

# Solar Energy Questions and Answers for Wayne County Ohio

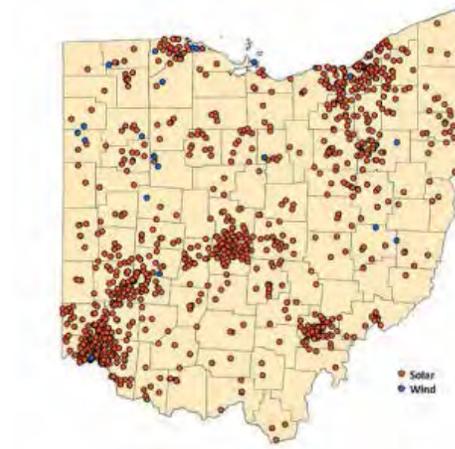
## Questions

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## I want solar, now what?

If you are interested in installing a solar energy system on your home, you are not alone. Many homeowners and businesses in Ohio have installed renewable energy systems and interconnected them to the electric grid (Fig. 1). Here is some information and answers to questions to help decide how to move forward.

Fig. 1. Certified solar and wind renewable energy system sites in Ohio (source: Public Utilities Commission of Ohio)



### Solar thermal versus solar electric (photovoltaic)

There are two types of solar energy systems that can be installed at a residential location; solar thermal and solar electric (or photovoltaic). One system heats water that can be used as a source of hot water for washing and bathing or for radiant floor heating. The other produces electricity that can be used to power lights, electronics, appliances, charge batteries or be put onto the grid for others to use.



Solar Thermal



Solar Photovoltaic

In the last few years, there has been a dramatic drop in the price of photovoltaic systems (from \$8 per watt in 2006 to less than \$3 per watt installed in 2016), making the most economical choice more clear. Today, solar photovoltaic electric systems dominate the market and are the least expensive choice for renewable energy generation, especially in temperate climates like Ohio. In fact, it is much less expensive to use PV panels to produce electricity and use that to heat water, than it is to produce the same amount of hot water using a solar thermal system. Solar thermal systems are also prone to leaks and require frequent maintenance to prevent freezing. They are also most productive during



summer months when little hot water is needed, and produce little, if any, heat in the winter when it is.

In the future, panels that capture both light and infrared (heat) energy [may be available in the same system](#). Liquid flowing through a PV panel would be used to cool it, improving its efficiency, and then pumped to a heat exchanger where the heat is recovered and used to provide hot water. Phase changing materials that absorb heat and change from a solid to a liquid at 120 F have been developed for this purpose. But these types of systems are not yet commercially available or economical. Nearly all solar energy systems installed today are grid tied photovoltaic systems.

### **Does my location have enough sunshine for solar?**

Usually, a site with lots of shade will not receive sufficient light to make a solar energy system economical. Many sites in Ohio towns and cities with tall shade trees fall into this category. One solution to this is to remove the trees and use the wood for heating. But often this is not desirable since the trees provide cooling with their shade, and a neighbor's trees may be the culprit anyway. Small amounts of shade usually are OK for solar energy generation, but a location with little or no shade is ideal. A [solar pathfinder system](#) can be used to determine the amount of shade at a site for every month of the year with one measurement. WCCEN has these systems available if requested.



### **Where can I mount a solar energy system?**

While some rural properties have sufficient area for ground mounted systems, most solar energy systems are mounted on a roof. Ideally the roof is at a pitch slightly less than the sites latitude and faces solar south. Wayne county's latitude is 41 degrees north so the ideal angle would be from 30 to 40 degrees. In Ohio, solar south is 7 degrees west of magnetic south, however a roof facing anywhere from southeast to southwest is suitable for solar energy production here. Flat roofs also work well for solar systems especially when the panels are tilted to face south. Solar will work poorly on a roof facing north and or any direction north of east or west.



### **My roof is old, should it be replaced first?**

The structure and condition of a roof where a solar energy system is to be mounted is important. A solar PV system will typically last more than 25 years. If a roof is old or damaged, it is better to replace or fix it before installing a solar energy system. A solar system can protect a new roof from heat and ultraviolet light damage. The roof must also be able to support the weight of a solar system. A typical array will add 3 lbs per square foot to the roof. Many roofs are able to accept 10-20 lbs per square foot of additional weight.

Racking systems are generally anchored to rafters which must be able to support the weight of the system and accept the mounting screws. On raised seam metal roofs, clips that attach to the raised seam that do not require a roof penetration can be used to clamp racks to the roof. Amorphous silicon panels have an adhesive backing can be stuck directly to a roof surface and do not require racking or penetrations. Thin film panels however require nearly twice the roof area to produce the same amount of electricity as a poly, or mono crystalline, solar panel. New mounting systems, like the Dynoraxx PR system, can be mounted directly onto the roof decking and clamp to the panels, making rails unnecessary.

### **How large should the system be?**

A solar PV system should not produce more than 85% of the electricity used annually at a site, and must fit within the available roof area and your budget. The amount of electricity used each year at your site can be found on your electric bill. A typical household in Ohio uses approximately 1000 kWh per month or 12,000 kWh per year. It ranges from 100 to 3,000 kWh per month and varies with the size of the home, how energy efficient it is, whether it has electric or gas heat, the amount of air conditioning used, and whether an electric or plug-in electric vehicle is charged.

Electric heat can add 30-40% to the amount of electricity typically used by a homeowner. Air conditioning is usually the single largest load in a home. Dryers, electric stoves, and electronics can also use substantial amounts of electricity. Electric cars use less electricity than one might think. For example a Nissan Leaf uses 0.34 kWh to drive one mile. If the car is driven 5,000 miles per year it would use just 1700 kWh per year equal to the amount produced by 5 or 6 solar panels.

It is always cheaper to improve home efficiency by using Energy Star appliances, heaters and air conditioners, and using lighting with motion sensors and LEDs, then it is to produce photovoltaic electricity. So this is usually done prior to installing a solar energy system.



The amount of electricity that a low shade solar system will produce in Ohio is approximately 1,100 kWh per installed kW per year. For example, a 5 kW system would be expected to produce approximately 5,500 kWh per year. If your electric bill indicates that your overall cost for electricity is 12 cents per kWh, then this system would produce approximately \$660 ( $\$0.12/\text{kWh} * 5500 \text{ kWh}$ ) worth of electricity per year.

### **Should I install the system myself?**

An important decision to make is who will install your solar energy system. It could be you, a contractor, or a company experienced in solar system installation. The majority of systems are installed by solar system installers. Solar systems are usually too complex to be installed by a do it yourselfer. But those with experience in construction or electrical systems can usually install parts of the system. However a

certified electrician must always review electrical systems, and is required to interconnect the system with the grid. Installing panels on a roof can be hazardous, especially on steep roofs. Solar panel reliability can vary and an experienced installer usually will know which types of panels have a good track record. Low cost panels, used panels and homemade panels may not hold up over time. When solar panels are connected in series, they can generate as much as 600 volts of direct current (DC) in full sun, easily enough to kill an inexperienced installer.

A list of solar installers that serve Ohio can be found at the [Green Energy Ohio website](#). It is also good to ask a friend who has had a system installed locally to see who they would recommend. It is usually good to ask for more than one estimate just as one would for any expensive item.

### **How much will a system cost?**

The cost of a complete PV system, including panels, inverter, racking, wiring, interconnection, permitting and labor ranges from \$2.60 to \$3.00 per watt in Ohio. The 5 kW system described above would cost from \$13,000 to \$15,000 and produce roughly half of the electricity used by a typical Ohio household. With the 30% federal renewable energy tax credit, the net cost would be \$9,100 to \$10,500. Over the 25 year life of the system it would produce electricity worth approximately \$16,500 assuming that the price of electricity is constant. If the price increases, as it has over the past 10 years at a rate of more than 3% per year, then the value of the electricity produced over the 25 year life of the system would be \$24,000. Since the cost of the solar electricity system would be \$10,000 and the cost of the electricity produced by the system would be \$24,000 if it was purchased from the utility, homeowners could realize a 60% savings in electricity costs. In almost every circumstance, solar energy will cost less over time than purchasing grid electricity. The [PV Watts calculator](#) can be used to get a rough idea of the value of energy produced based on your address, the size of the system, and its orientation. A more detailed design can be developed using the [Systems Advisor Model](#) developed by the US National Renewable Energy Lab.

### **Are there maintenance costs for Solar Energy systems?**

Solar PV systems have almost no maintenance costs. Panels are cleaned when it rains. Snow quickly melts when the sun shines. There are no moving parts, nothing to lubricate, no filters to replace and no liquids to drain. A central inverter may need to be replaced once during the 25 year life of the system. Some microinverters are warranted for 25 years. The systems are designed to withstand hail, freezing and thawing and strong storms. Lightning strikes can damage a system but are rare.

### **What is Net Metering and why is it important?**

Net metering is a way of getting paid for producing excess electricity and putting it on the grid for others to use. It means that the amount of solar energy placed on the grid is subtracted from the amount used from the grid, and only the net amount appears on your monthly bill. Net metering is required by state law in Ohio for



investor owned utilities (AEP, Duke, First Energy and Dayton Power and Light).

Most solar systems will produce more electricity than can be used at midday. This electricity goes onto the grid and is used by others. In the evening, or on cloudy days, electricity is taken off the grid. The monthly bill reflects only the net amount used.

The value of solar energy varies depending on whether it is used in your home, or sent to the grid and used later. If used immediately to meet on-site loads, it will be worth the full cost of the electricity, including the generation, transmission and distribution cost. This is essentially the total amount of the monthly bill divided by the kWh and ranges from \$0.11 to \$0.20 per kWh. Any electricity sent to the grid and taken off later, will only be worth the generation cost (~ \$0.06 to \$0.08 per kWh).

Municipal utilities and rural electric cooperatives are not required to net meter in Ohio. In addition, alternative electricity providers that are selected through investor owned utilities are also not required to net meter. You will need to negotiate with these other utilities how they will pay you for the unused electricity. They may have more or less favorable net metering rules than those required of investor owned providers.

In Wayne county, there are two investor owned utilities (AEP and First Edison), two municipal utilities, Orrville and Marshallville, and one rural electric cooperative (Holmes-Wayne). The Orrville Municipal utility does not net meter, despite the fact that they are required to increase the amount of renewable energy generated in their portfolio. For example, the Orrville United Church of Christ is paid nothing for the electricity that their 7 kW solar system puts onto the Orrville grid. Rather than supporting citizens who would like to produce solar energy on their own property, they have elected to purchase property using city funds to install solar farms.

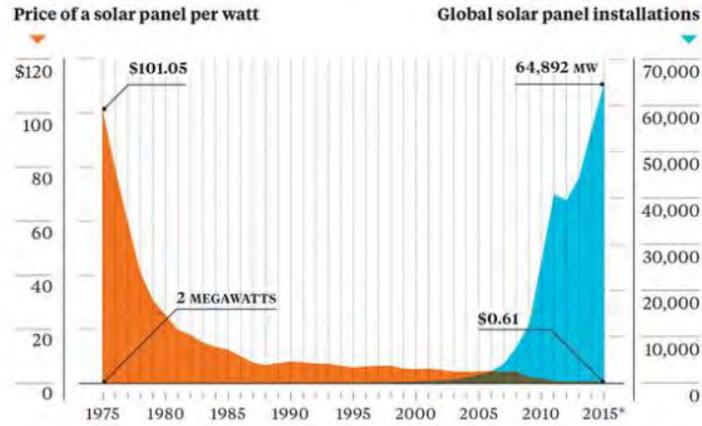
Holmes/Wayne electric is a rural electric Coop operating in southern Wayne county that has a more citizen favorable policy toward net metering. They allow excess electricity to be banked as kWh from one billing period to the next. This results in the value of solar energy being equal to the full retail cost.

A system producing more electricity than the annual load will receive an even lower price for its excess generation.



### **Should I install a system now or wait until prices drop further?**

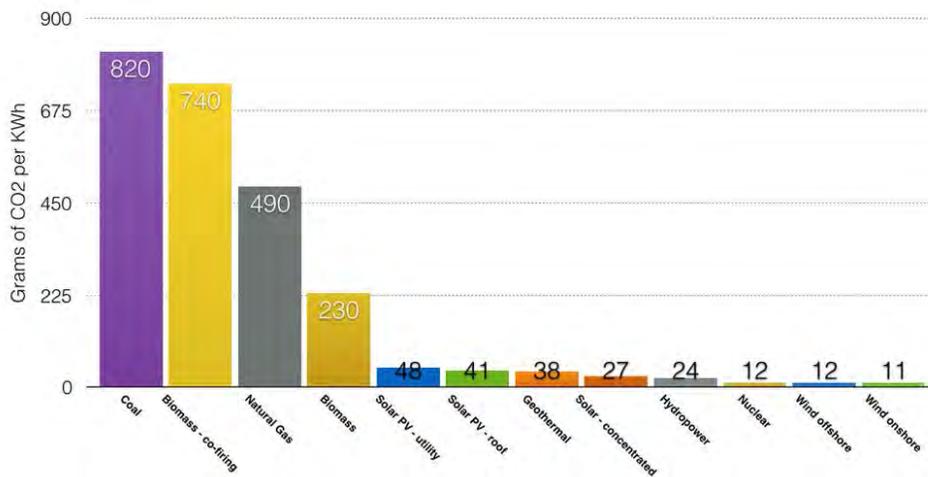
Solar energy system prices have dropped dramatically over the past 10 years from more than \$8 a watt installed to less than \$3. But the prices are not likely to drop this dramatically in the future. Most of the drop in the price is due to the decreased cost of solar panels. However other costs of a solar system, such as for the inverter, racking, engineering, permitting and labor drop more slowly. The sooner you install a system, the sooner you can take advantage of cost savings and the sooner you can join your neighbors and other citizens in reducing our carbon footprint and reducing the adverse impacts of climate change.



Source: <https://cleantechnica.com>

### Do PV solar system really reduce my carbon footprint compared to grid electricity? Doesn't it take as much energy to make the panels as you get from the sun when using them?

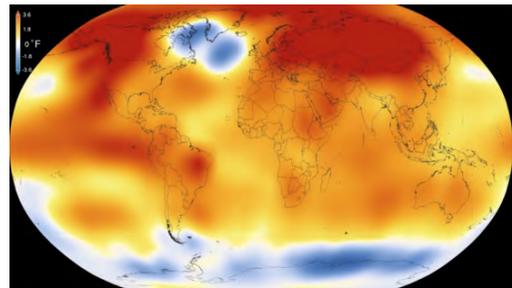
Life cycle analyses of solar panel production have revealed that it takes less than two years of solar system production to offset all of the energy used to manufacture the panels, the balance of system and install the system. That means that for a system that has a 25 year life, more than 90% of the energy your system produces has no carbon footprint. In fact solar PV is one of the lowest carbon intensity energy sources there is. In addition, the amount of fossil energy embodied in a solar system is a function of the electricity used at the location of manufacture. Many locations already have electricity with as much as 50% renewable energy content (from hydropower, [nuclear](#) or solar). To reach a zero carbon energy future, we all must embrace not only solar energy, but other low carbon intensity energy sources.



### What if I buy a system and then decide to move ?

If you decide to move before you have recovered your investment in a solar system, you usually can recoup most, if not all of the cost, when you sell your home. NREL estimates that a home with a solar energy system is worth 10 times the amount of electricity produced per year more than an identical home without a solar energy system. For example, the 5 kW system described above, that produces \$660 worth of electricity per year, has an estimated value \$6,600 greater than an identical home without a PV system. Since the system only cost \$9,100 to \$10,500, the entire system would be paid off in as little as 4 years when the added home value is monetized.

In some areas (like Wayne and Holmes county) where citizens are uneducated about climate change or unfamiliar with solar energy systems, there may not be home buyers willing to pay more for a home with a solar energy system. However many educated home buyers, and those who have lived elsewhere, may be very interested in a solar energy system. The overall supply of homes on the market with solar systems is usually very limited. In fact out of all of the homes for sale in Wayne county, there are usually none at any given time with solar energy systems.



To home buyers who are concerned about climate change, their children's future, or just the rising cost of electricity, your home may be the only one they are interested in buying.

### What are microinverters?

Inverters convert direct current (DC) generated by a solar panel to the alternating current (AC) used in your home and on the grid. There are two types of inverter systems each with different advantages and disadvantages. Most systems use *central inverters*, where all of the solar panels are connected in strings, combined into a single set of wires that carries DC current from the array to a single inverter. The inverter is usually located inside the home in the basement or garage. Central inverters usually are the lowest cost option for systems larger than 3 or 4 kW. Some central inverters have back up electrical circuits so that a small amount of electricity can be provided when the sun is shining and the grid is down.



A microinverter system being installed



A central inverter with an auxiliary power plug

Another type of inverter system is a *microinverter*. Microinverters are inverters located on each solar panel that convert DC to AC electricity. Microinverters usually cost less on small systems (<3 kW). Some of the advantages are that a combiner box, remote disconnect and DC disconnects are not needed, simplifying the system. Also, the system is safer since alternating current, not high voltage DC current, flows from the panels to the service box. Since each panel is independent, shading effects, panel variability or damage only affects a single panel and not every panel in a string. Also, each individual panel output can be monitored. Microinverters are usually warranted for 20-25 years, as compared to 10 years for central inverters. So over the long run they may be less expensive even for systems larger than 3 kW. They also instantly disconnect when the grid goes down preventing line workers from being injured.

### **Are batteries necessary with a solar energy system?**

Batteries are not needed with a solar energy system and few installations in residential areas have them. Unless you have problems accessing the grid for extended periods of time, a grid-tied system is the best and least expensive option. Utilities in Ohio are required to interconnect your solar system as long as it meets certain requirements. With grid interconnection you essentially use the grid as your battery.

Adding batteries to store 2-3 days of electrical load can more than double the cost of a solar energy system. A better option is to purchase a 2 to 5 kW gasoline generator to use in case the grid goes down. Or better yet, get to know a friendly neighbor who chose to spend \$10,000 on a natural gas electric generator.

Battery storage can make some sense if the price of electricity changes at different times of day. But in Wayne county, time of day metering is not commonly used.

The newest central inverters have auxiliary power outlets that can power a critical circuit like a freezer when the grid is down and the sun is shining. You may have heard of the Tesla battery system. These systems accumulate solar energy during the day and allow you to use it at night. However this only really makes economic sense when there are different prices for electricity at different times of the day as there are in Germany or California. Utilities in Wayne County charge the same amount for electricity regardless of the time of day.

### **What Incentives are available?**

The main incentive available to homeowners for solar energy installations is the Renewable Energy Investment Tax Credit. This federal tax credit allows tax payers to reduce their tax bill by 30% of the total cost of a Solar Energy system. The credit can be extended over multiple years. For example, if you install a solar system that costs \$20,000 you could claim a \$6,000 tax credit. If you only pay \$3,000 in federal taxes each year, then you can take a \$3,000 credit each of the next two years. The renewable energy tax credit will remain at 30% through 2019 and then gradually decline to 26%, 22% and 10% each of the following years.

Many incentives other have been available in the past, such as a \$1.50 per watt AEP incentive, a \$3.00 per watt Ohio Development grant, these are no longer available. The USDA provides a Renewable

Energy Application Program or ([REAP](#)) to rural businesses that provides up to 25% of the cost of a system and a low interest loan guarantee for up to 75% of a system cost that is available to rural businesses.

Solar Renewable Energy credits are another incentive that are used to meet Ohio's Renewable Portfolio Standard. But their value has dropped from around \$350 per SREC (1000 kWh) in 2011, to less than \$40 in 2013 as Ohio legislators backed away from our commitment to renewable energy.

### **How Can I pay for a Solar System?**

There are three ways to pay for a solar system. It can be purchased using savings, using a home equity or other type of loan, or using a power purchase agreement (PPA). The highest return is usually through using savings to pay for a system outright. Savings earns less than 1% interest in the bank. Using the same money to pay for a solar system can result in a return on investment of 5% or greater over the life of the system letting you put that money to work.

Another way to pay for a system is to use a home equity loan. The Federal Renewable tax credit can still be used in this case and can help make loan payments for the first few years. In later years the reduction in the electricity bill will likely more than offset the annual loan payments. After the loan is repaid, the electricity produced is free.

Power purchase agreements are arrangements where an investor pays for, and owns, the solar installation on your property and sells the electricity it produces to you at an agreed upon price. This price is usually less than the wholesale price meaning you can save money immediately. While available in other states, in Ohio PPAs are usually only available on larger systems (> 50 kW).

### **Is solar energy a good choice?**

Yes. Solar PV electricity is less expensive, and much better for the environment, than grid electricity. It is a good choice for your wallet, the environment and your brain.

### **References**

[NREL Systems Analysis Model \(SAM\)](#)

[Wayne County Sustainable Energy Network](#)

[Ohio Extension, Agricultural Solar Energy series](#)

[Solar Energy Rocks!](#)

[Public Utility Commission of Ohio Renewable Energy](#)

[Rural Energy for America Program](#) (REAP)