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## small wind

### Small Wind Energy Systems Frequently Asked Questions

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- ▶ I've heard about a new small wind turbine that starts up and runs at very low wind speeds. Is that a new idea?
- ▶ Aren't wind turbines too "high-tech" for rural people?
- ▶ What companies make small wind electric systems?
- ▶ What companies make water pumping wind turbines?

### How do residential wind turbines work?

A wind turbine, which is installed on top of a tall tower, collects kinetic energy from the wind and converts it to electricity that is compatible with a home's electrical system.

In a normal residential application, a home is served simultaneously by the wind turbine and a local utility. If the wind speeds are below cut-in speed (7-10 mph) there will be no output from the turbine and all of the needed power is purchased from the utility. As wind speeds increase, turbine output increases and the amount of power purchased from the utility is proportionately decreased. When the turbine produces more power than the house needs, the extra electricity is sold to the



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utility. All of this is done automatically. There are no batteries in a modern residential wind system.

Small wind systems for remote applications operate somewhat differently.

**More reading:**

[Small Wind Systems Slide Show](#),

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### Will a small wind turbine save me money?

A wind turbine typically lowers a household electricity bill by 50% to 90%. It is not uncommon for wind turbine owners with total-electric homes to have monthly utility bills of only \$8 to \$15 for nine months of the year. In northern parts of the U.S. where less air conditioning is used the bills can be very low year-round. The amount of money a small wind turbine saves you in the long run will depend upon its cost, the amount of electricity you use, the average wind speed at your site, and other factors.

Since energy conservation is usually less expensive than energy production, making your house or farm more energy-efficient first will likely reduce the amount of investment in a wind system to meet your needs. Most wind system purchasers have done all the reasonable efficiency measures first.

**More reading:**

[The Economics of Small Wind](#),

[Small Wind Systems Slide Show](#),  
(see *Small Wind 102: Economics*)

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### What size turbine do I need for my home?

Homes use approximately 10,000 kilowatt-hours (kWh) of electricity per year (about 830 kWh per month). Depending upon the average wind speed in the area, a wind turbine rated in the range of 5 to 15 kilowatts would be required to make a significant contribution to meet this demand.

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### Who should consider buying a wind turbine?

A residential wind turbine can be a relatively large device and is not suitable for urban or small-lot suburban homes. Except for very small wind turbines (i.e., with rotors one meter or less in diameter) on very small towers, a property size of one acre or more is desirable.

The economics of a wind system are very sensitive to the average wind speed in the area, and to a lesser extent, the cost of purchasing electricity. As a general rule of thumb, if economics are a concern, a turbine owner should have at least a 10-mph average wind speed and be paying at least 10 cents/kWh for electricity.

Residential wind turbines have been installed in at least 47 of the 50 states, but the majority of the units have been installed in the Northeast and the Midwest.

**More reading:**

[The Economics of Small Wind](#),

[Small Wind Systems Slide Show](#),  
(see *Small Wind 102: Economics*)

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### Will it help the environment if I install a wind turbine at my home?

Yes. Wind turbines produce no pollution and by using wind power you will be offsetting pollution that would have been generated by your utility company. Over its life, a small residential wind turbine can offset approximately 1.2 tons of air pollutants and 200 tons of global warming pollutants (carbon dioxide and other gases which cause global warming).

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### Don't I have to take wind measurements for a year or more?

For most residential systems the cost of taking wind measurements is not justified. Wind resource data published by the U.S. Department of Energy is sufficient for an experienced evaluator to predict wind turbine performance. In very hilly or

mountainous areas, however, it may be best to collect wind data before purchasing a system to ensure that your site is not in a sheltered area.

**More reading:**

[Small Wind Systems Slide Show](#),  
(see *Small Wind 102: Economics for ways to estimate your wind resource*)

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### Do wind turbines make noise or interfere with TV reception?

Small wind turbines do make some noise, but not enough to be found objectionable by most people. A typical residential wind system makes less noise than the average washing machine. Small wind turbines do not interfere with TV reception.

**More reading:**

[How Much Noise Do Small Wind Systems Make?](#),

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### Do small wind turbines kill birds?

While no studies have been done of this question, anecdotal evidence indicates that birds occasionally collide with small wind turbines, as they do with any other type of structure. However, such events are rare and very unlikely to have any impact on bird populations. House cats in the U.S., by contrast, are estimated to kill roughly one billion birds each year. Statistically, a single house cat is a much greater threat to birds than a small wind turbine.

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### Are small wind turbines safe?

Yes. However, neighbors who are uneasy about a nearby homeowner installing a small wind turbine may raise all sorts of questions about safety. Brief answers to some of these concerns:

**Falling tower:** Thousands of wind turbines are installed in the U.S., and their safety track record is excellent. Trees are much more likely to fall than a properly installed wind turbine, but no setbacks or minimum property sizes are required for trees.

**Safety of utility repair personnel during a power outage:** Small wind systems shut down automatically in the event of a power outage, and will not energize a dead power line.

**Ice throw from rotor blades:** Ice buildup makes wind turbine blades less aerodynamic, so that they turn more slowly. Typically, ice will drop to the base of the turbine tower instead of being thrown.

**Children climbing the tower and falling:** Possible, but wind turbines should be treated no differently than other climbable structures such as water towers or amateur radio antennas.

**More reading:**

[Small Wind Systems and Public Safety](#),

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### Will a small wind turbine damage neighboring property values?

With thousands of small wind turbines installed today in the U.S., there is no evidence to support this claim, and several surveys or other information sources that indicate otherwise.

**More reading:**

[How Do Small Wind Systems Affect Property Values?](#)

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### Will my utility allow me to hook up a wind generator?

Federal regulations (specifically, the *Public Utility Regulatory Policies Act of 1978*, or PURPA) require utilities to connect with and purchase power from small wind energy systems. A wind turbine manufacturer should be able to help arrange the required utility company approvals.

See the "State-By-State Small Wind Information" section of the American Wind Energy Association Web site at <http://www.awea.org/smallwind> for lists of interconnection requirements for many U.S. states.

**More reading:**

[Connecting to the Grid](#),

[Small Wind Systems Slide Show,](#)  
(see *Small Wind 104: Grid Interconnection*)

[Utility Connections,](#)

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### **Will my local government allow me to install a wind turbine?**

A wind turbine is a tall structure that normally requires a building permit. Zoning regulations often limit the height, placement, and other characteristics of "appurtenant" structures, so a conditional (special) use permit or variance may be necessary. It's usually best to let your neighbors know about your installation. Be prepared to answer questions and clear up common misconceptions with well-documented facts about small wind turbines.

#### **More reading:**

[Getting a Building Permit,](#)

[What About Visual Impact?,](#)

[Sample Letters](#)

(to Neighbors, Local Officials, Local Newspapers),

[Model Zoning Ordinance for Small Wind Systems,](#)

[Streamlined Zoning and Permitting Procedures,](#)

[Permitting Small Wind Turbines: Learning from the California Experience,](#)

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### **Will I have to change any of the wiring in my house?**

No. A wind turbine can easily be installed at virtually any existing home without the need to change any wiring or appliances. In most cases, the utility will install a second utility meter to measure how much surplus electricity it is receiving from the turbine owner.

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### **What about towers?**

An 80- to 120-foot tower is usually supplied along with the wind turbine. Towers this tall are necessary to raise the wind turbine above turbulence generated by obstacles on the ground and trees. Wind speed increases with height above ground, and increasing speed increases wind power exponentially. Thus, relatively small investments in increased tower height can yield very high rates of return in power production. For instance, installing a 10-kW generator on a 100-foot tower rather than a 60-foot tower involves a 10% increase in overall system cost but can result in 29% more power. Taller towers also raise blades above air turbulence, allowing the turbines to produce more power. A rule of thumb for proper and efficient operation of a wind turbine is that the bottom of the turbine's blades should be at least 10 feet (3 meters) above the top of anything within 300 feet (about 100 meters).

Several different types of towers are available, depending upon which manufacturer you select. Each type has its advantages; the most economical type of tower is the guyed lattice tower, but a hinged tower can be easier for you to install yourself and provides easier access for maintenance.

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### **How much does a wind system cost?**

Small wind energy systems cost from \$3,000 to \$5,000 for every kilowatt of generating capacity, or about \$40,000 for a 10-kW installed system. This is much cheaper than solar systems, but the payback period can still be lengthy.

That's why it's important to take advantage of rebates or tax credits available for small wind system installations. Well-sited small wind turbines can usually pay for themselves within 15 years, about half their serviceable lifetimes, if the right incentives are applied.

#### **More reading:**

[Financing a Small Wind Project,](#)

[The Economics of Small Wind,](#)

[Small Wind Systems Slide Show,](#)

(see *Small Wind 102: Economics*)

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### **How reliable are wind turbines? Will I have to perform much maintenance?**

Most small turbines have very few moving parts and do not require any regular maintenance. They are designed for a long life (up to 20 years) and operate completely automatically.

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### **How do wind turbines perform as an investment?**

The wind system will usually recoup its investment through utility savings within six to 15 years and after that the electricity it produces will be virtually free. Over the long term, a wind turbine is a good investment because a well-sited wind system increases property value, similar to any other home improvement. Many people buy wind systems in preparation for their retirement because they don't want to be subject to unpredictable increases in utility rates.

#### **More reading:**

[Financing a Small Wind Project,](#)

[The Economics of Small Wind,](#)

[Small Wind Systems Slide Show,](#)  
(see *Small Wind 102: Economics*)

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### **How would I have a wind turbine installed at my home?**

Most dealers offer either complete turnkey (ready-to-operate) installations or the option to purchase direct from the factory and install the system yourself. The first option offers more customer support from the company. Self-installation offers significant savings and a hands-on understanding of the turbine. Prospective owners can discuss the options available with manufacturers to decide which method best suits their budget and technical skills.

Approach buying the equipment as you would any major purchase. You will need to weigh costs and various degrees of ruggedness/durability of designs. Obtain and review the product literature from several manufacturers, and research those you want to pursue to ensure they are recognized businesses and their parts and service will be available when you need them. Find out how long the warranty lasts and what it includes, and ask for references of customers with installations similar to the one you are considering. Ask system owners about performance, reliability, maintenance and repair requirements, and whether the system is meeting their expectations.

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### **Is there anything I should watch out for in buying a small wind turbine?**

"If it seems too good to be true, it probably is" are words to keep in mind when shopping for a small wind turbine. Over the years, a steady stream of "breakthrough" wind turbines has promised exceptional performance at an incredibly low price. Sometimes the claimed performance violates the laws of physics, promising more power than the total kinetic energy available in the windstream that is intercepted by the rotor's swept area. These often well-meaning entrepreneurs usually do not have the engineering background to perform proper calculations and tests.

There have also been out-and-out frauds in the wind business where the entrepreneur set out to intentionally defraud the public. This has been possible, at least in the short term, because most people aren't experts on the physics of wind energy, and they have a hard time sorting out reasonable claims from unreasonable ones. Who wouldn't be tempted to buy a new wind turbine "twice as efficient as anything on the market"?

Most of the popular models of small wind turbines operate at about the same efficiency. The energy production you should expect will be closely related to the swept area of the rotor blades, which is based on the diameter of the rotor. If you are offered a product that promises to run your whole house with a turbine that is much smaller than conventional products, it's time to start asking hard questions. Another way to protect yourself is to make sure that the dealer who sold you the wind turbine can provide references from prior satisfied customers.

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### **How can I find out more about the experiences of people who own small wind systems?**

See [Small Wind Turbine Success Stories](#), for an excellent compilation of owner testimonials and customer interviews.

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### **How many turbines are needed to power a household or farm?**

or a home or farm, one turbine is normally installed. The turbine's size is chosen to meet the energy requirements given the available wind resource. Turbines with power ratings from 1 kW to 25 kW are typically used.

For village electrification applications, both single and multiple turbine installations are common, and turbines up to 100 kW in capacity may be used.

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### **How do small turbine costs compare to the costs of other alternatives?**

Small wind turbines (ranging in size from 250 watts to 50 kW) are often the least expensive source of power for remote sites that are not connected to the utility system.

A study by the Congressional Office of Technology Assessment found wind to be cheaper for meeting remote loads (loads not connected to a utility system) than diesel generators, photovoltaics, or utility transmission line extensions. (Micro-hydro also was found to be less expensive in many locations.)

Hybrid systems wind/photovoltaic, wind/diesel, and other combinations can often provide the most efficient and cost-effective option for rural electrification. Photovoltaic (PV) solar cells, which convert sunlight directly into electricity are often used to supplement wind power since PV tends to operate best in low wind months. Diesel generators or batteries can be used for backup power and to maintain power production during low wind seasons.

One study of an Arctic community with annual average wind speeds of 15 mph compared the cost of a 500-kW diesel system to that of a 200-kW diesel generator and four mid-sized wind turbines. It found that the wind/diesel combination cost considerably more to install (\$378,000 versus \$125,000), but would deliver fuel savings of \$90,000 per year, paying for itself in less than three years.\*

\*For more information, see *Proceedings of the Seventh Wind-Diesel Workshop, 1993*.

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### **Why are small wind turbines better than diesel generators or extension of utility lines in developing countries?**

Small wind turbines are better because they are more sustainable and offer a number of other socioeconomic benefits. Wind systems come in smaller sizes than diesel generators and have a shorter construction lead time than extending the utility lines ("grid"). For grid extension distances as short as one kilometer, a wind system can be a lower cost alternative for small loads. While wind turbines cost more initially than diesels, they are often much better from the user's point of view because of typical foreign aid practices. Donor agencies, for example, typically supply diesels at no cost, but leave operational costs (fuel, maintenance and replacement) to be supplied by local residents. These expenses (in particular, fuel and parts) require scarce hard currency. This usually leads to limited utilization and a shortened diesel lifetime due to inadequate maintenance. Many countries must also import their fossil fuels, further magnifying the burden imposed by diesels.

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### **How do small wind turbines compare with other renewable energy technologies suitable for decentralized rural electrification?**

Wind power is very competitive with photovoltaics (solar), biomass, and diesel generators, but is usually more expensive than micro-hydro. Wind is also very attractive for the ease with which the technology can be transferred to developing countries. Generally speaking, wind power complements these other power sources by providing a least cost approach under certain conditions. This expands the range of potential projects, pointing to the day when decentralized electrification projects will be implemented on the same scale as current utility line extension projects. In many situations, the lowest-cost centralized system will be a hybrid system that combines wind, photovoltaics, and diesel.

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### **What policies can help small wind turbines gain a foothold in the energy market?**

The single most effective policy that states have used to help persuade homeowners and small businesses to take a closer look at small wind systems is a substantial tax credit or rebate, often funded by a very small "system benefits charge" on every kilowatt-hour of electricity that is delivered in a state (funding from the charge is usually used for a variety of measures to promote energy efficiency and the use of renewable energy sources).

#### **More reading:**

[Structuring a "Buy-Down" Program for Small Renewable Energy Systems: Some Recommendations,](#)

[Markets for Green Power,](#)

[Financial Incentives,](#)

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### **I've heard about a new small wind turbine that starts up and runs at very low wind speeds. Is that a new idea?**

No. Many inventors have developed turbines that run at low wind speeds. But because the energy available in the wind is a function of the cube of its speed, there is very little energy available to be harvested at wind speeds less than 4 meters per second (m/s) (9 mph). If you are considering the purchase of a small wind turbine, the ability to run at low wind speeds should not be an important consideration in selecting a machine.

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### **Aren't wind turbines too "high-tech" for rural people?**

The high technology of a wind turbine is in just a few manufactured components such as the blades. A wind turbine can actually be much simpler than a diesel engine, and also require substantially less attention and maintenance. Some types of small turbines can operate for extended periods, five years or more, without any attention. With training and spare parts, local users can support the wind turbine equipment they use.

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### **What companies make small wind electric systems?**

The following AWEA members manufacture small wind electric systems:

- Bergey Windpower Co.
- Fuhrlaender Wind Turbine Co.
- Global Wind Technology
- Innovative Technologies Group
- Point Power Systems
- Solar Wind Works
- Southwest Wind Power Co.
- Wind Turbine Industries Corp.

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### **What companies make water pumping wind turbines?**

The following AWEA members manufacture water pumping wind turbines:

- Bergey Windpower Co.
- Point Power Systems
- Southwest Wind Power Co.
- WindTech International
- Wind Turbine Industries Corp.

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