DRAFT

Legislative Project No. 9

Amendments to the Baltimore County Zoning Regulations
Regarding Small Wind Energy Systems

A Staff Report of the Baltimore County Office of Planning
Draft--June 22, 2009

PROJECT DESCRIPTION

This report pertains to the Baltimore County Zoning Regulations regarding the location and use of windmills. On July 7, 2008 the Baltimore County Council passed Resolution 52-08, which asks the Planning Board to propose amendments to the zoning regulations in order to regulate the location and use of windmills for residential energy use. At the request of the Planning Board, the Office of Planning has proposed the following amendments to the zoning regulations.

BACKGROUND AND PROJECT SCOPE

Windmills have been a part of Baltimore County's history since the mid-1800s. Windmills were used for grinding grains into flour, to draw up water, as well as other uses. They were powered by the wind, converting this energy into mechanical energy[1]. The modern day windmill is more formally known as a wind turbine and is commonly used to convert the power of the wind into electricity. Other names for a wind turbine include wind generator, wind energy system, wind power unit (WPU), wind energy converter (WEC), or aerogenerator. This report will use the term wind turbine.

Where there is sufficient steady wind, large commercial wind turbines can be arrayed in wind farms to provide renewable power for sale to the electrical grid. Commercial units can be 300 feet high and have megawatt electrical output for each turbine. However, the US Department of Energy's National Renewable Energy Laboratory rates the wind resources in Baltimore County as generally poor (Figure 1, following page). Since there does not appear to be sufficient wind in this area to justify commercial wind farms, this report does not address their use.

Rather this report focuses on smaller wind turbine systems primarily used to offset the cost of electrical energy for individual homes or businesses. These are described generally as "small wind energy systems," and have an electrical capacity of 100 kilowatts or less. While these systems can be connected to the electrical grid in some circumstances, they are not intended to generate electricity for sale off site.

Currently, Baltimore County's zoning regulations do not define small wind energy systems and their allowed uses. Consequently, Baltimore County has treated small wind energy systems as accessory uses under Section 400.3 BCZR which allows a maximum height of 15 feet thus requiring variances to allow installation. Several jurisdictions in Maryland have passed legislation to allow small wind energy systems. The legislative resources used for this staff report come from these jurisdictions, as well as ordinances from other states. The report will address the use of small wind energy systems on residential properties as well as other locations. As described later, small wind energy systems are becoming more prevalent throughout the country and their benefits are becoming increasingly apparent. Therefore the Office of Planning believes that wind turbine legislation should not be limited to residential areas but rather extend to all zones in the County.

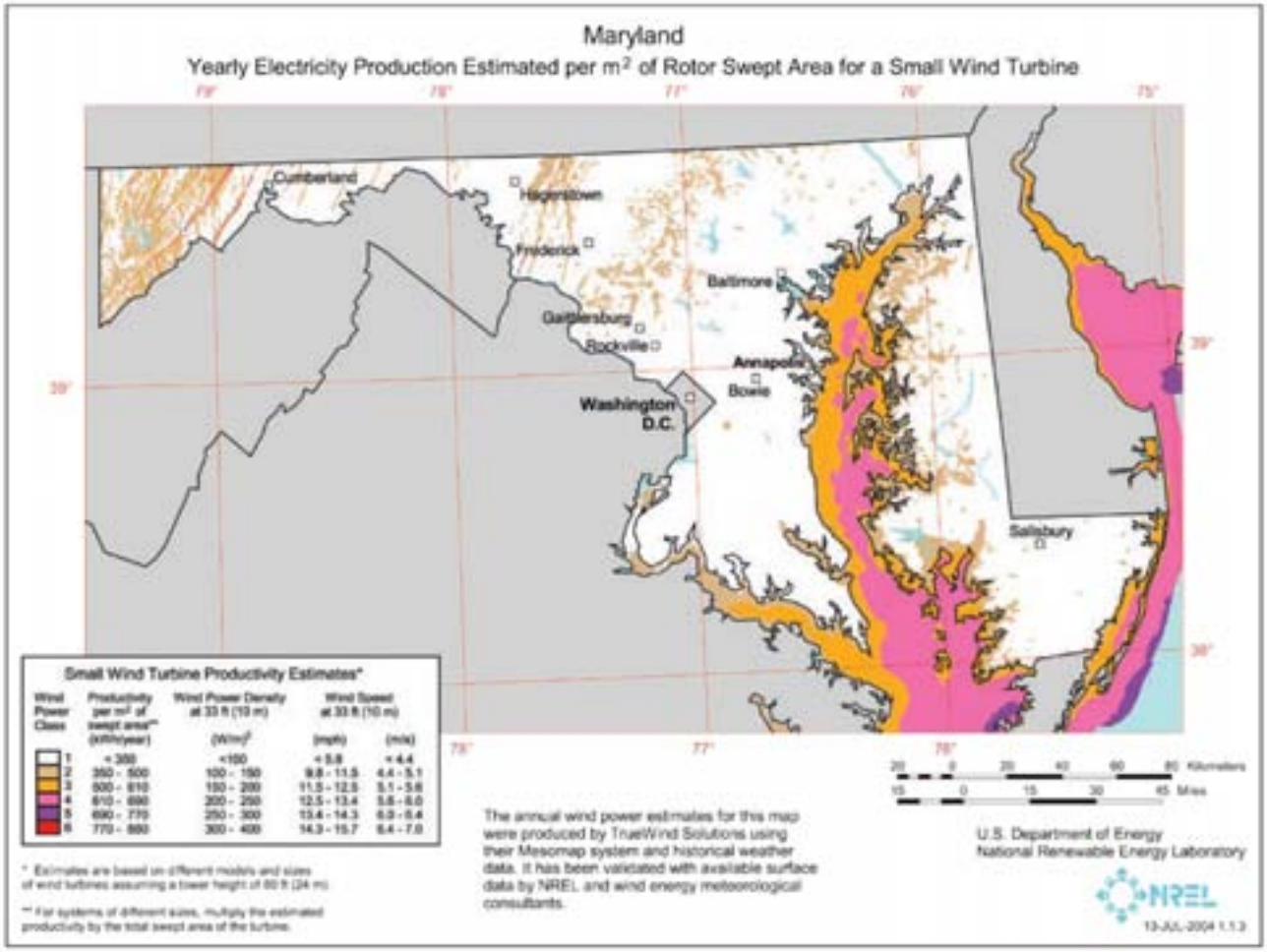


Figure 1: Maryland Small Wind Turbine Productivity Estimates

There are two physical configurations of wind turbines – horizontal axis and vertical axis. Horizontal axis wind turbines, also known as HAWT, have blades, or rotors,which must be pointed into the wind (Figure 2).

Vertical axis small wind energy systems (VAWT) have their blades arranged vertically and do not require being pointed into the wind (Figure 3). Both types of turbines can be mounted on top of wind towers or on-buildings (Figure 4) and can reach speeds up to six times the wind speed. A wind tower can be constructed as a monopole as in Figure 2, or as a lattice or guyed structure.

Figure 2: Horizontal Axis Wind Turbine

Figure 3: Vertical Axis Wind Turbine

To operate efficiently, the wind turbine must be placed at a height to

Figure 4: Building-mounted wind turbine.

avoid the friction, or ground drag, created when the air moves across the earth's surface. It also must be placed high enough to avoid the turbulence caused by ground clutter, which includes trees and buildings. The rule of thumb is to site the turbine so that the bottom of the blade clears the highest wind obstacle that is within a 500 foot radius by at least 30 feet. To reduce the effects of ground clutter, the best location for a wind turbine is often the highest point on the property.

An added benefit to placing a turbine at increased heights is that wind speeds can increase dramatically with distance from the earth. Generally, the higher the tower, the greater the potential energy to be captured. Because of the costs involved, however, tower height is usually limited to suit the needs of the user. Typically, freestanding wind turbines used in small energy systems range in height from 35 to 150 feet.

The smaller scale systems, in the range of 1 to 10 kW, are generally capable of producing enough energy to support a household, farm or small business. Even smaller turbines can be used for

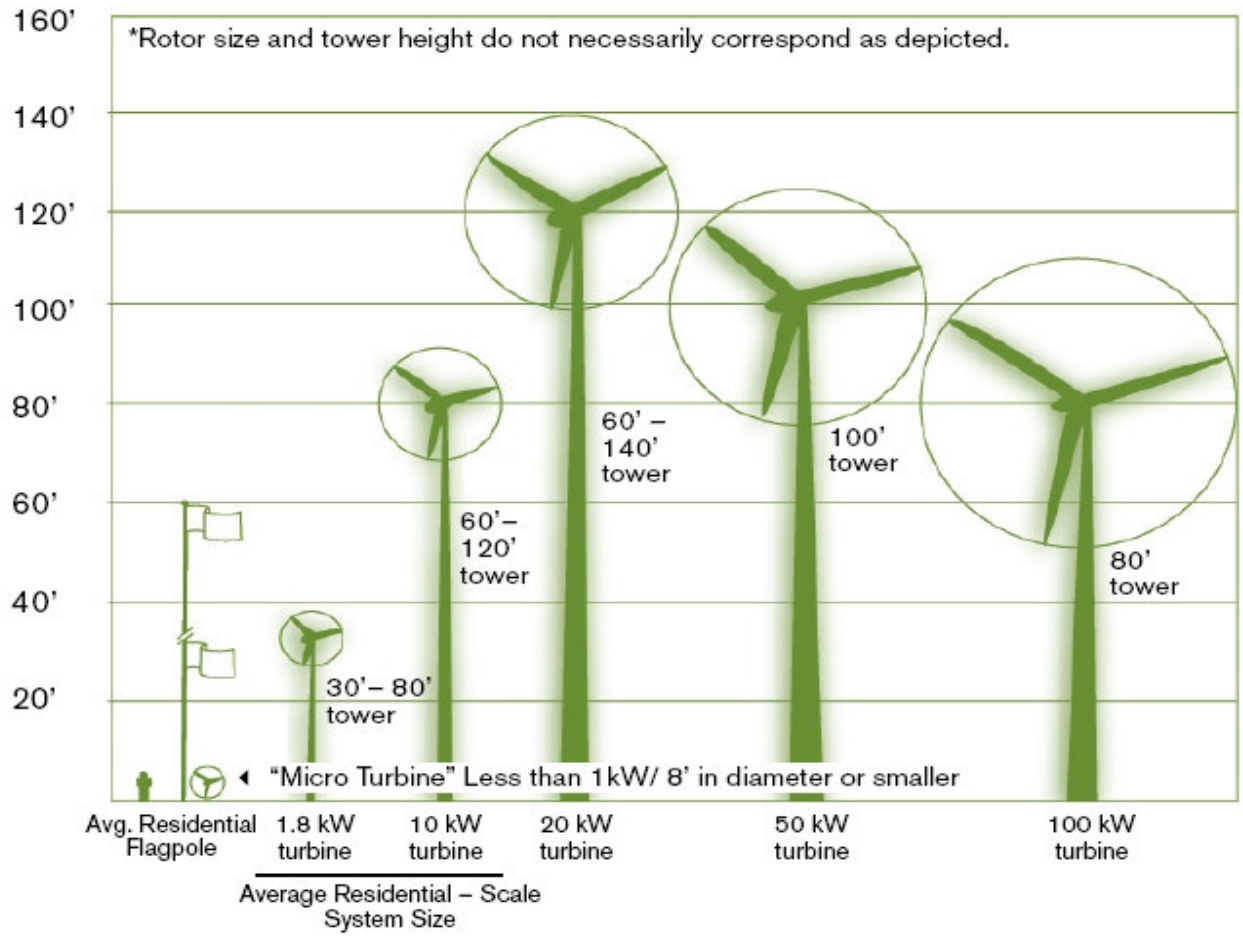


Figure 5: Typical Range of Small Wind Energy Systems

specific purposes, such as pumping water for irrigation or to run appliances. The larger turbines are appropriate for commercial or institutional uses with larger energy needs.

While small wind energy systems can be mounted on buildings to capture wind energy above the rooftops, this is not recommended. Over time, the wind turbine can damage the structure of the building because of the vibration it produces. Additionally, there is evidence that building-mounted systems are not efficient in producing energy. Recent studies show that the performance of building-mounted models is generally poor due to wind turbulence.[2] However, in some places, such as along shorelines, good wind may be available at rooftop height.

The cost of a small wind energy system can range between $3,500 and $40,000, depending on the size and type, or approximately $3,000 to $5,000 per kilowatt of generating capacity. Thus, a 2kW system, which, under ideal conditions, has the potential to generate enough energy for an average household, would cost around $8,000. If optimally located, the system will typically pay for itself in 15 years while the life of a wind turbine is typically 20-30 years.[3]

Technology is quickly evolving in this field. More and newer kinds of wind turbines are being created which are better able to capture the potential power with less wind resources. The energy ball (Figure 5) sold by Dutch Based Home Energy International, for example, spins at lower wind speeds and creates less noise, while still capturing ample potential power.

Figure 6: Energy ball

DISCUSSION

In general, small wind energy systems can be a reliable and inexpensive source of electricity and can serve as a backup during utility outages. In addition to personal energy savings, the larger community could benefit through increased local energy independence, reduced pressure on the local electricity grid, and the use of a clean energy source that will reduce the pollutants contributing to global warming. Because of these benefits, small wind energy systems are proliferating across the country and are beginning to appear in the Baltimore region.

However, with the lack of steady energetic wind in this area, it is not likely that there will be a substantial demand for small wind energy systems. But, there may be certain areas or situations where use of wind energy will be of benefit to the property owner. The Baltimore County Zoning Regulations should allow for their use in these situations, while at the same time, ensuring that there will not be any unintended negative impacts for the property owner or the surrounding community. These potential negative impacts include safety, noise, visual aesthetics and danger to wildlife.

Safety: A number of safety precautions should be addressed for wind turbines. All components of a small wind energy system must be securely anchored and be able to withstand high wind force. Systems must be equipped with both manual and automatic shut-off controls to reduce the potential for turbine failure. For wind towers, the ability for an unauthorized person to climb up the structure should be minimized. Additionally, there should be ample room on the site to accommodate the

tower in a horizontal position should it topple or need to be taken down for maintenance. Most ordinances from other jurisdictions require a setback equal to 110% of the tower height.

Noise: The wind turbines manufactured today create less noise than those produced in the past. The typical wind turbine creates between 52-55 decibels or dB(A), which is equivalent to the noise of a humming refrigerator. The amount of noise created by a particular wind turbine will depend on the make of turbine, how much wind is present, and site conditions. Ambient noise levels found outdoors, which could include the sounds of traffic, dogs barking and rustling leaves, average 55 dB(A)--generally the same as wind turbines. While the noise level is not usually louder than the background noise, the frequency level of the turbine may be different so that it may be discernible. The noise will usually decrease, and blend into the background noise, with increasing distance from the tower. However, on some sites, the terrain and other features may actually amplify the noise.

Visual aesthetics: Because of the height and clearance requirements of wind turbines, they are generally sited in very visible locations. Many people are concerned about visual clutter. In examining ordinances from other jurisdictions, most provide limitations to reduce the potential for negative visual impact. These include measures that limit color, reflectiveness, lighting and signage. A light gray color is often recommended as a color that blends best into a background of sky. Most ordinances also require a large setback, generally for safety purposes, but this also helps to reduce the turbine's visual impact. Some also exclude wind turbines from areas where the visual character is especially important, such as historic districts or scenic preservation areas. Other regulations limit the number of wind turbines allowed on a property, or restrict the type to monopoles because of their more attractive, streamlined design, although the latticed poles will disappear into the background more readily. Some ordinances limit the height of wind turbines based on the use it is serving. For example, in residential areas, the wind tower may be limited to a 10 kW capacity with an 80-foot tower.

Property Values: The effect of small wind energy systems on adjacent property values due to visual impact has not been documented. Several studies have been done on the effect of large, commercially operated wind farms. Based on its review of these studies, the National Association of Realtors states that "wind farms appear to have a minimal or at most transitory impact on real estate."[4]

Figure 7: Wind turbines tend to blend into the background with distance. Lattice towers blend more quickly than monopoles. This 10 kW turbine system is located approximately 250 feet behind the house on a 100-foot guyed-lattice tower.

An analysis sponsored by the US Department of Energy found that in many areas the property values within the viewshed of wind farms actually increased more rapidly than those in comparable regions.[5]

For small wind energy systems, only anecdotal reports from wind turbine manufacturers and owners are available. These reports note that the presence of a wind turbine can be attractive to some buyers, who may be looking for a home equipped with a renewable energy system, or who want to live in a community where people care about the environment.

Environmental Impact: Concern has been raised about the damaging effect of wind turbines on wildlife, including birds and bats. These problems are generally related to large, commercially-operated turbines. Studies have found that on average, a small wind energy system kills fewer birds than housecats or sliding glass doors.[6]

STAFF RECOMMENDATION

While current wind energy technology is not at a point that it generally will provide economic benefit for county property owners, there may be certain situations where owners may want to install a wind turbine for their personal use. In general, the County supports citizen efforts to reduce their carbon footprints and become more energy self-sufficient. Thus, staff recommends that small wind energy systems be allowed in any zone as an accessory use with certain limitations to reduce any potential negative impacts.

The primary objection to wind turbines is likely to be its potential negative visual impact. Restrictions on height and setback are most critical in addressing the visual impact on neighboring properties. Since the height of a turbine is an important factor in capturing wind energy, staff recommendations seek a balance between the height requirements needed to provide wind energy and the property line setbacks that will minimize the system's visual impact. Setback restrictions will also address safety and noise issues.

As mentioned previously, to access optimal wind, the lowest blade of the turbine must be 30 feet higher than any obstacles within 500 feet, including existing and future neighboring buildings and trees. As shown in Figure 8, a wind energy system with a total height of about 100 feet is needed to clear the height of ground clutter at 40 feet, the height of a small tree. In the examples that follow, a 10 kW wind turbine, generally the largest that would be used to support a residence, is approximated at 30 feet in diameter (one manufactured by Hummer Wind Power LLC has a 26.5 foot diameter; a 20kW turbine has a 29.5 foot diameter[7]).

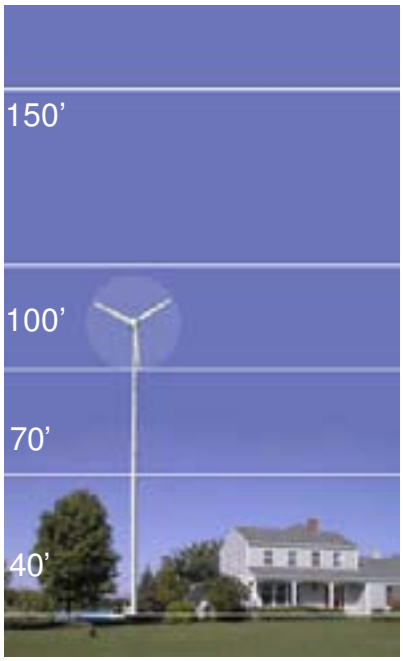


Figure 8: To operate efficiently, the turbine blades should be above any objects on the ground by 30 feet.

Figures 9 and 10 illustrate the relationships among the height of the wind energy system, setbacks to property lines and lot area. The examples use setbacks of 110% of the total height of the wind turbine and tower, which is a setback frequently used in other jurisdictions for safety reasons. In Figure 9, using the example of a 100-foot tall wind energy system, the smallest lot size that could accommodate it is approximately 1.4 acres.

At 150-feet high, the height restriction often found in other jurisdictions, a wind turbine would clear the height of mature trees, and be able to access higher wind speeds. Figure 10 shows that at a maximum height of 150 feet, and with setbacks at 110% of the total height, the smallest lot size is 3 acres.

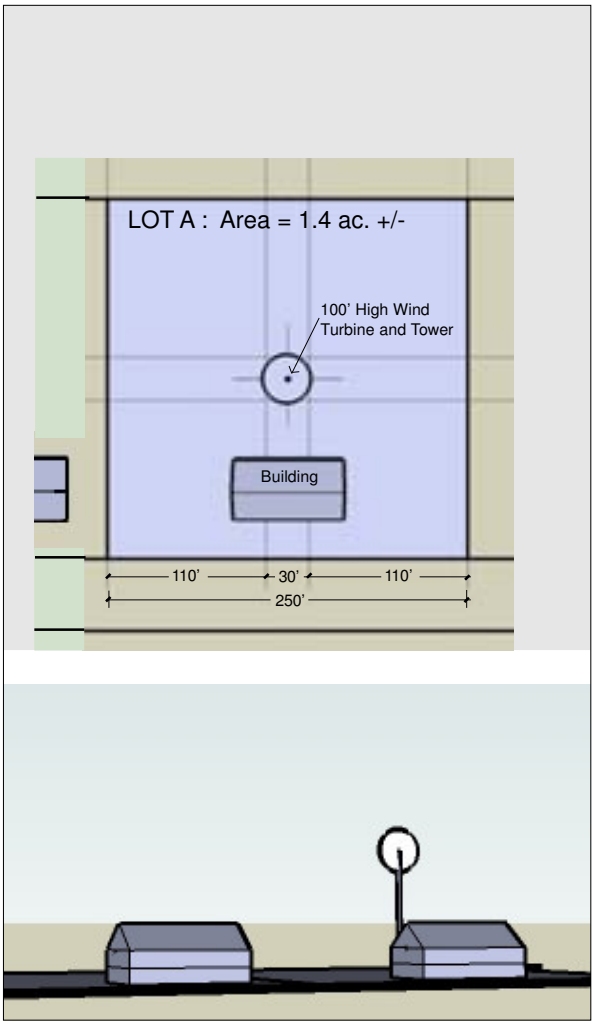


Figure 9: A 100' wind tower and turbine with a 110% setback from the side property line, and an adjacent building.

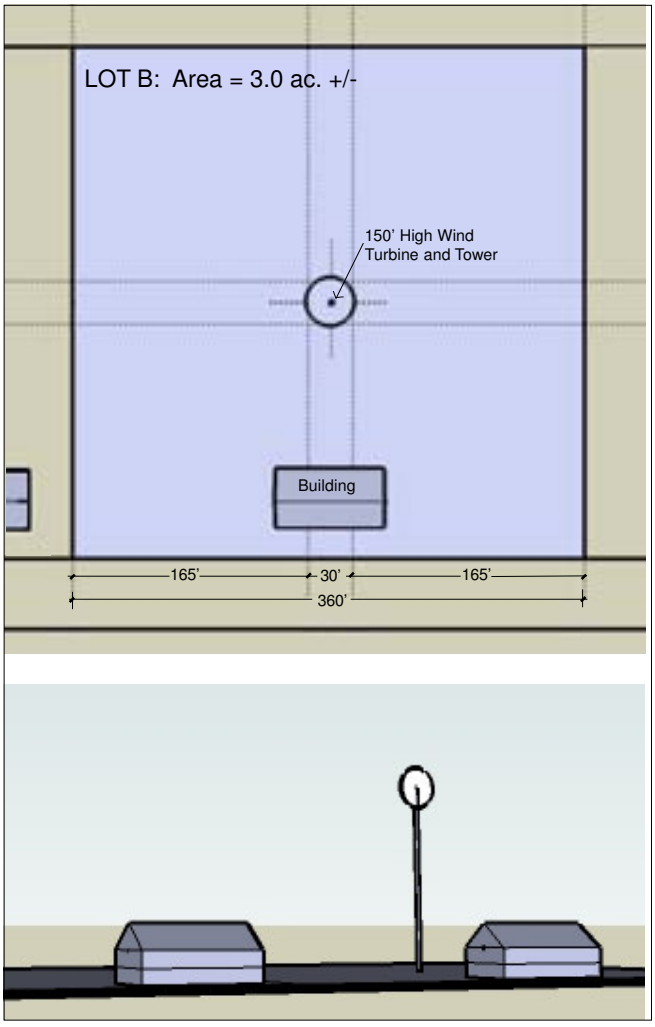


Figure 10: A 150' wind tower and turbine with a 110% setback from the side property line, and an adjacent building.

Most likely, property owners will select smaller systems than those depicted in Figures 9 and 10 because of their cost. The final example, Figure 11, shows that a lot size of one acre would accommodate a wind energy system up to about 80 feet tall.

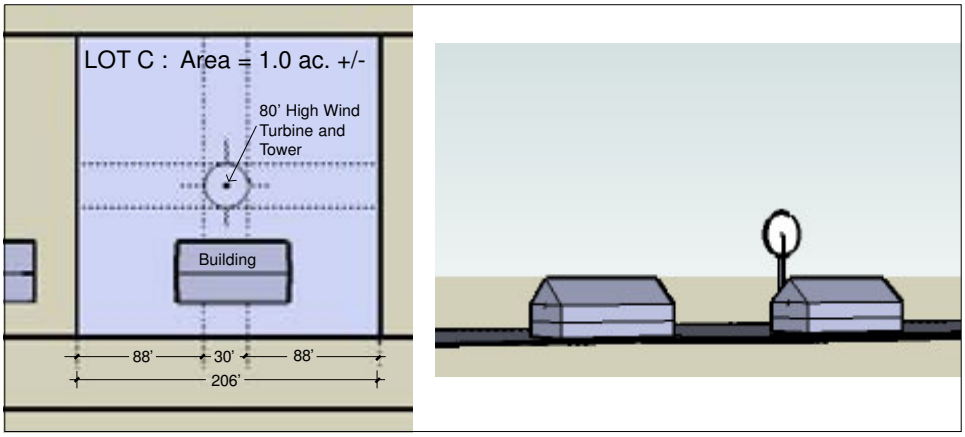


Figure 11: Using setbacks at 110%, a minimum lot size of one acre will support an 80-foot tall wind energy system with a 30-foot diameter turbine.

The perspectives in Figures 9-11, and the elevational views in Figure 12, illustrate the vertical scale of these examples on a neigboring residence that is located 25 feet from the side property line, which is the minimum side setback in DR 1. In these examples, the wind tower base and the buildings' first floor are set at the same topographic elevation. In Figures 9-11, the towers are placed at a significant distance behind the buildings, which reduces their apparent height. In Figure 12, the towers are shown on the same plane as the buildings. How a wind energy system is actually perceived will vary with the location of the viewer, and site conditions such as changes in topography and other objects in the view.

In the opinion of staff, a one acre minimum lot size, combined with a minimum setback at 110% of the system height, and a maximum height of 150 feet provides the balance in meeting the needs of property owners who desire to utilize wind energy and in limiting potential negative visual impacts on the adjoining property owners and the surrounding community. Staff also recommends additional restrictions concerning color, noise, and flickering effects to further limit negative impacts.

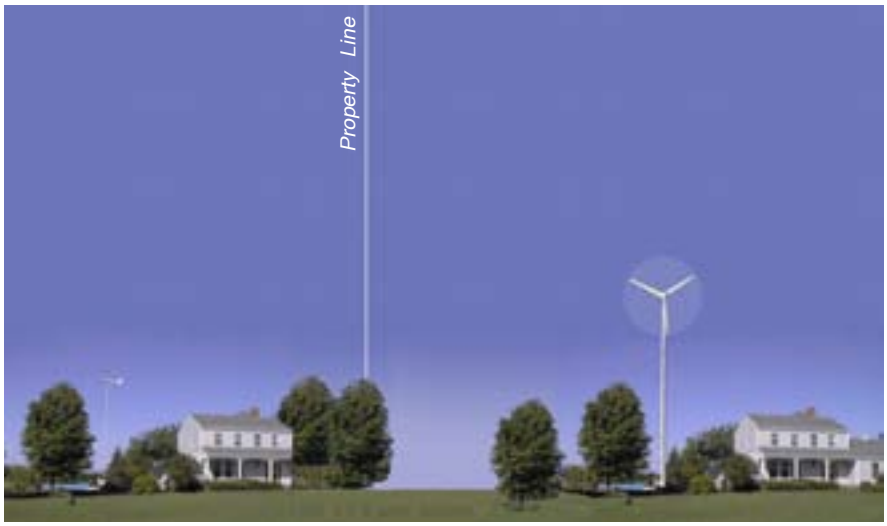


Figure 12 : This photomontage illustrates another view of the relationships between wind turbine/tower height and side property line setback. In these views, the horizontal distance between the wind energy system and adjoining property is demonstrated, without the foreshortening that occurs in a perspective view.

Wind turbine and tower at a total 80 feet high

Wind turbine and tower at a total 100 feet high

Wind turbine and tower at a total 150 feet high

REGULATORY RECOMMENDATIONS

~~Strike through~~ indicates material to be deleted. **Bold** indicates material to be added.

1. Add the following section to Article 4, Special Regulations:

Section 451, Small wind energy systems

451.1 Definitions

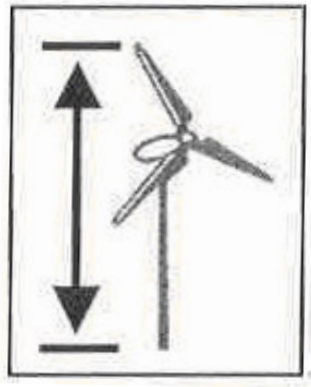
Meteorological Tower (MET Tower) – An accessory structure designed to support the gathering of wind energy resource data, and includes the tower, base plate, anchors, guy cables and hardware, anemometers (wind speed indicators), wind direction vanes, booms to hold equipment anemometers and vanes, data logger, instrument wiring, and any telemetry devices that are used to monitor or transmit wind speed and wind flow characteristics over a period of time for either instantaneous wind information or to characterize the wind resource at a given location.

Physical Removal – Removal of a wind turbine, including all aboveground structures and equipment, as well as restoration of the location of the wind turbine to its natural conditions.

Rotor Diameter – The cross sectional dimension of the circle swept by the rotating blades.

Shadow Flicker – The moving shadow created by the sun shining on the rotating blades of the wind turbine.

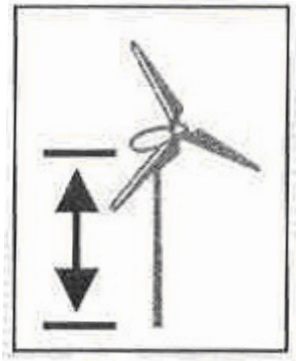
Small Wind Energy System – A wind turbine mounted on a freestanding wind tower or building having a maximum output of 100 kilowatts of energy for use primarily on site and not for sale. However, the energy output may be delivered to a power grid to offset the cost of energy on site.



Total Height

Total Height, for a wind turbine mounted on a wind tower – The vertical distance from ground level to the tip of a wind generator blade when the tip is at its highest point. For a small wind energy system mounted on a building, total height is the vertical distance from the top of the roof or parapet, to the tip of a wind generator blade when the tip is at its highest point.

Tower Height, for a wind turbine mounted on a wind tower – The vertical distance from ground level to the top of the fixed portion of the tower, excluding the wind turbine.



Tower Height

Wind Turbine – An accessory structure, which is mounted on a monopole, lattice or guyed structure or mounted on a building, composed of rotating blades that converts and then stores or transfers energy from the wind into usable forms of energy, such as electrical energy. The equipment includes any base, blade, foundation, generator, nacelle, rotor, tower, transformer, vane, wire, inverter, batteries, guy wire or other component used in the system.

Wind Tower – The freestanding monopole, lattice, or guyed structure that supports a wind turbine.

451.2 Legislative policy for small wind energy systems. It is the intent of Baltimore County that small wind energy systems should:

A. Be placed in appropriate locations;

B. Minimize any adverse visual, safety, and environmental impacts; and

C. Protect the public's health, safety and welfare.

451.3 Location, height and area restrictions

A. A small wind energy system shall be permitted in any zone in accordance with the requirements of this section, except as limited by Section 451.3.B and Section 451.3.C.

B. A small wind energy system shall be permitted only by special exception on parcels designated as Baltimore County Preliminary or Final Landmarks, parcels within designated as Baltimore County Historic Preservation Districts, or areas within the viewshed of scenic routes or views identified in the Baltimore County Master Plan.

C. Wind turbines are not permitted within the Chesapeake Bay Critical Area buffers as defined in the Baltimore County Code Section 33-2-401. All environmental regulations to protect natural resources must be met.

D. The minimum lot size required for a small wind energy system is one acre.

E. The maximum total height for a wind turbine mounted on a tower is 150 feet, unless Federal Aviation Administration regulations require otherwise.

F. The maximum total height of a building mounted wind turbine is one-third of the total height of the building, unless Federal Aviation Administration regulations require otherwise.

G. Minimum Ground Distance. The blade of any wind turbine shall, at its lowest point, have a ground clearance of no less than 15 feet, as measured at the lowest point of the

arc of the blades.

451.4 Setback requirements

A. A wind turbine shall be set back a distance equal to its total height plus 10% from:

1. Any State or County right-of-way or the nearest edge of a State or County roadway, whichever is closer;

2. Any right of ingress or egress on the owner's property used by the public;

3. Any overhead utility lines or easement, whichever is closer;

4. Any property line; and

5. Any existing guy wire, anchor or tower on the property.

B. For building-mounted turbines, all components of the system shall comply with the principal building setbacks.

451.5 Safety

A. Access.

1. All ground mounted electrical and control equipment shall be labeled and secured to prevent unauthorized access.

2. The wind tower shall be designed and installed so as to not provide step bolts or a ladder readily accessible to the public for a minimum height of 12 feet above the ground.

3. All access doors to wind turbine towers and electrical equipment shall be lock-able.

B. Electrical Wires. All electrical wires associated with a wind turbine shall be located within its tower or mounting structure, or within an existing structure, or underground. There shall be no additional towers or structures erected to support electrical wiring or connections to any power grid or use on the subject property.

451.6 Visual Impacts

A. Lighting. A wind tower and wind turbine shall not be artificially lit unless such lighting is required by the Federal Aviation Administration.

B. Appearance, Color, and Finish. Small wind energy systems shall be painted or finished in a non-reflective, non-obtrusive color or finish that conforms to the environment and architecture of the community as determined by the Director of Planning, unless Federal Aviation Administration regulations require otherwise.

C. Signs. All signs including flags, streamers and decorative items, both temporary and permanent, are prohibited on a wind turbine, wind tower or other structure associated with a wind turbine, except the manufacturer or installer's identification or appropriate warning signs or placards.

D. Shadow Flicker. Small wind energy systems shall be sited in a manner that does not result in significant shadow flicker impacts. Significant shadow flicker impact is defined as a flickering shadow that is cast by a wind turbine on a principal building and the area within 100' of the principal building on a neighboring or adjacent property for more than 30 hours per year.

451.7 Additional conditions for small wind energy systems

A. Code Compliance. A small wind energy system including wind turbine and tower shall comply with all applicable construction and electrical codes.

B. MET towers shall be permitted under the same standards, permit requirements, and permit procedures as a wind turbine, except that a temporary MET tower may be erected for the purposes of performing a wind study to determine the optimal location for a small wind energy system. This temporary MET tower must meet the same height and setback standards, but does not require a permit if it is erected for less than 120 days.

C. Sound Levels and Measurement. Audible sound due to wind turbine operations shall not exceed 55 dB(A) for any period of time. The level, however, may be exceeded during short-term events such as utility outages and/or severe windstorms. The sound level shall be measured at ground level at the property line.

D. Each property is eligible for one small wind energy system. A property includes all lots and parcels within the overall property boundaries owned by or controlled by the applicant.

E. A small wind energy system shall not have more than one wind turbine.

F. A wind turbine shall have a maximum output of 100 kilowatts of energy which shall be used on site and not for sale. However the energy output of a wind turbine may be delivered to a power grid to offset the cost of energy on site.

G. Small wind energy systems constructed and installed in accordance with these

regulations shall not be deemed to constitute and expansion of a nonconforming lot, use or structure.

451.8 Variances. The Zoning Commissioner, and Board of Appeals upon appeal, may grant a variance to a height, setback, and number of small wind energy systems in accordance with Section 307 of these regulations.

451.9 Removal of defective or abandoned small wind energy systems.

A. Any small wind energy system found to be unsafe shall be repaired by the property owner to meet these regulations and any applicable federal, state and local safety standards or be physically removed within 90 days.

B. A small wind energy system that has been inoperable for a period of 12 consecutive months shall be physically removed by the property owner.

End Notes

1. Wikipedia
2. National Renewable Energy Laboratory for the U.S. Department of Energy
3. National Renewable Energy Laboratory for the U.S. Department of Energy
4. National Association of Realtors
5. National Renewable Energy Policy Project, May 2003
6. American Planning Association
7. Hummer Wind Power, LLC

Figure Credits

Figure 1: National Renewable Energy Laboratory for the U.S. Department of Energy
Figure 2: Wind Energy 7
Figure 3: CNet available at http://news.cnet.com/greentech/?keyword=wind
Figure 4: LaMonica, Martin
Figure 5: American Wind Energy Association
Figure 6: Shirber, Michael
Figure 7: Bergey WindPower Co., "Bergey Windpower Case Study, Norman, Oklahoma."
Figure 8: Photomontage by Baltimore County Office of Planning. Base photo from Bergey WindPower Co., "Bergey Windpower Case Study, Charlotte, Vermont." Wind energy system from Hummer Wind Power, LLC.
Figure 9: Baltimore County Office of Planning using Google SketchUp
Figure 10: Baltimore County Office of Planning using Google SketchUp
Figure 11: Baltimore County Office of Planning using Google SketchUp

Figure 12: Baltimore County Office of Planning using Adobe PhotoShop

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