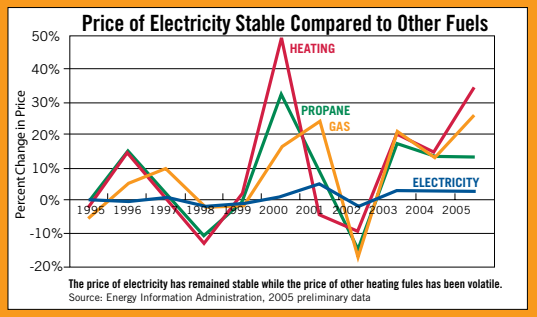
RENEWABLE ENERGY

Photo courtesy of Department of Energy/National Renewable Energy Laboratory

RENEWABLE ENERGY — AN OHIO ELECTRIC COOPERATIVE MEMBER'S GUIDE

ASK YOUR ENERGY ADVISOR

Whether you're replacing a furnace or water heater, choosing new appliances, or building a new home, how well you use energy has become an increasingly important factor in your decision. Making the right choice can mean big cost savings. But other factors are important too, like size, efficiency and reliability.



That's a lot of information to collect and digest, especially if you need to decide quickly. Wouldn't it be easier if there was someone you could go to for advice? Someone who knows all the options and won't try to sell you on just one?

That's when your local electric cooperative's Energy Advisor can help. As a member-owner of a Touchstone Energy® cooperative, you already have energy professionals who work for you. It's one of the benefits of ownership – being able to call on your employees for expertise. And because they're also your neighbors, they understand your needs and will give you honest, unbiased advice.

You have the power to control your energy costs. It's the power of human connections provided by the Energy Advisors at your local Touchstone Energy® cooperative. And it's there to help you make the best choices both for your family and your community.

THE IMPORTANCE OF EFFICIENCY

Regardless of whether you purchase "green power," use renewable energy in your home, or drive an alternative-fuel vehicle, it is better for the environment and less expensive for you to *reduce your energy use first* and then meet your energy needs with renewables.

Can you increase the energy efficiency of your home? To find out, conduct a home energy audit, which will tell you where you are using the most energy in your home. Your Energy Advisor at your Touchstone Energy® electric cooperative can offer you a number of energy-saving tips. By making a few of the improvements they suggest, you can save as much as 10 to 50 percent on your energy bills.

Investing as little as $25 in inexpensive, easy-to-install items such as caulking and insulation around doors and windows, compact fluorescent light bulbs, and low-flow shower heads can save $100 or more each year in heating and air-conditioning costs. Spending a little more on attic insulation and ventilation, replacement windows and appliances with EnergyStar® designations also increases your savings, and you keep saving over the life of the investment. When it comes time for major changes, consider a geothermal heating and cooling system to replace or supplement a fossil-fuel furnace or air conditioner, and take a look at new, more efficient water heaters, some of which come with life-of-the-home warranties. Look for Federal energy-efficiency incentives that also may be offered.

Your Energy Advisor at your Touchstone Energy® electric cooperative has more information about all of these easy ways to make your home more comfortable, lower your bills, and help the environment.

WHAT IS RENEWABLE ENERGY?

Mankind has used renewable energy for thousands of years. Certain forms of energy are called "renewable" because these fuel sources are constantly replenished and will not run out. Renewable energy – like the sun and wind – is readily available (in varying degrees) throughout the United States. Renewable energy technologies convert this energy into usable forms – most often electricity – but also heat, chemicals, and mechanical power. These technologies are often described as "clean" or "green" because they produce few or no pollutants.

Most renewable energy comes directly or indirectly from the sun. Solar energy can heat and light homes, heat water, cook food, generate electricity, and power industrial processes. Heat from the sun causes air-temperature differences which, along with the earth's rotation, cause the wind to blow. The wind powers generators which produce electricity or mechanical energy. Sunlight is vital to growing plants and trees, which are referred to as biomass. Using biomass to generate electricity, fuel vehicles, and produce chemicals is called bioenergy.

Hydropower uses the energy in flowing water to operate turbines that generate electricity. The hydrologic cycle, in which water

evaporates into the atmosphere and then falls back to earth as rain or snow, is powered by the sun.

Geothermal energy can come from both the sun and the earth. Direct geothermal systems use the heat from deep inside the planet to produce electric power. Indirect geothermal systems use the solar energy stored in the soil to provide heating via heat-pump systems.

RENEWABLE ENERGY TECHNOLOGIES

Many renewable energy technologies make sense for consumers today. Prices have dropped during the last 20 years and efficiency and reliability have improved. Using renewable energy is easier than ever.

Alternative fuels such as biodiesel and ethanol are becoming more widely available, and new vehicles that feature advanced fuel-system technologies are on the market. Utilities are starting to offer "green power" programs, in which you can opt to obtain electricity from renewable energy sources.

Photo courtesy of Department of Energy/National Renewable Energy Laboratory

TODAY'S CLEAN ENERGY CHOICES

These renewable energy technologies might be offered in green-pricing programs in your area.

HYDROPOWER

Hydropower is the most mature and, currently, largest source of renewable power, producing about 10 percent of the nation's electricity. Existing hydropower capacity is about 80,000 megawatts, enough electricity to meet the needs of about 30 million households.

Hydropower plants convert the energy in flowing water into electricity. The most common form of hydropower uses dams on rivers to retain large reservoirs of water. Water is released through turbine engines to generate power. Other hydropower plants, called "run of the river," do not dam up large amounts of water, but divert water from the river and direct it through a pipeline to a turbine.

Photo courtesy of Department of Energy/National Renewable Energy Laboratory

Hydropower plants do not produce air emissions, but can affect water quality and fish and wildlife habitats. To lessen this impact, many hydropower projects are diverting a portion of the flow around the dams to mimic the natural flow of the river. Although this helps fish and wildlife, it also reduces the power plant's output. "Fish ladders" and other approaches also are being used to assist upstream migration of fish like salmon. Other measures such as improved turbine design, offer the promise of reducing fish kills in downstream migration. In addition, low-impact hydropower plants have been designed and in operation minimizing the impact on rivers.

BIOMASS

Biomass already is this country's second leading source of renewable energy, accounting for more than 10,000 megawatts of capacity. Biomass fuels come from a variety of sources. The majority consist of waste from industrial processing by-products – forestry and wood products, and agriculture and food products. Other industries such as construction and transportation often generate large quantities of unused biomass.

Gasification – converting biomass to a gas and burning it in a gas turbine engine – is another way to generate electricity from biomass.

Electricity also can be generated using gas produced by the decay of biomass in landfills. Landfill gas consists largely of methane, which can be burned in a boiler to produce steam for electricity generation or for industrial processes. Thus, this potentially harmful gas can be used in a beneficial way.

WIND ENERGY

Currently, wind energy capacity amounts to more than 11,600 megawatts in the United States, although much of it is in California (2,300 megawatts) and Texas (2,700 megawatts).

Buckeye Power and Logan County Electric Cooperative installed a demonstration 10-kilowatt wind turbine at Indian Lake High School in 2006.

Residential solar-panel array

Photo courtesy of Department of Energy/ National Renewable Energy Laboratory

Wind energy has been the fastest-growing source of energy in the world since 1990, increasing at an average rate of 20 to 30 percent per year, a trend driven largely by dramatic improvements in wind technology.

Wind turbines operate on a simple principle. The energy in the wind is used to rotate blades around a hub. The hub is connected to the main shaft, which spins a generator. Utility-scale turbines range in size from 50 kilowatts to 1 or 2 megawatts. Small turbines, below 50 kilowatts, are used for homes, farms, ranches, telecommunications, or water pumping.

Buckeye Power, Inc. and Logan County Electric Cooperative installed a demonstration 10-kilowatt wind turbine at Indian Lake High School in 2006. Students at the school monitor the performance of the turbine as part of their science curriculum. You can view real-time data on how much electricity is generated by the turbine by logging on to www.buckeye-power.com. You also can learn more about wind power by contacting your local electric cooperative and requesting a copy of the "Small Wind Electric Systems – An Ohio Electric Cooperative Member's Guide."

PHOTOVOLTAICS

Photovoltaic (PV) cells – also called solar cells – produce electricity from sunlight. A small, but growing amount of PV generation is connected to the power-delivery grid in 36 states.

The photovoltaic cell is the basic unit in a PV system. The cell is made from semiconductor materials similar to those used in computer chips. Sunlight is absorbed by the materials, freeing electrons from their atoms, and allowing the electrons to flow through an external circuit to generate electricity.

Solar-panel array at Butler Rural Electric Cooperative near Oxford, Ohio.

The greater the intensity of the sunlight, the more power generated in the cell.

Because photovoltaic systems have no moving parts they offer durability, low maintenance, high reliability, and low environmental impacts. Because their basic building block, the module, is small, photovoltaic systems are suitable for both large and small electricity supply applications. For example, systems of several hundred kilowatts in size have been built in a number of locations.

In 2006, Buckeye Power and Butler Rural Electric Cooperative installed a demonstration 2.3-kilowatt solar array at the Butler Cooperative office near Oxford, Ohio. Miami University students are studying the unit and monitoring production. Real-time data can be viewed at www.buckeyepower.com.

GEOTHERMAL ENERGY

About 3,000 megawatts of direct geothermal electric capacity – electricity generated using heat from inside the earth – are produced in the United States annually. Direct geothermal power plants use naturally occurring steam and hot water, which originate under the earth's surface. All of the geothermal plants in the United States are in California, Hawaii, Nevada, and Utah. Direct geothermal power plants use steam to rotate a turbine, which powers an electric generator. Another growing use

of direct geothermal energy is to heat buildings using hot water. More than 600 megawatts of direct geothermal heating capacity are installed today.

Indirect geothermal systems use heat pumps and heat-exchanging loops to extract or store heat energy underground. The heat extracted comes indirectly from solar energy absorbed by the soil.

SELF-GENERATION

MAKING YOUR OWN POWER

At first glance, generating your own electricity using renewable fuel seems like the ideal way to avoid monthly utility bills. For some homeowners, self-generation is a choice that makes sense for their circumstances and fits into their values. However, self-generation involves investing your money and your time doing research, comparing products, and maintaining your system. Depending on your situation, you might not end up saving money, but homeowners who choose to generate clean energy like being independent and knowing they are minimizing their impact on the environment.

SELF-GENERATION MIGHT BE RIGHT FOR YOU IF:

- a grid connection is not available in your area or can be made only through an expensive line extension
- your site has adequate renewable resources
- you have a strategy for meeting your energy needs when renewable resources aren't available

In addition to considering the above, you should also:

- research potential legal and environmental obstacles
- obtain cost and performance information from manufacturers
- understand the basics of small renewable energy systems
- review possibilities for combining your system with other energy sources, backups, and energy-efficiency improvements
- plan for ongoing system maintenance

Be careful when considering potential revenue from self-generation. This requires what is called "interconnection" with your utility's power delivery system (frequently called the "grid"). Rules for interconnection vary widely by state and even locality, as do the rates paid to self-generation owners for the power they produce. Contact the Energy Advisor at your local electric cooperative for more information.

ANALYZING YOUR LOADS

Performing a detailed load analysis is critical to sizing your renewable energy system. A load analysis is a measure of your daily energy needs. To conduct a load analysis, list everything that uses electricity from your power source, such as lights, heating and air conditioning, televisions, radios, and small and major appliances. To determine your total energy consumption, multiply the wattage of each appliance by the number of hours it is used in a day. Some appliances do not provide their wattage, so you may have to calculate the wattage

by multiplying the amperes times the volts. (Information about wattage, amperage, and voltage can be found on a sticker or metal plate attached to the appliance or on a tag attached to the electric cord.) After adding the totals for each appliance, you can decide the amount of power you need from your renewable energy system.

WIND ENERGY SYSTEMS

All wind energy systems consist of a wind turbine, a tower, wiring, and the "balance of system" components: controllers, inverters, and/or batteries.

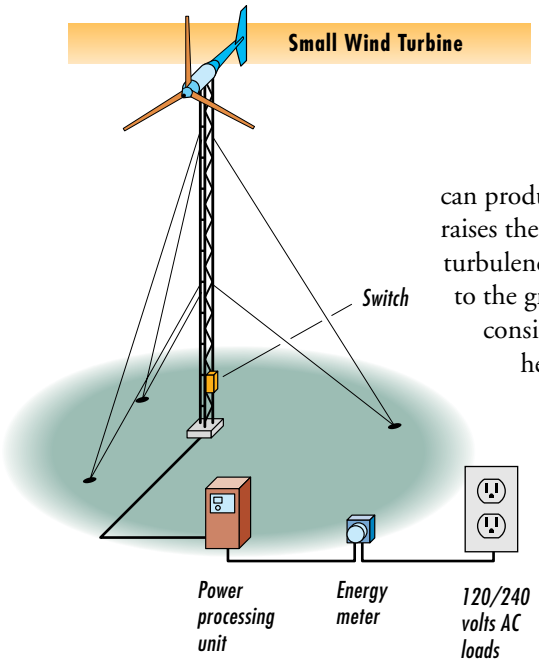


Illustration courtesy of Department of Energy/ National Renewable Energy Laboratory

Home wind turbines consist of a rotor, a generator mounted on a frame, and (usually) a tail. With the spinning blades, the rotor captures the kinetic energy of the wind and converts it into motion that drives the generator. Rotors can have two or three blades, with three being more common. The best indication of how much energy a turbine will produce is the diameter of its rotor, which determines its "swept area," or the quantity of wind intercepted. The tail keeps the turbine facing into the wind.

Because wind speeds increase with height in flat terrain, the turbine is mounted on a tower. Generally speaking, the higher the tower, the more energy the wind system can produce. The tower also raises the turbine above the air turbulence that can exist close to the ground. An important consideration about tower height is zoning. Many local governments place limitations on the installation of structures taller than 30 to 35 feet.

The manufacturer will provide you with the expected annual energy output of the turbine as a function of annual average wind speed and elevation at the site. The manufacturer will also provide information on the maximum wind speed at which the turbine is designed to operate safely. This information, along with your local wind speed distribution and your energy budget, will allow you to select the turbine size.

An important note about the viability of wind energy in Ohio: Unfortunately Ohio is not blessed with the geography or topography needed to provide the consistancy of wind velocity to make wind energy practical in most locations. (See the Ohio wind map on the right.) Generally, the most viable places are in the northern third of the state, especially along Lake Erie. You should consider checking with multiple sources to verify wind data for your location to ensure your system is economically feasible.

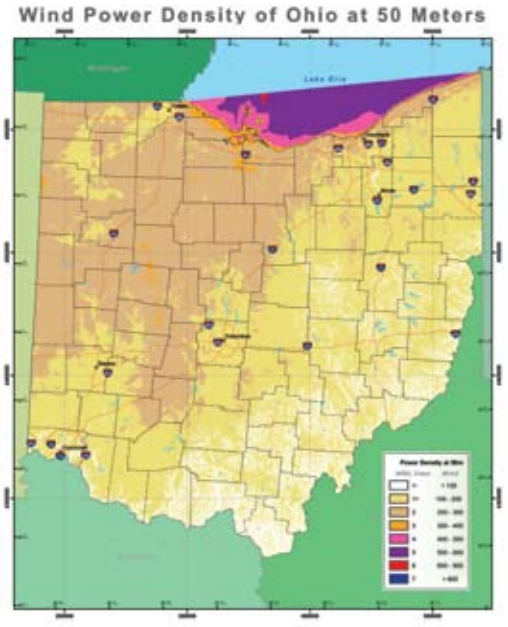


Illustration courtesy of Department of Energy/ National Renewable Energy Laboratory

SOLAR ENERGY SYSTEMS

Photovoltaic cells produce direct-current (DC) electricity. About 40 cells are joined together in enclosed, protective casings called modules. About ten of these modules are mounted in one PV panel. These flat-plate PV panels can be mounted facing south or on a tracking device that follows the sun, allowing them to capture the most

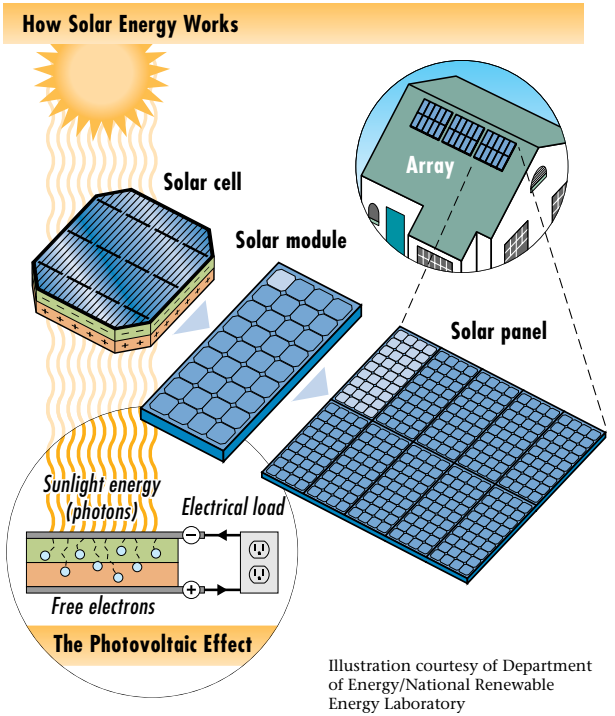


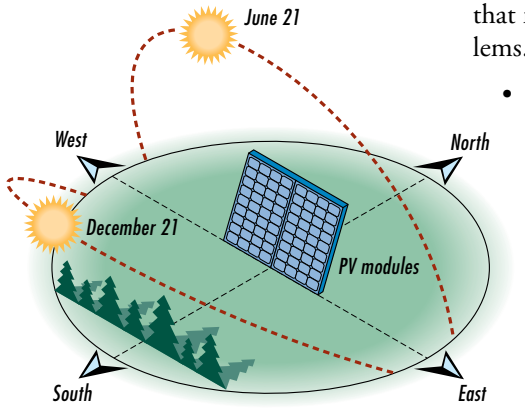
Illustration courtesy of Department of Energy/National Renewable Energy Laboratory

sunlight over the course of a day. About 10 to 20 PV panels can provide enough power for a household.

Two primary types of PV technologies available commercially are crystalline silicon and thin film. With crystalline-silicon technology, individual PV cells are cut from blocks of crystalline silicon. With thin-film technology, the glass or thin metal that mechanically supports the module is coated with the PV material. Thin-film-based modules are produced in sheets that are sized for specified electrical outputs.

Several companies have started integrating PV products into building materials. For example, PV shingles look like traditional asphalt or slate shingles and can be installed by roofers, as well as standing-seam metal roofs incorporating PV. Soon, glass that will generate electricity will be available for windows and skylights.

The costs will vary quite a bit depending on your location, solar resources, and available subsidies.



Sun's Path in the Sky

Illustration courtesy of Department of Energy/National Renewable Energy Laboratory

In addition to PV modules, the components needed to complete a PV system may include a battery-charge controller, batteries, an inverter or power control unit (for alternating-current loads), safety disconnects and fuses, a grounding circuit, and wiring.

ESTIMATING SOLAR RESOURCES AT YOUR SITE

There are three factors to consider when determining whether your site is appropriate for photovoltaics:

- Systems installed in the northern hemisphere must have southern exposure. For maximum daily power output, PV modules should be exposed to the sun for as much of the day as possible, especially during the peak sun hours of 10 a.m. to 3 p.m.
- The southern exposure must be free of obstructions such as trees, hills and buildings that might shade the modules. Consider both summer and winter paths of the sun, as well as the growth of trees and future construction that may cause shading problems.
- The unobstructed southern exposure also must have appropriate terrain and sufficient space to install the PV system.

HYBRID POWER SYSTEMS

According to many renewable energy experts, a stand-alone "hybrid" system that combines generation sources, such as wind and PV, offers several advantages over a single generation system.

In much of the United States, wind speeds are low in the summer when the sun shines brightest and longest. The wind is strong in the winter when there is less sunlight available. Because the peak operating times for wind and PV occur at different times of the day and year, hybrid systems are more likely to produce power when you need it.

For the times when neither the wind generator nor the PV modules are producing electricity (for example, at night when the wind is not blowing), most stand-alone systems provide power through batteries and/or an engine generator powered by fossil fuels.

If the batteries run low, the engine-generator can be run at full power until the batteries are charged. Adding a fossil-fuel-powered generator makes the system more complex, but modern electronic controllers can operate these complex systems automatically.

Adding an engine generator can also reduce the number of PV modules and batteries in the system. Keep in mind that the storage capability must be large enough to supply electrical needs during non-charging periods. Battery banks typically are sized for one to three days of operation.

A general rule is to design the renewable energy system to provide 80 percent of the energy and use fossil fuels for the remaining 20 percent.

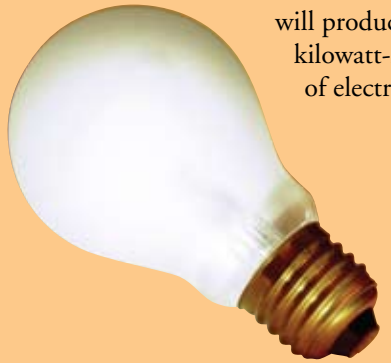
A NOTE ABOUT ELECTRICITY TERMS

When describing electricity production, the terms "electric power" (or capacity) and "electric energy" (or electricity) often are used. "Power" is the ability to do work and "energy" is the actual performance of the work, or the use of that ability over a period of time.

The distinction is like a person's ability to lift weights and the actual lifting of the weights; although they have the capacity to lift the weights, until they actually lift them, they do not expend the energy.

The unit used in this text for electric power, or capacity, is the megawatt (MW). The unit used for electric energy, or electricity, is the kilowatt-hour (kWh). It takes 60 watts of capacity to power a 60-watt light bulb. To light a 60-watt light bulb for 1,000 hours requires 60,000 watt-hours of electricity, or 60 kilowatt-hours. To power 1 million 60-watt light bulbs, 60 megawatts of capacity is required.

The distinction between capacity and electricity is important. A wind turbine, for instance, might have a 1-kilowatt capacity, but its electricity production per day in kilowatt-hours depends on how often and how strongly the wind blows. If a strong wind blows for 24 hours, the wind turbine will produce 24 kilowatt-hours; if the wind only blows strongly for 8 hours and doesn't blow at all the rest of the day, the wind turbine will produce 8 kilowatt-hours of electricity.



OHIO COOPERATIVES' GREEN POWER PROGRAM

Ohio's electric cooperatives recognize the member benefits of power derived from renewable resources. Development, promotion and utilization of locally-generated renewable energy can be beneficial to the environment and bring added value to Ohio's rural economy.

The green power program EnviroWatts® was introduced by Ohio electric cooperatives in 2006. A portion of money from the purchase of EnviroWatts was dedicated to research and development of green power projects such as a wind turbine at Indian Lake High School in Logan County near Bellefontaine and a 230-square foot solar panel built in partnership with Miami University near Oxford.

In 2008, research efforts began to come to fruition. The Ohio cooperatives, through their generation-and-transmission cooperative, Buckeye Power, worked hand-in-hand with cooperative members on bio-digester projects to purchase electricity produced from animal waste.

These new power sources transitioned the EnviroWatts program to one based on renewable generation originating in Ohio. Funds from the sale of EnviroWatts go directly to the cost of purchasing renewable energy for the program.

Contact the Energy Advisor at your local electric cooperative to see if the EnviroWatts program is available in your area.

EnviroWatts®
Earth Friendly Energy Alternatives

RENEWABLE ENERGY AT HOME

CLEAN CHOICES FOR HEATING, COOLING AND LIGHTING

Heating and cooling uses more energy than anything else in your home. Typically, about 50 percent of your utility bill goes for heating and cooling. Using solar energy and geothermal heat pumps can help heat and cool your home while significantly cutting your utility bills and helping the environment.

The sun is the cleanest energy source for heating and lighting. Everyone uses solar energy to some extent. Just opening your drapes during the day and turning off your lights is one way of using the abundant energy of the sun. Today, new technologies can help you use more solar energy in your home while creating a more comfortable living space.

South-facing windows designed to let in the sun's heat will help lower your energy bills, while overhangs above those windows can prevent the hot summer sun from heating your home when you want it cool inside.

FUEL CELLS: A LOOK TOWARD THE FUTURE

Could your home-heating system and your electricity be powered by a fuel that produces no emissions but water vapor? It could be possible in the future.

Hydrogen technology for powering fuel cells is advancing by leaps and bounds. Researchers see the potential to use green power sources – such as wind power or solar photovoltaic electricity – to produce hydrogen by applying an electric current to two electrodes immersed in water.

CHOOSING WINDOWS FOR SOLAR HEATING AND LIGHTING

Besides properly shading your windows, you'll want to choose windows that will maximize your use of sunlight while minimizing energy leaks. The U. S. Department of Energy (DOE) and the Environmental Protection Agency (EPA) have developed an Energy Star® designation for products meeting certain energy performance criteria. The energy-efficient performance of windows, doors, and

Photo courtesy of Department of Energy/National Renewable Energy Laboratory

skylights varies by climate zones. Look for new high-efficiency Energy Star® windows that can let in the sun's rays while insulating against the outside cold. In addition to the Energy Star® symbol, look for the label provided by the National Fenestration Rating Council (NFRC). The NFRC label includes the U-factor – an indication of how well a window insulates – and the solar-heat gain coefficient (SHGC), which indicates how well a window admits solar heat.

Of course, another benefit of sunlight is the light itself, which can supplement electric lighting while creating a brighter, more inviting living space. Because the sun's visible light actually is a separate component of solar energy than the sun's heat – which is actually non-visible infrared light – the two aspects of sunlight can be handled differently by windows. For instance, a window with a low SHGC – designed to reject the sun's heat – still can allow most of the sunlight. The recent innovation of "spectrally selective" coatings allows windows to reject heat without the dark tinting that was common in older heat-rejecting films.

STORING SOLAR ENERGY

Letting solar energy into your home is only half of the story; the other half is storing the energy for later use. It's coldest at night, so the best use of solar energy is to absorb it with heat-retaining materials during the day, then allow those materials to keep the house warm at night. One option is heavy tile flooring. Anyone who has a tile floor knows it can still feel warm hours after the sun has set. Brick and other masonry are also great materials.These can be used both in sun-exposed floors and walls.

The idea of using heat-retaining materials has led to other solar energy innovations. For instance, Trombe walls incorporate heat-storing materials, such as masonry, in south-facing walls. A layer of glass or plastic glazing is mounted on the outside of this wall, leaving a small airspace between the glazing and the wall. This helps the wall absorb and retain heat. Trombe walls absorb the sun's heat during the day, then radiate that heat from the inside of the wall into your home during the night.

CLIMATE-RESPONSIVE ARCHITECTURE

So-called "climate-responsive" architecture is based on designing homes to be as efficient as possible. For a poorly insulated home that uses a lot of energy for heating, the effects of solar heating may be insignificant. But some super-insulated homes can use solar heating as their main heating source. For information on how to make your home more energy-efficient, talk to the Energy Advisors at your Touchstone Energy® electric cooperative.

Photo courtesy of Department of Energy/National Renewable Energy Laboratory

USING MORE SOLAR ENERGY IN YOUR EXISTING HOME

In an existing home, any renovation or window replacement project is an opportunity to improve your home's energy performance. Most existing homes have poorly insulated, leaky windows that are cost-effective to replace. When replacing windows, consider increasing the number of windows on the south side of your home and decreasing the windows on the north, east, and west sides.

Also, look for opportunities to increase the use of natural sunlight in your home, because this reduces your energy costs for lighting. You also might consider eliminating unnecessary internal walls to create a more open space in your home. This allows the sunlight to penetrate deeper, creating a brighter, more comfortable living space. Dividing walls that don't reach to the ceiling can be used to provide some structure while still maintaining an open environment. The use of light-colored paints with a matte finish will help reflect and diffuse the sunlight throughout your home.

Renovating provides an opportunity to not only improve windows and lighting, but also to add heat-storing

materials in areas warmed by the winter sun. In homes where it's difficult to make use of solar energy, you might even consider adding a sun space.

Although many of the choices for enhancing the solar energy performance of your home are straightforward, sometimes the correct approach is not so obvious. For instance, if you live in a climate that's both hot in the summer and cold in the winter – as is most of the United States – and you're not able to add overhangs to your south-facing windows, would it be better for them to admit or reject solar energy? Or if you're totally renovating the south side of your home, what would be the ideal number and size of windows?

To answer questions such as these, there are many computer programs available, from the very simple to the extremely complex. The U.S. Department of Energy developed one of the easier programs to use, called RESFEN, which is available free of charge. This program helps you examine the energy performance of windows in your home.

When using solar energy in a new home or when extensively renovating an old one, an architect can examine the energy performance of your house in terms of how each of the components – the insulation, windows, heating and cooling system, ventilation, and lighting – all work together. This approach, called "whole-house" design, allows the architect to optimize each of these components for your location to achieve the best energy performance at an economical price.

When using a whole-house design for a new house, solar energy features can be incorporated at little or no additional cost. The only key requirement is for the house to have an orientation to the south to take full advantage of the winter sunlight.

A typical benefit of a whole-house design is that your heating system often can be downsized because of the use of insulation, high-efficiency windows and solar energy. Not only does this save you money up-front on the heating system, but it also allows the heating system to operate more efficiently, because most systems perform best when they're used at or near their full capacity.

GEOTHERMAL HEAT PUMPS

One of the most energy-efficient options for heating and cooling your home draws on another form of renewable energy – indirect geothermal energy, or heat from the earth. This is not the hot steam and heat that comes from deep underground, as discussed previously with direct geothermal systems. Rather, geothermal heat pumps draw on the relatively stable temperatures of the ground surrounding your home as a source of heat in the winter and cooling in the summer.

Geothermal heat pumps require the installation of a large loop of tubing at least several feet under the surface. For some systems, narrow trenches are dug to install the tubing; other systems use vertical loops that can be installed much like drilling a well – a simpler process for retrofitting existing homes.

Some models also use geothermal energy to heat water for your home. These "hydronic" systems save you money and energy by heating water efficiently.

Just as a refrigerator uses electricity to keep the inside cool while releasing heat into your kitchen, a geothermal heat pump can keep the inside of your home cool while releasing heat into the cool earth. In the winter, this process is reversed, so the geothermal heat pump draws heat from the earth and releases it into your home.

Because geothermal heat pumps actually move heat between your home and the earth, rather than creating heat by burning fuels, they operate very cleanly and efficiently. In fact, geothermal heat pumps are at least three times more efficient than the most energy-efficient furnaces on the market today.

The relatively stable temperatures underground allow geothermal heat pumps to operate more efficiently than conventional air-source heat pumps, which exchange heat from the home with the outside air rather than the ground. During hot summer days, it's much easier to release heat into the cool earth than into the hot air. Likewise, during frigid winter days, it's easier to draw heat from the ground than from the much colder air. For these reasons, geothermal heat pumps operate efficiently even in harsh climates.

RESOURCES AND REFERENCES

Our thanks to the United States Department of Energy/Energy Efficiency and Renewable Energy for a portion of the content of this brochure.

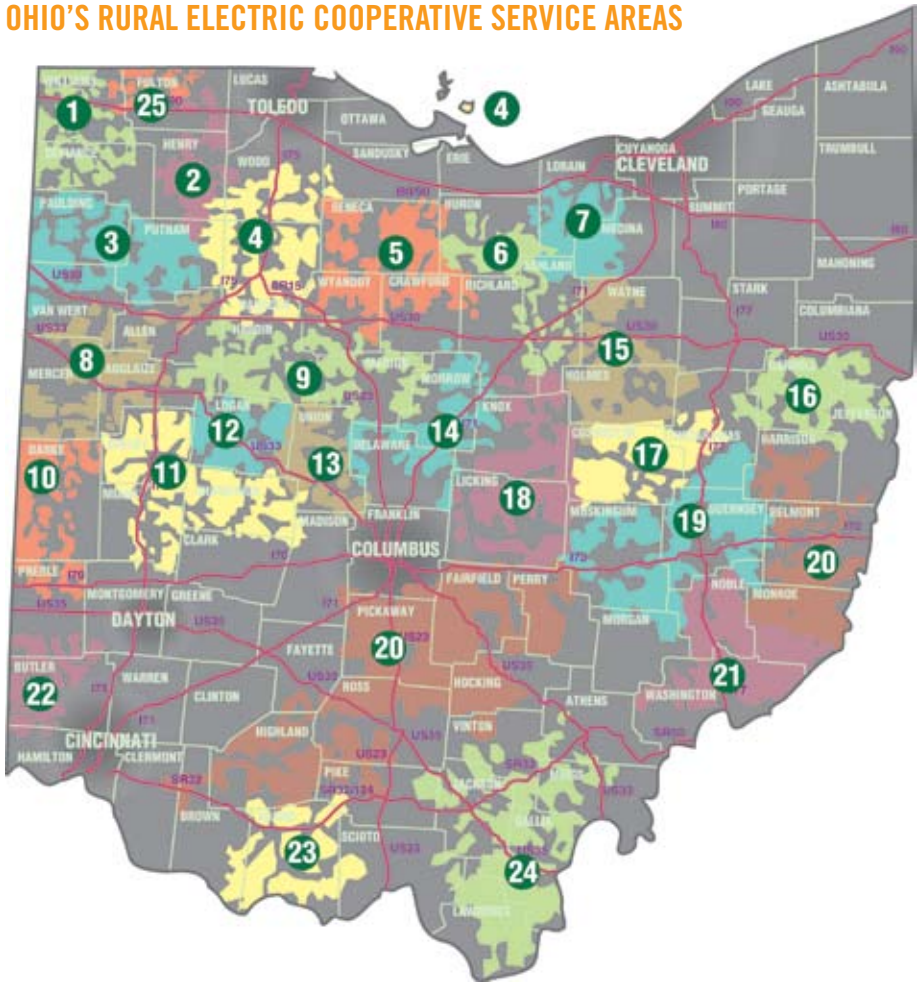
For additional information on renewable energy and energy efficiency, contact the organizations below:

Center for Resource Solutions: www.green-e.org

U.S. Department of Energy Efficiency and Renewable Energy: www.eere.energy.gov/consumer/

NOTES

OHIO'S RURAL ELECTRIC COOPERATIVE SERVICE AREAS



1 North Western
2 Tricounty
3 Paulding-Putnam
4 Hancock-Wood
5 North Central
6 Firelands
7 Lorain-Medina
8 Midwest
9 Mid-Ohio
10 Darke
11 Pioneer
12 Logan
13 Union
14 Consolidated
15 Holmes-Wayne
16 Carroll
17 Frontier
18 Licking
19 Guernsey-Muskingum
20 South Central
21 Washington
22 Butler
23 Adams
24 Buckeye
25 Midwest Energy

YOUR ELECTRIC COOPERATIVE IS A TOUCHSTONE ENERGY® COOPERATIVE.

Touchstone Energy® is an alliance of more than 600 cooperatives in 46 states that offers reliable power, a strong local presence, and the expertise and resources of a nationwide network of energy professionals.

Your Touchstone Energy® electric cooperative is there for you when you have questions or need information. Call the Energy Advisor at your local cooperative to learn how you can use energy wisely and save money too!