

WINDLETTER

THE MONTHLY NEWSLETTER OF THE AMERICAN WIND ENERGY
ASSOCIATION

Volume 25 Issue No. 6 – June, 2006

SMALL TURBINE COLUMN:

Rules of Thumb for Siting Wind Turbines

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Over the past eight months, I've done a series of columns about the importance of tower height when siting small wind turbines on your property. This column will be a synopsis of the considerations and rules of thumb for deciding where to site your tower as well as how tall that tower should be.

A basic tenant of siting wind turbines, whatever the size, is that wind speed increases with height. Ground drag, or the friction between the earth and the air masses that flow over it, reduces the wind's speed—and therefore the kinetic energy that could have been available to convert to electricity with a wind turbine. As a result, wind turbines are placed on tall towers to get them above the surface of the earth. But how far above do we need to be?

Unlike wind prospectors who go out specifically looking for the ideal piece of property on which to site a wind farm, most of us are stuck with the real estate that we purchased and live on. We are also stuck with the various trees and buildings sitting on our properties as well as those of our neighbors. (see "Siting Towers and Heights for Small Wind Turbines", *Windletter*, October 2005). This ground clutter, as it is known, causes considerable turbulence in the air masses that blow over our property. Turbulence does many things to a wind turbine. Compounding ground drag, it further reduces the kinetic energy in the wind, resulting in reduced energy production. The gusty winds of turbulence cause the wind turbine to continuously hunt in the wind, resulting in increased wear and tear on the machine. This wear and tear leads to additional maintenance as well as a reduced life for the wind turbine.

As a result of both ground drag and turbulence, the standard rule of thumb for siting a wind turbine is to make sure that the entire rotor (that is, the three spinning blades, or the collector, of the wind generator) are at least 30 feet above anything (e.g., houses, barns, trees, whatever) within 500 feet of the tower. However, this is considered only a minimum; going above the 30 feet will always result in increased energy output because ground drag is further diminished with height above ground. (see "Considerations for Wind Generator Towers, *Windletter*, November, 2005.)

Some people may live on a site that is relatively open, with perhaps only a bit of ground clutter, but yet there may be a mature tree line just beyond the 500 foot rule. In this case, the rotor must be 30 feet above the area tree line.

Another thing to keep in mind is the age of the trees around your home. They may be only 20 feet tall today, but one thing we know is that trees grow over time. Twenty-five years down the road, those 20 foot trees will likely be 50-60 feet tall. Keep in mind that trees grow, but towers don't, no matter how much it rains in your yard. So, be sure to specify your tower height not on how tall the trees are today, but how tall they will be in the next 25 years.

Folks living in hilly terrain need to pay even closer attention to these guidelines. Rougher terrain results in more disruption of the wind, which can only be minimized with increased tower height. At some point tower height simply gets prohibitive. If this is the case, rethink how successful your wind turbine will be by compromising the tower's height. Just because you want a wind turbine doesn't necessarily make it a good idea in an extremely complicated site where you cannot get above the tree line or ground clutter.

People have made good use of reducing the wind's damaging effects for centuries by putting something in its path to disrupt its flow. We use fence rows to reduce soil erosion. County highway crews use snow fence to reduce the amount of snow they have to plow off the roads in the winter time. Some people plant tree lines around their houses to reduce frigid arctic winds robbing their house of heat in the winter. The object is to reduce the kinetic energy in the wind so that it cannot do the work it could do if the wind were not disrupted: soil erosion, blowing and drifting snow, a cold chill blowing through the house. Knowing this, we understand that any obstacle in the wind considerably reduces its impact. The reverse of this can be of use to us when siting towers in very open areas. Typically, the zone of turbulence is twice the height of an object in its path. A 25 foot tall building on an otherwise relatively open piece of property would influence the wind up to 50 feet above the ground.

There may be an obstacle in your yard that you simply cannot reasonable get above, say one prize tree planted generations ago that towers dozens of feet above everything else. What to do? Chop down the tree? Definitely not! Do you need to get the rotor a minimum of 30 feet above this tree, given a shorter treeline ground clutter in the yard? Not necessarily, but you do need to minimize the impact of the tree on your wind turbine. The best way of doing this is to determine the direction of the prevailing winds in your area. Then site the tower as far upwind of the tree towards the prevailing wind direction.

In dealing with hundreds of people and their wind systems over the past two and half decades, the one regret that people repeatedly express is that they wished they had purchased a taller tower when they first installed their system. Learn from their mistakes. Do it right the first time.

All of this can be boiled down to the following rules of thumb for siting small wind turbines:

1. Wind speed increases with height above the ground due to reduced ground drag.
2. Wind farm developers seek horizontal separation from ground clutter. Since we cannot do the, we look for vertical separation to reduce turbulence.
3. The minimum acceptable tower for a given site must be at least 30 feet above anything within 500 feet...
4. Or 30 feet above the areas proximate treeline, which ever is higher.
5. Your “neighbors” (usually the trees in your area) determine your tower height (not what the manufacturer offers or the local dealer sells).
6. Remember that trees grow, but towers do not (no matter how much you water them). Size your tower for 20 to 30 years of tree growth.
7. Rougher terrain will produce gustier winds. This can be mitigated somewhat with a taller tower.
8. Site your tower upwind towards the prevailing wind direction of any major obstacles on your property.

Keep these rules in mind when installing your wind system and you will be rewarded with many years of reliable energy production.

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