

BioEnergy

Fueling America Through Renewable Resources

Energy from the Wind: Planning a Small Wind Turbine for Rural Areas of Indiana

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Introduction

If you are a rural resident or landowner considering adding small wind turbines to either supplement your energy usage or with the goal of supplying 100 percent of the electricity you use (going “off the grid”), you must carefully assess multiple factors. You must first assess your level of interest in “going green” to help to reduce your carbon footprint, and/or your interest in generating revenue from the power you produce. The feasibility of installing a small wind turbine depends upon policies for purchasing excess power and the economies of scale when generating electricity. These affect the payback period after a small turbine is installed. With uncertain utility rates in the future, this publication will provide insight to help you decide if a turbine is right for your interests and for your property.

Think Energy Efficiency First

Before installing a new, renewable energy system, first determine the efficiency of your current energy consumption. Heating, cooling, and water heating are the largest consumers of energy within the home, some of which may operate on electric power. Consider hiring an expert to conduct a home energy audit to determine the efficiency of your appliances and loads and your energy consumption habits. Conserving energy and increasing efficiency are the

quickest and most cost-effective methods for reducing your carbon footprint. Remember, consuming less is the first way to save.

Community Relations and Environmental Considerations

If you decide to pursue wind power, it will be beneficial in the long run to engage your neighbors and other community members early on in the process. Investigate any possible ordinances for wind turbines in your community, and communicate with your local airport. Consider wildlife and proximity to designated areas such as wetlands that may impact your project development (Figure 1).



Figure 1. A rural residence with a Bergey Excel 10 kW turbine with a 23-ft rotor located in Charlotte, Vermont.

Credit: Trudy Forsyth, NREL/DOE www.awea.org (graphics library)

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Knowledge to Go

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Assess Your Current Electricity Needs and Costs

A first, basic step in assessing the feasibility of installing a small wind turbine is to determine the amount of electricity in kilowatt hours (kWh) consumed during a year on your property. It is also important to look at the electricity load requirements for different months in the year, which may not likely correspond with the available wind to sufficiently generate electrical power. Typically, the winter months are more suitable for ample wind speed and wind power generation. Also, consider the starting loads of your appliances, which are different from the operating loads. For some appliances, such as electric motors, the starting loads can sometimes be as high as seven times the operating loads. You need to factor this in when calculating the total electric load demand from your windpower. In addition to identifying the quantity of electricity consumed, also determine what you are paying for electricity at different tiers of energy consumption. Ask your power utility for the true cost of electricity per kWh. The price for electricity from the utility company includes costs associated with maintenance and service for delivering power to your property in addition to their costs of electricity generation. This makes up a considerable amount of your actual power cost. Recognize that **power** is measured in kilowatts (kW) and is the *rate* at which energy is consumed, while **energy** is measured in kilowatt-hours (kWh) and is the *quantity* consumed.

Determine Available Wind Resource – Is the Site Truly Windy?

A wind turbine requires an ample, consistent, and clean source of wind to generate power up to its given capacity. Wind is the fuel for generating the electricity, and without ample fuel, the turbine will not be efficient or a wise investment. The map of the Indiana (Figure 2) has been generated by the U.S. Department of Energy's National Renewable Energy Laboratory to illustrate locations in Indiana where ample wind is located.

The map illustrates that the “general” higher wind locations shaded in brown and yellow in the northern half of Indiana, as well as in remote areas near Evansville, show more wind availability than areas not shaded. Another resource for determining wind speed in your specific area can be located at the following Web site: www.navigator.awstruewind.com, which allows users to enter a specific address and provides a geographic information system (GIS) map.

To get a highly accurate reading of wind resources, developers of large wind farms measure wind speeds at specific locations with wind anemometers placed on meteorological towers. This is economically not effective for a small turbine installer, because the costs of measuring wind with an anemometer can be high — actually as much as installing a small wind turbine. Expertise in determining where to install small wind turbines involves a combination of assessing wind resources through visual appraisal of wind flagging on trees and shrubs combined with computer-simulated estimations. Figure 3 shows the impact of various levels of wind on local vegetation. Wind speeds increase greatly with higher altitudes. So, you may find you need a taller wind turbine than you'd expected, which increases the cost of installing the turbine.

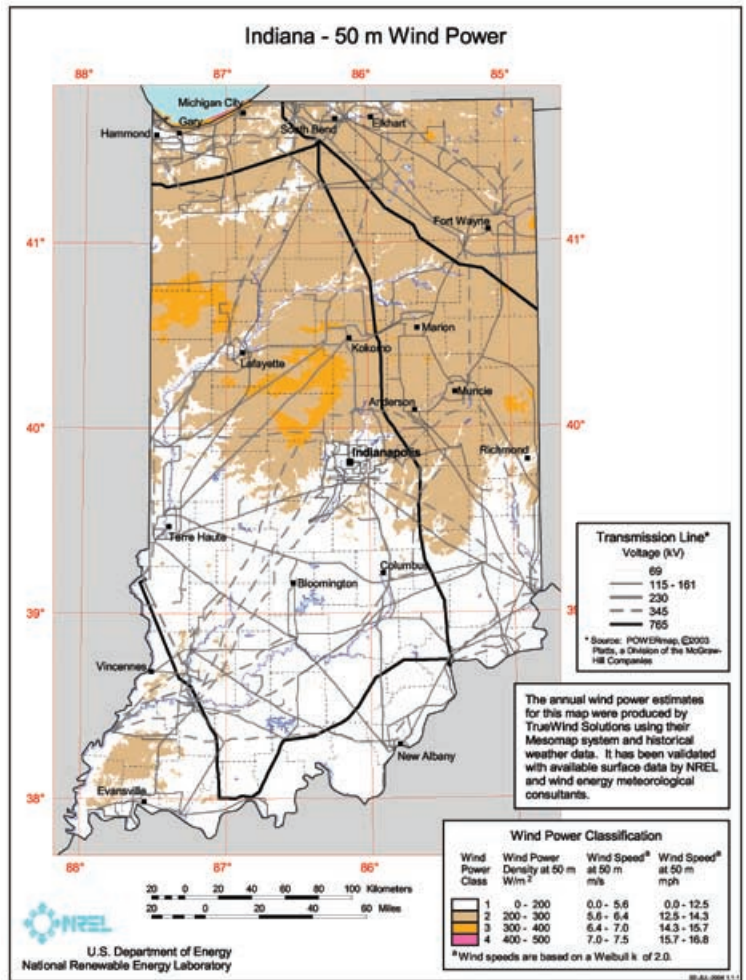


Figure 2. Indiana Wind Resource Map
 Source: U.S. Department of Energy, National Renewable Energy Laboratory – “Wind Powering America” Web site. Located at: <http://www.eere.energy.gov/windandhydro/windpoweringamerica>

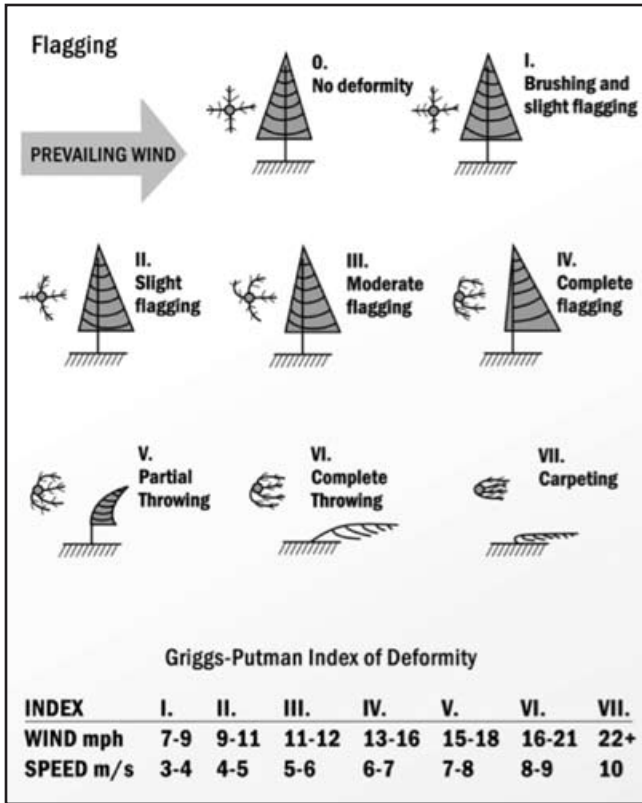


Figure 3. Source: American Wind Energy Association, www.awea.org

Siting Considerations of a Small Turbine

Not only is the quantity of wind a concern, but it is necessary to consider the quality of wind, as well. Wind should be clean flowing, unlike turbulent wind found close to buildings and other obstructions such as trees and highway traffic. The turbine should be mounted on a tower high 30 feet higher than and 300 to 500 feet away

from the tallest nearby obstruction. Figure 4 illustrates proper placement of a turbine to access a more potent and consistent wind resource.

Why or Why Not Wind Energy?

Wind energy is a clean source of electricity that is not generated from the combustion of fossil fuels or coal. The energy created is homegrown and helps create more independence from foreign fuel sources. It is a renewable source of power in which the fuel (wind) cannot be used up or traded as a commodity. Because wind energy can be generated primarily in rural areas, which are less populated and have large expanses of land for installing wind towers, it helps provide a rural economic development opportunity (U.S. DOE, 2008).

One disadvantage of wind energy is that it must compete with conventional sources of power. Within Indiana, utility rates for electricity are moderate relative to those in other states across the United States. With that perspective, small-scale wind energy production can be economically challenging until rates escalate and public policies requiring the use of renewable energy sources are integrated. Small wind towers require regular maintenance to protect the initial investment. There is a shortage of technicians, because of the relatively early stages of adoption of the technology.

Additional Resources

There are many resources available for those interested in investigating small wind turbines. A more detailed guide to small wind turbine development in Indiana is available through the U.S. Department of Energy (USDOE) and can

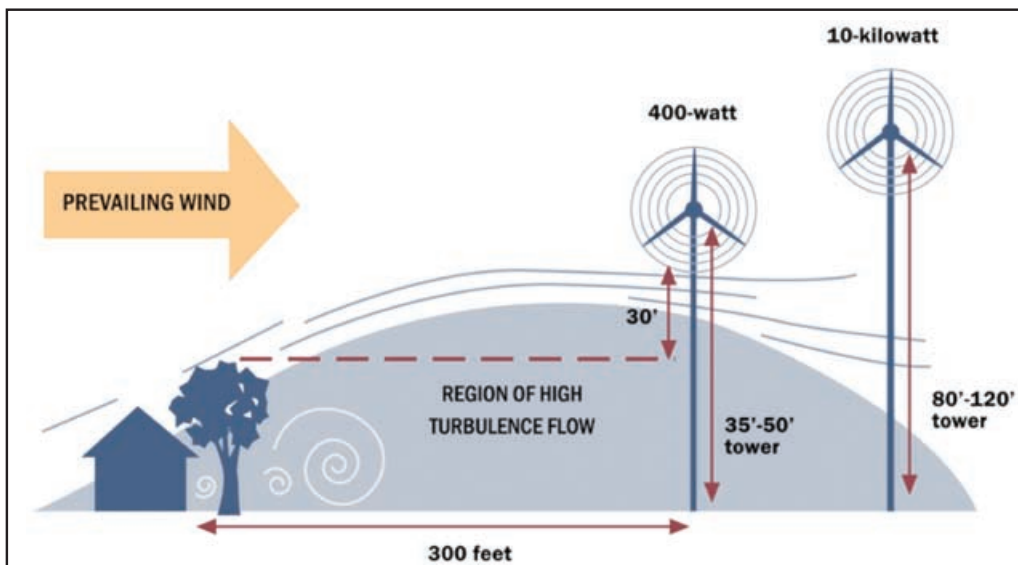


Figure 4. Source: American Wind Energy Association – www.awea.org

be found through the following link:

www.nrel.gov/docs/fy05osti/37710.pdf (PDF file, 1.48 MB).

Here are additional places to find more detailed and relevant information:

- **National Renewable Energy Laboratory**
www.nrel.gov/learning/re_wind.html
- **U.S. Department of Energy – Energy Efficiency and Renewable Energy, Wind & Hydropower Technologies Program/Wind Powering America**
www.windpoweringamerica.gov
- **American Wind Energy Association – Small Wind Toolbox (includes a listing of manufacturers)**
www.awea.org/smallwind/
- **U.S. Department of Energy – Energy Efficiency and Renewable Energy Program, Wind & Hydropower Technologies Program /Technologies**
www1.eere.energy.gov/windandhydro/wind_technologies.html

Funding programs available from the federal or state level can assist in the economic viability of a small wind turbine installation. The following Web sites provide information about available grant and loan programs.

- **Indiana Office of Energy and Defense Development – Alternative Power and Energy Grant Program (APE)**
www.in.gov/oed/files/APE_guidelines_FY09.pdf (PDF file) or contact Julie Howe at jhowe@oed.in.gov
- **USDA Rural Development – Renewable Energy and Energy Efficiency Program**
www.rurdev.usda.gov/rbs/farbill/ or contact Sharon Ellison at Sharon.Ellison@in.usda.gov

Conclusion

To assess all of your options and to evaluate your available wind resources, it is important to consult with an experienced developer and even ask for references from their previous clients. Following up with owners of small wind turbines and discussing their experiences with the technology is advisable. Investing in a small wind turbine is an investment in a new technology, so work with those who are experienced and can provide trustworthy advice.

References

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Acknowledgements

The authors would like to thank the Indiana Office of Energy and Defense Development for their financial support for making this publication possible (contract number 8-WWG-001 and 8-WWG-002).

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