SUBURBAN SMALL WIND

HOW COUNTY POLICIES MAY ENCOURAGE THE USE OF SMALL-SCALE WIND ENERGY SYSTEMS

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I. EXECUTIVE SUMMARY

Harnessing viable energy from the wind is no longer confined to large, utility-scale wind farms in rural areas. Today's small wind systems are less visually intrusive and noisy than those of the past. The installed costs are also getting cheaper for homeowners with a viable wind resource nearby. The market for small wind systems is growing rapidly across America as concerns about global climate change increase and technology advancements are made.

It seems as though suburban homeowners could greatly benefit from small wind systems generating electricity for their families. However, the major hurdle that many face is land use restrictions in the local county plan or code. Currently, small wind systems are often lumped in with general building code provisions with their applicable height limitations.

If a person wishes to build such a system that would exceed these limits, they may have to apply for a variance or special use permit. These processes take time and money and there is no guarantee that the application will be granted. These barriers have killed many once-feasible small wind projects.

One place that could easily revise its current land use code to encourage small wind is Boulder County, Colorado. County policy-makers are currently looking at revising the county comprehensive plan with a sustainability element. This would be an excellent time to incorporate a reasonable policy that encourages small wind system development into the land use code.

This report briefly explores policy options for county governments to adopt towards the goal of encouraging installation of small wind systems. Section II looks at the context of small wind use in America. Section III provides a table that compares three policy options that encourage reasonable small wind development. These options are provided by a small wind company, a small wind advocate/lobbyist, and an actual ordinance from San Bernardino County, CA. Section IV describes the current situation in Boulder County. Finally, section V provides conclusions/recommendations for policies that Boulder County may wish to adopt in the process of restructuring their Comprehensive Land Use Plan.

II. INTRODUCTION TO SMALL WIND

There is nothing new about the concept of using wind to power individual family homes. As early as the 1920s, Midwestern families were using wind to generate electricity for their farms.[1] Today, with growing concern for the environmental, social, and pecuniary costs of conventional methods of generating electricity, many homeowners are looking for alternative sources of power. Solar PV systems are still too costly for the average homeowner.[2] The most current trend in renewable energy is

[1] Bergey, Michael. *Small Wind Turbines: Primer*. Alternative Energy Store Website: http://howto.altenergystore.com/Small-Wind-Turbines-Primer/a28/

[2] Komor, Paul (2004). *Renewable Energy Policy*. Diebold Institute.

installation of small wind systems.[3] This section explores the basics of small wind systems and its viability as a real option for producing electricity on a non-utility scale.

A. What is it?

What qualifies as a small wind system can vary by location, resource amount, and availability of technology. Usually what is meant by 'small wind' is non-utility scale electricity generation from a single wind turbine. Generally, a small wind project consists of the tower and turbine on the property of the house that it will provide power to. How much electricity will be generated depends on many variables involving the location, height, and size of the system.

i. Defining Small Wind

The National Resource Energy Laboratory (NREL) and Clean Energy States Alliance (CESA) both define small wind as systems up to 100 kW capacity.[4] The American Wind Energy Association (AWEA) also defines small wind systems as 100 kW capacity or less.[5] The Canadian Wind Energy Association has recommended that the definition be 300 kW or less and "not intended or used to produce power for resale."[6] For the purposes of this paper, the definition of 'small wind' will comprise systems that are up to 100 kW, used on-site.

ii. Where Can It Be Used?

Small wind is certainly not viable for every property. The general wisdom is that a property should have at least one acre before erecting a small wind tower and turbine[7], although the latest technologies may only require an unobstructed half-acre.[8] In addition, there must be enough consistent wind in the area to power the turbine. For small wind, the average annual wind speed should be at least ten miles per hour.[9]

B. Key Problems with Small Wind

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[3] Alsever, J. (2007). *Wind that powers your home*. CNNMoney.com, Business 2.0 Magazine. Feb. 19, 2007. http://money.cnn.com/2007/02/16/magazines/business2/windpower_homes.biz2/index.htm

[4] Cooperman, David. *State Programs to Support Small Wind Energy Systems: An Examination of Key Issues*. Clean Energy States Alliance, Inc. http://www.cleanenergystates.org/library/Reports/CESA%20Small%20Wind%20Project%20Overview%20Report%20FINAL.pdf

[5] American Wind Energy Association Website: Small Wind http://www.awea.org/smallwind/

[6] Rhoads-Weaver, et al (2006). *Small Wind Siting and Zoning Study: Development of Siting Guidelines and a Model Zoning By-Law for Small Wind Turbines.* Canadian Energy Wind Association Website: http://www.smallwindenergy.ca/downloads/Small_Wind_Siting_Guidelines.pdf

[7] National Renewable Energy Laboratory (2004). *Small Wind Electric Systems*: *A Colorado Consumer's Guide*. May 2004.

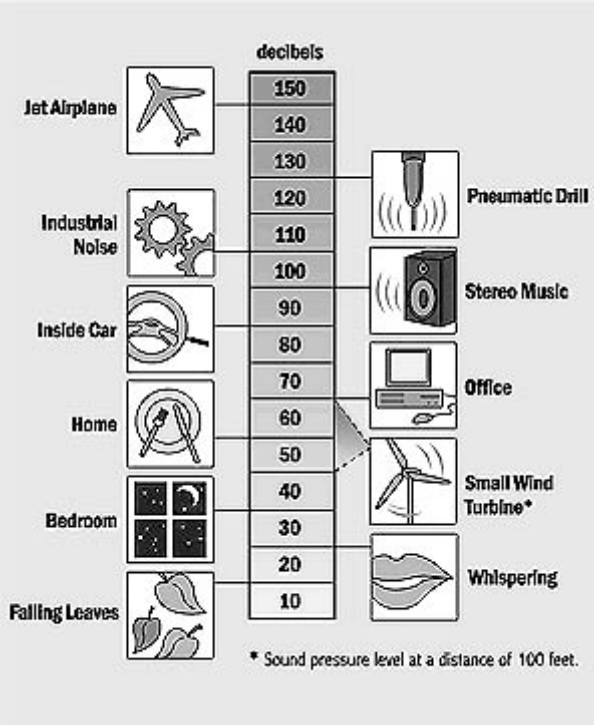
[8] Skystream 3.7 website. *Will Skystream Work For Me?* http://www.skystreamenergy.com/skystream/will-skystream-work/

[9] *Id.*

The benefits of small wind for homeowners can be great, but there are several issues that a county planning commission should consider before coming up with a policy towards this technology. The key issues are noise, visibility, and aesthetics. Although a small wind turbine is much less imposing than a large wind farm, the small wind tower and turbine will most likely be in a more populated area and thus subject to more criticism.

i. Noise

One particular concern of many homeowners and local planning boards is how different sources and volumes of noise will affect the enjoyment and value of one's property. Noise generated from small wind systems can be significant depending on the type of turbine used and its location relevant to other homes. In addition, because wind turbines may be spinning at all hours, there may be a particular concern of noise during the nighttime hours, when other background noises have subsided.



Source: AWEA: FAQs About Small Wind Noise

The majority of the sound created by a small wind system is from the blades cutting through the air, particularly at the tips of the blades.[10] Thus, as wind velocity increases, sound increases. In 2004, the National Renewable Energy Laboratory (NREL) conducted an acoustic study of eight small wind turbines.[11] For several of the turbines, the study concluded that "the turbine noise could not be separated from the background noise."[12] This is an important finding because it displays the ability for small wind to blend in to the soundscapes of day-to-day life.

Many of the issues with noise can be assuaged by simply requiring a turbine to be a reasonable distance from neighbors. Mark Sagrillo of Sagrillo Power and Light offers a simple equation for determining where a particular turbine may be located to limit the noise generated.

> Sound decreases with the distance from its source by the square of that distance. That is, a noise at 200 feet will have only one-fourth of the intensity as that same sound heard from 100 feet away. Therefore, any sound emitted

[10] Sagrillo, Mark (2004). *Residential Wind Turbines and Noise*. American Wind Energy Association Website. http://www.awea.org/faq/sagrillo/ms_noise_0404.html
[11] Migliore, P., et al (2004). *Acoustic Tests of Small Wind Turbines*. National Renewable Energy Laboratory. http://www.bergey.com/Technical/AIAA%202004-1185.pdf
[12] *Id*.

from a wind turbine will quickly blend into the background noise with increasing distance from the tower.[13]

Such setback requirements will most likely not be a major impediment to siting a turbine since the tower should be high enough and far enough away from wind obstructions like buildings and trees.

In general, small wind systems have traditionally been louder than large wind turbines for two main reasons:

"(1) The rotational speed of the blade tips is higher; and
(2) Much more research money, both from the government and private industry, has been invested in reducing noise from large turbines."[14]

Recent advances in the design of small wind have not only reduced much of the noise emissions from the turbines, but have also altered the type of noise emitted. For example, the older technologies produced a tonal sound (humming or whining) that was often considered an annoyance or nuisance.[15] Modern noise emissions are described as a comparatively more pleasant broadband sound (swishing or wooshing).[16]

Current local noise ordinances may be a barrier to a small wind system, but as the technology continues to improve, the issue of noise from small wind turbines will most likely become moot.

ii. Visual Obstruction

Just like any tall structure, wind towers and turbines may partially block scenic views. This is especially true for small wind systems because, unlike most large wind farms, a small wind turbine in a suburban setting has the potential for a larger sector of the public to have an obstructed view. This issue is comparable to concerns about the siting of cell phone towers, water towers, and utility poles. However, a wind tower may not be as easily disguised as these structures due to its need to be in a relatively breezy corridor. Ultimately, the right balance must be struck with any potential obstruction to the local scenery.

iii. Aesthetic Concerns

Many people disagree about the aesthetic appearance of wind towers and turbines. Some feel that the wind systems should be appreciated for their emotional and artistic appeal. For example, one month-long exhibit has just ended within the city of Vail that involved a sculpture comprised of 2,700 small wind mills, each powering one

[13] Sagrillo, Mark (2004). *Residential Wind Turbines and Noise*. American Wind Energy Association Website. http://www.awea.org/faq/sagrillo/ms_noise_0404.html
[14] American Wind Energy Association Website: *Facts About Wind Energy and Noise*. http://www.awea.org/pubs/factsheets/WE_Noise.pdf
[15] *Id.*
[16] *Id.*

light bulb.[17] On the other hand, many others see will find such a structure to be an unsightly new 'sore thumb' to the skyline.[18] Regulation of the wind should take these latter concerns into consideration when drafting the appropriate policy. Just as billboards and cell phone towers are restricted aesthetically in many places, each county should also work to alleviate the aesthetic concerns of its constituents as to small wind projects.

C. Status of the Market

The small wind industry is growing rapidly. Unlike other renewable technology industries, the United States is leading both domestic and foreign markets in the manufacturing of small wind.[19] Compared to other domestic renewable systems (mostly solar), small wind is much cheaper and is projected to stay cheaper in the long run (Table 1). The American Wind Energy Association has reported that by 2020, small wind could be providing 3% of U.S. electricity.[20] This is assuming that the cost continues to come down, technology improves so that systems can run well in less-wind areas, and current land use and zoning problems are resolved.

Table 1: Comparison of Home Based Renewables

Status of Technologies	Small Wind	Solar Thermal Electric	Photovoltaics
Status	Commercial	Demo	Commercial
Installed Cost	$4,000/kW	$10,000/kW	$8,000/kW
Payback Period	15 Years	30+ Years	25 Years
Cost Potential	$1,500/kW in 2010	?	$3,000/kW
Typical Site	Rural	Southwest	Suburban
Available Resources	Poor-Great	Poor-Good	Poor-Good

Source: American Wind Energy Association (2002).

III. POLICIES THAT ENCOURAGE SMALL WIND DEVELOPMENT IN SUBURBAN AREAS

Local land use planning policies and zoning ordinances are the primary procedural hurdles that a homeowner faces when looking to install a small wind

[17] Garner, Joe (2007). *Vail Turning Wind Into Art: Project Will Light Up Night If Gusts Do Their Breezy Bests*. Rocky Mountain News (online ed.).
http://www.rockymountainnews.com/drmn/local/article/0,1299,DRMN_15_5399706,00.html
[18] Town of Vail, News Release, *Windmill Project Debuts*. (Mar. 19, 2007).
http://ci.vail.co.us/release.asp?nr_id=3190&type=0
See also, Whitcomb, Robert (2007). *Wind Farms – Beautiful or Unsightly*. Scripps News (editorial). Mar. 9, 2007.
http://www.scrippsnews.com/node/20036
[19] American Wind Energy Association (2002). *The U.S. Small Wind Turbine Industry Roadmap: A 20 Year Industry Plan for Small Wind Turbine Technology*. June, 2002.
http://www.awea.org/smallwind/documents/31958.pdf
[20] *Id*.

system.[21] Conditional use permits and variances are often required due to the height of the towers.[22] In many county codes, structures over 35 feet are prohibited without a special use permit or variance.[23] Other issues that may arise at the county level are restrictions on noise, visual obstructions, and historical preservation.

This section provides details into three potential policy options that tend to encourage reasonable small wind development. Categories were broken up by issue with small wind systems. This list may not be exhaustive, however, it does represent the foremost concerns of those involved in the development of small wind projects.

A. A Model Ordinance from Southwest Windpower

Southwest Windpower, based in Arizona, is the world's largest producer of small wind generators. Data provided in Table 2 was provided by one of the company's co-founders, Andy Kruse. It is a model ordinance from a major industry player, but comes with the caveat that it is an evolving document, subject to change.

B. A Model Ordinance from the American Wind Energy Association

The American Wind Energy Association (AWEA) is a national trade organization that represents interests of the wind energy industry. In addition to education and industry support in general, AWEA also lobbies various policy-makers for implementation of industry-supporting guidelines. This model zoning ordinance was released in 2002 and is available on the AWEA website at http://www.awea.org/smallwind/documents/modelzo.html.

C. An Actual Ordinance from San Bernardino County, CA

In 2002, San Bernardino County adopted ordinance 3373 into the County Code dealing with "accessory wind energy systems." This is defined as a "wind energy conversion system consisting of a wind turbine and blades, a tower, and associated control or conversion electronics, which will be used primarily to reduce onsite consumption of utility power."[24] The version of this ordinance that appears in table 2 is as amended in 2005 by ordinance 3966.

Table 2: Approaches to Incorporation of Small Wind Into County Policy by Issue

[21] Cooperman, David. *State Programs to Support Small Wind Energy Systems: An Examination of Key Issues*. Clean Energy States Alliance, Inc. http://www.cleanenergystates.org/library/Reports/CESA%20Small%20Wind%20Project%20Overview%20Report%20FINAL.pdf

[22] *Id*.

[23] This 35 foot limit is based on the highest level in a building that water could reach in the early 1900s. *See* Green, Jim (2006). *Applying Interconnection and Net Metering to Small Wind*. Presentation: Feb. 22, 2006.

[24] San Bernardino County Code, § 812.23015.

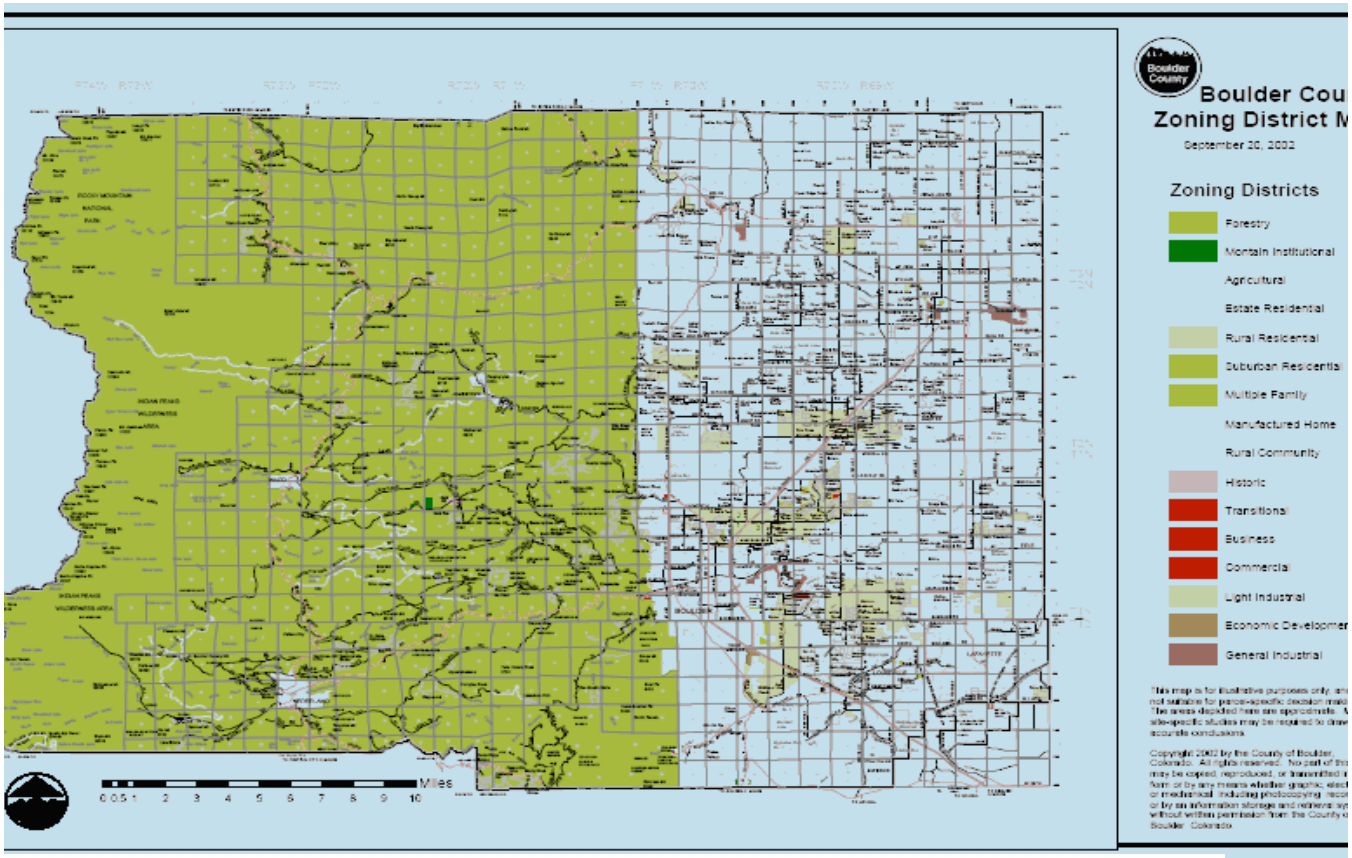
	Southwest Windpower Model Ordinance	AWEA Model Ordinance	San Bernardino County
Power	Up to 10 kW	Up to 100 kW	No maximum restriction, systems that generate les than 1 kW and are less th 35 feet in height are exer from getting a permit
Tower Height	• If up to 2.5 ac., then 70 ft. and/or 20 ft. above treeline w/in a 500 ft. radius of the proposed installation • If 2.5 ac. or more, then 100 ft. (except if FAA regs preempt)	• If between 0.5 – 1 ac., then 80 feet • If more than 1 ac., no limit. (except if FAA regs preempt)	• Specific limitations by land use area and landscape. Variance may be granted to the height restrictions as well.
Clearance of Blade	• System at least 30 ft. from ground • Blade at least 20 ft. from ground • No blades over parking areas, driveways, or sidewalks	• No restrictions	• No restrictions
Minimum Set-back	• At least 10 ft. set-back from property line of site (including guy wires). • Set-back cannot exceed the height of the system (and must be in compliance with fire setback requirements)	• At least 10 ft. set-back from property line of site (including guy wires)	• Minimum distance fro property line must be equal to the system height
Number of Units/parcel	• No restrictions	• No restrictions	• Maximum of 3 units/parcel, one unit acres. • Exception: If 1 kW un 50 feet or under, ther units/5 acres.
Separation Between Multiple Units	• No restrictions	• No restrictions	• At least 240 feet between units. • Exception: If 1 kW un 50 feet or under, ther separation is limited t twice the height of the system.
Auto Over-speed Controls	• All systems must have manual and automatic over-speed controls	• No restrictions	• No restrictions
Sound/Noise	• No more than 60 dBA	• No more than 60 dBA	• No more than 55 dBA

	(measured from the closest neighboring inhabited dwelling) • Exception for short bursts in severe windstorms • Manufacturer-provided sound data submission before permit issued	(measured from the closest neighboring inhabited dwelling) • Exception for short bursts in severe windstorms	from 7 am – 10 pm. • No more than 45 dBA from 10 pm – 7 am. • Note: This standard is for residential land us receiving the noise. T standard is different f Industrial land uses receiving the noise.
Visual Effects	• No restrictions	• No restrictions	• No substantial obstruction of adjacer property owners' viev • Construction must be below any major ridgeline as viewed fr any designated sceni corridor. • Shall not be within an designated scenic corridor.
Climbing Apparatus	• No restrictions	• No restrictions	• Located at least 12 fe above the ground • Tower designed to prevent climbing on fi 12 feet.
Tower Lighting	• No restrictions	• No restrictions	• Prohibited unless required by another code or regulation.
Approved Wind Turbines	• No restrictions	• AWEA certified or approved by the CA Energy Commission's Emerging Technologies Program.	• Approved by CA Ene Commission, or • National Electric Cod certified, or • American National Standards Institute certified, or • Underwriters Laboratories certified
Other	Compliance with the Uniform Building Code, FAA Regulations, National Electric Code, and Utility Notification	Compliance with the Uniform Building Code, FAA Regulations, National Electric Code, and Utility Notification	Compliance with FAA regulations and CA Aeronautics Act.

IV. CURRENT SMALL WIND POLICY IN BOULDER COUNTY

Boulder County is currently working on adding a "sustainability element" into the Boulder County Comprehensive Plan (BCCP). This includes a green building program that is tentatively called "BuildSmart."[25] Through this process the county is looking at how land use regulations effect the installation of renewable energy systems.[26]

There are currently no regulations that specifically relate to small wind systems. The county code height limitations for building structures are set at 35 feet for most of the county.[27] In parts zoned "agricultural," the height limit for a nonresidential structure is 50 feet[28] (See Boulder County Zoning District Map). Amendments to these restrictions and others that may pertain to small wind systems are being reviewed and will mostly likely occur as part of the BuildSmart program expected to be released in the fall of 2007.[29]



ce: Boulder County Land Use Department.

[25] Interview with Michelle Krezek, Boulder County Land Use Department (March 2, 2007).
[26] *Id*.
[27] Boulder County Code, Zoning Table: Article 4-100.
[28] *Id*.
[29] Interview with Michelle Krezek, Boulder County Land Use Department (Mar. 2, 2007).

V. CONCLUSION

Today's small wind energy systems can provide clean energy solutions using mostly American manufactured products and labor. However, archaic land use policies are the major stumbling block to more widespread growth of this technology. The right policy should not be the major barrier to the market, but restrict use as necessary to mitigate for concerns like noise, visual effects, and aesthetics. This will most likely come in the form of specific new county code provisions pertaining to wind energy systems.

Every county is different and has to decide what the best land use policies are for its current and future constituents. Boulder County is no exception. Boulder policy-makers should examine all of the key issues with small wind systems and incorporate the best language that suits the needs of those who live and work in the community. Due to demand of such systems within suitable areas of the county, these changes should be made without delay.