In the Public Interest

How and Why to Permit for Small Wind Systems

A Guide for State and Local Governments

American Wind Energy Association
September 2008

In the Public Interest: How and Why to Permit for Small Wind Systems

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The greatest challenges to small-scale renewable energy are not technical, but rather financial, political, and regulatory. Confusing, inconsistent or even absent permitting processes discourage the very people a forward-thinking community would want to enable: those with the motivation and resources to generate their own clean electricity.

Small wind turbines allow homeowners, farmers, small business owners, and public facilities to generate their own clean, safe, and reliable energy for on-site use. Though thousands of towns and counties already do, many have not yet included small wind systems in their zoning codes to allow their use. The reason is often no more than a lack of familiarity with the technology, resulting in overabundant care to avoid setting a controversial precedent. This often renders the permitting process the single most daunting obstacle for would-be consumers and prevents the installation - and associated public benefits - of thousands of small wind systems.

The good news is this is easy to fix. Making the permitting process affordable, streamlined, and accountable is in the best interest of the consumer, environment, and community. This guide explains why, and identifies best practices for local governments to balance the interests of property owners and the community.

Ron Stimmel
September 2008

"We ought to have a law that allows homeowners and small business people to put up photovoltaic generators and small windmills and any other new sources of widely distributed generation that they can come up with."
- **Al Gore, March 19, 2007 CNN Glenn Beck Show**

"Bad zoning not only scares away potential customers, but also dealers - the local small businesses that distribute, install, and maintain small wind systems."
- **Mike Bergey, Bergey WindPower Co.**

"Planners can encourage efficient energy use, diversification of energy supply, and emissions reductions through their influence over the built and natural environments - including both where and how we build, and where and how we preserve open spaces."
- **American Planning Association.** Planning and Climate Change: Mitigation and Clean Energy Strategies. www.planning.org/energy/index.htm

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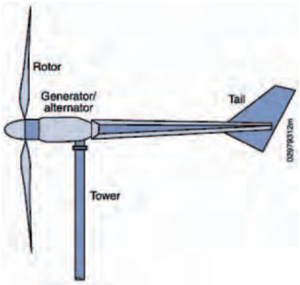


Basic parts of a traditional, Horizontal-Axis Small Wind System

Vertical-Axis Turbine

Skystream 1.8kW turbine size compared to lampposts

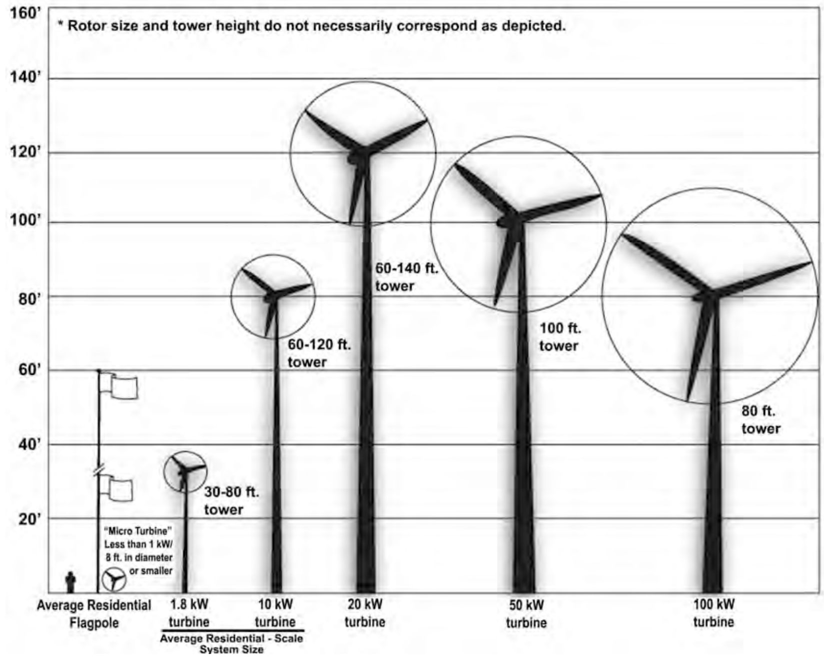
INTRODUCTION

What Are Small Wind Turbines?

A small wind turbine is a device that produces electricity from wind. Moving air causes the turbine to rotate, which generates clean, emissions-free energy that can be used to power a home, farm, school, or small business.[1] Though most small wind turbines look like a miniaturized, "back yard" version of the large, utility-scale, three-bladed turbines, the industry encompasses over 200 different models and they can vary widely in appearance. A small wind turbine is technologically advanced but mechanically simple, with only two or three moving parts. Most feature three blades of 2-15 feet in length, a generator located at the hub, and a tail. The turbine is mounted on a steel tower 35-140 feet high, which is designed as a freestanding monopole (like a street light), a lattice tower (like a radio tower), or a guyed monopole (like a street light with support cables from mid-tower to the ground). (See p. 10 for illustration)

Some models eliminate the traditional propeller-shaped blade design and instead feature a cylinder-like component that revolves similarly to a barbershop pole or corkscrew. Systems of this configuration are known as "vertical axis" turbines because the plane of rotation is perpendicular, or vertical, to the ground.

The technology has advanced considerably in the recent years, making small wind turbines quieter, more reliable, and better able to blend in with surrounding aesthetics. A forthcoming (2009) program to certify small wind turbines to a safety, performance, sound, and reliability standard will further promote high performance and increase consumer confidence.[2]



[1] "Small wind system" encompasses not only the turbine, but the tower, foundation, and wiring equipment often necessary for an installation. "Small wind turbine" and "small wind system" are sometimes used interchangeably.

[2] The Small Wind Certification Council (SWCC) is an independent, third-party program that will, upon its introduction in 2009, certify small wind turbines tested to a performance, safety, and reliability standard. Proposed and enacted incentives for small-turbine consumers at state and federal levels have already begun to account for this impending program by making future certification a requisite for eligibility. Other states, such as California and New York, have incorporated their own criteria for eligibility into their incentive programs in order to grant incentives only to products that meet certain performance and safety conditions.

How Are They Used?

Tens of thousands of homes, farms, small businesses, schools, and other institutions throughout the country use small wind turbines to lower or eliminate their electricity bills. Uses are diverse and quite similar to those of solar photovoltaic panels. The two technologies are in fact natural complements (wind resources are strongest in the winter and spring while solar resources are strongest in the summer) and are often used together in hybrid systems.

Some small wind systems connect to the utility grid while others charge batteries for backup power for remote, stand-alone applications like cabins or even sailboats. Connecting to the electric grid allows a turbine owner to use electricity from the local utility when the wind does not blow, but also allows any surplus electricity - energy produced in excess of consumption, such as when winds are strong and usage is low - to be sent back into the grid and used by a neighbor. But unlike large turbines that power entire cities, small wind systems are used to produce power primarily on-site for a single user.

What Can Neighbors and the Community Expect?

After installation, which takes about two to 10 days to complete, life with a turbine in the neighborhood is largely uneventful. Visual assimilation of the new turbine is similar to neighbors becoming accustomed to a new building addition, landscaping project, or the removal of a prominent tree. The best way to assess the impact is to visit an actual installation. With approximately 10,000 turbines sold in the U.S. every year, and in all 50 states, they are relatively easy to locate. Contact a manufacturer or local installer to see an installation first-hand. (See www.awea.org/smallwind/smsyslst.html)

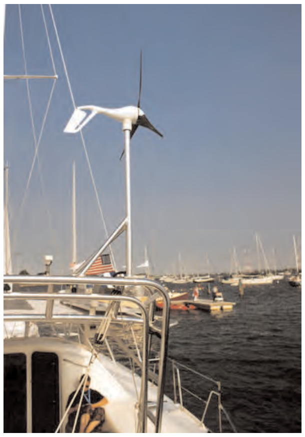
Responsibilities of Turbine Owners

The small wind industry is indeed small, and every installation potentially affects public perception of not only small wind turbines, but of renewable energy as a whole. Each installation is, in essence, an ambassador of the industry. It is in the long-term, self interest of the industry and consumers alike that owners exercise good judgment and courtesy toward their neighbors and community. Doing so often includes informing neighbors, in writing, of a proposed installation and educating them about potential impacts - both real and perceived - of a small wind turbine (see www.awea.org/smallwind/toolbox2/INSTALL/building_permits.html for a sample letter to neighbors).

For fundamental reasons though, topography and the wind itself largely determine precisely where and how high a turbine must be installed. Sometimes there is no way to avoid these physical constraints other than to place or elevate the turbine into a more aesthetically sensitive place on a property. But a turbine owner should make a deliberate effort to take all reasonable measures to minimize impacts on neighboring areas.

Common Applications

On- or Off-Grid...
- Single-Family Homes
- Businesses
- Farms
- Institutions
- Schools
- Government Buildings
- Industrial Sites
- Military
- Communications Systems



0.4 kW turbine on a sailboat

"Everybody knows the good things about using renewable energy. I wanted to set an example down here and perhaps encourage others to do the same thing."
\- **Small-turbine owner Chuck Heide, Somers, WI**

The "Power" of Good Zoning

"Never before has the general public been so interested in solar and wind energy, nor has the potential for political support ever been so high."
- **Ingrid N. Kelley, Chair, Environment, Natural Resources and Energy Division, American Planning Association**

Bergey WindPower 10kW turbine

"The way we plan urban areas significantly affects the energy usage of individual building sites. Appropriate site design standards and building codes can encourage energy conservation and the use of renewable energy technologies on site."
- **American Planning Association**[3]

Precedent: Commonplace or "Bleeding Edge"?

Understandably, community leaders are sometimes hesitant to enact regulations that appear to be first of their kind. But with tens of thousands of small wind turbines in the U.S., in every state, zoning officials need not fear being on the "bleeding edge" of a new movement. Thousands of townships, counties, and cities have had small wind zoning regulations on the books for decades, setting a substantial precedent for others to follow.

Below is a very small sample of localities with small wind zoning ordinances:

Great Falls, MT
San Bernardino County, CA
Clarke County, VA
Currituck County, NC
Kern County, CA
Long Lake Township, MI
Norwich, VT
Ocean Gate, NJ
Mason City, IA
Wicasset, ME
Rockingham County, VA
Denver, CO
Thetford, VT
Eliot, ME
Henry County, GA
Cape Elizabeth, MA
Rochester, NY
Tippecanoe County, IN
San Francisco, CA
Chicago, IL
Fillmore County, MN
Weber County, UT

Why Zone for Small Wind Systems?

Your family's electric bill has climbed to $400 per month and you expect it go higher. You are worried how global warming will affect your kids. And you don't want to wait around for others to fix these problems. Generating your own, clean power sounds like a great idea, and something you may even be able to afford with the rebate program your state offers for small wind turbines.

So you spend months researching equipment, your neighborhood's wind resource, and ways to pay for a new turbine. All your ducks are finally in line, but when you apply for a building permit, the county office has never heard of small wind systems, or if they have, only of rumors that they are noisy and kill birds. This technology is also nowhere to be found in the zoning code and it is hard for the zoning office to find out information about how to treat this unique structure. Or, since the closest thing the zoning office has dealt with before is large, utility-scale turbines, your 5 kilowatt turbine is treated the same as a 50,000 kilowatt power plant and the permitting requirements and costs are impossibly out of reach.

[3] "Policy Guide on Energy." American Planning Association, April 2004. http://www.planning.org/policyguides/pdf/Energy.pdf See also: "Planning and Climate Change: Mitigation and Clean Energy Strategies." American Planning Association. http://www.planning.org/energy/index.htm. Accessed May 2008.

[4] For a list of states and incentives available for small wind systems, see the Database of State Incentives for Renewables & Efficiency at http://dsireusa.org.

Left without a solution readily at hand, the permit is denied, and you are stuck with high electricity bills and a dependency on conventional fuels. Your community misses the opportunity to increase clean, in-state generation, reduce the pressure on a stressed power grid, and employ local businesses to sell, install, and maintain these systems.

Simply listing small wind systems as an allowed use (such as an accessory, permitted, or conditional use) can avoid this scenario that happens with startling frequency around the country.

Other reasons to permit for small wind systems include:

To Be Prepared. Many states[4] carefully craft incentive programs to help consumers purchase small wind systems only to find that local zoning ordinances stand in the way of the systems' installation. Communities may wish to design zoning policy to anticipate and accommodate small wind installations, especially in states that try to encourage them.

To Retain Autonomy. The states of California, Nevada, Oregon, Wisconsin, Michigan, Vermont, and New Hampshire have been the first to create statewide rules for the permitting of small wind systems. Whether to follow suit or preserve local autonomy, knowing how best to deal with this technology in your community is good long-term strategy.

To Conserve Public Resources. Case-by-case application reviews and hearings cost time and money. Proactively planning for small wind installations can be a rewarding investment.

For the Personal Benefits. Owners of small wind systems enjoy:

- Personal energy independence
- Free electricity after recouping costs
- Relief from high and volatile prices of other forms of electricity
- Reliable electricity
- Ability to support clean energy and fight global warming in a tangible way
- Increased property values

For the Public Benefits. Though the power generated by a small wind system is used only by a single residence or facility, the benefits of wind power extend to the entire community. Community benefits include:

- Reduced pressure on the local electricity grid
- Increased security: can provide back-up power to strategic applications like police stations or hospitals for "hazard mitigation" purposes[5]
- Increased local energy independence
- Increased property values
- Enhanced reliability and power quality of the power grid
- Reduced peak power demands
- Increased in-state electricity generation
- Diversified energy supply portfolio
- Reduced pollutants from traditional forms of energy
- Increased market competition from more consumer choice
- Increased visible indicators of community support for clean energy
- Increased regional economic growth

[5] Sandia National Laboratory has begun development of strategic Energy Surety Microgrids http://www.sandia.gov/news/resources/releases/2006/microgrid.html

A turbine's productivity is largely in the hands of zoning officials.

"Distributed small wind energy systems... enhance the reliability and power quality of the power grid, reduce peak power demands, increase in-state electricity generation, diversify the sate's energy supply portfolio, and make the electricity supply market more competitive by promoting consumer choice."
- **California Government Code**, Section 65891.13 (a)(2) www.leginfo.ca.gov/cgi-bin/displaycode?section=gov&group=65001-66000&file=65892.13

Manufacturers ask: "In which state should I base my operations?"

The answer is: "States with the best policies."

Ventera 10kW turbine

Putting a turbine on too short of a tower is like placing a solar panel in the shade.

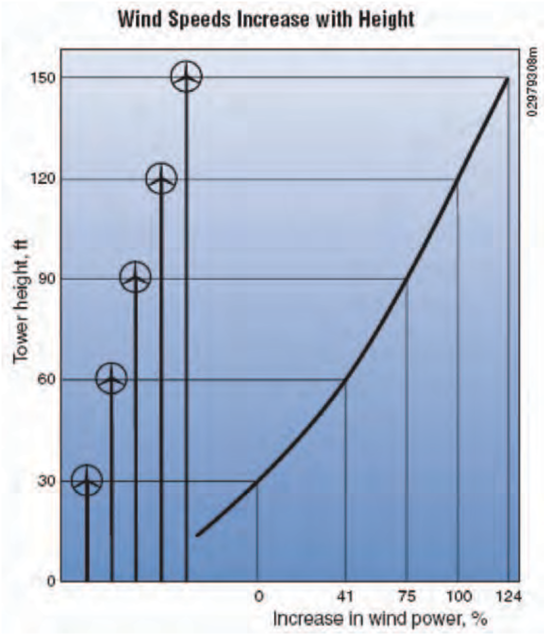
Restrictive Zoning Rules Can Undermine State Law

Several states offer financial incentives to promote small wind turbines and clean energy. But zoning height limitations can prevent turbines from generating any meaningful amount of energy, thwarting the intent of the state incentive.

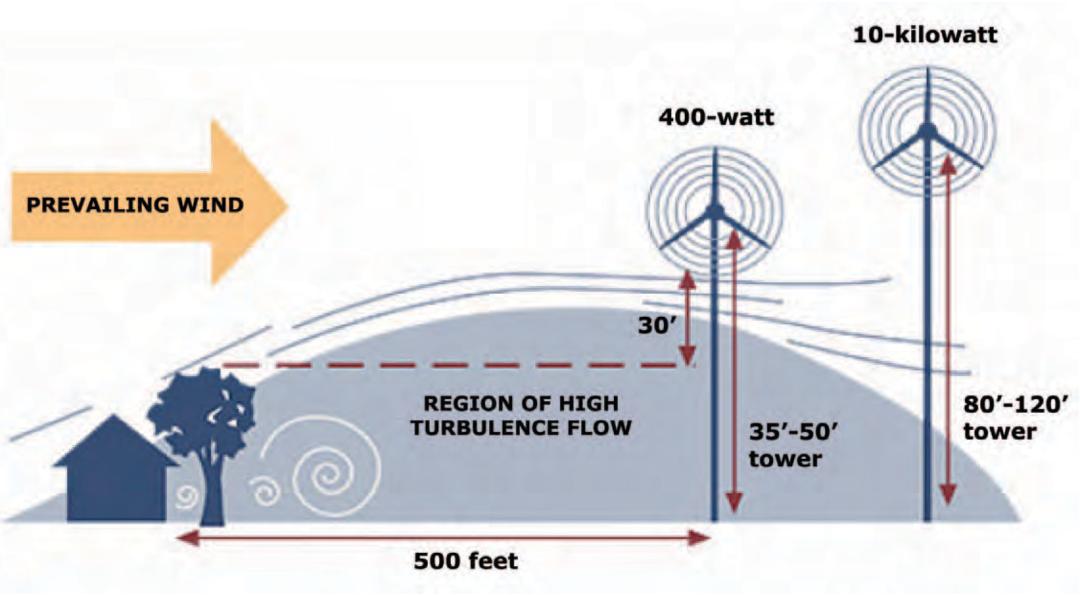
The Importance of Height

Why Do They Need To Be Tall?

A tall tower is the single most important factor in the economic viability of a small wind system. Tall towers enable turbines to access faster and better quality winds, and even small increases in wind speed translate to exponentially more energy the turbine can generate. In other words, a taller tower means far more - and cheaper - energy.



The best sites for turbines are those where the wind is least obstructed, which is often the highest point on a property. The bottom of the turbine rotor should clear the highest wind obstacle (rooftop, mature tree, etc.) within a 500 foot radius by at least 30 feet. Doing so ensures the turbine reaches consistent, fast wind speeds and prolongs the life of the turbine by avoiding stressful air turbulence.



For a 10kW residential-scale turbine

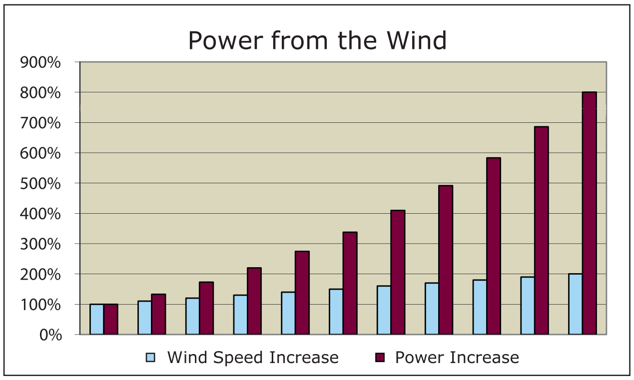
Tower height (feet)	Wind speed (mph)	kWh/year	System cost	Incremental cost from 60′	Incremental energy output from 60′	Incremental energy ÷ incremental cost = ROI*
60	7.3	2,709	$48,665	---	---	---
80	9.3	6,136	$49,841	$1176 or 2.4%	226%	226% ÷ 2.4% = 94 to 1 ROI
100	10.7	9,338	$51,346	$2681 or 5.5%	344%	344% ÷ 5.5% = 63 to 1 ROI

* = Return on Investment   Mick Sagrillo, AWEA Windletter, January 2006

Mariah Power Windspire
1kW turbine

Overly conservative zoning height restrictions therefore cost the owner money - and a lot of it. They can also mean more sound, since taller towers raise the generator high above the ground, diluting sound considerably. Sound decreases four-fold with every doubling of distance from the turbine (including distance above the ground) so taller towers are better for their owners as well as neighbors. (See also “Sound” p. 11.)

For zoning officials, the importance of strong winds also means that tower height cannot be compromised as a gesture to neighbors concerned about the visibility of the turbine. "Hiding" a turbine from neighbors using a shorter tower almost always means hiding it from the wind, too.



Bergey WindPower
10kW XLS turbine

Nor do two shorter installations make an acceptable substitute for a single, taller one. A tower alone can comprise 50% or more of a system's total cost, so multiple, shorter turbines (on multiple towers) cost the owner far more than a single, taller system. (See also "Multiple Turbines," p. 14.)

It is also important to keep in mind that a turbine's generator size (generating capacity, measured in kilowatts or kW) has little, if anything, to do with its tower height. Sometimes zoning regulations mistakenly limit tower heights based on the size of the turbine's capacity, thinking that a 2kW turbine, for example, always corresponds to a 40 foot tower. This is not the case. Appropriate tower height is matched to a turbine depending on surrounding terrain, trees and buildings, and wind resource. Therefore, tower height restrictions, if any, should only reflect sound and safety concerns rather than be designed to correspond to a system's generating capacity. Most often, in fact, established sound and setback requirements negate the need even to mention height in regulations for small wind systems.

Issues

The following issues are key components of land use law, as well as public acceptance of small wind systems, and are critical for the successful placement of a turbine:

1. **Setback Distances and Height**
2. **Lot Size**
3. **Aesthetics**
4. **Sound**
5. **Property Values**
6. **Insurance**
7. **Abandonment**
8. **Multiple Turbines**
9. **Urban and Building-Integrated Installations**
10. **Potential of Structural or Electrical Failure**
11. **Soil Studies**

Southwest Windpower "Air" on lamppost

Many existing height limitations still exist based upon the fact that 100 years ago water pressure in firefighters' hoses could not reach higher than 35 feet.

EnergiePGE 35kW turbine

Flagpoles, lamp posts, and utility poles are allowed in front of schools and parking lots among cars and people because they are engineered structures, just like wind turbine towers. They should all receive the same treatment under law.

1. Setback Distances and Height:

To balance against the need for tall towers (see p. 6), good practice requires that a turbine in a residential district be "set back" from a property line some given distance. (For commercial or other zones, this distance is often considerably less, even zero, since in these areas affected parties seldom exist immediately outside a property line.) The mandated distance in residential zones should reflect valid concerns for property rights of abutting neighbors, as well as those of the turbine owner.

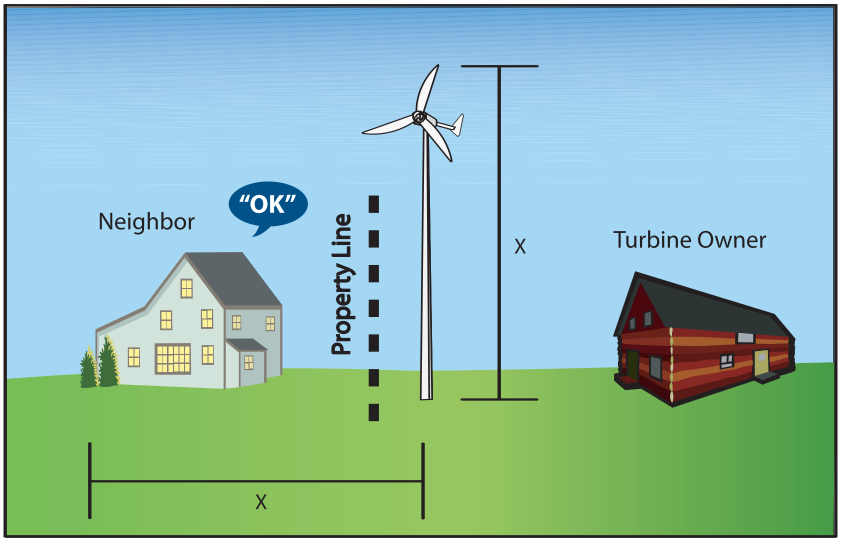
This most commonly translates to the tower height plus the length of one blade (the turbine's "total extended height") from the property line, inhabited neighboring structures, utility lines, and/or road right-of-ways. This distance should suffice so long as the tower is professionally engineered and/or the installer provides engineered plans of the tower, the foundation, and the system does not exceed the definition of nuisance noise as established in the zoning code. (See also "Sound," p. 11.)

Independent structural analyses of a tower and its foundation are readily available from the manufacturer, so requiring additional studies is unnecessary and also prohibitively expensive for a turbine owner. For their own protection and insurance considerations, the manufacturer conducts these studies for reasons of economics, responsibility, and - even if for no other reason - self-preservation. (See "Potential of Structural or Electrical Failure," p. 15.)

However, in residential zones, some argue that a turbine's setback should be no different than that of a house, cellular tower, flag pole, street lights, or any other engineered structure, and that height should not be expressly limited nor specified in zoning regulations. Instead, they argue that in residential zones turbine heights are already self-regulated based on sound level restrictions at the property line.

Also keep in mind that:

- Turbines on the market are engineered to withstand hurricane force winds (110 -130 mph).
- Allowing abutting property owners to submit signed easements may be an alternative form of compliance should roads and utility lines be absent in the immediate vicinity.
- A manufacturer's engineering specifications should be an acceptable means of ensuring safety and practicality.



Allowing abutting property owners to submit signed easements may be an alternative form of compliance should roads and utility lines be absent in the immediate vicinity.

2. Lot Size:

Some zoning rules limit turbines and/or their heights to a corresponding property size. For example, some jurisdictions limit tower height to 80 feet for lots 0.5-1.0 acre and impose no height limit for lots larger than 1.0 acre.

This regulatory approach, however, usually has no meaningful effect simply because sound and setback requirements, which are usually more restrictive, make such a stipulation redundant. Such a requirement may contribute only to additional administrative burdens and unnecessarily limit the use of wind turbines.

Bergey WindPower 1kW turbine

Skystream 1.8kW turbine

Skystream 1.8kW turbine dual-use on lamppost

"By placing these windmills where many people can see them, [people] will be able to learn about and experience alternative energy as part of their daily lives."
- **Pennsylvania Gov. Edward Rendell, April 11, 2006**

Monopole Tower

Lattice Tower

Guyed Monopole Tower

3. Aesthetics:

To function, wind turbines must be tall and unobstructed, which means that they will likely be visible at some distance (see p. 6). It is also a fact that some people object to their appearance. However, legislating "taste" becomes a difficult task - and an inappropriate one for any authority other than a homeowners' association (and even homeowners' associations may wish to create policies that prohibit aesthetics from entering the debate). Regulating aesthetics requires balancing the perceived or desired character of a community; the public and private benefits of clean, renewable energy; and property rights of all parties.

Advocates say that small wind turbines are icons of the American rural landscape, dating back to the 1920s, and that today they have again emerged as a symbol of independence and a cleaner future. They argue that so long as a turbine is installed safely, particularly on private property, they should be allowed. System owners compare the aesthetics of their turbine to that of a street lamp, utility pole, or flag pole, and like a flag on a flagpole, a turbine only moves or makes a sound when the wind blows (see "Sound," p. 11). Advocates also point to precedent, noting that communities already accept water towers, buildings, billboards, relay towers, cell phone towers, utility poles and lines, grain silos, and radio antennas as part of the landscape.

But the aesthetic impact of wind turbines may be unacceptable in areas with historic significance where aesthetics play an important role in a district's long-established character. Opponents say that their height and movement are a distractive and unpleasant sight and visually intrude on their rights as property owners. Both views are based on emotion, however, not fact. As such, aesthetics are often a very sensitive issue and policymakers should take care to address any concerns fairly.

Small turbines are designed to blend in with their surroundings as much as possible. Studies show that turbines best blend into the sky when painted the factory-default color. Manufacturers avail themselves of expertise to determine how to prevent their turbines from standing out like a sore thumb on the landscape. So requiring owners to "disguise" a turbine or tower by painting it green or other colors to match vegetation would actually make it stand out more and should be avoided.

Some communities regulate appearance by prohibiting the use of commercial markings, messages, or banners on the turbine or tower. Some towns also dictate which tower types are acceptable in order to ensure only the most visually appealing design. This, too, is a subjective assessment, and such decisions are often made without considering the added cost of a "sleeker" tower that performs just as reliably as another design. A monopole tower (like a flag pole) generally has a "tidier" appearance than a lattice tower (like a radio tower) or guyed tower (like a flag pole with wire supports), but they can cost several thousands of dollars more and should not be considered equal economic substitutes. All towers on the market are professionally engineered for safety and reliability, leaving appearance and cost the only significant differences among them.

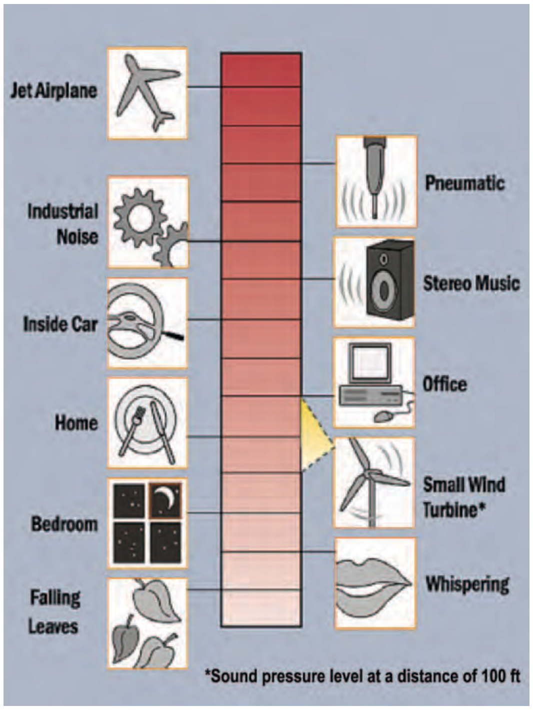
4. Sound:

Modern wind turbines have better insulation, lower rotation speeds, fewer moving parts, no gearboxes, and more efficient blades that make them much quieter than their ancestors. Today's turbines emit sound that is barely discernible from ambient noise, even with a decibel (dB) meter. Sound from traffic, rustling trees, airplanes, and people in fact often sufficiently mask the dull, low, "white noise" sounds a small turbine can make at certain wind speeds. Only during short-term events like severe storms or utility outages do turbines make distinctive sounds, but in these occurrences ambient sound levels increase as well.

To put this into further perspective, the sound made by the lanyard clasp on a flagpole line hitting its pole is far more "tonal" and distinguishable than any sound a small wind turbine makes, and is less easily masked by ambient sounds.[6]

Zoning policy should reflect ambient sound levels as well as occasions where no affected parties are located immediately outside a property boundary. Therefore, except during short-term events like storms and utility outages, a small wind system should be installed and operated such that sound pressure levels do not exceed the definition of "nuisance noise" as established by existing zoning code. or at the nearest dwelling, whichever is greater. Sound levels should always be measured downwind of the turbine to account for the canceling effect of the sound of the wind itself. If ambient sound levels exceed "nuisance" levels on certain occasions, such as during storms, sound level limits of small wind systems should also be given reprieve during these events which are out of everyone's control.

Or, instead of singling out wind turbines in sound regulations, it may be more fair and administratively simple to use default sound/noise regulations that apply universally to other objects and appliances in a community. The small wind section of Wisconsin's (state-wide) zoning ordinance, for example, has no mention of sound because its designers chose to treat small wind turbines equally with other allowed devices/structures.



Sound Level Comparison

Modern small wind turbines are typically quieter than most external air conditioners.

A clasp hitting a flagpole is far more distinguishable than any sound a small wind turbine makes

[6] Flag clasp photo credits: Flags Unlimited

Most people's reaction to turbines, even up close, is that they are much quieter than they expected.

"Vermont turbine owner David Blittersdorf reports that the home next to his sold within one day for the full asking price. His new neighbors later told him that his 10kW turbine was a major factor in the quick sale. 'They said they wanted to live in a place where the community cared about the environment. They told me that they, too, wanted to install a small wind turbine someday,' says Blittersdorf."
- **Permitting Small Wind Turbines: A Handbook: Learning from the California Experience. California Energy Commission, 2003. www.awea.org/smallwind/documents/permitting.pdf**

4. Sound (con't):

Planners and zoning committees should also keep in mind that:

- Sound decreases significantly with distance from the source (including height - another good reason to allow tall towers). Doubling the distance from the turbine decreases the sound level by a factor of four. For example, sound level readings at 25ft. from the turbine hub drop by a factor of 4 at 50ft., and by a factor of 16 at 100ft. Noise intrusion across a property line from a turbine that is set back 100ft. or more is typically very limited.

- Turbine manufacturers are keenly aware of the public demand for quieter machines and have invested in new materials and designs to minimize sound. As a result, today's turbines operate at near-ambient sound levels.

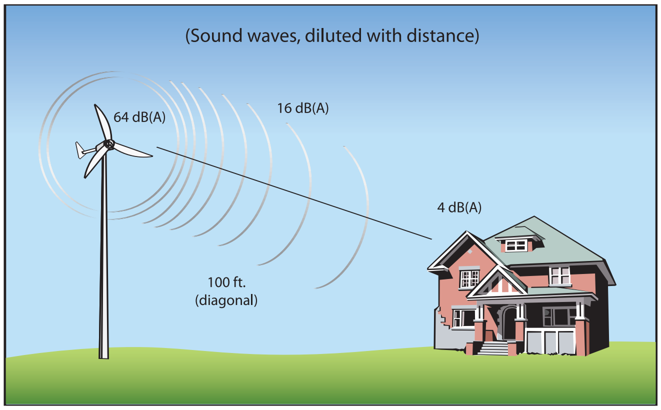
- Only a few events or circumstances can cause a normal operating wind system to become audible, including utility blackouts (or a full battery bank for those models that incorporate batteries). Both situations are temporary, and in many cases (but not all), easily remedied by the owner by manually shutting down the turbine.

- Sound level test data for some turbines is available from the U.S. Department of Energy's (DOE) National Renewable Energy Laboratory (NREL).[7]

- Requiring certified noise tests for a residential wind system is unnecessary given the lower sound emissions of today's turbines and that sound data is readily available from manufacturers. Such tests are also beyond the budget of any homeowner.

- "Noise" is a subjective term. Whether a person generally favors wind turbines or not can determine how he or she views a single, seemingly objective sound.

- The single best way to understand the nature of a turbine's sound is to visit an installation site. All turbines are a marginally different so be sure to visit a location with a similar wind resource and the same model turbine as is in question.



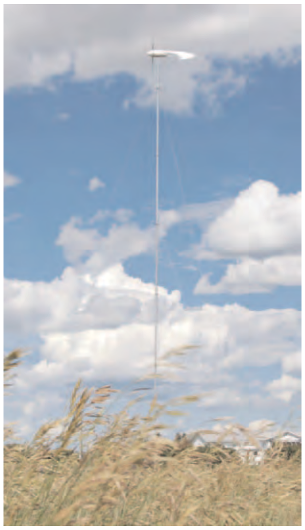
[7] The National Renewable Energy Laboratory (NREL) has tested several residential-sized wind turbines for sound emission levels. NREL engineers noted a "marked progress toward quieter turbines" in recent years and concluded in one case that "the turbine noise could not be separated from the background noise." This is generally true of most of today's residential wind equipment over a great range of operating wind speeds. NREL engineers noted, however, that "the operating condition [of the wind turbine] has a strong influence on the noise characteristics." They found two scenarios where sound actually increased above normal operating conditions: when grid connection was lost (for grid-connected models) and when the batteries were full (for battery-charging models). The solution is simply for the owner to shut off the turbine in these situations to avoid excessive noise. See the NREL report, "Acoustic Tests of Small Wind Turbines," NREL/CP-500-34662, by P. Migliore, J. van Dam, and A. Huskey at http://www.nrel.gov/docs/fy04osti/34662.pdf.

Additional Resources:
Alberts, Daniel J. "Primer for Addressing Wind Turbine Noise". Lawrence Technological University, 2005. http://home.nethere.com/dja1701/technical_writing/papers/AddressingWindTurbineNoise.pdf

5. Property Values:

Evidence[8] indicates that the presence of wind turbines increases neighboring property values. No study has ever concluded that wind turbines - neither large nor small - have had a depressing effect on nearby residential property values.

A recent survey found that most people are interested in or willing to pay more for homes equipped with solar panels or wind turbines.[9]



Windward Engineering
4.25kW turbine

6. Insurance:

The small wind system should simply be added to existing homeowner, farm, or business policies as an "appurtenant" (uninhabited) structure and not require a separate policy. Precautions such as setback requirements for wind turbines are designed specifically to protect that which is beyond one's own property line. Homeowner's insurance policies make no distinction based on how far a turbine is from one's own house, so neither should zoning rules.

7. Abandonment:

Some towns require assurance that any non-functioning turbine will be removed after a period of time to prevent unnecessary clutter in a community. Abandonment due to malfunction has become particularly rare due to today's improved technology, though a community should be entitled to recourse should an abandoned turbine present a nuisance.

Security bonds may be required for large, utility-scale turbines which are located on land leased from a third-party property owner, but these are inappropriate and unduly burdensome for owners of small systems who install turbines on land they own. It is recommended that any small wind turbine owner whose equipment is inoperable for six months be notified by the zoning committee that the owners have six months from the notice date to restore their system to operating condition. If the owner fails, the wind turbine should be removed from the tower for safety reasons. The tower itself would then be managed under the Public Nuisance language of the rest of the existing zoning code.

Bergey WindPower
10kW XLS turbine
lowered for
ground maintenance

[8] A May 2003 study by the Renewable Energy Policy Project (REPP) study, *The Effect of Wind Development on Local Property Values,* finds that "...for the great majority of projects the property values actually rose more quickly in the view shed than they did in the comparable community. Moreover, values increased faster in the view shed after the projects came online than they did before." Available at http://www.crest.org/articles/static/1/ binaries/wind_online_final.pdf.

See also: Advice from an Expert: Residential Wind Turbines and Property Value. American Wind Energy Assoc. http://www.awea.org/faq/sagrillo/ms_zoning_property values.html.

[9] "Renewable Energy Study." California Energy Commission, Nov. 2001. http://www.energy.ca.gov/reports/2002-04-03_500-02-016.pdf. p. 28

8. Multiple Turbines:

Abundant Renewable Energy ARE 110 2.5kW and ARE 442 10kW turbines

Though rare, some small wind systems come in "arrays" of multiple turbines, each of which is usually very small. However, regulations should treat additional turbines no differently than the first. So long as each turbine, or the resulting aggregate installation, meets the sound, setback, and safety requirements as exist for other structures, there should be no need for further or special considerations.

When determining height limits (if any - see "Setback Distances and Height," p. 8), keep in mind that rarely are multiple units equal economic substitutes for one larger, taller turbine. Therefore to meet restrictive height limitations, multiple small turbines are not an equal substitution. See the payback period table in the "Height" (p. 7) section of this guide for an illustration.

9. Rooftop Turbines and Urban Environments:

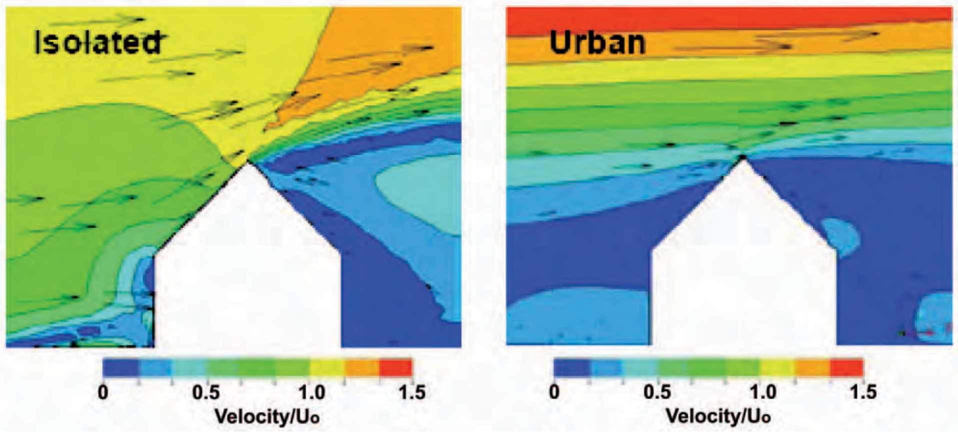
Proven Energy 2.5kW turbine rooftop array

In very rare instances turbines are installed directly onto building rooftops or even designed as part of the building itself (known as "architecturally integrated"). These installations appear mostly in urban or densely-built areas where small property sizes may prevent the use of towers elsewhere on a property. These types of installations currently account for less than 1% of all applications, but interest is increasing rapidly and zoning officials may receive permit applications for urban or rooftop installations.

Siting becomes especially important for turbines in urban settings. Wind patterns behave very differently around buildings and in densely-built areas, so a turbine must be sited very precisely in order to gain access to wind of sufficient quality. Height, for example, becomes increasingly important in order for the turbine to rise above aerodynamic obstacles and turbulence, as depicted in the graphic below.

Regardless of these unusual physical conditions, as long as other sound and setback requirements are met, no additional or unusual standards should be imposed for architecturally-integrated turbines and/or those in dense environments.

AeroVironment rooftop array



Source: Watson, S.J. "Predicting the Yield of Micro-Turbines in the Urban Roof-Top Environment." Centre for Renewable Energy Systems Technology, Loughborough University, U.K. Presentation, March 2008.

10. Potential of Structural or Electrical Failure:

Requiring code compliance and manufacturer drawings should sufficiently balance the public and private needs for an installation to be safe, practical, reliable, and affordable.

Wind turbines are professionally engineered structures and are designed to withstand decades of near-constant operation (see "Setback Distances and Height" p. 8). They shut down automatically during utility outages in order to protect utility line workers, and will not energize a dead power line. They are also equipped with manual and automatic over-speed protection devices that keep the turbine operating in a controlled range of speeds. Because of these and other factors, mechanical failures are very rare, especially those that would have an impact on surrounding areas.

But as a precaution, just as for any other allowed structure, the applicant should submit to the zoning board a line drawing of the electrical components, as supplied by the manufacturer, in sufficient detail to allow for a determination that the manner of installation conforms to the National Electrical Code. Doing so also serves to demonstrate that the installer and manufacturer are engaged in an evaluation of the suitability of the site.

Though rare, some zoning boards require an engineering analysis of a tower and its foundation, but this is a very costly and often redundant measure. Even more rare is the requirement of an engineer's "wet stamp," which is a from-scratch calculation performed by a structural engineer of the tower's integrity. Such a study can cost thousands of dollars and serves only to duplicate work that the manufacturer originally performed as a prerequisite for securing liability insurance.

Proven Energy, Ltd. manufacturing facility in Scotland, UK

"Renewable energy equipment has become more reliable and economical, and installation standards are more professional." - **American Planning Association, 2004.**[10]

Bergey WindPower blade testing

A small wind turbine can in fact be one of the more aesthetically pleasing features in a city. Rooftop heating and ventilation systems, antennas, and other structures found in urban environments usually reduce any aesthetic impacts from small wind turbines in comparison.

[10] "Policy Guide on Energy." American Planning Association, April 2004. http://www.planning.org/policyguides/pdf/Energy.pdf

Northern Power
100kW turbine

Entegrity Wind Systems
50kW turbine
in Quinter, Kansas

11. Soil Studies:

Wind turbine foundations face forces that are not unlike those seen in light-pole or flag-pole foundations, but for the same height, wind turbine towers generally experience higher forces at the very top of the tower. The wind turbine foundation therefore plays an important role in an installation, as does the soil in which it is installed.

As standard practice, manufacturers engineer foundations for "worst-case" scenarios by assessing soil conditions based on U.S. Geological Survey soil maps, core samples, studies from the National Resource Conservation Service, or other resources. For "abnormal" soils consisting of rock, gravel, sand, peat or water-saturated earth/muck, etc., a manufacturer or local professional engineer conducts a tailored, project-specific soil review and often designs a custom foundation for the site. The installer always confirms with the manufacturer or an independent professional engineer that the site's soil conditions meet minimum standards as specified by the tower manufacturer, and that the tower is designed to local engineering standards (which vary by jurisdiction). For decades this has effectively ensured safe, durable installations while maintaining their affordability.

These built-in safeguards make formal site soil analyses unnecessary for residential-scale (20kW or smaller) turbines and avoid the need for special studies and designs that can exceed the cost of the foundation itself. For example, a foundation designed for a "worst case" scenario might require 50% more concrete than that for another, similar structure. Assuming this fortified foundation also costs 50% more, an installation for a residential turbine normally costing, say, $4,000, would increase to $6,000. This is expensive, but a relatively small share of the total cost of the system. However, a foundation 50% more robust (and expensive) for a turbine larger than 20kW, where the foundation might normally cost $30,000, would now cost $45,000 - an increase of $15,000. At this point, a professional engineer's "wet stamp" based off a site-specific geotechnical study is now the best economic option for achieving the same, safe ends.

The best practice would be to require an engineer's wet stamp and a soil analysis for turbines greater than 20kW, but allow "worst-case" foundations (already the industry's standard practice) for turbines any smaller. This would ensure quality, secure, and affordable installations.

NON-ISSUES/"RED HERRINGS"

The following are common misconceptions about small wind:

- i. **Shadow "Flicker"**
- ii. **Fences/Attractive Nuisance**
- iii. **Birds**
- iv. **"Icing"**
- v. **Electrical Signal Interference**
- vi. **Lightning Strikes**
- vii. **Stray Voltage**

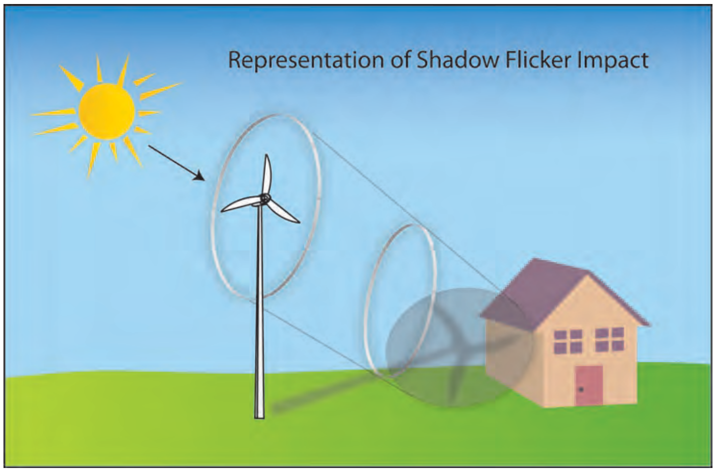
i. Shadow "Flicker":

Under very specific circumstances, low sunlight passing through the moving rotor of a turbine can cast visible shadows on the ground or on structures. This issue pertains almost exclusively (and similarly rarely) to large, utility-scale turbines because of their slower-moving blades. Shadows also depend on the time of day, day of year, and latitude of the site's location.[11]

Small turbines are shorter, have narrower blade profiles, and spin much faster than utility-scale turbines so that any shadows become essentially invisible at operating speeds. Turbines of all sizes are designed to start spinning only after a minimum wind speed has been attained, so chances are very slim that a small turbine will spin slowly enough to make shadow flicker a concern.

Furthermore, normal setback distances dictated by property lines or sound requirements mitigates, if not entirely eliminates, this potential nuisance, especially at U.S. latitudes.

Northern Power 100kW turbine in Golden, Colorado



[11] The possibility of shadow flicker affecting a given location can be calculated very precisely. See http://www.windpower.org/en/tour/env/shadow/shadowc.htm for a shadow flicker calculator.

Bergey WindPower 10kW XLS monopole turbine with fence in Erie, PA

ii. Fences/Attractive Nuisance:

Some voice concern that a turbine could pose a temptation to unauthorized climbers and should be fenced off to prevent potential climbing-related injuries. However, decades of experience and tens of thousands of installations have shown that unauthorized climbing is exceedingly rare. A fence, which is itself climbable, can impose its own attractive and aesthetic nuisance and in the process do little more than create false, negative impressions about renewable energy.

Furthermore, for a turbine tower to be an "attractive nuisance" to the public, in most cases a potential climber would first have to trespass on private property - a much more prevalent issue and one that should be dealt with separately. Requiring fencing also places a burden on turbine owners unlike any imposed on flagpoles, utility towers, or other common, climbable structures.

Perhaps most detrimental of all, fences prevent access to the turbine in emergencies. Sometimes a turbine must be shut down manually during storms or electrical problems, and emergency shut-off switches are most often located at the base of the turbine tower. Utilities also require that the turbine be readily accessible to workers performing routine or emergency maintenance on power lines.

Instead, to prevent unauthorized climbing:

- Remove climbing foot rungs on the lower 10 or 12 feet of a freestanding tower.
- For lattice or guyed towers, fasten sheets of metal or wood to the lower part of the tower to cover all hand - and foot-holds.
- Display "Danger-High Voltage" or "Caution-Electrical Shock Hazard" signs to the sides of the tower. Of the thousands of freestanding utility high-line towers across the country, few, if any, are policed or fenced, but they all are posted with such signs.

Utilities, tower manufacturers, and the small wind industry have successfully employed these techniques for decades and are more effective deterrents than any fence.

iii. Birds:

The most common - and most exaggerated - misconception about both large and small turbines is that they are disproportionately harmful to bird and bat populations. Even the vastly larger, utility-scale wind farms that are grouped closely in large arrays account for less than 0.003% of all human-caused bird deaths.[12] House cats and glass windows, by comparison, cause 10,000 times more bird deaths than do wind turbines. No study has been performed specifically to address avian effects of small wind turbines, but because of their dispersed nature and small size, it can be inferred that they have an even smaller impact than their larger counterparts.[13]

Environmental impact or avian migration studies should not be required for individual small wind turbine installations. Are environmental impact studies required for every plate glass window or pet license? Small wind turbines in fact offer a net benefit to local and global environments: they emit no air pollutants, require no mining for fuel nor water for cooling, and have land use "footprints" of only a few square feet.

iv. "Icing":

Like trees, street lamps, or other structures, turbines in cold climates can become covered in ice, which falls to the ground as it melts. But just as an airplane's wing must be de-iced in order for it to fly, a turbine's blade must be free of ice in order to rotate at any significant speed. The weight and aerodynamic interference of ice buildup slows the blades' rotation to a near stand-still, making any melting ice fall straight downward rather than being thrown from the blade.

To put this in further perspective, a 1998 study calculated that the risk of personal or property damage from ice falling from a (large) turbine is lower than the risk of being struck by lightning.[14]

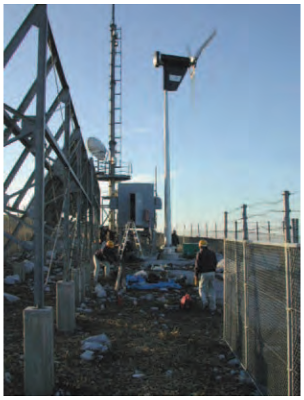
[12] "Environmental Impacts of Wind-Energy Projects." National Academy of Sciences, 2007. http://books.nap.edu/catalog.php?record_id=11935

[13] Erickson, et.al, 2002. Summary of Anthropogenic Causes of Bird Mortality

[14] Bossanyi, Morgan, and Siefert. "Assessment Of Safety Risks Arising From Wind Turbine Icing." Finland, April 1998.

Small wind turbines are commonly used to power communications equipment. They will not cause signal interference.

Bergey WindPower 1kw turbine on telecommunications station in Bristol Bay, Alaska



Proven Energy 6kW turbine powering telecommunications equipment

v. Electrical Signal Interference:

Small wind turbine blades are made from materials that are "invisible" to radio frequency transmissions and cannot cause interference problems. In fact, small wind turbines are used by the U.S. Navy to power military communications equipment.[15]

In the past, wind turbine blades were sometimes made of metal which did create unwanted radio or television interference, but the industry has long since abandoned the use of metal blades.

Any structure under 200 feet high - that is to say, any small wind turbine - is also too short to interfere with civilian or military radar. Radar usually does not even scan for objects this close to the ground because common land features at this height, like trees, would normally cause distorted, cluttered, or misleading radar images.

vi. Lightning Strikes:

Wind turbines do not attract lightning, so pose no threat to neighboring properties.

Lightning is essentially the release of pent-up static electricity that moves from a turbulent atmosphere to the ground. Small wind turbines are "grounded," meaning that any static electricity on the tower or generator is dispersed into the ground, preventing a build-up that could invite lightning strikes. As a result, even though small wind turbine towers are made of metal (a conductor of electricity), by virtue of their grounding they are less susceptible to lightning strikes than trees, which cannot shed built-up static electricity. To a lightning bolt, a turbine is therefore no more "appealing" than the ground itself.

However, lightning strikes are still possible, which is why small wind turbines incorporate back-up technologies like surge and lightning arrestors (also known as silicon oxide varistors) and metal oxide varistors, which are also used to protect home computers from electrical surges. Lightning strikes are never completely preventable, but these industry-standard measures offer the best protection available to the owner of the wind system. Good practice in the wind industry includes grounding of all towers and guy wires, which significantly reduces the chance of a lightning strike.

[15] Sagrillo, Mick. "Telecommunication Interference from Home Wind Systems." AWEA Windletter, Volume 22, Issue 4, April 2003.

vii. Stray Voltage:

This unusual phenomenon, primarily affecting farm livestock, is the result of faulty wiring on any number of electrical systems (not just wind turbines) and easily prevented by industry-standard practices. It is also a strictly localized issue that will not affect off-site parties or properties.

For safety reasons, including to minimize lightning strikes (see above), nearly all types of electrical systems in the U.S. are, at some point in the system, connected to the earth or "grounded." Electric current flowing in the ground dissipates quickly as it moves away from its source (much like sound from a wind turbine). Grounding also allows power systems to detect equipment malfunctions and automatically shut down before harming people or equipment.

If a system is not properly wired, the point(s) at which a system is grounded can develop a small voltage (electrical pressure, essentially) that can push current through the earth and end up contacting unintended objects. Hence the name, "stray" voltage. This phenomenon is rare and primarily affects cattle, whose legs are far enough apart to stand on two points where different voltage levels in the ground exist. The cow may or may not feel this voltage difference, depending on the level and duration of the exposure.

While the design of electrical system makes stray voltage possible, its actual occurrence is the result of poor grounding practices, improper or inadequate wiring, or deteriorated wire insulation. Most small wind turbine inverters - those that are IEEE 1547 or UL1741 compliant - can detect faulty grounding and automatically shut down current flow. Like solar photovoltaic installations that require "ground-fault circuit interrupter" (GFCI) devices to protect consumers from any stray voltage, small wind turbines are also equipped with GFCI measures.

In other words, stray voltage is caused by problems on a particular customer's side of the utility billing meter so is not a problem beyond the electrical system of a particular home or farm. Nor can stray voltage move or be transferred from one property to another, since it is an "on-site" problem stemming from electricity distribution or wiring, not the generation of electricity. The issue therefore does not fall under the jurisdiction of zoning rules, which are designed to protect that which exists outside a property line.

Making It Happen: Best Practices and a Model Ordinance

Entegrity Wind Systems
50kW turbine

Permitted use? Accessory use? Or conditional use?

Anticipating, acknowledging, and understanding small wind turbines not only reduces administrative burdens for zoning boards, but it lowers permitting time and costs to the point where it makes the project within the realm of financial reason for the owner. Streamlining the permitting process is often best achieved by listing small wind turbines as a conditional or accessory use.

A ***Permitted Use permit*** allows a small wind system by default, provided it meets applicable design standards, and is applied commonly to flag poles, church steeples, and grain silos. A permitted use indicates that a justification has been established for the structure's standing eligibility. As such, no public hearings are required and a permit can be obtained quickly. Permitted uses are frequently found in rural areas where potential impacts are minimal.

A ***Special/Conditional Use permit*** allows an installation under certain conditions identified in the statute. This option usually requires a more detailed description of the project from the applicant and often involves a public hearing. A hearing can disadvantage both the zoning board and potential owner, however, since each application must be decided on a case-by-case basis and educational efforts must begin from scratch. Many documented experiences show that this process can cost potential small-turbine owners thousands of dollars and take hundreds of hours to accomplish, if at all.

A ***Site Plan Review*** allows an installation after a physical inspection of the proposed project site and surroundings. This option is usually accompanied by a special/conditional use permit.

An ***Accessory Use*** of land is one that is subordinate, incidental to, and customarily found in connection with the principal use allowed on a lot by the zoning law. A garage, for example, is incidental to the principal use of a lot as a single-family residence and customarily found on a single-family lot. For small wind, this normally appears in agricultural, commercial, or industrial settings where energy produced by a turbine is instrumental in accomplishing a main function of the property's use. Importantly, allowing small wind as an accessory use avoids the need for special use permits for future applications.

A ***Variance*** is a modification or waiver of certain zoning requirements for a permitted use structure. For a small wind turbine, this usually means making an exception for setback distances or height limits. Variances are issued when prevailing regulations cause an unreasonable "burden" on the property owner and usually require public hearings, making a variance for a small wind turbine very difficult to obtain.

An ***Overlay Zone*** supersedes prevailing zoning rules in certain geographies. A jurisdiction may establish an overlay zone to indicate that a certain area is appropriate for small wind turbines or other renewable energy technologies. This expedites the permitting process, but planners must be careful that this strategy does not overly limit areas outside of zone.

Recommendations

See also AWEA's "Policies to Promote Small Wind Turbines: A Policy Menu for State and Local Governments" 2008. www.awea.org/smallwind

Education may be the single most important factor in streamlining the permitting process.

For State and Local Governments

■ Create regulations in advance of public inquiries.

■ Recognize that small wind systems have very different impacts than large, utility-scale turbines and require completely separate siting considerations. In terms of impact, a residential-scale wind turbine has more in common with a solar photovoltaic panel than it does with a utility-scale wind turbine.

■ Treat small turbines as improvements to an individual property, not as commercial or industrial projects.

■ Promote consistency among fees, requirements, and procedures across jurisdictions. Doing so reduces complications and inefficiencies for installers, applicants, and governments.

■ Experience your own permitting process firsthand: Mayors or governors may want to try to obtain a permit for a turbine for installation at city hall or the governor's mansion.

■ Educate permitting staff, zoning officials, and governments about small wind. Share with them this and other publications listed in the "Contributing & Additional Resources" section (p. 28).

■ Base code compliance on a common set of standards (IEEE 1547 and UL 1741) that ensure the reliability and safety of a turbine's electrical components, as installed according to the National Electric Code. But also ensure the grid interconnection process formed around these standards is well-founded. See "Freeing the Grid" 2007 report.[16]

Keep in mind the <u>public</u> benefits of small wind:

- Increased property values
- Increased in-state electricity generation
- Reduced pressure on the utility grid
- Increased local energy independence
- Increased security/can provide back-up power to strategic applications like police stations or hospitals for "hazard mitigation" purposes[17]
- Reduced dependence on polluting forms of electricity
- Enhanced reliability and power quality of the electricity grid
- Reduced peak power demands
- Diversified state energy supply portfolio
- Displaced pollutants from traditional forms of energy
- Increased consumer choice
- Increased visible indicators of community support for clean energy
- Increased regional economic growth. Manufacturers ask, "In which state should I base my operations?" The answer is: "States with the best policies."

Proven Energy
2.5kW turbine

[16] http://www.newenergychoices.org/uploads/FreeingTheGrid2007_report.pdf

[17] Sandia National Laboratory has begun development of strategic Energy Surety Microgrids http://www.sandia.gov/news/resources/releases/2006/microgrid.html

Additional Options

Creating incentives: Beyond removing obstacles and enabling installations to occur on their own, a state or community can create incentives to make small wind turbines a more attractive option for individuals and businesses. These include:

- Reducing, or waiving, permit and development impact fees
- Fast tracking review periods
- Permitting small wind systems by-right in some or all districts to avoid costly and contentious hearings
- Awarding points in performance-based review and green building programs
- Awarding density bonuses for developments that reduce or generate >50% of energy demand on site

Protecting windy areas: A town or state might also anticipate future installations by protecting areas in the community that have exceptionally good wind resources. Local dealers and installers are trained in wind resource assessment and can help locate these areas.

Specifically for Local Governments

Federal preemption of home rule for **cell phone towers** enabled the industry to expand dramatically, which would not have likely occurred without it. Fair zoning for small wind turbines could bring similar economic benefits.

■ Implement a stand-alone ordinance specifically to address small wind turbines (see "Appendix," p. 30).

■ Expedite processing times by consolidating a jurisdiction's permit review process to as few departments or agencies as possible.

■ Encourage permit applicants to notify their neighbors of their proposed installation.

■ Educate permit department staff about small wind to ensure safe, fair, expedited, and less costly installations. Demonstration projects offer an excellent educational opportunity. Contact a local dealer to locate a nearby installation.

■ Coordinate with neighboring zoning jurisdictions to establish consistent practices, rate schedules, etc. This can be done through Regional Councils of Government or independently, and will save time and money for the town, turbine owner, and installer.

■ In the absence of pertinent state legislation, local governments can overrule neighborhood covenants that unnecessarily restrict renewable energy.

■ Initiate a Community Energy Plan to assess the renewable energy potential of a locality and devise strategies for meeting energy goals. (This may include implementing a renewable energy overlay zone - see last paragraph.)

■ Consider establishing renewable energy overlay zones.[18] This policy would be ideally situated in a local government's Comprehensive Plan (or equivalent) that describes a town's future objectives and strategies.

Without proper care however, a renewable energy overlay zone could inadvertently prevent small wind installations outside the zone where they may be perfectly acceptable. As a precaution, make the zone sufficiently large and create or maintain a provision that allows small turbines (and other renewables) outside of the zone. It may in fact be easier to identify any areas *not* suitable for such installations and make distributed renewables an allowed use elsewhere by default.

Specifically for State Governments

State government action can very effectively streamline the permitting process by standardizing permitting requirements across local jurisdictions. Consider implementing the following:

- Establish statewide zoning standards for renewable energy systems. Oregon state law, for example, requires cities and counties to list small wind turbines as an allowed use on any land zoned for agricultural or forest use, pending they meet certain conditions.[19]

- Provide educational opportunities for planners and zoning officials.

- Preempt private covenant restrictions that prohibit or restrict small wind and other distributed renewable energy systems on aesthetic grounds.

- Follow precedent set by over 10 states that prohibit the unreasonable restriction of renewable, distributed energy use within planned communities.[20] These laws are, unfortunately, not often publicly known and so are violated frequently. Therefore accompany any such rules with educational outreach efforts. The Community Associations Institute (CAI) and its chapters, for example, could provide a platform upon which to educate community associations and homeowners about their rights and responsibilities under the law.

- Preempt local zoning jurisdictions. Though likely a politically sensitive measure, the most effective way to enable small wind installations is for a state to preempt "home rule" jurisdiction of local zoning codes to allow the (conditional), statewide installation of small wind turbines under a single umbrella policy. Several precedents demonstrate that doing so helps consumers, communities, and industry. Home rule was preempted on a national scale for cell phone towers (Telecommunications Act of 1996) and was far stronger than what would be needed for small wind systems. This federal preemption succeeded in passing largely because of the perceived national benefit that wireless communications would bring. Advocates argue that the same could surely be said of renewable energy. The states of Wisconsin,[21] Nevada,[22] Vermont,[23] Michigan,[24] Oregon,[19] New Hampshire,[25] and California[26] have all agreed and enacted laws that preempt home rule specifically to prevent undue prohibitions of small wind systems in their states. As a direct consequence, these states enjoy more in-state (non-imported) energy generation and other environmental and economic benefits that small wind offers.

Northern Power
100kW turbine
in Kotzebue, AK

[18] Example renewable energy overlay zone: Klickitat County, WA. Klickitat County Planning Department: http://www.klickitatcounty.org/Planning/filesHtml/200408-EOZ-EIS/06-01-map-EOZ.pdf

[19] Northwest Sustainable Energy for Economic Development. Community Wind: An Oregon Guidebook. Report for the Energy Trust of Oregon. (No date given). p. 41-42. http://www.energytrust.org/RR/wind/community/forms_request.html.

[20] These states include Arizona, California, Colorado, Florida, Hawaii, Indiana, Iowa, Massachusetts, Nevada, Utah, and Wisconsin.

[21] 1993. Wisconsin statute 66.0401. Wisconsin's small wind zoning ordinance http://renewwisconsin.org/wind/Toolbox-Zoning/Small%20Wind%20System%20Model%20Ordinance%2012-06.pdf. Available from http://renewwisconsin.org/wind/windtoolbox.html

[22] Nevada State Legislature NRS 278.0208 http://www.leg.state.nv.us/Nrs/NRS-278.html #NRS278Sec0208

[23] Vermont Statute Title 30 Sections 219(a) and 219(b), and 248 amended with bill 209 from 2008 http://www.leg.state.vt.us/statutes/statutes2.htm

[24] Michigan Siting Guidelines for Wind Energy Systems http://www.michigan.gov/documents/Wind_and_Solar_Siting_Guidlines_Draft_5_96872_7.pdf

[25] New Hampshire House Bill 310 http://www.gencourt.state.nh.us/legislation/2008/HB0310.html

[26] California AB 1207 http://info.sen.ca.gov/pub/01-02/bill/asm/ab_1201-1250/ab_1207_bill_20011007 _chaptered.html

Vermont's Net-Metering Permitting Process

Vermont's permitting process for net metered (thus, grid-tied) small wind turbines is straightforward and simple: A customer applies for a Certificate of Public Good (CPG), at no cost, from the Vermont Public Service Board (PSB) and distributes the application to adjacent landowners, the town planning committee, and select board, local utility, and several state agencies. Barring any objections within 30 days, the CPG application is generally approved and is exempt from additional state or local zoning regulations. Should there be any public objections, witnesses for each party testify at a public hearing where the PSB makes a final decision.

Windward Engineering Endurance 4.25kW turbine in Arkport, NY

Permitting Process: Time & Cost

Even the best zoning ordinances are often thwarted by overly expensive and lengthy requirements for obtaining a permit. We recommend the following:

	Permitted or Accessory Use	Conditional Use
Time	The permit should be granted upon timely review of the application, not exceeding 30 days.	Hearings are usually required to determine whether the installation meets the "conditions" upon which permission is contingent. Any hearings should be held within 30 days of the application date. Promptly thereafter the zoning board should notify the applicant whether or not the permit has been granted and what conditions are necessary to satisfy the permit.
Time	If an application must be approved by a town or county board after being passed through a planning committee, a reasonable timeframe is 60 days or less.	
Costs	Total permitting costs should be commensurate with any other non-commercial end-use objects or structures, and should reflect the cost of administering the permit and any associated reviews or inspections. Most localities levy fees at a flat rate, but some occasionally use a "valuation method" that calculates the fee as a percentage of the system's cost. However, there is little, if any, correlation between the size of a turbine and the costs and time required for its inspection and review process. Flat fees are therefore more practical and desirable. Furthermore, the valuation method inadvertently discourages larger systems and their associated public benefits. Paradoxically, under this fee structure, the more a turbine owner wants to contribute to the community, the more difficult it becomes to do so. Some localities have implemented a tiered fee structure to distinguish between residential and commercial uses. Still others have waived permitting fees entirely for on-site renewable generators, sending a powerful message of local government support for clean energy and their associated community benefits. Some communities that have waived permitting fees for on-site renewables include Tucson (AZ), San Diego (CA), Fairfax (CA), and the entire state of Vermont.[28]	

[28] http://lomaprieta.sierraclub.org/global_warming/ pv_permit_study.htm Damian Pitt, "Taking the Red Tape out of Green Power." Network for New Energy Choices, September 2008. In Vermont, permitting is free for all grid-tied renewables statewide under the Certificate of Public Good application process.

Conclusion

Good zoning for small wind is important, achievable, and good public policy.

Planners and zoning officials are in a unique and powerful position to help renewable energy and those who rely on it. Of all the challenges consumers and the industry face to deliver the benefits of clean, on-site power generation, the permitting process can be the most severe. But fortunately, a remedy is available and implementing it can come at a net benefit to the community at large.

By understanding the issues and identifying a variety of potential solutions, renewable energy will be able to play a more vibrant part in American communities.

Entegrity Wind Systems 50kW turbine

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Articles written for the American Wind Energy Association's Windletter by Mick Sagrillo, Sagrillo Light & Power, available at http://www.awea.org/smallwind/sagrillo/index.html and/or RENEW Wisconsin's Small Wind Toolbox at http://renewwisconsin.org/wind/windtoolbox.html:

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Entegrity Wind Systems
50kW turbine
in Quinter, Kansas

APPENDIX: AWEA MODEL SMALL WIND ZONING ORDINANCE

Writing Small Wind into Existing Laws

This model zoning ordinance is used by many localities across the country and aims to strike an equitable balance among the interests of the consumer, industry, and community. It is the product of lessons learned over decades of industry experience and tens of thousands of installations.

AWEA MODEL ZONING ORDINANCE

Use Regulation for Small Wind Energy Conversion Systems

Section 1: Purpose

It is the purpose of this regulation to allow the safe, effective and efficient use of small wind energy systems installed to reduce the on-site consumption of utility supplied electricity.

Section 2: Findings

See p. 4 for a sample of cities, counties, and states that have enacted zoning laws for small wind systems.

The [city or county] finds that wind energy is an abundant, renewable, and nonpolluting energy resource and that its conversion to electricity will reduce our dependence on nonrenewable energy resources and decrease the air and water pollution that results from the use of conventional energy sources. Distributed small wind energy systems will also enhance the reliability and power quality of the power grid, reduce peak power demands, and help diversify the State's energy supply portfolio. Small wind systems also make the electricity supply market more competitive by promoting customer choice.

The State of ___________ has enacted a number of laws and programs to encourage the use of small-scale renewable energy systems including rebates, net metering, property tax exemptions, and solar easements. [*As appropriate*] However, many existing zoning ordinances contain restrictions, which while not intended to discourage the installation of small wind turbines, that can substantially increase the time and costs required to obtain necessary construction permits.

Therefore, we find that it is necessary to standardize and streamline the proper issuance of building permits for small wind energy systems so that this clean, renewable energy resource can be utilized in a cost-effective and timely manner.

Section 3: Definitions

Small Wind Energy System: A wind energy conversion system consisting of a wind turbine, a tower, and associated control or conversion electronics, which has a rated capacity of not more than 100 kilowatts (kW) and which is intended to primarily reduce on-site consumption of utility power.

Tower Height: The height above grade of the fixed portion of the tower, excluding the wind turbine itself.

Total Extended Height: The height above grade to a blade tip at its highest point of travel.

Section 4: Allowed Use

Small wind energy systems shall be allowed as an accessory use in all zoning districts where structures of any sort are allowed; subject to the requirements of Section 5 below. Small wind energy systems not meeting the performance standards of Section 5 may be allowed by conditional use permit.

Section 5: Use Standards for Small Wind Electric Conversion System

5.01	**Setback:** The base of the tower shall be set back from all property lines, public right-of-ways, and public utility lines a distance equal to the total extended height. Turbines shall be allowed closer to a property line than its total extended height if the abutting property owner(s) grants written permission and the installation poses no interference with public utility lines or public road and rail right-of-ways.
5.02	**Tower Height:** So long as the total extended height meets sound and set-back requirements, there shall be no specific height limitation, except as imposed by Federal Aviation Administration regulations as stated in 5.07.
5.03	**Sound:** Sound produced by the turbine under normal operating conditions, as measured at the property line, shall not exceed the definition of nuisance noise. Sound levels, however, may be exceeded during short-term events out of anyone's control such as utility outages and/or severe wind storms.
5.04	**Wind Turbine Equipment:** Small wind turbines must have been approved under the state public benefits program or any other small wind certification program recognized by the American Wind Energy Association.
5.05	**Requirement for Engineered Drawings:** Building permit applications for small wind energy systems shall be accompanied by standard drawings of the wind turbine structure and stamped engineered drawings of the tower, base, footings, and/or foundation as provided by the manufacturer. Wet stamps shall not be required.
5.06	**Soil Studies:** For standard soil conditions (not including gravel, sand, or muck), foundations developed by the wind turbine manufacturer shall be acceptable for turbine installations of 20kW or less and will not require project-specific soils studies or an engineer's wet stamp.
5.07	**Compliance with FAA Regulations:** No WEC shall be constructed, altered, or maintained so as to project above any of the imaginary airspace surfaces described in FAR Part 77 of the FAA guidance on airspace protection.
5.08	**Compliance with National Electric Code:** Building permit applications for small wind energy systems shall be accompanied by a line drawing of the electrical components, as supplied by the manufacturer, in sufficient detail to allow for a determination that the manner of installation conforms to the National Electrical Code.
5.09	**Utility Notification:** No small wind energy system shall be installed until evidence has been given that the utility company has been informed of the customer's intent to install an interconnected customer-owned generator. Off-grid systems shall be exempt from this requirement.
5.10	**Insurance:** Additional insurance beyond homeowners' coverage shall not be required.
5.11	**Abandonment:** If a wind turbine is inoperable for six consecutive months the owner shall be notified that they must, within six months of receiving the notice, restore their system to operating condition. If the owner(s) fails to restore their system to operating condition within the six-month time frame, then the owner shall be required, at his expense, to remove the wind turbine from the tower for safety reasons. The tower then would be subject to the Public Nuisance provisions of the zoning code.
5.12	**Signage:** All signs, other than the manufacturer's or installer's identification, appropriate warning signs, or owner identification on a wind generator, tower, building, or other structure associated with a small wind energy system visible from any public road shall be prohibited.
5.13	**Lighting:** No illumination of the turbine or tower shall be allowed unless required by the FAA.
5.14	**Access:** Any climbing foot pegs or rungs below 12 feet of a freestanding tower shall be removed to prevent unauthorized climbing. For lattice or guyed towers, sheets of metal or wood may be fastened to the bottom tower section such that it cannot readily be climbed.

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