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Small Wind Systems for the Ranch, Home and Business

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Small wind electric turbines intended to serve a ranch, home or business – given the right combination of a good wind resource, favorable utility policies, incentives and relatively high electric costs – are an economically feasible option for many in our region.

Types of Small Wind Systems

Small wind systems can be defined as turbines with a capacity ranging from 20 watts to 100 kW. They are significantly smaller than commercial scale turbines that are 1,500 kW (1.5 MW) or larger. Within the small wind energy category there are two sub-categories: "micro" turbines (20-500 watts) and residential or business (1 kW to 100 kW). Micro turbines are used for a variety of functions involving low electric demand such as charging batteries.

Ranchers and agricultural businesses will typically be looking at turbines ranging from 1 kW to 100 kW in capacity for such applications as wind-electric water pumping, powering your home or farmstead, and feedlot operations. In areas with low wind the common mechanical windmill will likely be the best option; however, "wind-electric pumping is a little more versatile and . . . can pump twice the volume for the same initial investment."[1] Wind-electric pumping systems do not have be located adjacent to the stocking tanks, they can be installed where the wind resource is better and connected by an electric cable to the pump motor. A pumping system for stock water may only need a turbine with a 1 kW system capacity to serve a significant number of cattle.

A typical home will consume about 10,000 kWh of electricity per year or 830 kWh per month. To match this load a turbine of 5 kW to 15 kW in capacity would be needed. Many homes and businesses today are taking steps to reduce energy consumption by installing compact fluorescent lights, purchasing more energy efficient appliances, or insulating the walls and attic. Such energy efficiency measures may reduce electric consumption in a home to 300 kWh per month. Monthly energy consumption at this lower amount may only need a 1.5 kW turbine to match the load. It is always a good first step to determine where you can reduce electric use before determining which wind system to purchase.

Many agricultural operations and businesses will have energy demands greater than a home. These energy loads are best matched with wind turbines ranging in size from 10 kW to 100 kW. The local rural electric cooperative or utility can provide their customers an annual electric consumption summary broken down by each month and for each meter. This

[1] National Renewable Energy Laboratory for the Department of Energy, Small Wind Electric Systems: A Colorado Consumer's Guide, December 2006.

summary data will be important for wind manufacturers and dealers to select the appropriate turbine.

Most small wind turbines today are horizontal axis upwind machines with two or three rotor blades. These upwind machines will have a tail. Downwind machines have also proven to be reliable for use on farms and homes. In addition, there has been a recent increase in attention and investment paid to vertical axis turbines. The Department of Energy's National Wind Technology Center will begin testing a vertical axis turbine in 2007. A turbine's rotor blades and generator are elevated by two types of towers: self-supporting (i.e. free standing) or guyed (wires that hold it in place). Guy wires may cause some problems with cattle rubbing against them and be a danger to wildlife. Other criticisms of wind systems stem from their noise; although, most small wind systems are about as loud as the average refrigerator.

Important Considerations for Small Wind Development

Other important questions to address for wind energy include:

- Do you have a good wind resource?
- Does your local government's zoning allow wind turbines and what permits are required?
- Will your utility allow the wind system to be interconnected to the grid?
- Where should you locate the turbine on your property?
- What incentives are available to lower your costs upfront and over time?
- What is the payback period or return on investment?

Determining the Wind Resource

You can determine the quality of your wind resource by examining wind resource maps. Wind resource maps can be viewed at the *Wind Energy Resource Atlas of the United States*. Web sites that link to these maps include www.nrel.gov/wind or www.windpoweringamerica.gov. Generally, small wind turbines will need average annual wind speeds of at least 10 mph. A more precise way of determining your locations annual wind speed it to install an instrument called an anemometer. An anemometer should remain installed for at least one year. Several state energy offices have loan anemometer programs enabling individuals to track wind power at a low cost. With a good estimate of your average annual wind power you can determine the annual energy production from your wind system.

System Applications

Some wind energy applications, such as water pumping, will allow for the intermittent nature of the wind. Other applications such as powering your home or business facilities will need to be much more reliable. Wind systems to meet energy loads that need high levels of reliability will be grid-tied or part of a hybrid system. A grid-tied system will connect to a meter that is also connected to the distribution power lines. When the wind system is not providing enough power to meet your demand, additional power can be drawn from the grid. At other times when your wind turbine is producing more power than you need, the extra

energy will go onto the grid and run the meter backwards – this is called "net-metering." It is important to check with your electric utility to determine interconnection requirement and "net-metering" policies. If you cannot grid-tie your system you should then consider a hybrid arrangement involving solar energy, batteries and a generator. Such an arrangement allows you to go "off-grid" and continue to have reliable energy production.

Costs and Incentives

The installed cost for a small wind system will range from $3,000-$5,000 per KW. These costs can be reduced with incentives like the Farm Bill's Renewable Energy Systems and Energy Efficiency Improvement Program (Section 9006). This USDA program provides grants up to 25% of the project cost along with guaranteed loans through participating banks. Other incentives are classified under green tag purchase programs that may provide upfront rebates for the clean energy produced over the life of the project. Net-metering policies through your electric utility can provide a long term incentive to lower your energy costs and reduce the payback period.

Payback Period

With enough information a consumer can then determine the systems payback period – this is the time period it takes for the savings from reduced energy costs to equal the cost of the system. Small wind calculators are available and configured to determine payback periods quickly. The NREL calculator can be found online at www.nrel.gov/wind/docs/spread_sheet_Final.xls.

For More Information

Below are three excellent resources to obtain more information on small wind systems.

- The American Wind Energy Association, www.awea.org, (202) 383-2500, 1101 14TH Street NW, 12th Floor, Washington, DC 20005.
- *Wind Power: Renewble Energy for Home, Farm, and Business*, by Paul Gipe, 2004, Chelsea Green Publishing Company.
- *Small Wind Electric Systems: A Colorado Consumer's Guide*, by the National Renewable Energy Laboratory, December 2006.