Guide to Renewable Energy

Installing geothermal heat pumps, solar systems, and wind turbines can save energy, cut utility bills, and sometimes earn homeowners money.

Home Energy Efficiency Basics

It is best to make your home efficient before considering renewable energy. Homeowners can save money by making their homes as energy-efficient as possible, installing proper insulation, air sealing, and using ENERGY STAR® qualified windows, heating and cooling equipment, kitchen appliances, and lighting systems. Smart use of water, available daylight, proper landscaping, and native vegetation can also improve the energy efficiency of a home.

Incorporating Renewable Energy

In addition to increasing a home's energy efficiency, homeowners may also want to consider renewable energy options, such as geothermal heat pumps, solar panels, and small wind systems.

Geothermal heat pumps use the ground as both a heat source and a heat sink to warm and cool the home, and are much more efficient than common air source heat pumps (ASHPs).

Solar energy can generate all or some of a home's electricity needs (depending on how many solar panels are used) and can heat water as well.

iStockphoto #11547592

Homeowners may want to consider renewable energy options such as solar panels, geothermal heat pumps, and small wind systems.

Small wind systems can be the most cost-effective home-based renewable energy system, if sufficient land and wind are available. They can potentially slash utility costs in half and provide an uninterrupted power supply.

Geothermal Heat Pumps

Geothermal heat pumps are one of the most efficient ways to heat and cool your home. They can achieve efficiencies two to three times greater than commonly used air source heat pumps because they rely on the relatively consistent ground temperatures to transfer heat to or from a home. Across much of the United States, the temperature of the upper 10 feet of the ground remains between 45°F and 75°F, and often between just 50°F and 60°F. By contrast, air temperatures can range over the course of a year from below 0°F to over 100°F.

Geothermal heat pumps are long lasting and durable, and specially equipped systems can also supply domestic hot water during the summer. While purchasing and installing a geothermal heat pump costs more than installing an ASHP system with similar capacity, the additional costs can be recouped through energy savings in 5 to 10 years.

Residential Solar Systems

Photovoltaic (PV) systems, or solar panel systems, convert sunlight into electricity. With ample sunlight, PV systems can harness energy in hot and cold climates. The basic building block of a PV system is the solar cell. Multiple solar cells form modules called solar panels that range in output from 10 to 300 watts. Panels are designed to survive storm and hail damage and are resistant to degradation from ultraviolet rays. More than 20 years of industry experience

continued >

with existing PV products has shown that they are highly reliable and require little maintenance.

Panels are typically grouped together on a building rooftop or at ground level in a rack to form a PV array. The array can be mounted at a fixed angle facing south (toward the sun), or mounted on a tracking device that follows the sun to maximize sunlight capture.

Solar water heaters use sunlight to heat water for the home. Solar water heating systems use insulated storage tanks and solar collectors to capture and retain heat from the sun, and heat circulating water. Solar water heaters require some kind of backup system (such as conventional hot water heaters) when there is insufficient sunlight.

Small Wind Energy Systems

Wind turbines use the motion of the wind to turn a shaft attached to a generator, which makes electricity. The size of the turbine and the speed of the wind determine how much electricity it will make. A small wind energy system will produce a power output of 100 kilowatts (kW) or less. Most systems are much smaller than that and have power ratings ranging from 2 to 10 kW, which can provide some, if not all, of a homeowner's electricity needs.

To be a suitable candidate for a wind system, a homeowner should have at least ½ acre of land, no local zoning laws, building codes or other covenants that restrict structure heights, and live in an area that has an average annual wind speed of at least 10 MPH. The turbine towers must stand 30 to 140 feet tall so that nearby trees and other structures do not prevent wind from hitting the turbines.

Estimated Costs

Installing renewable energy systems can be costly, but federal and state incentives in the form of tax credits and grants can significantly reduce the upfront costs. Plus, the systems can pay for themselves over time. Grid-connected solar and wind systems are particularly cost-effective because excess electricity sent back to the power grid can earn homeowners direct rebates or credits from local utility providers.

Geothermal heat pumps cost about $2,500 per ton of capacity. An average home requires a 3-ton unit, which would cost about $7,500, and could cut annual heating and cooling bills by 25 to 50%.

Solar PV systems cost about $10 per watt installed. A 2,000 watt (2 kW) system therefore costs about $20,000 to install. Such a system would provide 6 to 10 kilowatt hours (kWh) of electricity per day depending on climate, and could meet about half of a household's demand.

Solar hot water systems can meet 50% of the hot water needs for a family of four, and generally cost between $5,000 and $7,000 to install.

Small wind energy systems cost anywhere from $4,000 to $8,000 per kilowatt to install. Purchasing and installing a system can range from $10,000 to $70,000, depending on local zoning, permitting, and utility interconnection costs. These systems can cut utilities by at least half, and earn homeowners money by producing extra electricity.

Selling Energy

Many homeowners can sell any excess energy their solar and wind systems produce back to their utility providers, and therefore pay off their renewable energy investments more quickly. Most states have established "net metering" rules for customers who generate excess electricity through solar, wind, or other systems and feed it into the grid. In net metering, a single, bi-directional meter records both the electricity the home draws from the grid and the excess electricity the homeowner's system feeds back into the grid.

Further Reading

DOE Consumer Guides
www.energysavers.gov/publications

DOE Energy Savers: Geothermal Heat Pumps
www.energysavers.gov/geothermal_heat_pumps

DOE Guide to Small Wind Energy Systems
www.energysavers.gov/publications

Own Your Power! A Consumer Guide to Solar Electricity for the Home
www.nrel.gov/learning/pdfs/43844.pdf

Financial Incentives

Tax credits, incentives, and rebates may be available in your area. Please visit **www.energysavers.gov/taxcredits** for more information.

U.S. DEPARTMENT OF ENERGY
Energy Efficiency & Renewable Energy

EERE Information Center
1-877-EERE-INFO (1-877-337-3463)
www.energysavers.gov

Printed with a renewable-source ink on paper containing at least 50% wastepaper, including 10% post consumer waste.

DOE/EE-0353 • October 2010