



E³A: Small Wind Energy Applications for the Home, Farm or Ranch

Steps in the Small Wind Series

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Wind for Pumping Water

Wind for pumping water

Water pumping with wind energy is a type of off-grid system that could be of considerable use to livestock producers. The use of wind energy for pumping water has a long history in livestock production. The mechanical windmill enabled the expansion of livestock production on semi-arid grasslands from the 1870s to the 1920s. Wind is no longer the only choice for remote, off-grid water pumping because solar electric arrays are an increasingly popular source of energy for water wells. Despite the rise of solar-powered livestock watering systems, wind energy is still a viable source of energy for remote water pumps. However, wind energy is generally not viable for pumping large quantities of water needed for irrigation systems.



Photo credit: DOE NREL

How pumping systems work

Wind energy can be harnessed to power mechanical and electric water pumps. The simplest systems involve mechanical water pumps. Mechanical windmills that use positive displacement pumps are still commonly used, and they are often a cost-effective means of providing small quantities of water for livestock. Most new wind-powered pumping systems use a small wind turbine to power a direct-current electric pump. Wind turbines are often installed in conjunction with solar panels, because solar arrays offer predictable performance and wind turbines can more efficiently pump larger quantities of water. Systems typically do not include batteries to store energy because they are expensive and require significant maintenance. Tanks and ponds can be used to store water and provide a water supply when wind or solar systems are not in operation.

Key considerations

The design of any water pumping system depends on the amount and timing of the water required and the depth from which the water must be extracted. The location of the water well, the wind resource and a direct comparison to the cost and efficiency of a solar powered system are the most important considerations.

First, a wind energy-based water pumping system should be compared with the option of connecting to the electrical grid. Usually when electrical power is more than a quarter mile from the well, an off-grid renewable system should be considered.

Second, there must be a suitable wind resource close to the water well site. See the *Assessing Your Wind Resource* guide in this module for more information. If you're considering a new well, conduct a wind resource assessment that includes analysis of its seasonality and predictability. Many areas with sufficient average wind speeds have significant seasonal variation, often with stronger winds in the winter and less wind in the summer when livestock typically drink more water. Ensure that your wind resource is strong enough to pump water into storage tanks.

Once you know the viability of your wind resource, compare the costs of solar power and wind power. Research from the USDA Agricultural Research Service suggests that for systems requiring less than 1.5 kW of power, photovoltaic systems are often the most practical and cost effective (Vick and Clark 2009). Solar energy-based pumping systems have fewer moving parts, increased durability and more predictable production. Unfortunately, solar panels cost more per unit of pumping power than wind. Although

prices fluctuate, the purchase price of solar energy can often be two to three times as expensive as a comparable wind energy system. With an adequate wind resource and greater water needs, wind energy-based pumping systems may be advisable. However, a wind-based system generally requires more maintenance and has a shorter life expectancy than a comparable solar energy system.

References

Vick, B.D., and R.N. Clark. (2009). Determining the Optimum Solar Water Pumping System for Domestic Use, Livestock Water, or Irrigation. *Proceedings of the 38th American Solar Energy Society Annual Conference, May 11-16, 2009*. Buffalo, NY.

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