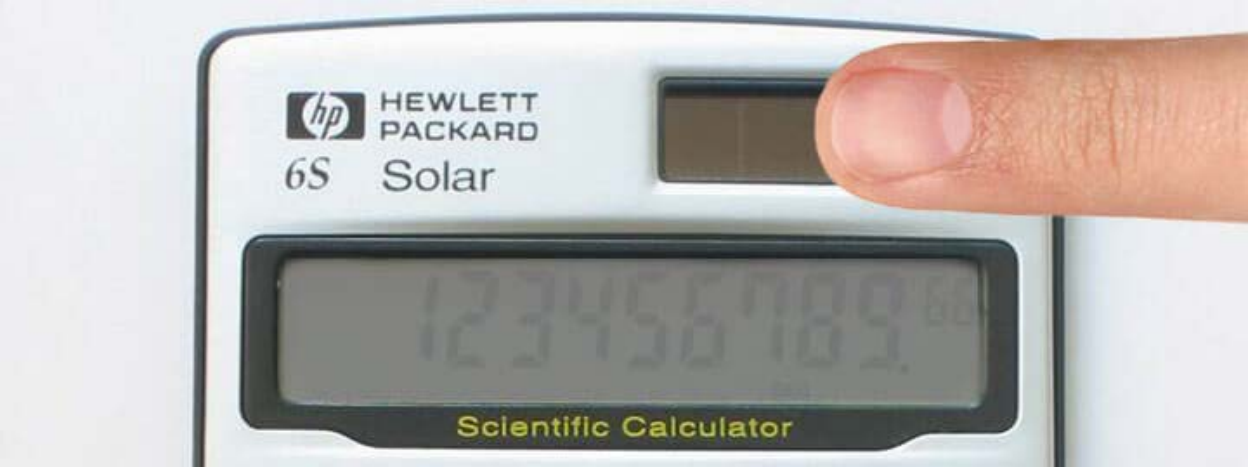
IX. How Can I Tell if My Solar Panels are Working?

So you've got a shiny new solar installation on your roof, and it's just started kicking out the kilowatts. How do you know that every panel is producing up to its potential? What if one or more of your solar panels breaks? Will the others keep working? These are all excellent questions, and, fortunately, they're also pretty easy to answer. But first let's get into the particulars of how solar panel systems are set up:

With One Inverter

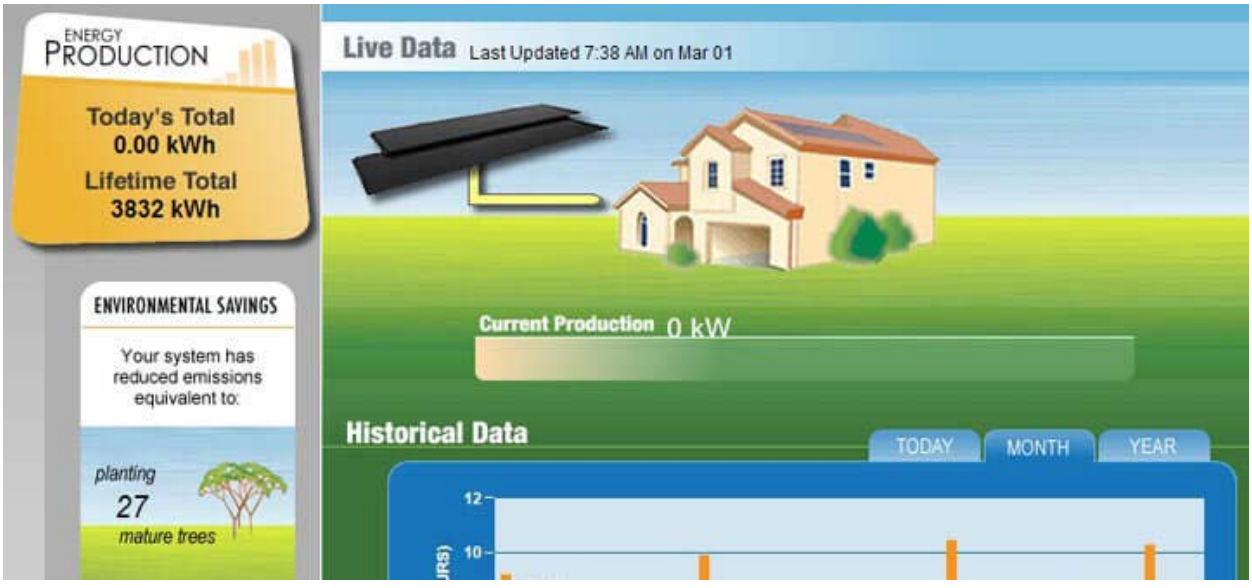
For a traditional solar panel system, panels are placed on the roof, and rows of panels are wired in strings. The strings are connected at one end of the system and the wires are run to a central inverter, which takes the DC electricity from the panels and changes it to AC electricity that can be used by your home appliances and the rest of the electrical grid.

In this kind of system, if a single panel isn't working, the whole string goes down, kind of like if you cover half the panel on a solar calculator with your finger, the calculator won't work.



Fading... fading... fading... don't let this happen to your panels.

This loss of power can also be experienced if a couple of your panels are extra dirty or shaded. You'll know if a panel in your system has problems because the system output in kilowatt hours (kWh) will be lower than it should be. Many companies that install solar panels offer some kind of system monitoring software that can help.



If you suspect a problem and your system is within its installation warranty period (typically 10 years), call your installer to have them come check each panel. If your system is outside the installation warranty period but within the manufacturer's panel warranty (typically 25 years), you may have to do a little bit of work to coordinate the repairs.

If your panels have been up for a while, you might be able to tell easily by looking at your electric bill whether your system is producing, but if you've just had panels installed, you'll have to go by estimates provided by your installer (or you can take a look at our handy calculator to see how much energy your panels should be producing). Remember that even a little shading on a couple panels in a string can cause a big dip in production for that string.

With Micro-Inverters

Many modern solar panel systems are installed with micro-inverters attached to each panel. While these micro-inverters can be more expensive than a single, centrally-located inverter, they also separate each panel's production, meaning when one goes down, the others keep working great. For systems that use micro-inverters, there is even more advanced monitoring software that can detect when one panel goes out.

Trés micro

That means your panels' output shouldn't decrease for any reason less than a lightning strike or other act of whatever-deity-you're-into. That's great news! So when you're talking to an installer about getting a system, examine the micro-inverter option carefully. It might cost you a bit more up front, but it pays for itself in piece of mind and risk avoidance. Some micro-inverters are even warrantied for 25 years just like the panels, so they're more durable, too.

Either way, make sure you're getting the option for monitoring software, so you can know your typical production and be ready to take action if your system isn't working like it's supposed to.

Chapter 3: How much will it cost?

So you've decided you want to explore going solar. Here are the big questions you should be asking yourself:

- Is solar right for me, in my house, right now?
- Are there any incentives out there to make solar cheaper?
- What can make solar more expensive for me?
- How big should my system be?
- Will my home be worth more after I install solar?
- What is the rate of return on an investment in solar?
- Are there any good examples of people making money on home solar?
- How else can I save money on energy costs?
- How am I going to pay for all this?

That pretty much covers it. The fact is, solar is not right for everybody. It all depends on whether it makes financial sense for you, in the house you live in, in the state you live in, right now. The following chapter is a guide to all of those questions and more, and it will serve you in good stead if you are thinking about getting solar installed on your house. Let's jump right in:

I. Is solar right for me, in my house, right now?

Solar is a good idea no matter where you live in the U.S. But there are many things that affect whether solar is right for a homeowner. You've gotta have the right mix of space, willingness, state laws, and finances. Let's tackle the first one of those: a large, unshaded space where panels can be installed. The ideal spot is a large, south-facing roof without any trees around (south-east or south-west orientations are ok, too). A large open yard next to the house can work as well, but you might give up some of that all-important green space to a huge pole with panels on it, or a ground-mounted array that can take up hundreds of square feet.

That's not to say that if you don't have a south-facing roof, you're out of luck. Panels can be installed on the sides of houses, on flat roofs, on poles in a yard (as mentioned above), and in a number of other configurations. Just make sure you don't have shade. We've seen some solar installations placed by unscrupulous installers under tree cover that aren't producing nearly as well as they should.

This goes for neighbors, too. One California homeowner had to sue when his neighbor planted a sequoia tree next to his panels. Luckily, California has right-to-sun legislation, so the homeowner got the offending conifer taken down. You may not be so lucky in your state.

II. Are there any incentives out there to make solar cheaper?

Yes there are! The number one biggest incentive is the federal Energy Investment Tax Credit (ITC). The ITC was established in 2006 to give tax breaks to entities who install energy-generating equipment that meets certain performance standards. What people interested in solar need to know is that the ITC gives a residential property owners who install solar a federal tax credit equal to 30% of the costs of installation.

The ITC is the single biggest reason solar makes so much sense right now. The tax credit can be carried forward for one year after the installation, so homeowners could conceivably owe no federal taxes for up to two years in a row. That's huge!

As for other available incentives, there are many. Most state legislatures have passed laws that mandate renewable energy be a big(ger) part of the overall picture, with fines imposed on utility companies that don't meet the targets. These laws are called Renewable Portfolio Standards (RPS), and they go a long way toward getting homeowners some help paying for solar installations on their houses.

In states with good RPS laws, utility companies usually offer rebates to their customers who want to go solar, instead of paying those huge fines. That helps the utility meet their goals and it helps you put panels on your house. Win-win!

Some states have also provided sales tax exemptions on equipment and installation, property tax exemptions for the value solar adds to a home, and tax credits that help homeowners cover some part of the cost of installation. The most forward-thinking states either pay homeowners a bonus for energy from their panels (called performance payments), or have created a special financial market for solar renewable energy credits, or SRECs. More on each kind of incentive below:

Rebates

Similar to getting a rebate card from your local big box store for a dishwasher purchase, state legislatures also provide rebates for solar panel purchases to spur on investment and create new jobs. If you purchase the solar panel system yourself, you qualify for this free cash, which many times is a lump payment back to you. Some solar installers like to take this amount directly off the total installed price, and they'll handle the paperwork for you to make things a lot less complex.

Tax Credits

State tax credits are not technically free money. However, they are 'credits' and not 'deductions,' which means that if you have the tax appetite to take advantage of them, they are a 1-to-1 dollar amount off your taxes. That's why they are such an important factor to consider. In certain circumstances, state tax credits can provide a very powerful incentive for people to go solar.

(Keep in mind, we are not tax professionals and give no tax advice so please consult a professional before acting on anything we say related to taxes).

Property Tax Exemptions

Many states have complete exemptions from added taxes when you install solar on your home. Property tax exemption status is a pretty big factor when putting together your investment considerations. There is a pretty solid consensus and some good data to show that solar power adds about 20 times your annual electricity bill savings to your home's value, so an exemption equals big tax savings.

Sales Tax Exemptions

It's just what it sounds like; a little less than half the states exempt the purchase of a solar installation (materials and labor) from sales tax. That means a savings of 4-8% off what solar costs in other states.

Performance Payments and SRECs

Some state RPS laws have very high fines for utility companies that don't meet renewable generation goals. That's why the utility companies are willing to pay their customers to generate electricity from renewable sources for them. The fines can be so high that the companies will pay you a bonus for each kWh of electricity you generate, as a reward for doing it.

True direct performance payments like the situation described above are rare, but there are several states that do performance payments differently: they give Solar Renewable Energy Credits (SRECs) to power producers that can then be sold on the open market to companies that need to meet their goals for renewable generation.

In states that offer SRECs, homeowners with solar power are given one SREC for every megawatt-hour (MWh, equal to one thousand kWhs) of electricity their system generates. The homeowner can then sell their SRECs to an intermediary company that bundles the SRECs of many homeowners together and sells them to the utility companies to offset their pollution. SRECs aren't making any homeowners wealthy, but it can be a nice way to reap several hundred dollars or more from your system, each year, for as long as the markets operate.

III. What can make solar more expensive for me?

There are several things you should be aware of that might inflate your cost of going solar. Here are a few:

- **Flat Roof Tilting**: If your roof is flat, you must build some scaffolding to tilt it up towards the sun. That framework costs some money.

- **Different Roof Types**: Some are harder to seal or flash, or find studs. Accordingly, some installers will charge more based on your roofing material.

- **Distance**: If you reside outside the regular service area of your nearest installer, there may be associated travel fees that will be passed on to you.

- **Monitoring Systems**: Some solar companies sell monitoring systems which upload data about your solar energy production to the web. If these interest you, expect to pay a little more.

- **Trenching**: Does conduit need to be run underground to near your meter? There may be a fee for that. This type of activity is generally associated with ground mounted systems… which brings us to….

- **Ground Mounts**: If your system is installed in your backyard instead of on your roof, not only does your contractor have to build the framework but also secure it to the ground. That usually means concrete. Concrete, building a frame, and securing it to the ground costs money. Therefore, this type of installation is usually more expensive than installing a system on your roof. The upside? You get to aim and tilt the panels optimally for your region, whereas on a roof you are bound by the direction your home is already pointed.

- **Permits**: Your region may have much trickier or more expensive building permits than the installer is used to. Therefore, you can expect higher fees for this.

- **Inverter Upgrade**: Let's say you want to install more solar down the road. Therefore, you could opt to purchase a beefier inverter to accommodate your planned upgrade for some extra money. For example, you might want to take advantage of utilities being required to pay for excess yearly production sometime in the near future. Currently they are not required to.

- **Service Upgrade**: The inverter (the thing that makes the unusable DC current your solar panels produce into usable AC current for your home appliances) is like an appliance itself. It will need to be connected in your main breaker panel and there may not be space for it. This can create an issue and an electrician may need to install a sub panel, or your utility may need to upgrade your service (for example, from 100 to 200 amp service). You can tell what service you have by looking at the door to your main breaker panel, it should say (MAX AC) somewhere.

Now the fun stuff: DISCOUNTS!

- **Employee Discounts**: Aside from the state rebates, you may qualify employee discounts. For instance, if you work for HP, Google, or SunPower, you get a discount. Check with your employer!

- **Group Purchase discounts**: This is where many people get solar at once. Solar companies are going to start exploring this business model soon, but for now you can do it yourself if you have friends that are interested. If you call up an installer and have five serious customers in the same neighborhood, you can seriously lower overhead for the installer, and they can pass those savings on to you. Approach the installer about it.

Bottom line – don't freak out about all this. The salespeople for your local solar company know their stuff and can explain all of it to you in better detail.

IV. What sized system do I need?

This is a big question, and there are as many answers as there are people interested in solar. The easy answer is: you need an affordable system that will fit where you have space for it. The complex answer is: it depends on your energy usage, how much you're willing to spend, and how easy and profitable your state's rules make it to sell your energy back onto the grid.

The good news is any reputable installer will be able to walk you through the benefits and costs of various possible sizes for your system. They'll assess your space, your usage, and what you want to get out of your installation. They'll also be able to provide you with references to some of your neighbors who went solar, and estimates of payback time and rate of return on your investment.

But let's say you're an intellectually curious person and you'd like to work things out on your own. To do those calculations, you're going to have to know a few things first:

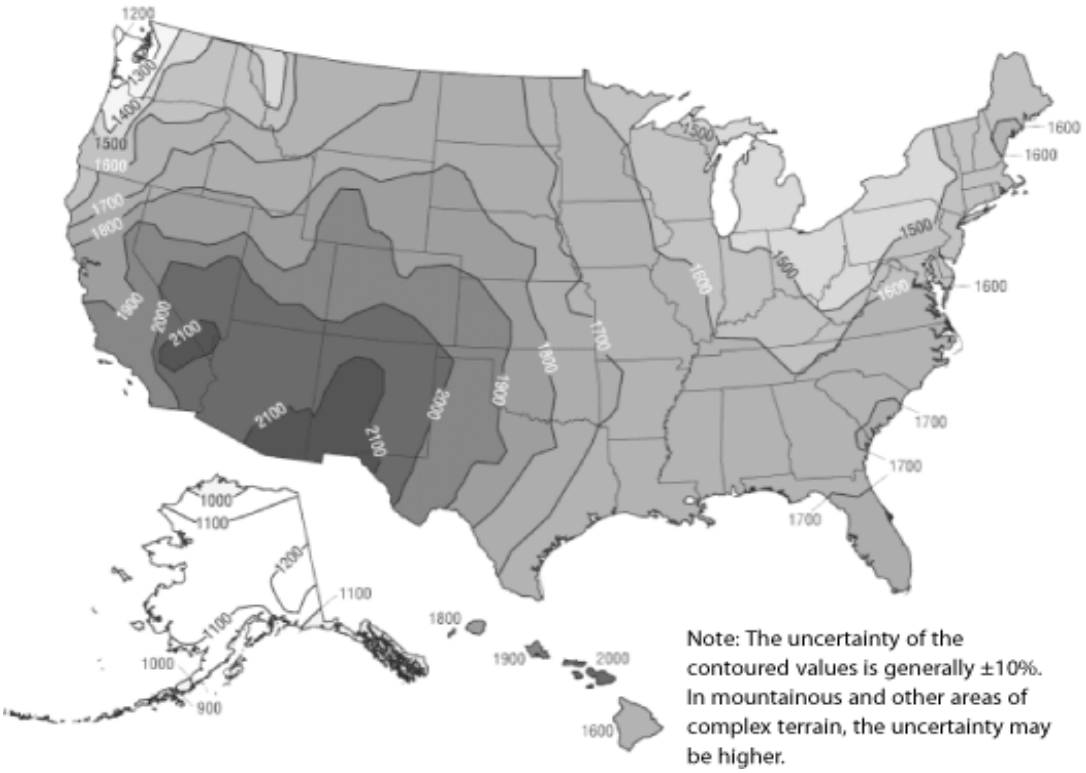
- How to find your yearly energy usage

- How to see how much roof space you have
- How much money you want to spend
- What your states rules are

Your yearly energy use should be fairly easy to figure out, especially if you keep all of your utility bills in your files. You simply need to see your average kWh usage for a year. And helpfully enough, each bill lists the amount of energy you consume in kWh. Add up all twelve, and there you have it!

If you don't keep records like an IRS agent, you can almost always call your utility company and get the necessary information. Many companies even have online portals that you can access with usage data. The more years you've been living in the same place, the more data you'll have to average out.

The next step is to see what sized system you need to offset that usage. To do that, you need to calculate how much energy you can generate in your area. Remember that image from the payback example above? Here it is again:



Here's the best way to do this. Find your location in the map above. Multiply the number of the shaded area your house lies within by 0.78. That number is equal to approximately how much electricity a 1-kW solar installation will generate in a year. Next, divide your total yearly usage by that number, and you end up with the size of system you need to just offset your usage.

Let's work through an example. Say you live in Minneapolis, MN, and your total yearly usage is 6,221 kWh. The city of Minneapolis is located within the 1600 band of the map, meaning a 1-kW installation would generate 1,248 kWh of electricity over the course of a year (1,600 x 0.78 = 1,248). Dividing your yearly usage by 1,248 shows that you will need a 4.98 kW solar array to offset your usage. Round it up to 5 kW, and there you have it.

So what do you do with that information? The first question might be, how much roof space will a 5-kW system require? This is another area where your installer, who is the expert for your locale, comes in handy, but let's say you install an array of 250-watt panels that are each 5 ft. x 3.5 ft. (average measurements for the industry). You'll need 20 panels (5,000 / 250 = 20). If you install them in two rows, you'll need a roof space of 35 ft. x 10 ft.

The next question is, how much will it cost? The average cost for installation around the country ranges between $3,500 and $5,000 per kW, **before** rebates and tax credits. If the cost was right in the middle of that range, a 5-kW system in Minneapolis would run you $21,250. Again, that's before rebates and tax credits, which can reduce the cost by half or more after the first year. And that doesn't include electricity savings, which for a usage of 6,221 kWh in Minneapolis would be about $800 in the first year alone.

Those numbers are great, but not everyone has all that cash lying around, so the size of the system can be adjusted down to meet a different budget. The savings won't be as sweet, but the initial cost can be reduced substantially. The system size can be increased, too, to take advantage of selling electricity back to the grid. Your state's laws may or may not be favorable to that, so this is an area you should discuss with your installer. You can also read more about your state on our website.

V. Will my home be worth more after I install solar?

Switching to solar power can pay you back in more ways than a lower electric bill: houses with solar panels have also been proven to have a higher resale value. Even if you sell your home before you've had the opportunity to use solar power over a long period, the panels are still a good investment.

After 8 ½ years of research on California home values, scientists at Lawrence Berkeley National Labs concluded that houses with solar power sell for more money. The premium varied from $3.90 to $6.40 per watt of power on the home. The average premium was $5.50 per watt. For a house with about 3 kW of solar power– the average amount in the study– that adds up to a sale price that's about $17,000 more than an ordinary house.

The study came out in 2011, and the researchers pointed out that the average premium was more than the average amount homeowners spent to originally get their solar systems. During their study period (2001-2009) people spent $5/watt on average. With those numbers, you're able to not only recoup your original investment, but actually make a little money. The cost of installing solar power is lower now– closer to $4/watt. If premiums stay the same, a homeowner could now get an even better return on their investment.

The premium is highest for homeowners who install on existing homes rather than those who build it into new homes, at least in the California study. Solar panels on an existing home can increase its value more than three times more than a new house.

Why do buyers pay more for homes with solar power? While there are many benefits to going solar, and many are motivated at least in part by environmental reasons, in the end you can't argue with the math: the new owners will be saving so much on their power bills that the premium makes sense.

Another way to estimate your house's resale premium is to calculate how much you have reduced your annual electric bill, and then multiply that by 20. So, if you've reduced your annual electric bill by $1,000, you can expect that your house will be able to sell for about $20,000 more than it would have without solar panels.

VI. What is the rate of return on an investment in solar?

This answer depends on very specific criteria that are unique to every house. It's another one of those things it's best to talk about with your installer, but if you want to run some numbers yourself, here's basically how we look at it:

1. Take the cost of the initial investment in solar, minus any immediate rebates
2. Calculate the cost after the first year based on any available tax credits, performance payments (SRECs), and expected energy savings
3. Extend the calculation to include recurring benefits; extend tax credits over the number of years they're expected to take to reach the maximum, and calculate performance payments over the life of the system
4. Calculate a 3.5% yearly increase in electricity prices, and figure that into projected energy savings
5. Make a table of the cash flow numbers (recurring payments + electricity savings) for each year, up to 25 years (expected system life)
6. Analyze the cash flow table with an IRR function (we do this in Excel).

These calculations give you a big negative number in the first year (cost) and small returns (savings and payments) over the next 24. For total profit in dollars and payback time, create a "net cash flow" column that simply adds each year's returns to the total. The negative numbers continue until the year in which payback occurs, with growing profits each year after. The final number is total profit in dollars. Use a rounded-up intercept function to determine the number of years after which payback occurs. Graph it if you like to have a good time in Excel like we do.

If you're interested in looking at the numbers but don't know where to start, we've estimated IRRs and payback times for example installations in every state in the union. You can find them by navigating to your state's page on our website.

VII. Are there any good examples of people making money on home solar?

There are people all around the country who have long since paid off their systems and are now making profits. Stories about some happy solar homeowners can be found on our case studies page. They may not all have paid off their systems yet, but they're well on their way, with no regrets. If you want to read about more examples of payback times and rates of return, check out your state's page on our website.

VIII. How else can I save money on energy costs?

By far, the best way to reduce your solar cost is to reduce the amount of electricity that you use. If you use less electricity, you don't have to buy as many solar panels. It's as simple as that. So what can you do to reduce your electricity usage? Here are the 3 best ways that make a tremendous difference:

Turn Your Air Conditioner Off. For every degree you turn it down below 78°F, your air conditioner uses 3-4% more power. Fans also help; run a ceiling fan along with your A/C, and you'll feel cooler at higher temperatures. A fan takes 70 times less energy to run than an air conditioner. When you head out to work, turn the AC temp up even higher to save energy while you're gone. It takes less energy to cool your home down when you return than to keep it cool for hours while no one's there. Pulling shades to keep out the sun also helps.

Use CFL or LED Light Bulbs. Home lighting can account for as much as 25% of your energy use. If you haven't already done this, replace all of your incandescent light bulbs with compact fluorescent (CFLs) or LED light bulbs when the old bulbs fail. The quality has gotten much better, prices have come down, and the energy savings are tremendous. Incandescent light bulbs use a whopping SIX TIMES the energy of a compact fluorescent that produces the same light, and

between 13 and 30 times as much an LED bulb. If you're worried about the mercury in CFLs, choose LED bulbs.

Replace Your Old Refrigerator. If you've got an old refrigerator and/or freezer, this can be an expensive energy drain—and a money drain. These things are on ALL THE TIME, so getting a new Energy Star-Certified appliance (refrigerator, freezer, dishwasher, dryer, television) will save you another solar panel or two, further reducing your costs. Plus, your state or city may give you cash for trading in that old refrigerator. Check out the government's DSIRE website for your local incentive programs.

Reduce "Phantom" Loads. Phantom loads are the "silent" bleeders of energy around your house. You think these things are off and not draining energy, but they're actually wasting a ton of watts. Any appliance with a plug that has a square black box attached to it is a potential phantom load. Examples include:

- VCR/DVD players
- Video game systems
- Stereo systems
- Computers (when turned "off")
- Printers, scanners, fax machines
- TVs
- Electric toothbrushes
- Microwave ovens
- Cordless phones
- Dust busters
- Cell phone and Bluetooth chargers

To kill these phantoms:

- Use a power strip to collectively turn off your entire entertainment system at once *TV, stereo, game systems). If you're through with your laptop and it's fully charged, pull the plug as well.

- Similarly, you don't need your cell phone charger plugged in if your cell phone is in your purse at work. Use a power strip and turn it off after charging.

- Switch to a more "corded" phone. Have just one or two cordless phones.

- Unplug your dust buster and toothbrush when they don't need charging. They have batteries. (However, be sure to re-plug them in every few days).

IX. How am I going to pay for all this?

Well here it is, your roof is ready, you've run the numbers to see how much you'll save, and you've got a local installer ready to place the order for the panels, but how are you going to pay for the darn thing? Here is the best information about all the options that may be available to you:

Pay outright

Bottom line: Pay outright if you want to make the most profit on your investment in solar panels. You take more responsibility and risk for dealing with the utility company and paying for ongoing maintenance costs, but the benefits generally outweigh the risks.

If you pay outright for your solar power system you own the panels and reap all the benefits. When we calculate return on investment for solar installations, we base our estimates on paying outright because it is the best way to ensure solar is a good investment; in many cases better than investing in an index fund.

The downside of paying upfront is, let's be honest, coming up with the capital. You'll pay between $10,000 and $20,000 out of pocket, depending on rebates in your state, and then get a decent-sized chunk back at the end of the first year from the big 30% federal tax credit, plus up to five years of tax credits based on your state's laws.

After that, you make money with your system by reducing electricity costs and/or selling power back to the grid until you break even. In most states (34 and the District of Columbia, by our most recent estimations), you'll make a better rate of return than the S&P 500. All this adds up to money for you, either in the form of profits throughout the life of your system, or increased resale price of your home if you move out while the system is still kicking out kilowatts.

Of course you'll take on some risk, too, being the sole owner and operator of an energy generation system. But don't worry too much—the panel and inverter manufacturers offer really great warranties that last for up to 25 or 30 years, and your equipment will likely function well for even longer. And a failure outside of a warranty isn't typically a costly expense. Other costs of operation are more abstract—the time you spend negotiating the world of feed-in-tariffs and interconnection agreements will mean you'll be dealing with some bureaucracy, too.

All told, buying a solar power system with cash is the best way to maximize your profit and control your energy future. And money spends the same in Georgia as it does in New York, so you can be sure to get a system, even if nobody is leasing or offering a Power Purchase Agreement in your area.

Take a PACE loan, HELOC, or other loan

Bottom line: A loan can give people interested in solar a way to put next-to-nothing down, and financing options can include payments lower than the electricity savings, creating positive cash flow. The system is still yours and you get all the tax benefits and incentives, but you are also responsible for lifetime maintenance and performance.

A solar energy system adds value to your home. Quite a bit, in fact. There have been studies in California and Colorado that show what's called a "home price premium" of $1,000 to $5,900 per kilowatt (kW) for solar installations. Even before those studies, a 1999 article in The Appraisal Journal stated that home value increases $20 for every $1 reduction in annual utility bills.

Considering the price premium for solar energy systems, many lenders now offer loans that take the added value into consideration, and finance the loans based on expected life of the system. Property-Assessed Clean Energy (PACE) loans are one kind of loan that is funded based on municipal bonds, and offered to homeowners with terms of 15 or 20 years. Many states offer PACE financing programs. The terms of the loan can be very favorable, including payments that are below the energy savings the system provides and the ability to deduct interest payments from a homeowner's taxes.

Taking a home equity line of credit (HELOC) is another way to finance a solar energy system. Some installers even have preferred lenders they work with to provide home equity-based financing to homeowners. The loan or line of credit works much the same way a PACE loan does, but might come without some of the same benefits. If your municipality doesn't offer PACE financing, a HELOC might be a way to get low-down payment solar.

Lease

Bottom line: Leases are becoming an increasingly popular way to go solar. The homeowner saves money on electricity bills, and the leasing company handles the installation and connection to the grid, and performs maintenance and repairs. They also get the tax benefits of the system and any other incentives available.

Solar is such a good deal that some companies are willing to put it on your house for free. In the best states for solar, you can get a system on your house with no money down, and your lease payments will be less than your energy savings. That's big news for homeowners without a lot of extra scratch lying around.

But wait, there's more! The leasing company is responsible for maintaining and handling all the hard work of interconnection and selling electricity back to the utility. You just put your feet up and save money while doing the environment a solid. Of course, this also means the leasing

company reaps the rewards, including tax breaks, performance payments, and renewable energy credits.

The other catch is leases aren't available in all states, because not all states have favorable economic climates. The sun shines everywhere, but stick-in-the-mud lawmakers rule over half the states. If you're in one of the best states for solar, you have a great chance of finding a company that will lease you a great system for decades to come. And many leasing companies offer a chance to buy the system at the end of the 10- to 25-year lease term or start a new lease.

Sign a Power-Purchase Agreement (PPA)

Bottom line: Like a lease, a PPA means a homeowner can get solar for zero down, provided they agree to buy the energy a solar system makes for a specified term and rate. The advantages and trade-offs are much the same as a lease, too.

A Solar Power Purchase Agreement is a lot like a lease. Really, one of the only differences is the agreement with the installer—in a lease, you agree to have the system on your property and lease its use over a given number of years. In a PPA, you agree to purchase the electricity a system generates.

Just like in a lease, the PPA company installs and maintains the system at no cost to you, and they reap the benefits, too. A PPA is designed to be easy for the homeowner; just sign on the dotted line and pay the company as agreed, and you'll see lower electricity costs overall. You can usually buy the system at the end of a PPA, too, or sign a new agreement. Terms range from 6 to 25 years.

All this is great if you can find a company that offers PPAs in your area, the economics are the same as a lease—the PPA company makes money based on whatever state incentives are available. Finally, just like a lease, you can buy the system at the end of the agreement, sign a new agreement, or have them remove the panels at their expense.

So which is right for you? If you're in a great state for solar, like New Jersey or Massachusetts, all these options are on the table. In states with little or no economic incentives for residential solar, lease and PPA deals are hard to come by, but buying outright or taking a home-equity loan is almost always an option.

Chapter 4: Solar Myths: Busted

We get emails from people all over the country saying that they can't go solar because of this or that, including expense and physical limitations. Some of these concerns are valid, but others not. So, here's the section where we dispel many of those errant thoughts.

Myth #1: Solar is too expensive.

This really depends on your state, legislators in that state, and your utility company. There are more and more solar friendly states that are cutting the price of solar in half if not more, plus everyone qualifies for a 30% federal credit. Visit http://solarpowerrocks.com for a summary of all the programs now available in your state. If you finance through your home equity or second mortgage, you also get the benefit of a tax write off on the interest. Also, solar raises the value of your home.

Myth #2: Even if it's less expensive, I don't have the upfront money.

Check out our Cash Poor financing series. These talk about solar leasing, solar PPAs, Zero-Down financing, and the growing number of cities financing solar through tax assessments. All of these require very little money down. Similarly, a second home mortgage or government energy efficiency mortgage also has little upfront cost.

Myth #3: Solar will get cheaper, so I might as well wait.

While it's true that improvements in technology and competition is making solar panels cheaper, the current number of State and Federal incentives are also getting less generous as these prices come down. So if you're already in a solar friendly state or municipality (see Myth #1 above), then yes, wait until local incentives improve. On the other hand, if you are in a solar friendly state, the price is going to remain about the same for the next ten years, so might as well start saving on your electric bills now.

We find people plenty of people who don't want to be burned by anticipated advances in technology, and prefer to sit on the sidelines until they are released to the public.

This is a common reaction among people considering solar. In other realms, it's referred to as "cognitive dissonance". People need to feel they are getting the best available option all the way through the buying process. That's why whizz-bang reports of newfangled solar technology can confuse people into thinking installing solar on their roof is now unwise. Continual "solar breaking news" makes it easy to hear the rumble of progress around the corner – even though nobody has seen any of it with their own eyes.

For the sake of argument, pretend you have the opportunity to attend a once in a lifetime concert performance with all your favorite musicians. You can leave now and get there 15 minutes before showtime with your friend who drives a Honda, or you could wait some indeterminate amount of time longer for this super sleek hydrogen powered neon limo to roll by and pick you up. After all, a flyer from the sky informed you earlier in the year the hydrogen limo is on pace to cruise by your house around now to give you a supersonic ride anywhere you want to go. Of course by waiting, you risk being late or missing the show.

Investing in solar panels may not seem like you're biting into the latest nectar filled bosom of solar technology the internet is all aflutter about, but you can rest assured those panels will perform admirably for decades, kinda of like your buddy's Honda. That neon hydrogen limo might not make it around the corner. If arriving on time to the once in a lifetime concert above is equivalent to your payback time on the solar energy system, we'd rather be in the Honda.

Myth #4: Making solar panels causes more pollution than the clean energy they produce.

Nope. A study by the US Department of Energy shows that, depending on your solar panels, the energy payback is 1 to 4 years. Solar panels usually last 25 years, so solar manufacturing is very green. That said, if you buy American made panels, it saves more carbon from the transport costs—something to consider when choosing your panels.

Myth #5: Solar panels will cause more harm to the environment when they're thrown away in 25 years.

Actually, most panel manufacturers will recycle the panels after you're through in 25 years. If they don't, don't buy those panels. However, it's hard to say whether people will actually recycle them because most panels are still being used today. So it's up to you find out about the manufacturer's panel recycling program. From our experience, they will come to you and take them away at no charge. However, if they were our panels, we'd just as soon leave them up there, since they'll still be kicking amps for decades longer.

Myth #6: Solar will look ugly on my roof.

Solar panels are getting very pretty—they no longer resemble a satellite crashing into your roof. Check out these sexy SunPower black panels:

And remember, any solar panel, no matter what they look like, raises the value of your home. In many states, this improvement is also exempt from a tax reassessment. Plus, many home buyers see solar as an attractive green statement, so your home will sell faster than another in your neighborhood.

Myth #7: Solar is hard to maintain.

If you buy a system that is connected to your utility, as most electric systems are, your solar panels are easy to maintain. They just need to be cleaned off with water to get off dust or debris or snow. And by the way, panels are pretty hardy, designed to withstand hail, sleet, and snow. On the other hand, if you buy a battery-based system, then yes, this will require more attention–and expense. But grid connected systems without batteries are the most inexpensive and common for most home owners.

Myth #8: I live in a cloudy, cold, climate, so solar doesn't work.

On a cloudy day, typical solar panels can produce 10-25% of their rated capacity. The exact amount will vary depending on the density of the clouds, and may also vary by the type of solar panel; some kinds of panels are better at receiving diffuse light. SunPower solar cells, for example, have been designed to capture a broader range of the solar spectrum. By capturing more red and blue wavelengths, their solar panels can generate more electricity even when it's overcast.

While you'll generate slightly less electricity with your solar panels when the weather is cloudy, because you'll be using more utility power to light (and possibly heat) your home than if you lived in a more sunny state, the investment still is sensible. And by the way, solar panels like sun, but not heat, so cold climates can actually make the panels more efficient. That's why clear and cool Colorado is one of the most ideal locations for solar from a weather standpoint.

Myth #9: Solar would be a lot cheaper if I just install it myself

When you decide to get solar panels for your home, it's tempting to consider installing them yourself—after all, going the DIY route is a great way to save money on many different home improvement projects. But solar power is a different story. We highly recommend you work with a professional solar installer, and here are some of the reasons why.

1. Planning your solar panel installation- size and placement

The biggest part of the process of getting solar panels isn't putting them up on the roof; it's taking the time to thoroughly research and plan every part of your system. It's important that you understand how solar panels work and the basic principles in the planning process, but a professional installer can best handle the details.

What size of a solar panel system is best suited for your electricity usage? Does your roof have sufficient space at the correct angle? Where should panels be positioned, and what is the optimal tilt for the panels? What solar technology is most appropriate for you, based on your climate and other unique needs? Can your roof bear the load of solar panels? These technical questions (and many more!) can easily be answered by a solar installer. A good installer will have a long track record, and experience with all types of roofs and situations.

What's the downside to getting this step wrong? If you don't place solar panels correctly, you won't be able to get the optimal amount of power. You won't save as much money on your electric bill, and over time, that difference can easily eclipse any initial savings from doing the installation yourself. Panels from a kit designed for DIY installation won't be as effective as a custom install based on your specific needs. Professional solar installers know how to correctly position panels to maximize your investment.

If you haven't correctly judged the condition of your roof, you could face additional expenses for repairs, and might even have to redo the entire installation after getting a new roof. Installing solar panels incorrectly can also cause new problems, like roof leaks. A professional installer knows how to install solar panels without causing costly roof damage—and you have the peace of mind that if anything did go wrong, they'll cover the cost of fixing it.

2. Installing solar wiring can be dangerous

Installing solar panels isn't as simple as plugging them in. Technically complicated, high-voltage wiring is involved. There's a risk of injury while you do the wiring work itself, and a further risk later if the wiring is done badly. Hooking up strings of solar panels incorrectly can create a surge in power that can blow up an inverter—and even burn down your house. If wires are cut improperly, they could later be shorted out by rain, and pose another fire risk. There's also the serious risk of electrocution.

In some states, you're required to have certain certifications, or even be a licensed electrician, to legally wire solar panels. You should have experience and training in residential wiring, and knowledge about how local grid interconnection works. You'll need to know how to purchase equipment that correctly matches your system requirements, including power conditioning

equipment that's critical for making the electricity produced by your solar panels compatible with the grid. You'll also need meters, instrumentation, and safety equipment.

A professional solar installer has experience in safely and correctly wiring solar panels. If panels are wired incorrectly, there's not only the risk of danger, but it can also reduce the amount of power you're able to get from your system. Just like with other parts of the installation, if something happens to go wrong, your installer will pay to fix it.

3. Applying for permits and meeting regulations

Another important part of a solar installation is meeting all of the necessary regulations. A professional installer can help you navigate the complicated details of ensuring that your equipment and install complies with all local, state, and national building and safety standards. You may need to get approval from a local electrical inspector, and your installer will also make sure you're meeting all applicable electrical codes. You may need approvals from city planning departments. Your installer will also help you work with your insurance company to meet any special requirements they may have. Your power company will also have specific requirements, and working with a solar installer will help you get everything set up correctly. Although it's not a regulation, you'll also want to follow all of the requirements that your solar panel manufacturer has laid out in their warranty, so that if you ever need to replace a panel you know that you've met all of their guidelines for installation.

4. Solar installers help you qualify for incentives and rebates

Local, state, and federal rebates for solar panels often require that a licensed installer do the work in order to qualify. Missing out on rebates and tax incentives can mean losing a significant amount of money. Not only will your installer make you eligible for this cash, they'll also know which incentives will work for you, and can help you apply.

Myth #10: Off-grid is the way to go.

Getting your solar system connected to the grid is usually pretty easy, and almost always a good idea. Do you live on the side of a mountain, with no running water, electric wires, or people for miles around? Off-grid solar might be right for you. If not, you should get hooked up to the grid.

The big problem with off-grid solar is that making it work requires battery backup. Lots and lots of battery backup. You see, battery technology is not nearly as advanced as you might think. That little lithium-ion battery in your smartphone lasts for what, 10 hours? Imagine the batteries it would take to run your home, which draws thousands of times that of your cellphone.

You might be able to do it for a few hours in the evening, but not much more. Batteries are extremely expensive, too. Enough batteries to run a home's electricity for all the hours it's dark every day cost between $15,000 and $20,000. That makes a solar installation double the cost, and incentives for batteries just aren't there, meaning that money is coming out of your pocket.

Myth #11: Thieves will steal your solar panels

Uh-oh.

Envision this: You get a white truck, a few magnets made for $40 that say "Joe's Solar" or whatever, then you go to people's homes who have solar systems and snatch the solar panels right off the roof in broad daylight. All the neighbors think you're doing maintenance.

Scary huh? Solar panel theft is *extremely* rare in the US, but it happens (probably not ever in the above scenario… most thieves lack solid planning). It also usually happens on properties with ground mounted systems (thieves are lazy). In Europe, where solar is much more prolific, solar panel theft is a more common phenomenon.

The good news is there's no good way to sell stolen solar panels. Often, the people who try get busted. But there will undoubtedly be a secondary market for used solar panels within a few years, as people upgrade or return leased systems.

How do you protect yourself against solar panel theft?

1. TELL YOUR HOME INSURANCE PEOPLE! This is number one. If you told them you installed solar panels, you're covered. If not, you're not. Often times they won't even raise your premium.

2. You could essentially create The Viper for solar with a wire that alarms if removed… or you could even use your solar monitoring system to alert you (although that would only work in the day). You could video them, but then is that really realistic?

3. They have serial numbers, but that probably doesn't help stop them from getting stolen, and may not be that great a help in getting them tracked down. However, asking for them when installed won't hurt.

4. Put some stickers on them that say "protected by blah blah blah alarm" whether it's true or not. Deterrence, yo. Just make sure you don't put the sticker on the face of the panel.

Chapter 5: Going Solar With Other People Around

I. Working with your HOA

The history of solar access laws is rooted in the English law of Ancient Lights, or the aptly named "Right to Light." Under this reverse easement, homeowners' rights to sunshine unobstructed by neighboring buildings or their accompanying structures were labeled and protected.

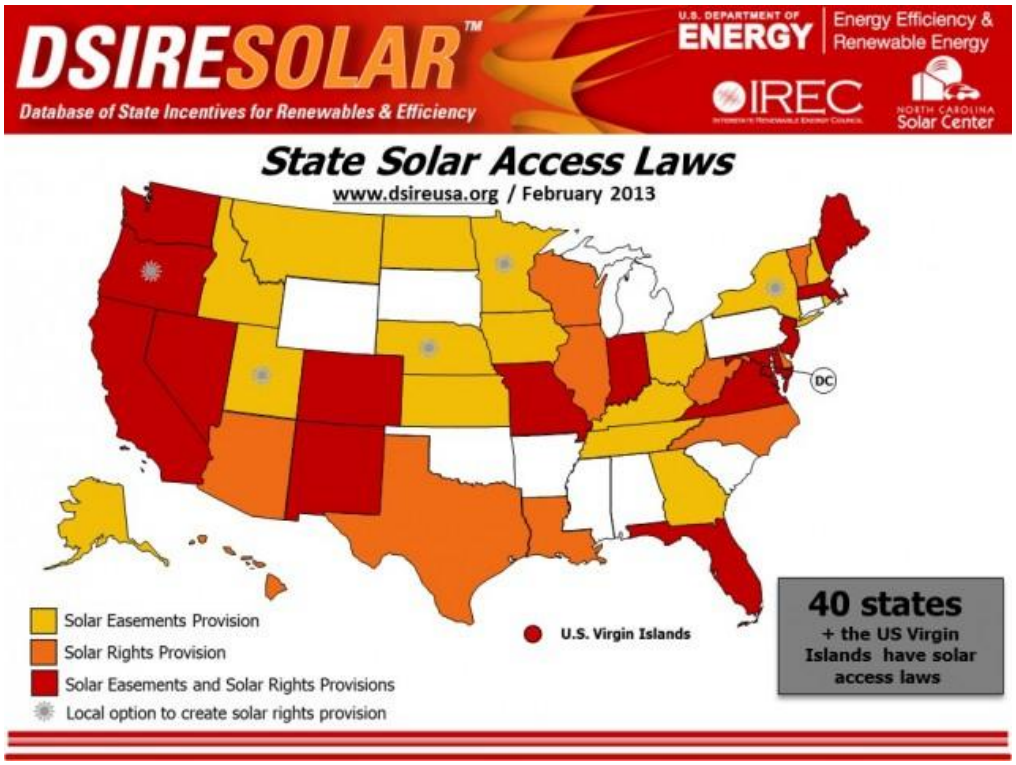
Unfortunately for the Americans in the audience, this blanket right to glorious sunshine was struck down in 1959 during a feisty hotel vs. hotel battle on the beaches of Miami, in which the Eden Roc Hotel tried to halt the Fontainebleau Hotel from progressing with a 14-story expansion that would block out the sun over the Eden Roc's swimming pool and cabanas. While the court originally sided with the Eden Roc, the decision was overturned when the Florida District Court of Appeals ruled that sunlight was not a legal right.

Now, homeowners are subject to fragmented policies of local legislation and neighborhood Covenants, Conditions, and Restrictions (CC&Rs). These varied restrictions must be navigated carefully, and always neighborly. After all, you have to live there after everything is said and done. To that end, we've provided a simple guide to working with your HOA to achieve solar satisfaction.

Step 1. Know Your Rights!

The first step to approaching your HOA is to understand the overarching solar access laws in your jurisdiction. Check out this list of rules, regulations, and policies by state to get a feel for the solar access laws in your area, if any. Though related, solar access laws can be divided into Solar Easement Provisions and Solar Rights Provisions.

This distinction is explained by the Solar America Board for Codes and Standards: Solar Easement Provisions dictate "the ability of one property to continue to receive sunlight across property lines without obstruction from another's property" — a law of Contemporary Lights — while, Solar Rights Provisions specify "the ability to install solar energy systems on residential and commercial property that is subject to private restrictions" (e.g. CC&Rs).



Thanks to the rapid growth of residential solar and mounting public pressures, many states have adopted solar access laws. Recent reports show that, as of mid-2013, forty states had passed solar access laws to protect the rights of homeowners to install solar systems. Of these forty, twenty-one addressed the issue of Covenants, Conditions, and Restrictions imposed by Homeowners Associations. The language used to express these laws can be difficult to parse, however. Below are some examples of the phrasing you should watch out for when your rights are well-protected.

Solar Easement Provisions:
"Any covenant, restriction, or Solar America Board for Codes and Standards Report 7 condition contained in any deed, contract, security agreement, or other instrument affecting the transfer or sale of or any interest in real property which effectively prohibits the installation or use of a solar energy device is void and unenforceable."

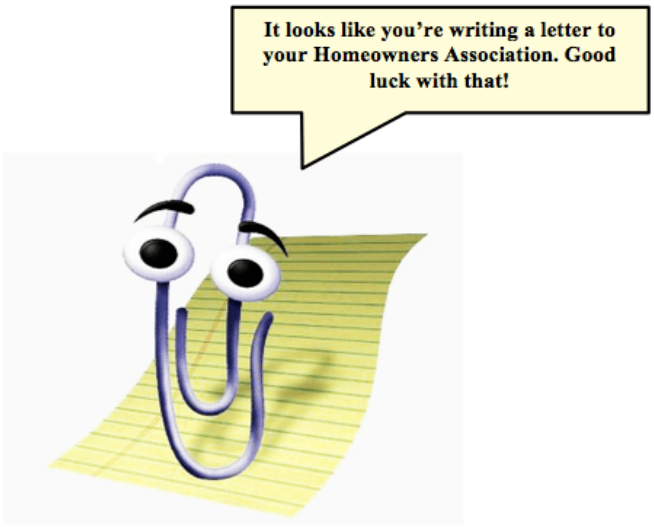
Solar Rights Provisions:
"The adoption of an ordinance by a governing body which prohibits or has the effect of prohibiting the installation of solar collectors is expressly prohibited."

Be sure to look into local zoning ordinances, comprehensive plans, and building codes, as well.

Step 2. Get to Know Your HOA.

After you've gotten familiar with the big picture in your state or region, narrow your focus down to your particular Homeowners Association. In essence, your HOA is your hood's residential private government, and as such, can run the gamut between benevolent and tyrannical rulers. On the one hand, HOAs strive to better their community through management, maintenance, and even by providing recreational amenities. Where many HOAs begin to rub their tenants the wrong way is through aesthetic restrictions.

These regulations on appearance are often targeted at solar systems. HOAs most commonly place restrictions on solar systems based on the following factors: placement, protrusions above roof level, wind-load tolerances, roof penetrations, color compliance, and paperwork requirements. While many of these factors are subject to the design of your system and the layout of your roof, be careful to consider all of your options and investigate how solar systems have been approved in the past in your neighborhood. If you're the first, be a trendsetter! Research shows that solar systems are contagious!



Once you've done all the research and are ready to submit your application for approval, double and triple check for completeness. Be sure to include all requested diagrams, pictures, and component product information, so your application cannot be rejected on the grounds that it is incomplete.

Step 3. Negotiate and Reach a Compromise

Your HOA's review committee may return your application with required changes regarding aesthetic or safety restrictions. If you believe these proposed changes are unreasonable in expense or effort, try to negotiate. Attempts to compromise may include arguments to the

exemption of your solar system from certain restrictive covenants, seeking a waiver from certain restrictions, modifying the system to conform to these aesthetic and architectural requirements, seeking a modification of the requirements to conform to your system, or obtaining release agreements. Whatever your approach, it should depend on how the covenant is written and your knowledge of how decisions are commonly reached within your unique HOA.

If a compromise cannot be reached between yourself and the review committee, get your installer involved. Many solar installers have dealt with neighborhood compliance issues and are skilled at cooperating with HOAs to find a creative solution to satisfy aesthetic requirements while maximizing system efficiency. If you don't have a relationship with an installer yet, get in contact with trusted experts in your area through our sign-up form.

Step 4. Don't Tolerate Bullying

Homeowners Associations have the power to levy heavy penalties on homeowners who fail to comply with their CC&R agreements. These penalties can include fees, forced compliance, and even HOA-driven lawsuits. However, these penalties cannot be used to punish you under the protection of your local legislative easement and rights provisions. Do your best to work in conjunction with your HOA, but know that you don't have to tolerate bullying, excessive delays, or unreasonable claims against your proposal.

II. Your Solar Bill of Rights

On, October 27, 2009, Rhone Resch, the President of the Solar Energy Industries Association (SEIA) declared that Americans are entitled to a Solar Bill of Rights©. It's a great document, but it's brief, so we're going to further explain each point with a "Why You Should Care?" explanation underneath. Please share this with your family and friends who'd like to go solar one day.

YOUR SOLAR BILL OF RIGHTS

1. Americans have the right to put solar on their homes or businesses. Restrictive covenants, onerous connection rules, and excessive permitting and inspections fees prevent too many American homes and businesses from going solar.

> **Why You Should Care**: Without this puppy, homeowner associations and cities with outdated building codes can continue to make up nonsense rules to prevent you from going solar with red tape and lawsuits. Excuse me, but access to the power of the sun should not be hijacked from my own home, be it ever so humble.

2. Americans have the right to connect their solar energy system to the grid with uniform national standards. This should be as simple as connecting a telephone or appliance. No matter where they live, consumers should expect a single standard for connecting their system to the electric grid.

> **Why You Should Care:** 99% of American homes don't need batteries to make solar work at night or cloudy days. Instead, homes can still remain connected to "the grid" (your utility) to get back up power. Problem is, every utility has its own rules and fees for you to get that back-up juice. Electricity is the same everywhere. Ask Ben Franklin. Let's agree on one standard way to safely connect your solar panels to the grid across America. That will make solar cheaper to install and less frustrating for everyone.

3. Americans have the right to net metering and to be compensated at the very least with full retail electricity rates. When customers generate excess solar power utilities should pay them consumer at least the retail value of that power.

> **Why You Should Care:** Let's say you go solar and cover 100% of your electric bill. A year later, your son goes to college. Suddenly, nobody's forgetting to turn off the lights, and your panels are producing more power than you actually need. Cool! Except many utilities won't pay you for that extra solar power you're feeding into the grid. Instead, they swallow your extra solar power and sell it to your neighbors for a profit. They don't even send you a thank you note. Wouldn't it be lovely if they had to pay you for that extra power instead of zero-ing out your bill? That's why you should care.

4. The solar industry has the right to a fair competitive environment. The highly profitable fossil fuel industries have received tens of billions of dollars for decades. The solar energy expects a fair playing field, especially since the American public overwhelmingly supports the development and use of solar.

> **Why You Should Care:** People yell and scream about solar subsidies, and yet, coal, gas, and oil companies all get HUGE tax breaks and other government cash for exploring ways to find more coal and oil so that they can continue to… you know…pollute our air and water, clear cut trees, yada, yada, yada, and reap profits. Solar needs a level playing field. If you're going to subsidize energy R&D, let's split the pie equally: 50% for solar, wind, and other modern clean technologies, and 50% for the old 19th century energy solutions. (Perhaps coal companies will use that money to invest in…solar. Wouldn't that be forward thinking? Nah.)

5. The solar industry has the right to equal access to public lands. America has the best solar resources in the world, yet solar companies have zero access to public lands compared to the 45 million acres used by oil and natural gas companies.

Why You Should Care: This one's pretty self-explanatory, but as in #4, it's a choice about whether Americans want to give away land to search for more 19th century fuel sources that pollute air, land, and water? Or should we give that same bit of public land for clean, renewable solar and wind farms. Think about it.

6. The solar industry has the right to interconnect and build new transmission lines. When America updates its electric grid, it must connect the vast solar resources in the Southwest to population centers across the nation.

Why You Should Care: Let's say we use this public land (#5 above) for solar and wind. Good choice. Thank you. Except to get the most out of it, the electricity has to be transported to cities by new "smart grid" wires and cables. Keep in mind that coal and oil companies use trucks and trains to transport their 19th century fuel sources. I'm not an engineer, but I'm pretty sure coal trains and trucks are a tad slower and less efficient than smart or dumb power lines. So, we've got to be able to make that investment in new smart grid power lines. Eventually, it will pay off in both environmental and energy savings.

7. Americans have the right to buy solar electricity from their utility. Consumers have no choice to buy clean, reliable solar energy from their utilities instead of the dirty fossil fuels of the past.

Why You Should Care: You should have a right to say whether you want to support the coal industry or to support clean energy. How? By getting to pick the kind of energy that feeds into your big screens and toasters. If everyone had a choice, I'll bet there would be a lot of people telling their utilities that they want to buy solar or wind power only. As it stands now, you pretty much get whatever they give you, like it or not.

8. Americans have the right, and should expect, the highest ethical treatment from the solar industry. Consumers should expect the solar energy industry to minimize its environmental impact, provide systems that work better than advertised, and communicate incentives clearly and accurately.

Why You Should Care: We really love this one because we love solar. This is the industry's way of saying that they're not going to be like the coal and gas industries. We want solar products to be almost as reliable as the sun, or…at least to live up to their stated warranties. We want easy to understand solar incentives without a lot of hassle or paperwork. And if we're going to put solar on public lands, Americans have a right to expect that it will be done with minimal effects to the environment.

Chapter 6: Connecting to the grid

Getting your solar system connected to the grid is usually pretty easy, and almost always a good idea. Do you live on the side of a mountain, with no running water, electric wires, or people for miles around? Off-grid solar might be right for you. If not, you should almost certainly get hooked up to the grid. Connecting your system involves two concepts: interconnection and net metering.

Interconnection is the physical process of hooking your system up to the utility company's wires. It's not as simple as your current one-way connection, because the electricity from your panels needs to be converted and transmitted based on how much you generate at any given time. The process is governed by rules called "standards" or "requirements," which determine the responsibilities of utility companies and homeowners in the interconnection process.

Net metering means what the name implies: the utility keeps track of your usage of their power, your production from solar power, and reduces the amount of energy they bill you for by the amount of your usage. There are times when a customer's solar array or other renewable energy system produces more electricity than is needed on-site. That valuable power is put onto the grid for use nearby where it is needed. Net metering also ensures that a surplus in one month is carried over to the next.

Like many aspects of going solar, connecting to the grid is not a one-size-fits-all proposition. But that's not because each individual might have different desires or needs. Instead, it's because the federal government and energy regulators have been largely silent on nationwide laws for small energy producers.

That means the states are left to devise their own rules, and, as you can imagine if you read about RPS laws above, some of the state laws make connecting a solar power system far more difficult and expensive than it needs to be. This is yet another area where your installer can provide you with the best, most accurate guidance, but we maintain a run-down of each state's net metering and interconnection standards on our website.

Read on to find out more about the ins and outs of connecting to the grid.

I. Using the grid as your battery

We often get questions from our friends about whether they should connect to the grid or go off-grid like a modern-day Grizzly Adams, but, y'know, with a whole bunch of expensive batteries taking up space in their rec room. Our advice is almost always the same: Battery-tied systems are NOT worth the extra cost for many reasons. Let us count the ways:

1. Most if not all State cash rebates require your solar panels to be connected to the utility. So you if you've got power going to your house already and you want free money from your State, then stay on the grid. (Go to your state's page on our site for summaries of state incentives.)
2. Grid tied only systems are relatively easy to install, requiring less time and money for installation costs.
3. Similarly, without batteries, you have to buy fewer pieces of electrical and safety components.
4. Being tied to the grid, you can take advantage of net metering and time of use rates.
5. Grid tied systems are very low maintenance. Battery systems, even those that are just backup systems, are less efficient, require more space and maintenance, not to mention frequent battery replacement costs.
6. For the 25 to 30 years of your solar panel life, the grid will almost always back you up at night and on cloudy days. It is extremely rare in America when the electricity goes down. Power is generally restored within hours or within a few days at the very worst.
7. If you consider that you're not eligible for state rebates, you could be losing $20,000 or more between the rebate cash that a State like California would have given you, plus the extra equipment and labor costs.

Just to show that we're balanced, battery-tied people have some non-financial advantages:

- You can have it both ways. That is, you can be on the grid and have a battery backup system in case of a black out. (Consider how often this happens, however. In most of America, a black out may happen once a year or less. Is that worth 20 grand?
- Grid-tied systems with a battery backup are still eligible for most State cash rebates and the 30% Federal Tax Credit. (However, neither of these discounts will apply to any batteries or battery components.)
- Grid-tied systems with a battery backup need fewer batteries, less maintenance, and less space than a system that has batteries only. (But you still have higher installation labor costs, extra equipment, and you'll eventually have to replace the batteries.)
- With a battery system that is not tied to the grid, you can proudly say that you are independent of coal-burning utility companies, that you use 100% renewable energy from the sun, and that your refrigerator will be on after an earthquake or problem with the grid.

It's up to you, but if you really want the most affordable system that is 95-99% reliable and less expensive, go with a solar system that is tied to the grid without battery backup.

II. More on Net Metering

Net Metering is very important when you're solar system is tied to the grid, which is most people. (Those with battery backup systems couldn't care less.)

Net Metering has nothing to do with the internet, but refers to your home's utility meter (that big round thing above) which keeps track of your energy usage. With net metering laws, the utility is required to keep track of your usage and store any extra power your solar panels generate.

Think of Net Metering as a solar powered piggy bank:

- Your solar panels generate electricity during the day, feeding electricity to your refrigerator and whatever else is on. Usually you're at work during the day, so your electric usage is low and the panels are producing MORE than your home is using and feeding the net metering piggy bank.

- In other words, Net Metering keeps track of the EXTRA power that your solar panels are generating. When you generate more power than you're using, the extra electricity makes your electric meter "spin backwards," crediting your solar piggy bank account.

- At night, you come home, turn on the lights, watch TV, but your solar panels aren't producing any electricity because there's no sun. Instead, you are withdrawing from your solar piggy bank, using up that extra electricity that your panels created during the day. The electric company essentially repurposes that power to your neighbors and buys less dirty coal.

- If your house uses more than what you've saved up, the electric company charges you their regular coal-powered night-time rates (which is lower than daytime "peak" rates.)

- At the end of the year, the electric company presents you with a bill that is the "net" between what your solar panels generated over the year and what you used beyond that.

- If your solar installer designed the system right, your entire electric bill for the year could be $100 or less for your entire year!

- Usually, the utility charges you a small monthly fee, like 5 bucks, to have net metering. Depends on the utility.

- **Caution**: If your solar installer designed too large of a system and you are generating more power than you actually used during the entire year, the electric company will NOT pay you for the extra power in California and many net metering states. Your bill will be zero, but you'll have donated that extra power to the utility company. So it's important that your system is sized to meet your current household needs or less than your needs, not exceed them. In some States (CT, FL, CO, others) they will pay for the net extra solar power at various rates.

- **Caution #2**: If you are planning to buy a new energy-efficient refrigerator or some other large appliance after your solar panels are installed, tell your installer. They will design a smaller system. Otherwise, as cautioned above, you'll eventually be giving away your extra power to the electric company–plus you'll have paid for an extra solar panel upfront. Keep in mind that you can always add another solar panel later if your electricity needs rise.

III. Take advantage of Time-of-Use

Time of Use (TOU) is a rate plan that your utility may or may not have, though most do for solar and/or wind. Time of Use works with net metering, something we've discussed earlier, to make your new electric bill lower–and therefore make solar have a faster payback. Here are the simple basics:

- During the day, especially during the longer days of summer, your solar panels produce more electricity than your house needs. So you send the extra energy back to the grid for storage, and at night, when the sun isn't shining and your solar panels aren't producing, your electric company sends you back the electricity that you didn't use. This is basically net metering.

- That power that your panels generate during the day and send back to the grid is the most expensive power of the day. Businesses and factories need that power and are willing to pay top dollar for it. That means your utility company is willing to pay for it.

- With a TOU rate, the utility buys the energy your solar panels produce at the high daytime "peak" rate. Now here's the big savings:

- At night, when you the sun isn't shining and you buy some or all of that power back, you buy it back at the cheaper night time rate. So you sell the solar electricity high, let's say 10 cents a watt, and buy back the night time "off peak" electricity at 5 cents a watt. You make a profit of 5 cents a watt on the energy your panels produce! That's Time of Use.

- Your utility and its various TOU rate plans determine the "peak" time periods. Some peak times are broken up to into 4 time periods, morning, night, and afternoon, and evening and weekends, each with its own rate. Others, like Southern California Edison, have peak rates set at M-F, 10am-6pm. All the other times are off-peak.

- **Caution**: If you're a stay-at-home-parent or person with a home office, you may not benefit from TOU because you're using up all of your solar power, plus buying extra coal power to run your computer(s) and the diaper genie. So you may be better off with the regular flat rate if this is the case. Consult with your installer about your energy usage during the day and the TOU rate plans. You'll still have net metering, but you won't have that bonus profit.

- **Tip**: Properly factoring in TOU into your initial solar panel design can decrease your system size because of the extra savings. In many southwest states peak prices are applied later in the afternoon when air conditioners are working hardest. Because of this, you may want to aim your panels a bit more to the southwest, to take full advantage of that precious afternoon sun.

- **Remember**: With net metering, utilities generally DON'T pay you extra if you lower your yearly bill past zero. So you want to make sure you have just enough solar power to get your bill close to a zero, but not lower than that.

IV. Take advantage of tiered rates

In many states such as California, utilities often will charge customers different rate tiers for kilowatt-hour (kWh) usage. The more power you use, the higher your rate jumps. As a result, using a small solar installation in a state with tiered rates can save a lot of money.

For example, the lowest rate in PG&E territory is about 12 cents per kWh for the "base tier." Everybody gets this rate for a certain amount of usage. When you use more than that certain amount, the utility charges you HIGHER rates. The next rate tier above 12 cents is 25 cents/kWh–more than double. If you use even more, the rate jumps even higher to 35 cents/kWh. The utilities do this to penalize energy hogs and to encourage conservation.

If you buy only enough solar panels to offset your usage by say just 50%, you're sort of tricking the utility into thinking you use a lot less energy. In reality, your solar panels are generating enough to get you out of the higher tiers back into the lowest tier. You can have smaller installation and save tons of money by avoiding high energy costs.

Chapter 7: Selecting your installer

So you want to get solar, but how do you pick a company to give you a quote? Once you have a quote or two, how do you pick the company? Well, here are some questions and concerns you should consider before you sign any installation contracts.

1. **Where's your contractor's license number?** Once you find it, look it up. All states will have a website to look up any contractor's license and give you contractor tenure and standing. Your installer NEEDS to have a contractor's license, period… Check it out and see how long they've been in the game and if they have any dings on their record. Installers should also be insured against damage to your home and injuries to their workers.

2. **Are your installers NABCEP Certified?** NABCEP is great sign. NABCEP is right now the best national standard certification program going right now. I'm told by hard core solar dudes that passing the exam is equivalent to passing a kidney stone. Think of the NABCEP test like the Bar exam for lawyers. To get the full certification, not only do you have to pass the test, you also have to have at least 2 years of hands-on experience in solar or a related field. So, at least one person on staff should have a full NABCEP certificate (not an intro one.) How to find a NABCEP installer? Click the NABCEP link above for a list.

3. **If not NABCEP, then go with experience.** Especially in such a young industry in a big country as ours, not everyone can be NABCEP. Some pros say they don't want to waste their money on something they've been doing for a decade. If this is the case, the company should be proud to give you references of their recent installs. Talk to these homeowners. Make sure they're satisfied. Ask the company how many homes they've done. Ideally, I'd feel comfy with someone who's installed panels on at least 10 roofs.

4. **Remember that the sales consultant will usually NOT be NABCEP certified**. The NABCEP guy knows how to play safely with electricity. He will officially design and inspect your system and probably be a part of the crew on your roof. Sales consultants are more about pre-inspecting your roof orientation, shading on your roof, explaining the various ways to finance your system, and giving you an estimate.

5. **Get 3 quotes and don't settle for the lowest price over experience.** When you get multiple quotes, issues can come to the forefront which previously were unexamined: "Why didn't other guy offer that?" Moreover, additional quotes will ensure cost

competitiveness across installers. And don't simply go with the cheaper one; Give them both a chance to explain where that extra value is. The more expensive quote could be advantageous if that contractor uses better installation procedures, higher quality parts, or extends greater warranty coverage.

6. **Does your contractor outsource their crew?** This is a big deal. Many companies outsource their installations to other contractors. Consequently, the company quoting your project may not know anything about their installation crew or how they're trained. If you have contractors installing solar power on your roof, they are going to be walking around up there, drilling holes in your roof… it's serious stuff and you need to know they were trained properly. Ask your installer for specifics about their relationship with their contractors. Look for terms like "installation partners," in the contract.

7. **Can you refer me to some of your happy customers?** If the installer is doing a good job, it will show in the words of their past customers. Get the names, addresses, and phone numbers of the latest two or three installations they have performed. Call the customers and ask about their experience with the installer, and drive by and take a look at the work they did.

8. **Whose panels and inverters are used?** Solar power requires two things: Solar panels and inverters. Panels collect and transmit the energy, and Inverters turn the direct current (DC) your panels produce into usable alternating current (AC) to run your blender, microwave, TV, or whatever you want to run in your house. Check warranties. Most panels are warrantied to work up to 85% of their nameplate capacity for 20 or 25 years. Inverter warranties are more like 10 or 15 years. Some inverters are cheaper than others – some suck while others rock. To see what is the story here, avail yourself of a product review site. Finally, if the inverter is not large enough to handle the system, you could have problems. If you're installer is NABCEP certified, this shouldn't be an issue!

9. **What about turnaround time?** Different installers will have different backlogs… Ranging from a few weeks to 8 months… get that up front so you can plan ahead and won't be disappointed.

10. **Do you offer warranties?** Warranties for equipment and warranties for installation are entirely different things. Good solar installers warranty their work and carry insurance to protect you in the event of damage. What are the warranty specifics? Has that solar contractor been around long enough for you to be confident they'll still be there when

it's time to honor those warranties? Solar lasts a damn long time, the company installing this technology needs be able to outlive the systems they install.

11. **Are the quoted prices for my solar system reasonable?** This is the tricky part. Pricing should be close to the same across the country, but solar incentives vary widely by state. A nice round number is somewhere between $3,500 and $4,500 per kilowatt capacity of your system (gross cost, before rebates and credits).

The key to this part is that second (or third) quote. It will create price competition between installers to get the deal, at the same time bring to light issues you may not have thought of. Unfortunately, the things brought to light often confuse and frustrate you. DO NOT GIVE UP.

The last thing we would ever want is advice from us or our site to stop you from getting solar. Hang in there, and ask for answers to questions you have. If they don't give them to you, find someone who can, but don't get frustrated and give up!

Chapter 8: Solar system maintenance

This question pops up in the FAQs of nearly every solar-related website and seems to be a great source of fear for many considering the switch to solar. Fear not, however, as we're going to break down all the required maintenance for solar panels! Whether you live in the ever-dependable rain of the Pacific Northwest, the snowy Midwest, or the relentless sun of the South, read on to sooth that nagging fear of the unknown.

General Maintenance

Regardless of where you live, your solar panels will require a good sudsing from time to time. This can easily be done yourself with good aim and a garden hose. If you want those power-producing panels to get squeaky clean, you can enlist the help of an extendable scrubber. Just be sure to hose them down afterward to avoid leaving any soapy residue behind.

Just like in the infomercials.

When cleaning your panels yourself, keep in mind that you have the terrifying power to void your warranty. Be careful not to scrape your solar panels, as this can cause micro-etching on the surface of the panels and reduce your efficiency. Also, remember not to use any sort of abrasive materials or harsh chemicals while cleaning your panels – for the same reason.

Of course, some solar panels are going to be more difficult to reach (not to mention some of us aren't very skilled with an extendable arm). If you fall into either of these categories, don't be afraid to hire a professional solar panel cleaner in your area. Regardless of which route you take, your solar panels should only need to be hosed down every few months at the most.

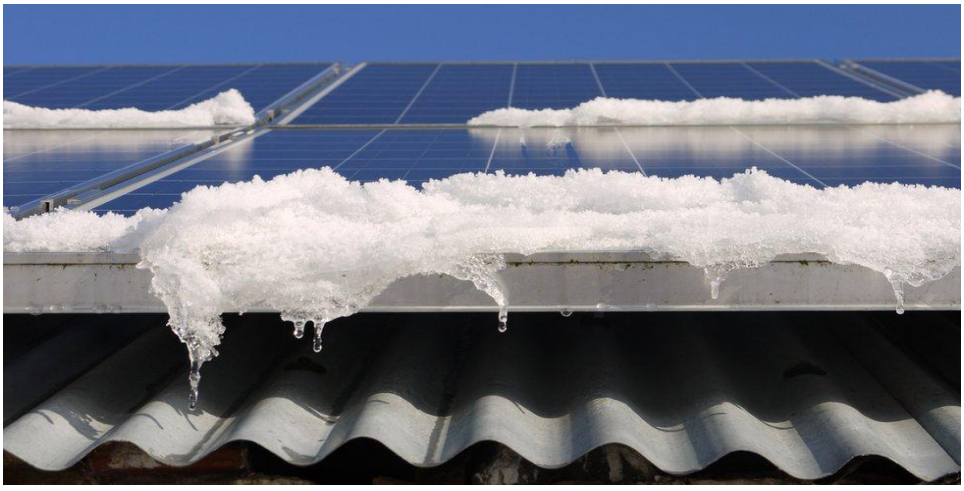
Rainy Days

Not only do your solar panels keep kicking throughout the cloudy months, the rain takes care of the maintenance, too! If you get a good downpour every few months, don't even bother busting out the squeegee. The rain should be sufficient to clear off the dust and dirt on your panels.

So fresh and so clean.

Snowy Weather

In keeping with their low-maintenance vibe, solar panels fare pretty well in the snow, too. In most cases, since solar panels tend to be installed at an angle and produce a small amount of heat, any snow should fall off your roof regularly. In some cases, it might take a few days after snowfall for your array to clear itself. But if you're grid-tied, this shouldn't be too much of a problem as you will have access to backup energy. In especially cold conditions, however, your panels might need a helping hand to keep producing that sweet, sweet electricity.



Better steer clear unless your name is Santa Claus.

This helping hand can come from you, but would require some risky behavior (e.g. climbing atop an icy roof, causing a small but deadly rooftop avalanche, etc.). Obviously, not recommended. Instead, you might consider integrating some snow clearing technology. Systems are now available which sense winter precipitation and redirect the necessary amount of panel production toward clearing snow, frost, sleet, and ice from your array.

For the most part though, snow shouldn't be a problem, as snow will slide off your solar panels more easily than it does your roof. Of course, if you aren't convinced, ask a solar installer in your area about your concerns.

Windy Conditions

Worried about your solar panels in wind? Again, not a problem. Panel fixtures are designed to withstand extreme weather conditions, including high wind loads. Just take a look at the picture below. Despite much of the roof having been ripped away by hurricane winds, these solar panels in Florida were designed to hang tough and did just that.

Rock me like a hurricane alright.

The only thing you have to worry about with wind is flying debris. Be sure to clear any obstructions off of your solar panel regularly, as they could reduce your solar array's efficiency.

With proper installation, solar panels can withstand nearly every weather condition, from the everyday to the extreme, while requiring very little maintenance on your part. Our trusted installers will ensure that your array is mounted securely and prepared for whatever your local environment can throw at it. The rest is up to you (and luckily, that's almost nothing!).

Chapter 9: Selling your house with solar

Some people worry that selling their house with solar panels on top will mean the house will take longer to sell and that they'll have to settle for a lower price. Boy have we got new for them. Homes with solar installations sell for more, and sell faster than comparable homes.

I. Are homes with solar really worth more?

For years, we've been talking about how much solar panels increase the value of your home. We use a simple calculation to determine the increase in value: We add the energy savings you'll see per year for 20 years. Well, it looks like we're not just blowing solar smoke; study after study after study comparing sales of solar and non-solar houses show clearly that homes—even near-identical homes in the same community—sell for more with solar. But we know you don't want to read a 200-page PDF to find out, so we've collected some of the most important information below.

In California, way back in the medieval times of 2001, the National Renewable Energy Laboratory began looking at what they called "high-performance" or "zero energy" homes, and compared them to similar homes without solar installed. The researchers followed the life of the homes for 5 years, from building to resale, and what they found is great news for anyone who wants to go solar: people who owned homes with solar panels were happier living in them, and they experienced the promised energy savings. Better yet, when the owners of solar homes sold them, they made 14% more money, in this case, that's over $43,500 more.

But wait, I can almost hear all you smart people saying "that was before the housing bubble burst! Those numbers can't be right anymore!" Well, I'm here to tell you that they're nearly as good today. Researchers responsible for the most recent study out of California concluded that "each 1-kW increase in size equates to a $5,911 higher Premium," meaning that homes with a 5-kW installation (the size on which we always base our estimates) sell for a price almost $30,000 higher than a similar home without solar.

And that value is shown to remain even years into the solar panels' usable life span. A Colorado study from 2013 that compared numerous sales of solar and non-solar homes from around the state showed price premiums of between $1,100 and $3,920 per kW for systems that were between 3 and 5 years old. We're still talking between $6,000 and $20,000 more for solar homes, even in snowy Colorado.

The bottom line with home value increase is that, should you decide to sell, you can be sure to recoup your investment in solar, even if your system hasn't paid for itself yet. Just another way that solar is a safe bet. And the best solar states recognize that value and provide property tax exemptions for the added value as an incentive to homeowners who install panels.

Chapter 10: Going Solar Without the Roof

Not every house has an ideal roof for solar. Maybe, like us, you live in a place with lots of tall shade trees and your roof doesn't get enough sun to make solar worthwhile. Or maybe you just rent, or you can't afford a huge solar system but want to contribute to solar in some way. Maybe you're just in it for the money and you want to buy stock or bonds in a solar company. That's okay with us—we just love that you're interested in the solar economy!

I. Community Solar

For many years, the best way for people to take advantage of the benefits of solar power was to purchase a system for their home and connect it to the grid, but that meant you had to own a home with an unshaded roof and be ready to spend many thousands of dollars.

More recently, with state and federal policies that specifically encourage solar development and big reductions to the installed costs of solar, other forms of solar ownership have arisen as possible ways for consumers to take advantage of solar power. One consequence of those favorable policies and cost reductions has been the rise of community solar installations, sometimes called "solar gardens."

Like this one here!

A solar garden is a solar installation that allows people to purchase portions (often called subscriptions) of the generated electricity to offset their electric bill. The main advantage of shared solar generation is that it opens the possibility of solar for people who can't get traditional solar installations—either because they live in a house without an ideal roof, or because they rent, or otherwise.

Shared solar installations are usually much larger than a home solar panel system but not as large as a utility-scale solar farm, although it isn't unusual for a utility company to own a solar garden. In fact, the most common types of community installations are either owned by a utility company or owned by a third-party with a power-purchase agreement (PPA) signed by a utility on behalf of its ratepayers.

Happy solar owners

The basic way community solar installations work is by selling "shares" as small as a fraction of a panel's worth of electricity, up to several panels' worth. The people who buy the shares pay either a one-time fee or a monthly fee, then get a monthly reduction in their electric bills equal to the amount of electricity produced by their share. The cost of a share varies widely depending on the individual circumstances of the installations, but it is not nearly as financially advantageous as purchasing a home solar system.

It's sometimes difficult to tell whether community solar is available in your area, but there are a few places to begin. The website SharedRenewables.org maintains a database of state-level policies that encourage community solar projects. It's a database of state policy and community solar installations all over the country. A couple other resources are Clean Energy Collective and SunShare, which actually partner with utilities in some states to build and manage community solar installations.

Two states have passed laws that specifically make "solar gardens" available to citizens: Minnesota and Colorado. The Minnesota solar gardens law, passed in 2013, specificaly names the state's largest utility, Xcel Energy, as being responsible for the establishment of the solar gardens. The Colorado bill makes no such requirement, instead laying out rules for how electric utilities will purchase the generation from the solar gardens, among other things.

If you're a renter or homeowner without adequate unshaded roof space, look for community solar in your area, but be aware that you'll most likely be financially better off by investing in the stock market. If you're interested for solar for moral reasons, however, you may find that a solar garden is the perfect way to green up your energy supply.

II. Invest in Solar

Even if you don't have a roof or live in a state that's great for solar, you can still make some money from the sun! That's because there are many companies that are thriving in the solar economy, and there are numerous ways to invest in them. Some of them are publicly-traded on the stock market, some offer ways to invest directly in solar projects, and still others offer special kinds of bonds that pay dividends over time.

We've got a full guide to solar investment options on our website, with information about how to invest and the pros and cons of each type.

Glossary

Azimuth – The angle (to the equator) at which a solar panel points. In the northern hemisphere, it should almost always be due south.

Clean coal – No such thing.

Grant – A cash distribution paid to homeowners. Grants often come from government agencies or non-profit organizations, as opposed to rebates, which mostly come from utility companies.

HELOC – Home equity line of credit. In certain states, a HELOC can be used to pay for a solar installation.

HOA – Homeowner's Association. Can sometimes be a barrier to putting solar on your roof. See our advice in chapter 5.

Interconnection – The physical and bureaucratic process of getting your system connected to the energy grid. Governed by sometimes nonsensical rules imposed by state governments and utility companies.

Inverter – A piece of equipment that converts DC electricity generated by solar panels to AC electricity used by your home.

IRR – Internal Rate of Return. Used to show the relative performance of an investment. Allows you to compare the potential return on solar to other investments.

ITC – The Investment Tax Credit. Federal tax policy to give homeowners a 30% tax credit on the purchase and installation costs of installing renewable energy generation (e.g. solar panels).

Kilowatt (kW) – A unit of measurement equal to one thousand watts. Solar panels are rated according to how many kW they produce at any given moment.

Kilowatt-hour (kWh) – A unit of measurement of electricity generation equal to one kilowatt of generation (or consumption) operating for one hour.

Microinverter – A type of inverter that changes DC electricity to AC electricity on a per-panel basis.

Megawatt (MW) – A unit of measurement equal to one million watts.

Nameplate Rating – Also known as STC, or Standard Test Conditions. Nameplate rating refers to the performance of a piece of electricity-generating equipment under ideal laboratory conditions.

Natural Gas – Still dirty. Still expensive.

Net Metering – The practice of calculating the difference between energy produced by solar panels and energy consumed by a home. Net metering acts like cell phone rollover minutes, in that any power solar panels produce greater than consumption in one month is carried over to the next month. Net metering sometimes leads to a credit at the end of the year.

Nuclear Power – Expensive and prone to violent radioactive explosions.

PACE Loan – Property-Assessed Clean Energy financing. A PACE loan is for homeowners who don't have the capital to finance solar on their own, but to whom leases

Performance Payment – A bonus paid to the owner of a renewable energy producing system for the energy they sell to the grid. Performance payments can be direct payments above market prices for all the power a system produces or Renewable Energy Certificates, which can be sold to traditional utility companies to offset their usage of fossil fuels.

Photovoltaic – The generation of electric energy from light.

PPA – Power Purchase Agreement. In this type of solar agreement, a company installs a system on a homeowner's property, and then sells the energy to the homeowner at sub-market prices for a defined period of time.

PTC – Performance Test Conditions. This type of measurement of electrical output from a solar panel accounts for real-world conditions, including energy losses from wiring, and more.

Rebate – Usually a direct, lump sum payment given to a homeowner or installation company when they install solar panels on a home. Rebates are most often paid by utility companies to homeowners, because the utilities can count the homeowners' generation as clean energy toward their goals under an RPS law.

RPS Law – Renewable Portfolio Standard. An RPS law (often simply called an "RPS") sets goal for renewable energy generation as a percentage of total output in a state. Most states have enacted RPS laws to spur development of renewable energy, and an RPS is the primary tool used to mandate rebates, tax exemptions, and tax credits for solar and other renewables.

Solar Lease – A financial agreement in which a company installs a solar generation system on a homeowner's property, then leases the panels to the homeowner over a given period. At the

end of the lease's term, the homeowner is often given the option to renew the lease or purchase the panels for the remainder of the cost, minus interest.

Solar Panels – The part of a solar power generation system that takes in photons from the sun and turns it into electrical energy, to be sent to the inverter and used in the home or transmitted to the utility company.

SREC – Solar Renewable Energy Credit. In states that have enacted laws mandating the creation of SREC markets, a solar power system earns the owner one SREC for each MW it generates. The SRECs are then sold to energy companies to offset their pollution and meet the goals of the RPS law in the state. SRECs are typically not sold directly by homeowner, but are bundled by intermediary companies for sale in large quantity.

STC – Standard Test Conditions (see Nameplate Rating). Laboratory conditions under which solar panels are tested.

The Sun – The most enduring, powerful energy source for the planet. Provides enough energy to power the earth for 20 years with just 500,000 sq. km of solar panels (0.3% of earth's land).

Tax Credit – A direct reduction of taxes for the owner of a solar power system based on the system's cost. The most notable tax credit in the US is the federal ITC. Tax credits are offered under some state RPS laws. Tax credits are often applicable over a number of tax years.

Tax Deduction – A reduction of income eligible for taxation for the owner of a solar power system based on the system's cost. This type of tax incentive is rare in state RPS laws.

Tax Exemption – A direct reduction in property and/or sales taxes based on the value of a solar installation based on an increase in home value following installation of a solar power system or the cost of the installation itself, respectively.

Thin Film – A type of solar cell that uses a chemical layer instead of a silicon crystal as the method of converting solar energy to electrical energy. Thin film is, as the name implies, thinner and less bulky than traditional solar cells, but not necessarily cheaper on a per-watt-generated basis. At last not yet.

Tilt – The degree of elevation of a solar panel relative to the ground. Tilt can either be fixed or adjustable by manual or automatic means. Tilt is one of two necessary orientation variables used to get maximum possible production from solar panels.

Tracking – A system that adjust the azimuth and tilt of solar panels to maximize the production of energy from solar panels.

Watt – A unit of energy equal to one joule per second. We know that doesn't mean anything.

That's all there is; there isn't any more.