



Solar Photovoltaic Basics

A solar electric system is a simple, no-maintenance way to reduce or eliminate your electricity costs. The right size system can zero out your bill, plus reduce carbon emissions by thousands of pounds per year.

Components

The system is an array of panels, on the roof, building side, or ground. Wires connecting the panels are run, in conduit, down to an inverter, near your electric meter. The inverter converts the DC power from the panels to AC and feeds it into your meter. Xcel Energy will, at the end of the installation, replace your old meter with a new “net meter”, which can run backwards.

You are a small power plant for Xcel Energy

Xcel buys all of your system’s electricity from you. They will pay you the same price they charge you, or “retail”, up to the amount of electricity you use per year. The power you produce runs your meter backwards. You are using power from the same meter running it forward. If you produce as much as you use in a given month your meter reading will be zero, therefore your bill is zero. Aside from a couple flat fees, all the incremental fees on the electricity half of your bill are based on usage. If your usage is net zero those also are zero.

If your solar system produces more than you use, at the end of the year Xcel Energy will send a check for the excess, but for this they only pay wholesale rate. So we work to install a system that produces only about what you use. This is your best investment. *If you live outside the Xcel Energy electric territory, please check with your local utility for possible rebates for system construction and payments for excess electricity that is returned to the grid.*



HomeSmart Solar from Xcel EnergySM Makes it Affordable

*Prices change regularly – cost of materials has reduced dramatically in the past two years. Xcel Energy’s Solar*Rewards rebates can change, depending on how differing categories of systems are completed. Check with HomeSmart’s estimator at the time of your home review for final costs, rebates, and federal and state (if any) incentives.*

**For additional information on Solar*Rewards from Xcel Energy, and other resources/organizations, please go to www.xcelenergy.com/solar. HomeSmart Solar is one of many approved Colorado solar contractors that are capable of installing your residential system.*

Take a Federal Tax Credit

At the end of the year you can take a federal tax credit equaling 30% of the after-rebate cost. This is a real credit off owed taxes, not a deduction. If you can’t use it all in one year you can carry the unused portion

Call HomeSmart Solar from Xcel EnergySM at 1-866-837-9762 for a home system estimate.
www.homesmartcolorado.com

Source: © Vibrant Solar Inc., HomeSmart Solar from Xcel EnergySM. Photos- Vibrant Solar Inc. Used by permission.
Solar Photovoltaic Basics / October 11 / Page 1

forward up to two years. You can even get out of the Alternative Minimum Tax with this credit. We will give you the correct IRS form for this tax credit.

The Three Factors

Your goal, your rooftop (or ground space) and your budget. The typical goal is to zero out your bill. If you have enough space, with good “solar access”, we can install enough panels to achieve that. Or, we can fit within your budget, down to a 12-panel system. The system is modular - you can add another set of panels, and an inverter for those, later. If the rebate program is still going the new section will also earn the rebate.

Site Visit, Design & Quote at No Obligation

One of our Solar Consultants will visit your home, answer any questions, get your instructions and help you determine your goal, then measure your rooftop for solar. They have an instrument that will measure how much sun hits each portion of your roof. Our designers will then create a 3D computer model of your home with its new solar array. Our Solar Consultant will bring you the design and quotation. This is all with no obligation. Once you have the full information you can decide whether to move forward.

Photovoltaics 101

What is a photovoltaic panel and how do they work?

Why is it good to have solar electric panels in Colorado?

What are the parts of a PV System?

Is there a battery involved?

How much maintenance is required?

What is a Watt?

What is a Watt-hour?

What does shade do to PV Panels?

Is there any water in these panels?

What is the difference between different brands of panels?



What is a photovoltaic panel and how does it work?

Photovoltaic (PV) panels are typically made from high purity silicon wafers similar to those used in computer chips. When light strikes the surface of the wafer it dislodges electrons, which then are collected and output as electric power. A typical solar panel is made of dozens to hundreds of these wafers all soldered together and framed with aluminum and then covered with a very tough low reflective glass. Because PV panels have no moving parts they have a very long life span with very little maintenance. Some panels have been in operation for over 50 years and still function – if at slightly diminished capacity.

Why is it good to have solar electric panels in Colorado?

Colorado, along with the rest of the southwest, is one of the best places in the country for photovoltaics. We typically get 300 sunny days per year here and have a relatively high altitude and low latitude. All these factors combine to make Colorado one of the sunniest places in the country. Cold weather is actually good for output. The best production is on a sunny, cold winter day.

What are the parts of a PV System?

There are four main parts to any PV installation. The **panels** produce the electricity. The **mounting system** connects the panels to the roof. The **wiring** takes the electricity to the main power panel. The **inverter** converts the DC current from the panels into the AC current used by your house and the electrical system.

Call HomeSmart Solar from Xcel EnergySM at 1-866-837-9762 for a home system estimate.

www.homesmartcolorado.com

Source: © Vibrant Solar Inc., HomeSmart Solar from Xcel EnergySM. Photos- Vibrant Solar Inc. Used by permission. Solar Photovoltaic Basics / October 11 / Page 2

Is there a battery involved?

No, we install only grid tied systems. In other words, you are generating electricity that is fed into the electrical grid. If you want a system that is off the grid, say, for a mountain cabin, we can refer you to an associated company that can install a battery operated DC system. Note that your regular appliances will not work on a DC system unless they each have a converter/adaptor. Or, you can purchase appliances specifically manufactured to work on DC rather than AC.

How much maintenance is required?

Very little. Typically PV panels require no maintenance. About the only thing that an owner can do is to wash them down if they get too dirty, but even that doesn't happen very often. Typically, the panels are kept clean enough by the rain and snow falling on them.

What is a Watt?

A watt is a basic unit of power. Think about the light bulbs in your house. They are rated in watts. The more watts they use, the brighter they are. Typically a 100-watt light bulb produces four times as much light as a 25-watt light bulb and it uses four times as much power. Solar panels are rated in Watts. This rating is the amount of power the panel can produce under full, direct sunlight.

What is a Watt-hour?

A watt-hour is a unit of energy. It is a measure of power over a span of time. If you have a 100-watt light bulb and you leave it on for one hour, it will consume 100 watt-hours of energy. In Colorado, a PV panel will produce its rated power for an average of 5.0 - 6.5 hours per day. This means that a 200-Watt panel will produce an average of 1000-1300 watt-hours per day. The actual number will be higher in the summer and lower in the winter.

What does shade do to PV Panels?

PV Panels are very sensitive to shade. Typical panels are broken up into rows of cells, or sections, which in turn are made of several photocell wafers. If any part of a section is shaded, then that section stops providing power to the panel. This means that any shade can cut the power output dramatically.

Is there any water in these panels?

No, photovoltaic panels have no water in them. They generate electricity directly from sunlight.

What is the difference between different brands of panels?

While all the panels we use are excellent and carry nearly the same warranty, each brand of solar panel has some unique attributes. Some panels are more efficient than others, some use different types of solar cells, some are manufactured to tighter tolerances and each looks a little different. In our experience the one factor that is the most important to our clients is dollars/watt. At various times, various companies have specials or just lower prices in general. We always strive to give our customers the best possible price on their system. Of course, if a customer has a desire for a specific manufacturer, we are happy to oblige them.

Colorado, Rebates & Tax Credits

Why is it good to have solar electric panels in Colorado?

What are my obligations to Xcel Energy if I get a rebate?

What if I move before 20 years?

What is net metering?

Does a PV system add to the value of my home?

What is the federal tax credit?

Do I have to declare the Xcel Energy rebates/incentives on my taxes?

Call HomeSmart Solar from Xcel EnergySM at 1-866-837-9762 for a home system estimate.

www.homesmartcolorado.com

Source: © Vibrant Solar Inc., HomeSmart Solar from Xcel EnergySM. Photos- Vibrant Solar Inc. Used by permission.
Solar Photovoltaic Basics / October 11 / Page 3

Why is it good to have solar electric panels in Colorado?

Colorado, along with the rest of the southwest, is one of the best places in the country for photovoltaics. We typically get 300 sunny days per year here and have a relatively high altitude and low latitude. All these factors combine to make Colorado one of the sunniest places in the country

What are my obligations to Xcel Energy if I get a rebate?

To get the Xcel Energy incentives you must sign a contract with them. This contract basically requires you to continue being an Xcel Energy customer for the next 20 years and requires you to keep your PV system in working order for that period of time.

What if I move before 20 years?

Xcel Energy requires that you assign your contract to the people who buy your house. In effect, they will take up where you left off and continue to enjoy the benefits of your system. This is a nice selling point for your home.

What is net metering?

Part of the law that requires Xcel Energy to provide the PV incentives also requires that Xcel Energy use net metering for new PV systems. This means that each installation only has one meter for metering both power used by the home/business and for power generated by the PV system. This means that Xcel Energy will effectively be paying the consumer the same rate for power that they generate as for the power that they use. With a large enough system, the consumer will see their electric meter turning backwards on sunny days and then turning forwards on cloudy days or at night. Every month, the customer only pays for what they used over and above what they generated. If the customer generates more power than they consume, then Xcel Energy will write them a check at the end of the year.

Does a PV system add to the value of my home?

According to a nationwide study by the American Association of Appraisers in 1999, a PV system will add \$10-\$20 to the value of your home for every dollar saved over the course of a year. Thus, if your system saves you \$700/year, it would typically add \$7,000-\$14,000 to the value of your home. That's a pretty wide range, though, and the market for home sales has suffered in recent years. Think of it this way – if you are selling your home and note that the electricity is free it's a great selling point. It's worth something, and the only question is how much.

What is the federal tax credit?

There is a federal tax credit of 30% of the total cost of the installed PV system. Starting January 1, 2009 through 2017 for residential systems it is 30% of the after-rebate cost, without any cap. At the end of the year when you install the PV system, you can remove that credit amount directly from your tax owed. So, if you owed \$10,000 in taxes and put a system on your house that cost \$12,000 then your tax credit would be \$3,600 and your tax bill would be reduced to \$6,700. If you are making prepayments toward your taxes, as many people are, you might reduce your prepayments to actualize the tax credit sooner. Just be sure to follow the IRS rules regarding how much you must prepay during the year. *Consult your tax attorney or certified public accountant for details on how to do this.*

Do I have to declare the Xcel Energy rebates/incentives on my taxes?

For residential systems, the new program launching in 2009 states 'no'. But we are not lawyers or tax accountants. *Please consult your tax attorney or accountant.* For commercial systems the rebate is considered taxable income, but you get a larger tax credit and accelerated depreciation. You make out quite well no matter which way you look at it.

Call HomeSmart Solar from Xcel EnergySM at 1-866-837-9762 for a home system estimate.

www.homesmartcolorado.com

Source: © Vibrant Solar Inc., HomeSmart Solar from Xcel EnergySM. Photos- Vibrant Solar Inc. Used by permission. Solar Photovoltaic Basics / October 11 / Page 4

Weather, Warranties and Lifetime

How long do PV Systems last?

What is the warranty?

Do I throw the panels out after 25 years?

How much maintenance is required?

What about hail?

What about lightning?

What about high winds or snow load?

Is there any danger from a PV system?



How long do PV Systems last?

50 years or more. The typical PV panel is warranted to produce at least 80% of its rated capacity at 25 years, losing less than 1% per year. They typically do much better than this, only losing about .4%, less than ½ of one percent, per year. The inverter is warranted for 10 years and is more likely to suffer a breakdown than the panels. The wiring and the mounting system should last as long as the panels.

What is the warranty?

Most panels have a 25-year power production warranty. The Inverter has a 10-year warranty and the installation has a 5-year warranty. Weather damage is a homeowner's insurance issue, though the panels are very tough and are unlikely to be damaged by weather.

Do I throw the panels out after 25 years?

No, panels will only rarely stop working. Instead you will see a gradual degradation in their power output after their warranted period. A .8% (point 8 percent) per year loss of energy output is typical.

How much maintenance is required?

Typically PV panels require no maintenance. About the only thing that an owner can do is to wash them down if they get too dirty, but even that doesn't happen very often – rarely in Colorado. Typically, the panels are kept clean enough by the rain and snow falling on them.

What about hail?

PV Panels are very tough. They are tougher than a typical roof and are rarely damaged by hail. In the unlikely event that the panels do get damaged, they will usually be covered by your homeowners insurance.

What about lightning?

Lightning is the chief cause of failure in PV Panels. The best way to combat this problem is to make sure that panels are well grounded. A separate grounding wire connects all the panels to one another and then to the ground in the house electrical system. This way, if a panel is hit, the electricity from the strike will be diverted to flow through the wires into the ground and it won't harm the panels. If you live in an area of high lightning risk you will want to run the grounding wire to a large spike buried in the ground.

What about high winds or snow load?

All of our PV systems are engineered for the wind speeds and exposure ratings of their installed location. We have a structural engineer who will analyze your roof and the wind speeds and snow loads. Only after we get the engineer's approval will we go forward with an installation.

Call HomeSmart Solar from Xcel EnergySM at 1-866-837-9762 for a home system estimate.

www.homesmartcolorado.com

Source: © Vibrant Solar Inc., HomeSmart Solar from Xcel EnergySM. Photos- Vibrant Solar Inc. Used by permission. Solar Photovoltaic Basics / October 11 / Page 5

Is there any danger from a PV system?

A PV system generates a considerable amount of electric power and thus should be treated with respect just like the outlets in your house. The owner should never cut wires or disconnect the system without a good understanding of what they are doing.

Location, System Sizing & Costs

What do I need to have for a PV system?

How many panels do I need?

Can I put panels on the ground?

What if my neighbors have trees that grow to shade my panels?

How long does installation take?

What if I need to replace my roof after I put panels on it?

Can my roof support these panels?

I have an HOA. Can they stop me from putting panels up?

What is the difference between different brands of panels?

What about PV shingles?

How can I pay for one of these systems?

What is the process for buying a PV system from HomeSmart Solar?

What do I need to have for a PV system?

You need roof or ground space that is not shaded from the south, east or west. The best roof space is unshaded, angled at an 8/12 to 10/12 pitch (30-40 degrees), and facing directly south. Don't worry if you don't have a roof like this. Most people don't. The only absolutely necessary qualification is having an area free of shade. We have put panels on all types of roofs at all types of orientations and angles.

How many panels do I need?

That depends on several things. It depends on how much power you use, how much money you want to spend, and how much unshaded roof area you have. A typical home will use about 700 kilowatt-hours of power per month though some homes use more and some less. In Colorado a 5 kilowatt system will provide you with that much power. That is about 21 3'x5' panels, 373 square feet (in our 5kw system example) but many homes do not have enough unshaded roof space for that many panels. Do be aware that it is not necessary to cover all your electrical costs for a PV system to make sense. Even if you only put in a one-kilowatt system, you will still get the same return on your investment and still benefit the planet. You can also start small and add to your system as money becomes available. At *HomeSmart Solar* we will be happy to talk with you about your needs and provide you with recommendations for a system to fit those needs.

Can I put panels on the ground?

Absolutely. We have ground mounting systems and pole mounting systems, which you can use to hold your panels. We even have side mounts - window awnings and parking canopies. The only thing necessary is having the unshaded space available.

What if my neighbors have trees that grow to shade my panels?

In Denver, and some other cities, if you install your panels in a place that is originally unshaded and a neighbor's tree grows tall enough to shade your panels or they put up a structure that shades your panels, you have the right to make them to remedy the problem.

How long does installation take?

This depends on the system size. A typical 5KW residential system takes 2-3 days to install the panels and 1-2 days to complete the wiring, so a total of 4-5 days. But the process may be much longer, often 10 to 12 weeks. This depends largely on how long it takes for the permits to be approved, but also how many projects we have going.

Call HomeSmart Solar from Xcel EnergySM at 1-866-837-9762 for a home system estimate.

www.homesmartcolorado.com

Source: © Vibrant Solar Inc., HomeSmart Solar from Xcel EnergySM. Photos- Vibrant Solar Inc. Used by permission. Solar Photovoltaic Basics / October 11 / Page 6

What if I need to replace my roof after I put panels on it?

If you need to replace your shingles after placing panels on the roof, you might need to take the panels down before replacing the roof. This will not add more than a few thousand dollars to the cost and typically much less. Of course, the panels themselves will provide a lot of protection for your roof and you may be able to get away with only replacing the shingles that are not covered by the panels. If you find yourself needing to consider a new roof after the panels are in place, don't hesitate to call us. We will help you find the least expensive alternative.

Can my roof support these panels?

Typically PV panels do not put much demand on a roof - just less than four pounds per square foot. Modern roofs are engineered with a large safety factor built into them. A PV system will almost never overload a newer roof. With most systems and especially on older roofs, our structural engineer will certify that the roof can handle the PV system without trouble.

I have an HOA. Can they stop me from putting panels up?

No, not in Colorado. There is a Colorado statute that prevents neighborhood associations, even historic districts, from stopping a homeowner from putting up PV Panels due to aesthetic considerations. The particulars include that they cannot cause you to spend more for, or get less power from, your solar electric system. HOAs are generally run by volunteers, and we want to continue your friendly relationship with your HOA. We show them the respect they are due by working with them for approval.

What is the difference between different brands of panels?

While all the panels we use are excellent and carry the same warranty, each brand of solar panel has some unique attributes. Some panels are more efficient than others, some use different types of solar cells, some are manufactured to tighter tolerances and each looks a little different. In our experience the one factor that is the most important to our clients is dollars/watt. At various times, various companies have specials or just lower prices in general. We always strive to give our customers the best possible price on their system. Of course, if a customer has a desire for a specific manufacturer, we are happy to oblige them.

What about PV shingles?

PV shingles are basically PV wafers packaged as a shingle. They lie flat on the roof like an ordinary shingle and provide less of a visual impact than normal panels. The current problem with these shingles is that they are nearly two times the cost of typical PV panels. They also often require special roof preparation. Prices have come down over the past couple of years. Check with us for current availability.

How can I pay for one of these systems?

In addition to cash or check, you may pay for your system by refinancing your home or with a home equity loan. When you pay for the panels this way, you are paying with pre-tax dollars. This effectively reduces the interest rate for the money you borrow by 25% to 50%!

Is Short Term financing available from HomeSmart?

Check with HomeSmart to see what financing may be available, with approved credit.

What is the process for buying a PV system from HomeSmart Solar?

The process is straightforward. It typically goes like this: Call HomeSmart for a free, no obligation home analysis and quote. We will come out and analyze your home and lay out your options.

Once you decide on a system size, we will provide you with a quote that itemizes all the expenses, rebates and expected benefits. At this point you will know what your out-of-pocket cost will be (or, your full costs should you decide to carry the rebate). This will be the price for the installed system minus the Xcel Energy incentives.

When you decide to purchase the system we will require a deposit based on either the total cost or, if we are carrying the rebate, on the out-of-pocket cost. This deposit is non-refundable, unless Xcel Energy declines the

Call HomeSmart Solar from Xcel EnergySM at 1-866-837-9762 for a home system estimate.

www.homesmartcolorado.com

Source: © Vibrant Solar Inc., HomeSmart Solar from Xcel EnergySM. Photos- Vibrant Solar Inc. Used by permission. Solar Photovoltaic Basics / October 11 / Page 7

rebate application. We will then apply to Xcel Energy for the rebate and REC (renewable energy credit) payment.

When we get confirmation from Xcel Energy then we will need a payment (or a financing agreement, with approved credit) from you of half the total, or out-of-pocket, cost. At this point we will order the system, assign a structural engineer to analyze your roof, and pull the permits with the city where your installation will be.

The system is delivered 3-5 weeks later and we will need the other half of your payment. At this point, we will schedule the installation date with you. This will typically be within a week.

We install the system on the scheduled date. This will take a total of 3-4 days, but might be a bit longer depending on the installation size, weather and other mitigating circumstances.

We schedule the final inspection with the city and, upon their approval, apply for the final inspection from Xcel Energy. Once Xcel Energy approves the system they replace your meter with one that can go backwards and you are now making energy from the sun!

Note that the timetable can be delayed for numerous factors, including changes in permits and inspections criteria. Cities and counties are learning about solar so changes happen - sometimes without our being aware until the next permit or inspection. We will keep you informed on the progress of your PV project.

About 60 days later you, or we, receive two checks – one for the rebate and one for the REC payment from Xcel Energy.

Environmental Topics

Why should I install a PV system on my home?

There are two main reasons for installing a PV system on your home. The first is concern for the planet. PV systems use a free and renewable energy source (our sun) to generate electricity. They don't produce any greenhouse gases and they lower our impact upon our increasingly crowded and stressed planet. The second reason is economic. For the first time in history, it makes good economic sense to install a PV system on your home. With the incentives provided by Xcel Energy to their customers in Colorado and current federal tax credits, PV systems are cheaper than they have ever been.

How long does it take a solar panel to replace the energy that it took to make them?

The answer to this depends upon the panel, but we have seen calculations ranging from 18 to 30 months. After this time, the energy coming from the panels is 'free'.

*HomeSmart Solar from Xcel EnergySM is a service of HomeSmart from Xcel EnergySM
HomeSmart is not regulated by the Colorado PUC.
HomeSmart Solar services may not be available in all areas.*



Call HomeSmart Solar from Xcel EnergySM at 1-866-837-9762 for a home system estimate.

www.homesmartcolorado.com

Source: © Vibrant Solar Inc., HomeSmart Solar from Xcel EnergySM. Photos- Vibrant Solar Inc. Used by permission.
Solar Photovoltaic Basics / October 11 / Page 8