



Top 10 Questions & Answers on Home Solar in Virginia

Taking the Confusion out of Getting Solar for Your Home



Introduction



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

-- Thomas Edison, 1931

It's taken a while to happen, but it seems like Americans have finally started to take Edison's advice about solar seriously. In the last few years, more and more families and businesses have gone solar. They're saving money on energy right now. They're taking control over their energy costs in coming years whatever happens to utility rates. And they're leaving a legacy to the future, whether by increasing the value of their home -- the biggest asset for most American families -- or by helping America to go green.

Why is it happening now?

Mainly, it's because solar has become more affordable than ever. And while you may have heard about what's happening with solar in places like California or New York, these days Virginia has also become a pretty good place to put solar on your home. Our state has got

plenty of sun. And as utility rates have risen, solar has become a better and better way to save money.

But if you want to put solar on your home, there are lots of questions you'll have to answer. For example, is my home right for solar? How much money could I save? What incentives are available in my area? And how can I find the best solar installation company for me?

If you have any of these questions or if you just want to know more about how solar would work for your home, then this guide is for you. It answers the top ten questions that Main Street Solar has gotten from hundreds of homeowners over the years that we've been installing solar energy systems.

The goal of this guide is to empower you with the information to become smarter about home solar. That's important if you want to get solar on your home. But it's good also just to understand how home solar works, so you can sound smart when you're talking with people at work or you meet someone at a party who just got a solar power system installed on his roof.

So, let's dive in!

And if you have questions, there's a place at the end where you can contact us just by clicking on a link. (Or you can just [click here!](#)) We like to think of ourselves as the solar educators for the whole state of Virginia, so we're always happy to talk to people who want to make themselves smarter on solar.

1. How Does Solar Power Work?



Solar power technology gives humans the ability to convert light from the sun into energy just as plants have been doing for millions of years. And while plants use photosynthesis to turn nutrients from the earth into food for plant growth, humans can get two different types of energy from the sun.

First, we can use the sun to produce heat, as humans have done for thousands of years. For example, homes built with a big window or a sun-room facing south create heat through **passive solar** design. A more high-tech way to create heat from the sun's light is to put glass tubes filled with water or some other fluid up on the roof. You can then pump the heated water down into the house for hot showers. This **solar thermal** technology also allows you to heat your home, by piping the hot water beneath your floorboards so that the heat can radiate up into the room.

Second, we can convert light from the sun into electricity that we can use to power lights, electric appliances, and more. This is the kind of solar power that everybody's excited about, since it can cut your electric bill, give you control over your own energy and help reduce pollution from conventional electricity sources like burning coal. And solar electricity, produced through **photovoltaic or PV panels**, is mostly what we'll talk about in this guide. Though we'll also go briefly into solar thermal systems too.

By the way, for those who want a little history of solar electricity:

In 1839, French physicist Edmond Becquerel discovered that sunlight could produce an electric current in a solid material. But it took more than a century for scientists to fully understand how it worked and develop a practical solar cell. Solar PV was first put into use in the 1950s to power NASA spacecraft.

Solar power systems include several components working together to convert the sun's energy into electrical power that can be connected to a building's standard electrical infrastructure and the utility grid.

As the [US Department of Energy](#) explains, solar power is bigger today in the US than ever before:

Solar power is more affordable, accessible, and prevalent in the United States than ever before. Since 2008, U.S. installations have grown seventeen-fold from 1.2 gigawatts (GW) to an estimated 30 GW today. This is enough capacity to power the equivalent of 5.7 million average American homes. Since 2010, the average cost of solar PV panels has dropped more than 60% and the cost of a solar electric system has dropped by about 50%.

Here are some other facts about solar energy from the Department of Energy:

- **173 Terawatts of Solar Power Hit the Earth Every Moment.** Solar energy is the most abundant energy source on the planet. Enough sunlight hits the Earth's surface in 1 1/2 hours to power the entire world's electricity consumption for a year!
- **Nearly 1/3 of All Energy Added to the Electrical Grid in 2015 was Solar.** While solar accounts for less than 2% of U.S. electrical generating capacity overall, it is one of the fastest-growing energy markets in the country. With solar power continuing to get more affordable and new installations happening every day, the solar industry is booming. For the first time, more solar generating capacity was added in 2015 than natural gas in the U.S.
- **The Word "Photovoltaic" Means "Light Electricity."** "Photovoltaic" has two parts: photo, derived from the Greek word for light, and volt, from electricity pioneer Alessandro Volta. And that's exactly what photovoltaic systems do -- turn light into electricity!

Want to know more? Get more facts about solar and test your own knowledge at the Department of Energy's online [Solar IQ Quiz](#).

2. Why Go Solar?



We've discovered that there are a few main reasons why people install solar power systems on their homes:

1. Save money on their electricity bills
2. Gain more certainty over their future electricity costs, even if utility rates rise
3. Increase the value of their home
4. Go green and help the environment while helping America achieve energy independence
5. Access backup electricity in case of a power outage or blackout
6. Live off the grid at a property in a remote location

The most common reason people install a solar energy system is to reduce their utility bills. Once your system is operating, the power it provides is free. There is little or no maintenance required. While it runs, your solar system reduces your electrical bills. It decreases how much power you pull from your utility, but also because any excess power you produce is pushed back into the grid, effectively turning your meter backwards. Eventually your solar energy system will pay for itself, and your energy savings will continue long after.

In addition to what you save on your electric bill, having solar energy system for your home raises the value of your property. Solar also makes a home more attractive to potential buyers, particularly when compared to an otherwise identical home. This can make a big difference should you decide to sell your home in a tight real estate market.

Another great incentive for installing solar is that the federal government, along with some local governments and utilities in Virginia offer rebates, tax credits, low interest loans and other incentives for adding solar power.

And of course, solar energy is a clean source of power. It reduces dependence on fossil fuels in a practical and effective way, and helps protect our environment.

Payback Time

Payback is usually used to describe the time it takes for an investment to pay for itself, similar to Return On Investment (ROI).

However, the basic assumption behind a payback calculation is that this is a discretionary expenditure, ie, “I can choose to invest in this energy equipment, or not, and if I don’t, I can put that amount of money in the bank with no risk, and earn some interest.”

However, in the modern world, paying an electric bill is not a discretionary expense for most people. If you want to live a modern life and keep the lights on, the refrigerator running and the air conditioner blowing on a hot day, then you need electricity. And most Americans still get that power from their local electric utility.

By buying a solar electric system you are taking money that you would be giving to your electric utility and investing it in your home.

A residential solar energy system connected to the grid in Virginia will typically pay for itself in 8-10 years, depending on where it’s located. Considering that solar panels come with a 25-year warranty, and have a 30-50 year design life (depending on manufacturer), that basically means that after the first 10 years they’ve paid for themselves.

They then go on to generate “free power” for the next 20 to 40 years. That’s 30 years of positive cash flow, money in your pocket in the form of avoiding electric bills. In addition to your reduced power bills, a home solar panel system increases the value of your home without adding additional tax value.

A residential solar power system will increase your home’s property value immediately. For every \$1 reduction in annual electric bills due to the installation of a residential solar power

system, your home's value will increase by about \$20. And nationwide, solar homes are outselling homes with traditional electrical systems.

Finally, solar can allow you to gain some independence from your local utility. If you invest in a battery system to store some of the solar power you produce, then you can have power even when there's a blackout. However, this kind of system adds considerable expense to a home solar energy system, and we don't recommend it for most homeowners unless your power goes out a lot and for extended periods.

A more practical way to gain more control over your energy is in terms of making your future energy costs more predictable. If your utility raises your rates in the future, as it certainly will, your bills can steadily increase over the years to come or they can spike if the utility if there's a big rate jump. The point is, if you rely for 100% of your power on your utility, then you have no control over their rates. But if you produce some amount of your own power through solar, then you'll gain more control over your future energy costs. Even if part of your power goes up as utility rates rise, the part of your energy you produce from solar will still cost the same -- in effect, zero.

And speaking of energy independence, if you own a property that's located in a remote area and doesn't have electricity now -- for example, a vacation home or hunting cabin -- then solar may be the most affordable way to bring in electric power. In that case you would need to make the extra investment for batteries, because you need to store power during the day when the sun is shining and your panels are producing energy for use at night when your solar panels aren't producing.

Off-grid solar systems are a little more involved than solar panels on a home that's connected to the electric grid. Below, we'll talk about both kinds of systems. But first, let's talk about what kind of properties can qualify to host a home solar system.

3. Who Can Go Solar?



While there are ways for people in apartments to use solar energy, today it's still most common for a solar energy system to be installed at a single-family home. So that's what we'll focus on here.

But if you're interested in shared solar, just Google "community solar" to learn more about opportunities that will come up in the future to use solar power even if you don't have a house to put it on or if your house isn't appropriate for solar.

How to Know if Solar is Right for Your Home

The US Census says there are about 72 million single-family detached homes in the US, and the National Renewable Energy Laboratory says that 25% of those houses are "solar compatible." That means the available market for residential solar in the US is around 18 million houses. Virginia has nearly 2 million of those homes, meaning that in the Old Dominion there are probably about 500,000 houses that could host a solar energy system.

Of course we'd love to see everyone in the state go solar, but homeowners have to be realistic about whether solar is a good investment for them right now. Not every house

that can host a solar system in Virginia will see the biggest benefit from getting solar. To decide if solar is really right for your house, you have to consider not only whether there's a spot that's free from shade on your roof or in your front yard to allow the sun to hit your solar panels. You also have to consider how you use electricity in your house.

Air conditioning serves as a pretty handy litmus test. If you run it during a big enough part of the summer, chances are very good that you'll save money from day one by going solar.

Other candidates for immediate solar savings are large homes, older homes, homes with electric water heaters, households that do a lot of laundry and homes with swimming pools, space heaters or grow lights.

But even if you're a fogged-in energy miser and your electric bill is minuscule, you're still going to save money with solar. Folks with high bills start saving right away. But virtually everyone will save money over the long run. For people who fall somewhere in the middle, you'll probably break even in the short run and save over the long term.

And contrary to popular belief, you can still have solar power on a cloudy day. The sun's radiation penetrates through clouds, so your solar panels can still absorb energy from the sun. In fact, some studies have shown that solar panels perform better when the sun is not scorchingly hot. An overcast day provides a cool environment for your panels while still allowing them to absorb solar energy.

If your home is not weatherized, it may make sense to invest in energy efficiency upgrades before going solar. Some efficiency upgrades are simple and inexpensive, such as changing out all your old energy-wasting incandescent lightbulbs for energy-sipping LED bulbs. It may also make sense to blow insulation into your attic, seal drafts around doors and windows and service your AC and heating systems.

A good solar installation company will recommend easy upgrades to make your home more energy efficient, or even refer you to a trusted contractor who can help, before recommending that you go solar. After all, going solar is not just about producing some or all of your power from the sun. It's also about saving you money and helping you get smarter about energy!

4. What Are the Options to Go Solar?



The two most frequently used types of solar energy are photovoltaic (PV) and solar thermal power. Here, we'll talk mostly about PV, since it's the most common. But we'll also talk a bit about solar thermal, since it can be a cost-effective way for some homeowners to go solar. And we'll also talk about where to locate your solar energy system, whether on the roof of your home or mounted on the ground in your yard or out in a field.

PV or Thermal

Photovoltaic panels can convert the light from the sun into an electric current using what is known as the photovoltaic effect. A solar panel system uses photovoltaic cells to capture the energy from the sun.

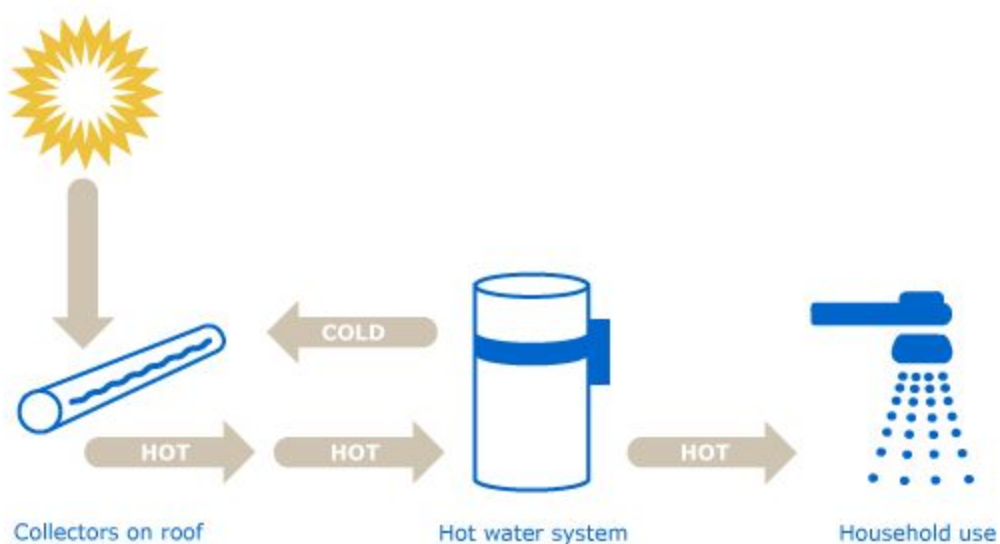
Many people don't know that PV cells don't require constant direct sunlight to function properly. Even on a cloudy day, PV panels can still generate enough electricity to make them worthwhile for the average Virginia home.

To understand how PV panels work, we have to get a little bit technical. If you're not into that, then you can skip over this part.

Photovoltaic cells are manufactured from a semi-conductive material which is layered; silicon is the most frequently used material for PV cell production. When the sunlight hits the cell, an electric field is created across the silicon layers. The amount of electricity produced is dependent on the strength of the sunshine. These layers of PV cells are then mounted together in panels which can be installed onto a rooftop or mounted on a rack on the ground in the front yard of a house or in the middle of a farmer's field.

PV cell power is measured in what is known as "kilowatts peak," or kWp. This is the rate at which the PV cell will generate electricity during its peak performance times, which are always in the sunniest times of the day and usually during the summer months.

The second type of solar energy which has been used by more and more people over the last decade or so is the solar thermal system. This kind of power uses some of the basic principles of the behavior of heat the conversion of solar energy into thermal energy. This system uses the heat from the sun to warm the water used in homes. Most people use this system in conjunction with a conventional immersion heater or boiler, in case cloudy weather prevents the system from producing enough heat energy.



A thermal solar system uses either a set of panels called collectors or a set of evacuated tubes, which are installed onto the rooftop. These panels then collect the sun's heat and use that energy to heat the water stored in a cylindrical storage device. This storage device contains a series of pumps, which are used to circulate a heat-transfer fluid (usually an antifreeze mixture) to the panels. When the heat fluid is warmed up in the collectors or evacuated tubes, it is then pumped back into the cylindrical tank, where a device called a heat exchanger then transfers the heat from the fluid to the stored water.

Solar thermal is not as versatile as solar photovoltaics -- while all electric appliances can use the energy from PV, hot water is great for showers but it can't run your fridge or your computer.

Advantages of A Solar Water Heater

But solar thermal can be more affordable than PV, especially when it comes to solar water heaters. Did you know your home's largest energy hog is the electric water heater? For families of four or more, installing a solar water heater can save you up to \$600 on your electric bill per year. That's enough to buy 200 pairs of slippers!

A solar water heating system harnesses the sun's energy to heat water, so your water heater uses less electricity to do the same work. In the US alone, there are hundreds of thousands of solar hot water heaters in operation and that number is growing all the time. Surely the main reason is that using a solar hot water heater saves the homeowner up to 70% in hot water heating costs. Additionally, and unlike conventional hot water heaters, you will always have hot water even when there is a power outage.

Rooftop or Ground Mount

The vast majority of solar energy systems we install on homes go up on the roof. The reasons for this are simple:

- Since ground-mounted systems require a special framework to place a collection of panels just above the ground, a ground-mounted system can be more expensive to install.
- Ground-mounted systems use extra land, whether in your yard or out in a field, while rooftop solar just uses your roof -- which you probably weren't using for anything else anyway.

Yet, ground-mounted systems are an alternative for homes whose roofs aren't right for solar. For example, if your roof is shaded, if it doesn't face the right direction (usually south or in some cases, west) or if your roof is too old or too small to hold many solar panels, then you may want to consider a ground-mounted solar system.

Ground-mounted systems can be more efficient than rooftop solar. Panels installed on the ground can be positioned in the best direction to get the maximum amount of sun at your location, increasing the efficiency of your solar system. And because ground-based systems can include a tracking system that moves your solar panels to follow the sun during the day. This can add 25% to the cost of a solar energy system, but in some cases, the extra investment can pay for itself. A qualified solar installer will be able to help you decide whether rooftop or ground-mounted solar is best for you.

5. Should I Get A Grid-Tie or Off-Grid Solar System?



We don't recommend that a homeowner who is already hooked up to utility power disconnect and go off-grid. There are many reasons, but some key ones are:

- Grid-tie systems are less expensive than off-grid because they require no storage batteries.
- Off-grid solar has some unique design limitations, which means most people will need to adjust their power use habits and may need to replace some appliances (such as an electric furnace or electric oven) to make an off-grid system practical.
- Batteries, which are necessary in off-grid systems to provide power at night or at other times when power is not being produced, can be expensive and they require regular maintenance.
- Batteries also have a shorter life expectancy than most other solar system components, which means that they not only add to the upfront cost of a system, but they add to the costs over time because batteries need to be replaced regularly.

We'll talk more about off-grid solar energy systems in the next chapter. For now, let's just say that if you're already on the grid, on-the-grid solar systems offer you the best of both worlds. You can have your system sized so that your 12-month average electrical bill comes in at next to nothing, but you still have the flexibility to at any time draw more than your solar array is producing from the electric grid without having to do a thing.

And when a grid-tie solar electric system generates more power than you are using in your home, the excess electricity is sent out into the utility grid. Since Virginia offers solar "net metering," it means power going into the grid spins your meter backwards, allowing your neighbors to use it and essentially giving you a credit on your utility bill. If you use more power than your system is producing, your inverter will automatically pull the needed power from the utility grid – and you will never notice a thing.

Net metering means you are only billed for the "net" electricity purchased over the entire billing period, usually each month. At the end of each billing cycle your meter will not have spun as far forward when compared to not having solar electricity, saving you money. If you produce more than you use during a billing period, your utility company will retain it as a credit, which will then be applied to future electric bills.

Sizing Your Grid-Tied System

Grid-connected PV systems are typically sized to eliminate part of your electric bill because of the higher upfront costs associated with purchasing a larger system. However, larger systems will cost less per kilowatt-hour generated due to the economies of scale associated with manufacturing processes.

Sizing your solar grid-tie system is not as complicated as you may think. With only an electric bill, you can determine the minimum system size you will need. Once you've determined that, you can determine how many solar panels you will need.

To begin, you will need your 12 month average electrical use – which you should be able to find on your utility bill. This number will be in kWh (kilowatt-hours). Then follow these steps to get a ballpark estimate of your minimum system size:

1. Record average monthly kWh electrical use: _____ kWh
2. Multiply this by the percentage you want the solar system to produce:
_____ kW (ie: 1000 kWh X 50% = 500 kWh)
3. Divide by 30 for the daily output from your solar power system: _____ kW
4. Divide by the daily average sun hours for your location: _____ kW (use 5 hours in VA)
5. Divide by 75% to compensate for system efficiency: _____ kW

As with anything math-related in solar, the easiest way to figure out how much solar you need is to ask a solar installer to give you an estimate.

Grid-Tie System with Battery Backup

The hybrid system takes advantage of the high efficiency of energy production of the on-grid system, but has a limited battery storage bank to supply power to critical appliances in the home like certain lights or a refrigerator. Because air conditioning uses so much power, normally it would be too expensive to get enough batteries to power it as well.

Hybrid systems are designed to supply critical loads without the benefit of a solar charge cycle period, referred to as the “days of autonomy” (3 days is typical). The autonomy period is based on the load demand of the appliances to be operated and the length of time those appliances are to be in operation. Of course the system can be built large enough to power any device as long as cost is not a consideration. If a generator is available to provide recharging of the battery bank, then the days of autonomy can be shortened, as the generator would be called on to offset the loss of access to the sun’s power during extended cloudy periods.

In general, these systems are best for applications in which backup power must be instantly available without interruption (for example, to power computers). Hybrid systems are also good for areas where power outages are a frequent occurrence, or an area where blackouts and brownouts are relatively common, such as after a hurricane.

Hybrid systems typically require a larger up-front investment than grid-tie systems. Batteries make a solar system more complicated and expensive because they:

- Require maintenance
- Need to be replaced after 5-10 years
- Decrease a solar system’s efficiency

Many of our customers opt for a grid-tie system and purchase a standby gasoline or propane generator with a properly installed manual transfer switch. Such generators are usually the least expensive option for backup power production. Generators provide the most reliable and cost-effective source of extended backup power, eliminate the additional expenses related to batteries, and have backup power available for as long as they have fuel.

Generators usually cost between \$3,000 and \$7,000, with manual-start gasoline generators at the lower end and auto-start propane/natural gas generators at the higher end. A more durable diesel-powered generator, such as a 10,000-watt auto-start unit, can

be purchased for about \$10,000. This type of generator has higher quality power output, requires less maintenance, and has a much longer life.

Since they don't require complicated carburetion, propane/NG generators are also good solutions for remote backup systems. With these higher price range generators you can install an automatic transfer switch and auto-start capabilities so that the generator automatically begins to supply your electrical needs in the event of a power outage. Most generator systems will take several minutes for the generator to come online and provide adequate power.

6. What Is Off-Grid Solar?



Living off-grid does not mean living without electricity, nor does it have to mean a very rustic lifestyle. Simply put, being “off-the-grid” just means you are your own power company. You can be off-grid in the middle of nowhere, or you can be off-grid in the middle of everything.

Why Go Off-Grid?

There are many reasons to be off-the-grid, but typically off-grid (stand alone) solar electric systems are used in remote locations where connecting to the local utility grid is impossible or prohibitively expensive, in areas where grid power is inconsistent, or due to the appeal of an independent lifestyle. With an off-the-grid system, solar panels, a small wind turbine, a small hydroelectric (micro-hydro) system, or a combination of these technologies and others, is used to supply all of the power a cabin, home or business needs. In some off-grid systems a backup generator running off of gasoline or propane may also be included, to supply power when the renewable technologies can't produce enough to meet demand.

Off-grid living completely relieves you of dependency on the electrical utility, because the system provides all of your power. Due to this, off-grid systems are generally larger than

grid-tied solar systems. To be fully independent, a system must have a larger array of solar panels, and greater battery storage capacity than in applications where grid power is available. However, if done properly, living off-the-grid can save you thousands of dollars over the life of the system.

Before Going Off-Grid

As we said earlier, if your home is already connected to the electric grid and if your service is fairly reliable, then we don't recommend disconnecting just to go off-grid. But if your property is not on the grid now or if it is on the grid but experiences unreliable electric service with frequent and long-lasting blackouts, then off-grid solar may be worthwhile.

If you are considering the off-grid lifestyle, you first need to fully understand your own power use habits, as well as exactly how an off-grid system works. To live off-grid you will likely need to make adjustments to when and how you use electricity so you can live within the limitations of your system's design, and to keep the system cost reasonable. This doesn't necessarily imply doing without, but rather a shift to a more conscientious use of electricity.

When designing an off-grid system it is critical that electricity consumption be determined for everything in your home, and to calculate for those cold, dark winter days and nights when energy consumption is at its peak and power production is at its minimum. Main Street Solar recommends taking energy conservation measures first, such as installing LED lighting and energy efficient appliances, before investing in an off-the-grid system.

We also recommend that before you choose an off-grid lifestyle you talk with a few folks who are already doing it. This will give you practical information that you may not come across in your other research. A qualified solar installer can usually put you in touch with others living off-the-grid, and you may also be able to find some folks through local organizations that support renewable energy and green living.

Another great resource for seeing off-grid or on-grid solar systems that are actually in use is to attend the National Solar Tour in your area. The Solar Tour is organized by the American Solar Energy Society (ASES) and its member groups, such as Solar Virginia. The main tour is held the first Saturday of October all across the country, but in some areas tours are held at different times of the year. The Solar Tour is designed so that people just like you can visit homes and businesses in your area where renewable energy and other green living products and practices are in place. It is a wonderful opportunity to talk with end-users about the ins and outs, ups and downs, and all arounds of what they're doing. For more information about the National Solar Tour visit the ASES website at www.ases.org.

Advantages and Disadvantages

Off-grid solar will allow you to live independent from utility power, and/or off the beaten path. And just like a grid-tied system, a well designed off-grid system also has an environmental advantage, helping you reduce your carbon footprint.

It is generally not cost effective or feasible to install a renewable energy system large enough to provide power for things like electric heat, air-conditioning, electric cooking or electric hot water. Geothermal, solar hot water, and of course, gas appliances, are just some of the alternatives available that will allow you to maintain a comfortable lifestyle without relying on utility power.

Now that you understand the purpose, benefits and limitations of going off-the-grid, let's take a look at how to actually do it.

How Much Power Do I Need?

Determining how much power your solar PV system needs to produce for off-the-grid living is similar to sizing a grid-tie solar system, except that there is no utility bill to refer to for historic usage. So the first step is to make a list of all the items you plan to power in your off-grid home. Just remember that the more electricity you use, the more solar power you will need to produce.

To be very accurate, you can refer to the label on each appliance or piece of equipment, and then estimate the amount of time you will use them each day, then do some math. For some appliances it is reasonable to make an estimate, but for those that have higher power consumption we suggest actual ratings for off-grid calculations. The simplest way though, is to let your solar installer help you. A qualified solar professional can save you time and ensure you have accurate information on which to base your PV array sizing,

Once you know how much power you use, you can proceed to sizing your solar PV system. In an off-grid application it is critical the system is properly sized, because you will not have utility power to draw from if your solar energy system does not provide enough to meet demand. That is why we recommend getting expert professional help sizing your off-grid system, so you can be sure that you have all the power you will need.

7. Do I Need Batteries?



Batteries are mostly used for off-grid solar systems. In a hybrid system, batteries can provide backup power for a grid-tie system in case of a blackout. Keep in mind that batteries can add 50% or more to the cost of a home solar system, so most solar installers will recommend the extra expense only if batteries will add significant value to a particular installation.

A battery based system is made up of several different components. These include solar panels, batteries and a charge regulator or controller, an inverter which converts the DC current produced by solar panels to AC current used by appliances; wiring; and mounting hardware or a framework.

Although a small amount of energy is lost in converting DC to AC (typical inverter efficiencies are in the range of 90 to 95%), an inverter makes solar-generated electricity behave like utility power to operate everyday AC appliances, lights, and electrical equipment. Please note that you will need a special type of inverter if you want a battery backup system. For safety reasons most grid-tied inverters are designed to shut down

completely if there is a power failure. The charge controller prevents the solar panel or array from overcharging your battery.

Batteries are the energy storage for your system. Without batteries there is no way to store the energy your solar panels produce during the day and provide you with the energy you need at night. Typically, off-grid homes receive their power from batteries instead of directly from the output of a solar panel. The solar panel is the basic building block of the system. This is your battery charger. If you have several solar panels wired together you have created a **solar array**. The size of the solar array determines the amount of power or energy that will be produced.

The batteries used in solar systems are similar to car batteries, but are designed for deep cycling use in which a larger percentage of the capacity of the battery is used each night (and then fully charged up each day). Batteries designed for solar projects pose the same risks and demand the same caution in handling and storage as automotive batteries.

The fluid in unsealed batteries is highly corrosive. Fluid levels should be checked periodically, batteries must be appropriately ventilated, and batteries should be protected from extremely cold weather. In practice we have found that when the batteries are maintained properly, they last for approximately 5-10 years. After which, their capacity is significantly diminished.

Battery Maintenance

Battery backed solar electric systems are fairly simple to maintain. With ordinary use, you just have to do a couple things:

- Check your deep cycle batteries every few months to make sure they have enough distilled water.
- Occasionally check the connections between the solar modules and the inverter(s), and tighten them when applicable.

8. How Much Does Solar Cost?



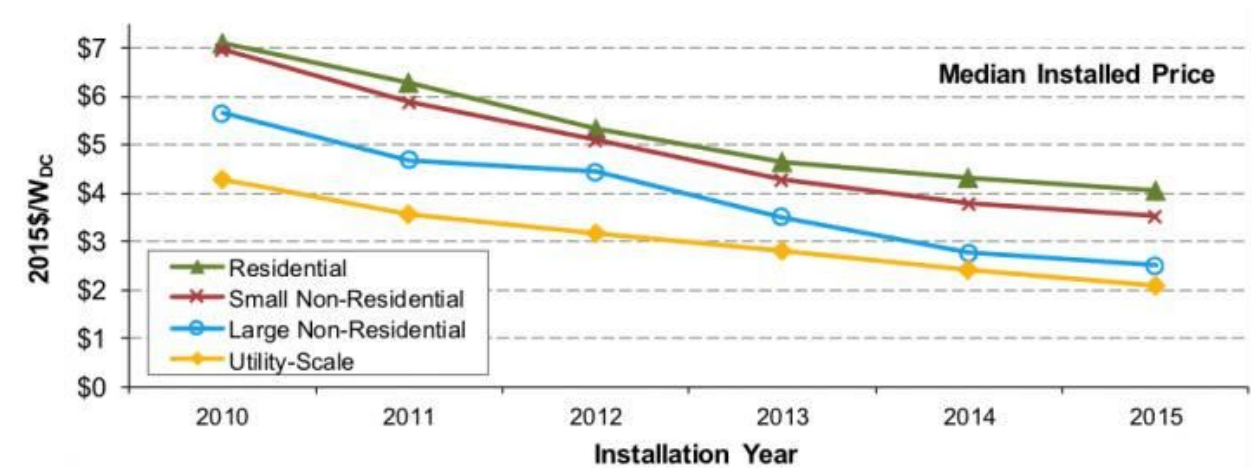
The number of solar panels you need and how you want to mount them -- for example, up on your roof or down on the ground -- are just two of the factors that will affect the overall cost of your off-grid system. Another important factor will be which brand of products you choose.

A reputable solar installation company will work hard to provide all the information and help you to select a renewable energy solution that gives you the best overall value for your investment.

For example, at Main Street Solar, we don't just look at the price of an item, though of course that is an important consideration. Sometimes the upfront cost of an item can be misleading. Though it may seem like a good deal at first glance, when you look more closely – at quality, dependability, efficiency and life expectancy – you may find a slightly more expensive product will offer a better value over the life of your system.

The price of solar in Virginia follows a national trend where the cost of home solar systems went down 5% from 2014 to 2015, according to a 2016 report from the US Department of Energy (DOE). In fact, last year was the sixth year in a row that prices declined on home solar.

This chart from their recent report on solar prices helps tell the story. The price of home solar is represented by the green line at the top, and costs are listed as dollars per watt for all the costs to install a solar system, including equipment, labor, permits, and company overhead:



It's Not Just Lower Panel Prices

In the past, the price of getting a system on your rooftop went down mostly because solar panels kept getting cheaper.

After dropping for years, now the price of solar panels (also called PV modules) has leveled off. But the costs of other things in a solar installation have started to go down. As the [DOE explains](#):

The continued decline is especially noteworthy given the relatively stable price of PV modules since 2012. The report attributes recent system price declines, instead, to reductions in other hardware costs and to solar “soft” costs. The latter includes such things as marketing and customer acquisition, system design, installation labor, and permitting and inspections.

Like many installers based in Virginia, Main Street Solar has always run a pretty lean operation, trying to keep prices for our customers down by keeping our overhead low. In my opinion, I believe that we've done a pretty good job — as have many of our friends in the Virginia solar industry.

What Home Solar Costs Today in Virginia

All that has meant that solar is now affordable for many more homeowners in the Old Dominion. Just take the figures listed by SolarPowerRocks.com for an average sized 5 kilowatt home solar system in Virginia with an expected lifespan of 25 years:

- Installing a typical 5-kW solar system should start at about \$18,750.
- The federal government offers a tax credit of 30% of out-of-pocket costs, so you'll get \$5,625 back next April.
- Then there's your first-year energy savings. That's another \$749, and it brings the cost after 1 year to just \$12,376.
- With all the energy bill savings rolling in, your system will pay itself back after 14 years. Once that happens, you'll be seeing over \$1,200 per year in savings until the end of your system's life.

Now, these are just averages and, as they say in car commercials, your mileage may vary.

For example, Main Street Solar installs home systems that start for much less than \$18,750, especially those smaller than 5 kilowatts. Also, we aim to design systems for our customers with a payback time of ten years or less.

9. What Incentives Are Available in Virginia?



The federal government, some cities and counties and many local utilities offer incentive programs. A knowledgeable solar installer should be able to help you discover if you qualify for additional incentives where you live.

Statewide, net metering is the main incentive in Virginia for home solar power. According to SolarPowerRocks.com:

Net metering is the billing arrangement where you can sell excess electricity back to your utility for equal the amount you are charged to consume it. The more customer friendly net metering policies, the higher the grade.

Net metering allows utility customers to generate their own electricity cleanly and efficiently. During the day, most solar customers produce more electricity than they consume; net metering allows them to export that power to the grid for credits and reduce their future electric bills.

Net metering is a billing mechanism that credits solar energy system owners for the electricity they add to the grid. For example, if a residential customer has a PV system on the home's rooftop, it may generate more electricity than the home uses during daylight hours. If the home is net-metered, the electricity meter will run backwards to provide a credit against what electricity is consumed at night or other periods where the home's electricity use exceeds the system's output. Customers are only billed for their "net" energy use. On average, only 20-40% of a solar energy system's output ever goes into the grid. Exported solar electricity serves nearby customers' loads.

Net metering allows residential and commercial customers who generate their own electricity from solar power to feed electricity they do not use back into the grid. In Virginia utility companies are required to credit alternative energy customers for any excess energy produced by that customer.

Customers of investor-owned utilities such as APCo and Dominion as well as those served by rural electric coops all qualify for net metering. Customers served by municipal utilities may not qualify.

Homeowners can net meter solar energy systems up to 20 kW in capacity located on the customer's property. Systems must be sized to approximate the customer's own energy use. Your utility may not approve net metering for you if you buy a solar system big enough to allow you to sell most of your power to the grid on a regular basis. Then they'll think you're trying to compete with them.

Also, home solar systems above 10 kW may incur one or more standby charges from their local utility, either for distribution, transmission or both.

10. How Can I Choose A Good Solar Installer?



With solar exploding across the US and growing quickly in Virginia, in most parts of the state homeowners should have at least a couple solar installation companies to choose from. But making the right choice can make the difference between a solar system that will serve you well for decades to come and a less attractive outcome.

Overall value is important when choosing between the increasing number of professionals offering solar products and services. Often the low bid is from a company that is highly qualified and has a well-managed operation, but sometimes it comes from a company that will cut corners or that may not fully understand the job requirements.

SolarReviews.com, one of the leading websites for customers to post reviews of solar installation companies, offers a helpful list of things you should do to find a solar installer that will provide the expertise, high-quality work and reliable service to make sure that your solar energy system hums along smoothly and offers you the maximum amount of money savings. Here's their list:

1. **Read Reviews and Get Recommendations.** Of course, every solar installer is going to say that they do good work. But reviews from their customers offer an outside view from someone who's worked with that company. SolarReviews.com, Yelp, and Angie's List are good places to find reviews of solar installers in your area. And if you know anyone -- a family member, friend, coworker or neighbor -- who's gotten solar in your area, ask them who they worked with.
2. **Get Multiple Price Quotes.** Don't just go with the first company that you find online or who calls you or comes by your place. Always talk to at least one more solar installation company before you decide who to go with. You may find a solar company that responds to your request for a quote quickly, which indicates that they really want your business. Other installers can take a couple days or longer to get back to customer inquiries -- possibly indicating that they're too busy right now or that they're just not that responsive.
3. **Learn about the Equipment They Sell.** As with anything for your home, better equipment usually costs more. Solar panels made in the USA cost more than imports, but the domestic panels may last longer and produce more energy. Likewise, monocrystalline panels -- the original black panels made from a single cell of pure silicon -- are more expensive but produce more energy than polycrystalline PV panels. However, the gap between the two is closing, and polycrystalline panels may be the best choice for your installation. A good solar company should be able to explain the difference clearly and make a recommendation to fit your budget and your home.
4. **Find out what Warranties and Guarantees They Offer.** Depending on the brand, solar panels (also called modules) come with a warranty on parts from 25 to 35 years. The inverter, which is the part of a solar system most likely to break down, should come with a warranty of at least 10 years and up to 25 years or more. And some solar companies offer their own guarantees on labor or even on the performance of your solar energy system. For example, Main Street Solar offers a Solar Performance Guarantee where we make sure that you get at least a certain amount of energy from your solar panels every month. If you don't, we'll fix it.
5. **Are they Certified?** Both solar companies and the installers they employ can be certified in solar system design, installation and maintenance. The North American Board of Certified Energy Practitioners (NABCEP) is one of the most reputable certification programs for solar PV and solar heating installers. For companies, the [Pre-Screened Solar Pro](#) means that an installation company has passed a background check, been in business a certain amount of time and has a minimum number of customer reviews. And the Better Business Bureau (BBB) can show how a company has dealt with customer complaints.
6. **Are they Committed to Service? Can They Offer Customer References Who Say that They Are?** The way that an installation company works with you before you sign a contract with them can help predict how they'll treat you while installing your solar energy system and afterwards if any maintenance is required. If they can

answer your questions in a way that's easy to understand, if they respond quickly to inquiries and if they seem helpful and skilled in the initial consultation, that's a good sign of quality work to come.

- 7. What Financing Options Do They Offer?** The financing options that a solar installation can offer vary by state, depending on government regulations, and also by company. In Virginia, the options for solar companies to finance home solar are pretty straightforward. After taking advantage of the 30% federal tax credit for solar installations, most homeowners in Virginia pay for their new solar systems with cash to get the maximum financial benefit for themselves. For customers interested in financing, loans at attractive rates are available from some installers directly while other installation companies work with their customers to apply for a home equity loan from a credit union or local bank. Beware of any financing that sounds too good to be true -- it probably is.

Finally, a solar installation company that you can trust won't use pushy sales tactics like cold calling or put on the hard sell to try to get you to sign on the dotted line before you're ready. Only choose a solar company that takes the time to listen and respond to your questions and concerns until you feel comfortable.

A solar company that provides educational materials on their website through a blogs or through ebooks like this one is even better. It shows that the company wants to deal with a customer who's empowered with the information to make the best decision about solar for his or her home.



We hope that you've enjoyed this guide. And when you're ready to learn more about solar for your home, if you're in the state of Virginia, we hope you'll contact us.

Main Street Solar has the experience and resources necessary to ensure your investment is a dependable, quality installation providing a lifetime of worry free savings. Guaranteed.

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