



# ENERGY

## Wind Energy for Colorado Home Owners, Farmers and Small Businesses **no. 10.623**

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### Quick Facts...

Winds on your site should be at least class 2 (annual wind speeds averaging 9.8 to 11.5 mph at 50 meters above ground level) to be suitable for wind generation.

A state law passed in 2008 requires all utilities to allow residential turbines of up to 10 kilowatts and commercial turbines up to 25kw to connect to the grid.

Cost of residential wind turbines varies depending on how much power they can produce and other factors.

No matter what kind of electricity you are using, the best way to reduce expenditures is to use less.

### 1. Is wind energy practical for me?

A small wind energy system may provide you with an economical source of electricity if you live in an area with fairly steady strong winds and at least one-half acre of open land.

Personal impressions of the windiness of a site are often not reliable – it is better to use an objective measure. The most precise information can be obtained by placing an anemometer (a device that measures wind speed) on your site for at least one year. You may be able to benefit from Colorado's free anemometer loan program.

A faster method is to look up wind data from the Colorado wind resource map and the anemometer loan program. Winds on your site should be at least class 2 (annual wind speeds averaging 9.8 to 11.5 mph at 50 meters above ground level) to be suitable for wind generation. The U.S. Department of Energy has more information on siting turbines, and the American Wind Energy Association offers a detailed siting handbook.

You also need to make sure your local zoning codes or covenants allow wind turbines and the fairly tall towers that allow them to catch enough wind to make electricity. You also need to do enough research to learn whether a turbine will pay for itself quickly enough to meet your financial requirements.

Small wind systems designed for individuals, businesses and farm or ranch operators are growing dramatically and evolving rapidly. The industry group, American Wind Energy Association, predicts a thirty-fold increase in the U.S. in the next five years.

While the cost of a wind turbine is steep, the wind energy system will not require further electrical purchases in the future. This allows you to avoid unpredictable future costs of other fuels by paying for wind energy upfront.

### 2. How does a wind turbine work?

A wind turbine works by catching the energy in the wind, using it to turn blades, and converting the energy to electricity through a generator in the part of the turbine called a nacelle. However, the turbine is only one part of the system. A tower lifts the blades high in the air where the wind is stronger. Because winds are more powerful and less turbulent higher off the ground, taller towers increase a turbine's energy production. (The non-profit group Windustry, [www.windustry.org/](http://www.windustry.org/), is a good resource for learning more about the importance of tower height.) In addition, the presence of trees and buildings interferes with the wind resource. One rule of thumb is that the bottom of the area swept by a turbine's blade should be a minimum of 30 feet above any trees or buildings within 300 feet.

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For wind machines that use batteries to store the power, a controller manages the electrical input to the batteries. An inverter converts direct current (DC) electricity to alternating current (AC).

### **3. What is the difference between grid-tied and off-the-grid?**

Until recently, most of the small wind turbines in Colorado were installed by people who lived ‘off-the-grid,’ that is away from a power company that supplied them electricity. They relied on their own ability to make power with a wind turbine and perhaps solar panels, with backup batteries to store power. But that is changing.

A state law passed in 2008 requires all utilities to allow residential and commercial users up to a certain size to connect to the grid. The grid performs the same function as a battery storage system. Power generated in excess of daily consumption gets credited back to the consumer at retail rate. This credit goes towards power consumed during calm periods, when electricity is not being generated. At the end of the year, any power that is generated in excess of consumption is bought by the utility, generally at very low rates. Therefore, it does not make financial sense to oversize your system. Colorado’s law is designed for people to offset their own power use, not sell it back to make an overall profit. It allows residential turbines up to 10 kilowatts of rated production and commercial turbines up to 25kw. Net metering is only allowed for systems sized up to 120 percent of the customer’s annual average consumption.

This “net-metering” law has sparked a lot more interest in small wind turbines that connect to the power grid. Because these turbines are tied directly into the electricity system, they will not work when the power goes out – unless there is a battery backup system.

### **4. How big a system do I need?**

Most small wind turbines have a rating or size based on the maximum electricity they can generate such as 1.8kw or 5kw. But that is not a very useful number for most consumers. Rated output is the peak production at a specific (and usually high) wind speed, and different manufacturers use different wind speeds to determine rated output.

A more useful measure is to determine how much of your power a wind turbine can supply. Any reputable small wind turbine representative will supply you a power curve, showing how much electricity the machine produces at a given wind speed. Use this to estimate how much electricity (kw) the turbine will produce each month or year at the average wind speed you expect or measure at your site. Match this output with your annual energy consumption. To determine this number, check your monthly bills to come up with the annual total of kilowatt hours of electricity you use.

Once you have determined your annual electricity use, you can decide how much electricity you want to offset with a turbine, based on budget and other considerations. For example, if you want to offset nearly all your electricity use and have determined you have annual usage of 10,000 kilowatt hours, select a turbine that will produce that much power over the course of a year at your average wind speed.

### **5. How much will it cost?**

The cost of residential wind turbines varies depending on how much power they can produce and other factors. A rough range is \$4,000 to \$8,000 per rated kilowatt. A system that would offset most of an average home’s electricity use (10,000 kwh/year) will cost roughly \$50,000 before incentives.

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## **6. How do I calculate a payback?**

Determine the amount you pay on electricity bills before you install your system. If your system offsets all your electricity, you can divide its cost by the annual bill to determine how many years it will take to pay off. If you are only offsetting part of your use, you need to adjust the calculation accordingly.

Windustry offers a wind energy payback period worksheet that goes into more detail, and the National Renewable Energy Laboratory has a calculator and a paper on the economics of grid-tied small wind.

## **7. Sticker shock?**

No matter what kind of electricity you use, the best way to reduce expenditures is to use less. That means making your home more efficient and finding ways to cut your use, such as opening your windows on cool nights and closing them as the day heats up. Turning off lights and unplugging appliances when not in use can really add up.

For more information, see fact sheet 10.610, *Energy Conservation in the Home*, [www.ext.colostate.edu/pubs/consumer/10610.html](http://www.ext.colostate.edu/pubs/consumer/10610.html).

*Ongoing regulations vary dramatically across states, counties and municipalities. Check with your county planning and zoning office before proceeding.*

## **8. What are the rebates or other incentives?**

There has never been a better time to buy a small wind turbine. Incentives from the federal government are the most generous ever, offering an Investment Tax Credit of 30 percent of the total cost of an installed system. Some local utilities may also have rebate programs.

Check with your local utility or with the Governor's Energy Office (GEO) to see if you are eligible for rebates or other programs. The Database for State Incentives for Renewable Energy and Efficiency maintains a list of rebates and incentives.

## **9. What zoning issues might I run into?**

Zoning regulations vary dramatically across states, counties and municipalities. Check with your county planning and zoning office before proceeding. In many urban counties, height restrictions may rule out a wind tower. It is always a good idea to discuss the idea with your neighbors, as they may have input on placement.

## **10. What kind of maintenance is there?**

Maintenance varies by system, so ask about requirements when you are considering which kind of turbine to buy and when you are reviewing literature from different manufacturers. Many small wind turbines require regular maintenance that generally consists of periodic inspections and adjustments. Representatives of manufacturers can give you an idea of the expected maintenance schedule and help you arrange maintenance. A rule of thumb is to allocate about 1 percent of the installed cost of the wind system for operation and maintenance expenses over the life of the system.

## **11. How long will the system last?**

When you consider buying a system, ask about its anticipated lifespan. Most reputable small turbines should perform well for many years with only periodic maintenance required. Buy a turbine that has a good track record and a good warranty— at least five years is preferable. A warranty is one indication of the manufacturer's confidence in the product. In general, you can expect 20 years from a properly maintained turbine from a reputable manufacturer.

## **12. Where can I go to research more about specific components of my system?**

Resources provided at the end of this fact sheet will help get you started. The National Renewable Energy Laboratory is currently testing numerous small turbines and making all the information publicly available on its website, [www.nrel.gov/wind/smallwind/independent\\_testing.html](http://www.nrel.gov/wind/smallwind/independent_testing.html).

*A small wind turbine, like other capital investments, should increase the value of your property. If you can tell a prospective buyer that your electricity bills are almost nothing, the value of the installed turbine may be an attractive incentive.*

## **13. Where can I find an installer?**

Installation is generally arranged by a representative of the manufacturer. Many will have a precise way of placing wind turbines, including determining the best place on your property to erect the turbine in order to catch the best wind. The American Wind Energy Association has a list of turbine manufacturers in the United States: [www.awea.org/smallwind/smsyslst.html](http://www.awea.org/smallwind/smsyslst.html)

## **14. Do I have to think about insurance?**

You will want to insure your turbine against possible damage and liability claims, and some counties require insurance. Ask your property insurance company whether they will insure the turbine. Generally, the most cost-effective way to insure a wind system is under an existing homeowner's insurance policy on your house; it is often insured as an "appurtenant structure" (an uninhabitable structure).

## **15. How will it affect the value of my house/ranch/farm?**

A small wind turbine, like other capital investments, should increase the value of your property. If you can tell a prospective buyer that your electricity bills are almost nothing, the value of the installed turbine may be an attractive incentive.

## **16. What is the impact on the environment?**

Small wind turbines emit no pollution and need no water. They also reduce the amount of pollutants that your utility would emit if you were relying on electricity from burning coal, for example. According to the American Wind Energy Association, over its life, a small residential wind turbine can offset approximately 1.2 tons of air pollutants and 200 tons of greenhouse gas pollutants (carbon dioxide and other gases which cause global warming). Although the impact of wind turbines on wildlife, especially birds, is of concern to many people, research has shown that bird impacts with small, unlighted turbines are quite rare. House windows and outdoor cats have a much greater negative impact. The National Wind Coordinating Collaborative, [www.nationalwind.org/](http://www.nationalwind.org/), has a list of wildlife/wind interaction publications for more information.

Most modern residential turbines are quite quiet – similar to ambient noise levels under average wind conditions.

#### *Additional Resources*

*Wind Powering America's Small wind for homeowners, ranchers, and small businesses; [www.windpoweringamerica.gov/small\\_wind.asp](http://www.windpoweringamerica.gov/small_wind.asp)*

*Small Wind from American Wind Energy Association, [www.awea.org/](http://www.awea.org/)*

*National Renewable Energy Laboratory, [www.nrel.gov/](http://www.nrel.gov/)*

*Windustry's Home and Farm Scale Wind, [www.windustry.org/](http://www.windustry.org/)*

*Farm wind resources from the National Sustainable Agriculture Information Service, <http://attra.ncat.org>.*

*Colorado State University Extension, [www.ext.colostate.edu](http://www.ext.colostate.edu)*

*Colorado Harvesting Energy Network, [www.harvestenergy.org](http://www.harvestenergy.org)*

## **17. What other renewable energy resources should I think about?**

Before considering adding any renewable energy to your home, ranch or farm, experts advise you to do everything reasonable to reduce the energy you are using through conservation and efficiency. After that, adding renewables depends on your location and budget.

Solar photovoltaic panels may make more sense than small wind turbines in most urban areas. A combination of the two, perhaps with a diesel generator backup, often makes sense for people who want to live completely independent of the power company.

A ground-source geothermal heat pump, which takes advantage of the relatively uniform temperature of the earth, makes sense for heating and cooling, especially in new construction. And if you have water running downhill on your property, a micro-hydro generator might be a good option to consider.

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