



# Considerations for small wind systems in Wyoming

By Lindsay Taylor

Wind energy is a familiar technology to many Wyoming residents.

There was a time wind was the most common form of energy used at the farmstead. Windmills were used to pump water and run the first of many electrical appliances to come into a home.

While today's technologies are more efficient and utilize electrical rather than mechanical energy, the concept is very much the same and can still be used on a farm or at a rural residence to offset our growing electricity needs and rising costs.

Residential wind energy, termed "small wind," is wind electricity generation of less than 10 kilowatts (kW). The average American home uses about 20 kilowatt hours (kW-h) per day. Residential scale wind development is much different than the commercial wind development projects seen throughout the state. Turbines are much smaller, as they are typically generating electricity for only one home rather than a region and they are much less invasive on both land and scenery.

Residential-sized turbines can be used to supplement existing electricity use or in a hybrid system designed to power a home or farm without tying into the existing power grid. Each of these uses has its own benefits, drawbacks, and considerations.

## Small Wind Turbines

A small wind turbine tied into the utility power grid can be practical for people who live in a rural residential location near an existing power line. To be a feasible option, the basic requirements are more than one acre of land in a place with no restrictions on tall towers, a known amount of electricity used, substantial wind, and economic feasibility. If the property to be powered sits on less than

one acre, siting a wind turbine in a place with unobstructed wind flow may be difficult. Typically, a 100- to 160-foot tower is needed for unobstructed and maximum potential wind access. Placing a turbine too low or behind trees and buildings is like putting solar panels in the shade.

Sizing of the system is the main factor in determining upfront costs. For most grid-tied systems – those producing electricity that flows onto the power grid – having a turbine that produces more electricity than is needed by the farm or residence is not cost effective. To determine individual needs, the number of kW-h used in one year is divided by the number of hours in a year, 8,760, and then divided by the capacity factor for the site. The number of kW-h can be found on old electricity bills. The capacity factor of the site depends on the wind resource. This number is the percentage of time the wind blows hard enough for the turbine to produce at maximum capacity. For most small applications, this number is between 15 and 25 percent. Currently, small wind turbines cost anywhere from \$2,000 to \$7,000 per installed kW.

## Important Considerations

The two most important considerations are the wind resource and economic feasibility. These two factors are directly related because the better the wind resource the more electricity can be generated by the wind turbine and the more quickly the turbine can return its upfront costs to the owner.

There are many advantages of using wind power to supplement electricity needs, ranging from self-sufficiency to environmental benefit to providing energy with little or no water requirement; however, most people will not embrace the technology unless it is cost competitive with existing sources of power. Wind energy is economically

## Example of wind turbine sizing:

750 kW-h average monthly use  
× 12 months =  
9,000 kW-h annual use

(9,000 kW-h) ÷  
8,760 h/year = 1.03 kW

(1.03 kW) ÷  
.20 capacity factor =  
5.14

In this case a 5-kW turbine would be a sufficient-sized tower



comparable if the upfront costs can be recouped in electricity savings before the end of the useable life of the equipment. The four factors that will determine this are the wind resource, average monthly electricity costs, state and federal policies, and financing.

## Wind Resource

Most of Wyoming has a high enough average annual wind speed to consider wind generation. A general rule of thumb is greater than 10 mph. For a better look at the map of Wyoming's wind resource shown below, please see [www.windpowerin-gamerica.gov/wind\\_maps.asp](http://www.windpowerin-gamerica.gov/wind_maps.asp). Without actual data collection from a specific site, determining the true wind resource is difficult; however, this map is a way to get a fair idea of a site's potential. If a site-specific study is desired, the Wyoming Business Council offers an anemometer loan program. An anemometer placed on site for a year will provide specific wind speed data that can be useful in a decision to purchase or site a wind turbine. The annual energy output (AEO) of a wind turbine is equal to  $0.01328 \text{ (a constant)} \times \text{rotor diameter}^2 \times \text{wind speed}^3$  so small increases in wind speed translate to big gains in energy output. For more information on the Wyoming Anemometer Loan Program, contact Tom Fuller at (307) 777-2804.

## Monthly Electricity Costs

Average monthly electricity costs are another important consideration and one that makes residential wind turbines less feasible in Wyoming than the wind resource would predict. The more money spent on electricity, the more quickly on-site production of electricity will pay for itself. In Wyoming, electric-

ity prices are generally quite low and therefore often not worth the upfront cost of installing a small wind system. A good rule of thumb for this is if someone has a greater than \$150 per month average cost of electricity.

## State, Federal Policies

State and federal policies are a consideration because they may decrease the upfront cost of the project and can dictate the availability of net metering. Federal and state governments have several grant programs, rebates, and other incentives to aide in installing renewable energy projects.

A listing of Wyoming-specific incentives can be found at the "Database of State Incentives for Renewables and Efficiency" at

<http://www.dsireusa.org/>. Net metering is a mandated policy in Wyoming. This means utilities are required to net meter their customers producing small amounts of renewable energies. Therefore, electric bills would reflect only the difference between what is used by the customer and what is produced. The specific terms of these agreements vary by utility and are on file with the Wyoming Public Service Commission.

## Financing

The final consideration in economic feasibility is financing options. If a turbine is financed, the interest will be a cost that needs to be considered in the payback period. Grants and cost-share programs are possible ways to decrease the amount of a project financed. Financing a wind turbine as a part of new home construction can greatly decrease the payback period but is not allowed

by all lenders.

All of these economic considerations will vary by situation but are factors in the feasibility of small wind use on the ranch or residence. There are several Web calculators available to help determine payback periods for these projects. The U.S. Department of Energy's Wind Powering America Web site has a free payback calculator program available on the "Small Wind Economic Model" link, which can be found at [www.windpoweringamerica.gov/small\\_wind.asp](http://www.windpoweringamerica.gov/small_wind.asp).

Renewable energy use and development is a popular topic in news and government policy. Whether people are interested in it for economics, energy independence, environmental concerns, or other reasons, there are many benefits to considering renewable energy sources for ranch or residential use. In many cases, it may be worthwhile for landowners to at least consider utilizing the wind resource that just might be Wyoming's next source of energy generation.

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