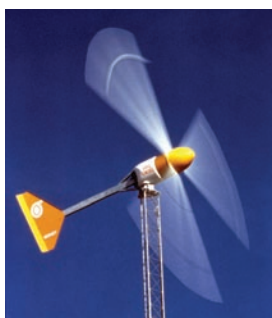


Small Wind Electric Systems

A U.S. Consumer's Guide



U.S. Department of Energy

Energy Efficiency and Renewable Energy

Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable



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Introduction

Can I use wind energy to power my home? This question is being asked across the country as more people look for affordable and reliable sources of electricity.

Small wind electric systems can make a significant contribution to our nation's energy needs. Although wind turbines large enough to provide a significant portion of the electricity needed by the average U.S. home generally require one acre of property or more, approximately 21 million U.S. homes are built on one-acre and larger sites, and 24% of the U.S. population lives in rural areas.

A small wind electric system will work for you if:

- There is enough wind where you live
- Tall towers are allowed in your neighborhood or rural area
- You have enough space
- You can determine how much electricity you need or want to produce
- It works for you economically.

The purpose of this guide is to provide you with the basic information about small wind electric systems to help you decide if wind energy will work for you.

Why Should I Choose Wind?

Wind energy systems are one of the most cost-effective home-based renewable energy systems. Depending on your wind resource, a



Bergy Windpower / FX01476

Homeowners, ranchers, and small businesses can use wind-generated electricity to reduce their utility bills. This grid-connected system installed for a home in Norman, Oklahoma, reduces the homeowner's utility bill by \$100 per month.

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small wind energy system can lower your electricity bill by 50% to 90%, help you avoid the high costs of extending utility power lines to remote locations, prevent power interruptions, and it is nonpolluting.

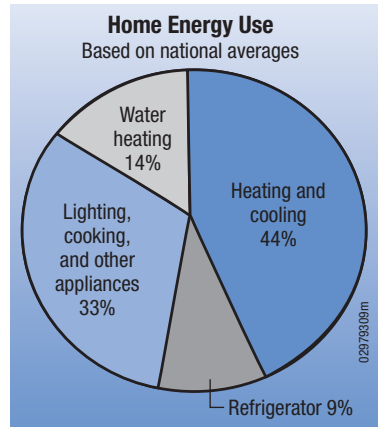
How Do Wind Turbines Work?

Wind is created by the unequal heating of the Earth's surface by the sun. Wind turbines convert the kinetic energy in wind into mechanical power that runs a generator to produce clean electricity. Today's turbines are versatile modular sources of electricity. Their blades are aerodynamically designed to capture the maximum energy from the wind. The wind turns the blades, which spin a shaft connected to a generator that makes electricity.

First, How Can I Make My Home More Energy Efficient?

Before choosing a wind system for your home, you should consider reducing your energy consumption by making your home or business more energy efficient. Reducing your energy consumption will significantly lower your utility bills and will reduce the size of the home-based renewable energy system you need. To achieve maximum energy efficiency, you should take a whole-building approach. View your home as an energy system with interrelated parts, all of which work synergistically to contribute to the efficiency of the system. From the insulation in your home's walls to the light bulbs in its fixtures, there are many ways to make your home more efficient.

- Reduce your heating and cooling needs by up to 30% by investing just a few hundred dollars in proper insulation and weatherization products.



The largest portion of a utility bill for a typical house is for heating and cooling.

- Save money and increase comfort by properly maintaining and upgrading your heating, ventilation, and air-conditioning systems.
- Install double-paned, gas-filled windows with low-emissivity (low-e) coatings to reduce heat loss in cold climates and spectrally selective coatings to reduce heat gain in warm climates.
- Replace your lights in high-use areas with fluorescents. Replacing 25% of your lights can save about 50% of your lighting energy bill.
- When shopping for appliances, look for the ENERGY STAR® label. ENERGY STAR® appliances have been identified by the U.S. Environmental Protection Agency and U.S. Department of Energy as being the most energy-efficient products in their classes.
- For more information on how to make your home energy efficient, see Energy Savers in the For More Information section.



Is Wind Energy Practical for Me?

A small wind energy system can provide you with a practical and economical source of electricity if:

- your property has a good wind resource
- your home or business is located on at least one acre of land in a rural area
- your local zoning codes or covenants allow wind turbines
- your average electricity bills are \$150 per month or more
- your property is in a remote location without easy access to utility lines
- you are comfortable with long-term investments.

Zoning Issues

Before you invest in a wind energy system, you should research potential obstacles. Some jurisdictions, for example, restrict the height of the

structures permitted in residentially zoned areas, although variances are often obtainable. Most zoning ordinances have a height limit of 35 feet. You can find out about the zoning restrictions in your area by calling the local building inspector, board of supervisors, or planning board. They can tell you if you will need to obtain a building permit and provide you with a list of requirements.

In addition to zoning issues, your neighbors might object to a wind machine that blocks their view, or they might be concerned about noise. Most zoning and aesthetic concerns can be addressed by supplying objective data. For example, the ambient noise level of most modern residential wind turbines is around 52 to 55 decibels. This means that while the sound of the wind turbine can be picked out of surrounding noise if a conscious effort is made to hear it, a residential-sized wind turbine is no noisier than your average refrigerator.



In Clover Valley, Minnesota, this 3-kW Whisper H175 turbine on a 50-foot tower is connected to the utility grid to offset the farm's utility-supplied electricity.

What Size Wind Turbine Do I Need?

The size of the wind turbine you need depends on your application. Small turbines range in size from 20 watts to 100 kilowatts (kW). The smaller or “micro” (20- to 500-watt) turbines are used in a variety of applications such as charging batteries for recreational vehicles and sailboats.

One- to 10-kW turbines can be used in applications such as pumping water. Wind energy has been used for centuries to pump water and grind grain. Although mechanical windmills still provide a sensible, low-cost option for pumping water in low-wind areas, farmers and ranchers are finding that wind-electric pumping is a little more versatile and they can pump twice the volume for the same initial investment. In addition, mechanical windmills must be placed directly above the well, which may not take the best advantage of available wind resources. Wind-electric pumping systems can be placed where the wind resource is the best and connected to the pump motor with an electric cable.

This 1-kW Whisper turbine provides direct AC power for the water pump for stock tanks on a ranch in Wheeler, Texas.



Ellicott Bayly / PLY/09681

Turbines used in residential applications can range in size from 400 watts to 100 kW (100 kW for very large loads), depending on the amount of electricity you want to generate. For residential applications, you should establish an energy budget to help define the turbine size you will need. Because energy efficiency is usually less expensive than energy production, making your house more energy efficient first will probably be more cost effective and will reduce the size of the wind turbine you need (see *How Can I Make My Home More Energy Efficient?*). Wind turbine manufacturers can help you size your system based on your electricity needs and the specifics of local wind patterns.

A typical home uses approximately 10,000 kilowatt-hours (kWh) of electricity per year (about 830 kWh per month). Depending on the average wind speed in the area, a wind turbine rated in the range of 5 to 15 kW would be required to make a significant contribution to this demand. A 1.5- kW wind turbine will meet the needs of a home requiring 300 kWh per month in a location with a 14-mile-per-hour (6.26-meters-per-second) annual average wind speed. The manufacturer can provide you with the expected annual energy output of the turbine as a function of annual average wind speed. The manufacturer will also provide information on the maximum wind speed at which the turbine is designed to operate safely. Most turbines have automatic overspeed-governing systems to keep the rotor from spinning out of control in very high winds. This information, along with your local wind speed and your energy budget, will help you decide which size turbine will best meet your electricity needs.