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SMALL TURBINE COLUMN:

Siting Towers & Heights for Small Wind Turbines

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Siting towers and determining tower heights for small wind turbines (up 100 kW in capacity) is quite different than for commercial or utility-scale projects. With a commercial project, the first consideration is access to a utility transmission line, followed by the wind resource, with the final consideration being the potential acceptance of the surrounding neighbors.

Wind farm prospectors look for open land with good elevation relative to the surrounding terrain. A critical criterion is good separation between the potential site of the turbines and nearby obstacles. Wind prospectors like to have at least 2,500 feet between the turbine site and woodlots, farmsteads, and if possible, heavily wooded fencerows. Once they have found some good potential locations, the prospectors will begin contacting landowners about their interest in hosting a turbine or turbines on their land. While prospectors for large-scale installations have specific criteria that they use to determine their ideal location for a wind farm, they have a wide choice of available locations.

This is quite different from the approach for siting small wind turbines. Most people interested in installing a small wind turbine, be they a homeowner, farmer, school district, or small business, has a plot of real estate that he or she owns, which restricts where the wind turbine tower can be sited. Prospective small turbine owners rarely, if ever, look for a patch of ground with a good wind resource to buy for their home, farm, school, or business.

People do not have a propensity to build homes, farms, schools, or businesses on an open, windswept landscape. They seem to prefer locations somewhat sheltered from the weather and their neighbors. As a result, these sites are cluttered with things like trees, besides the buildings that the people occupy. Woodlots are desirable home sites. Farmers often plant fence rows to act as wind breaks for livestock and to minimize soil erosion. Trees are the first things that come to mind when landscaping school or business sites. Achieving a half mile of separation from buildings, trees, and fencerows is nearly impossible for owners of small turbines.

Since prospective small turbine owners are stuck with the real estate they have, and that real estate is inevitably cluttered, there needs to be other considerations for siting the tower and determining tower height. For a wind farm, prospectors seek horizontal separation from trees and buildings. Since that is not possible for most small turbine sites, vertical separation becomes the critical factor.

There are two things that can diminish the wind resource for a small wind turbine. The first is ground drag. Ground drag is the friction that occurs between the surface of the earth and air masses that flow over it. The more cluttered the landscape (with trees and buildings), the greater the ground drag will be in a given area. Ground drag reduces the wind's speed, reducing its kinetic energy. The reason this is so important is because the output of a wind turbine is proportional to the cube of the wind speed. For example, increasing the wind speed from 10 miles per hour to 12 mile per hour results in a nearly 73% increase in the kinetic energy available in the wind.

The second thing that can reduce the output of a wind turbine is the turbulence caused by the obstacles that clutter the earth. Trees and buildings cause the wind to tumble and swirl rather than flow smoothly. Besides reducing the kinetic energy in the wind by slowing it down, turbulent winds also put undue stress and strain on the wind turbine and tower. Turbulence increases the maintenance on a wind generator, while it effectively reduces its life expectancy. Turbulence is the proverbial double whammy for small wind turbines!

In terms of tower height, the rule of thumb that is used is that the entire rotor of the wind turbine (that is, the three rotating blades) must be at least 30-feet above anything within 500-feet of the tower, or the local treeline, whichever is higher. While not ideal, the 30-feet gives minimum separation between the obstacles on the ground that can create turbulence for the wind generator (trees and buildings) and the wind turbine's collector, the rotor. Taller towers will always result in increased turbine output, since both ground drag and turbulence will be further reduced.

One final note on the 30-foot rule: in most cases, the tower height will be determined by the tree height around the site, or the area tree line. But remember that trees grow over time, while towers do not, no matter how much it rains over the 20- to 30-year life of the wind system. When determining tower height based on the 30-foot rule, you need to know the mature height the trees will reach in 30 years, not how tall they are today. That height becomes the baseline for the 30-foot rule.

In terms of tower location, turbulence can be reduced by siting the tower upwind of as many obstacles as possible, towards the prevailing wind direction. If the prevailing winds come out of the north to northwest in the winter, and south and southwest in the summer, the ideal location for a small turbine tower would be west of the ground clutter.

[Editors Note: The opinions expressed in this column are those of the author and may not reflect those of AWEA staff or board.]