REGULAR MEETING MINUTES

DATE & TIME: Thursday, April 15, 2010 @ 7:00 p.m.
LOCATION: Millcreek Township Hall, 10420 Watkins Road, Marysville Ohio 43040

LEGAL NOTICE: The Millcreek Township Zoning Commission will hold a regular business meeting on the third Thursday of each month for 2010. All meetings begin at 7:00 pm and are held at the Millcreek Township hall, located at 10420 Watkins Road, Marysville, OH 43040. The public is invited to attend.

CALL TO ORDER: Meeting called to order by Zoning Commission member Bob Whitmore at 7:08 p.m.

ROLL CALL: Zoning Administrator Joe Clase called the roll of members present.

Zoning Commission Present:	Kenny Coakley, Alternate Jim Lawrenz Bob Whitmore Greg Wisniewski
Zoning Commission Absent:	Joni Orders, Chair Freeman Troyer, Vice Chair
Others Present:	Joe Clase, *Zoning Administrator*

MINUTES REVIEW & APPROVAL: The following prior meeting minutes were reviewed for approval:

- 03/18/2010: Regular Meeting Minutes. Greg Wisniewski motioned to approve the minutes. Jim Lawrenz seconded the motion. All voted in favor of the motion and the motion carried.

- 03/18/2010: Special Workshop Meeting Minutes. Jim Lawrenz noted that the word "sense" was incorrectly noted as "since" in lines 7 and 8 of the second paragraph on page 4. Kenny Coakley noted that the word "if" should be added between the words "asked" and "it" in the second line of the second paragraph on page 4. Greg Wisniewski motioned to approve the minutes with the noted corrections. Kenny Coakley seconded the motion. All voted in favor of the motion and the motion carried.

CITIZENS' COMMENTS: None

TRUSTEES' COMMENTS: None

ZONING ADMINISTRATOR REPORT / COMMENTS: Joe Clase presented an overview of the March 2010 Report. In addition to his report, he noted that a court date has been set for 14136 Smart Cole Road for Monday, April 19th at 10:00 a.m.

Joe Clase also asked the board to consider whether the it is the intent of the Zoning Resolution to require a single-family residence to be on a property in the R-1 district where a service business is considered as a conditional use. Jim Lawrenz noted that he had the impression that it was required for a service business to be established in conjunction with a residence and not for the business to operate on its own. Greg appears to be working. Joe Clase noted that he would attempt to locate this resident and others that may be either have done this or thinking about it to ask them to join the board's conversation in the future.

- M-1 Zoning District: Joe Clase stated that he planned to look at this prior to the meeting, but didn't get a chance and would like to defer this to another meeting.

OLD BUSINESS: None

NEW BUSINESS: None

NEXT MONTHLY MEETING: Bob Whitmore announced that the next regular meeting will be Thursday, May 20, 2010 directly following the special workshop meeting scheduled for 6:00 p.m.

ADJOURNMENT: Greg Wisniewski made a motion to adjourn the regular meeting. Jim Lawrenz seconded the motion. All voted in favor of the motion and the motion carried. Bob Whitmore announced the meeting to be adjourned at 8:13 p.m.

PREPARED BY:

JClase

Joe Clase, Zoning Administrator

ATTEST:

Joni Orders

Joni Orders, Zoning Commission Chair

DATE APPROVED:

5/20/10

Millcreek Township Zoning Commission
Meeting Agenda
Thursday, April 15, 2010 7:00 pm

Call To Order

Roll call by Administrator

Minutes Review & Approval

- 08/12/2009 – Joint Work Session with Trustees re: Updates to Planned Residential Districts
- 10/15/2009 – Regular Meeting
- 11/19/2009 – LUGP Presentation Open House & LUGP Public Hearing
- 03/18/2010 – Special Meeting for Zoning Updates re: PCD & Regular Meeting

Citizen Comments

Trustee Comments

Zoning Administrator Report / Comments

Zoning Issues

- Zoning Resolution Updates – PUD / Definitions / Landscape Standards - Jill Tangeman
- List of Zoning Resolution Updates & Corrections (New date for Hearing continued)
    - Conditional Use Permits (Sections 42650 / 4260 / Review all)
    - Article XII – Parking
    - Appendix B – Signs
    - Article XI - Signs
    - Wind Turbines
    - Other items on list from 06/18/2009
- M-1 Zoning District – Update needed
- Old Business
- New Business

Next Monthly Meeting

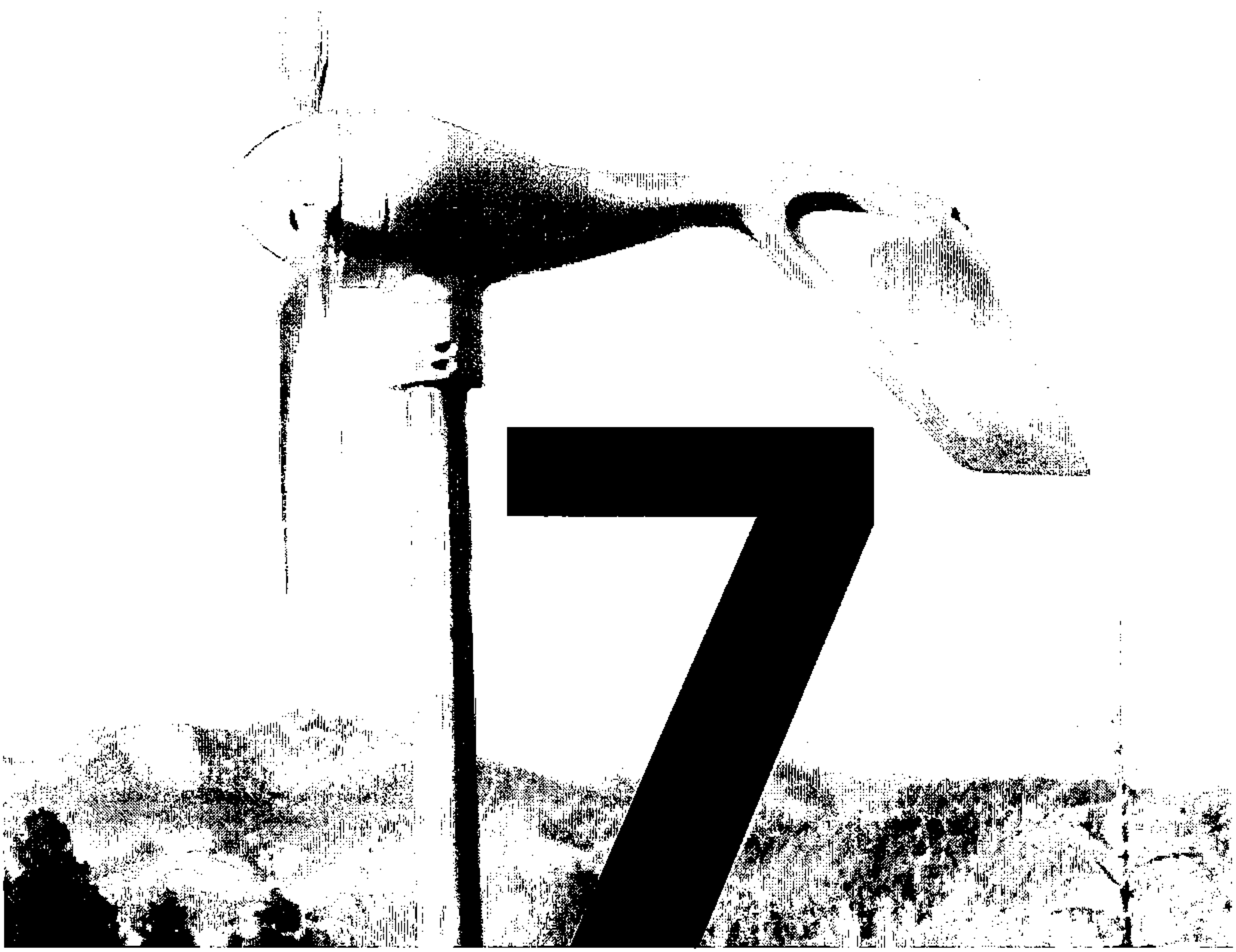
Adjourn

ZONINGPRACTICE July 2008

AMERICAN PLANNING ASSOCIATION

ISSUE NUMBER SEVEN

PRACTICE RENEWABLE ENERGY



Urban Wind Turbines

By Erica Heller

Wind is an abundant renewable resource in much of the U.S.

This turbine at the International Brotherhood of Electrical Workers Local 103 in Dorchester, Massachusetts, represents the upper limit of small wind energy conversion systems.

Courtesy of DOE/NREL–International Brotherhood of Electrical Workers

As wind power development expands, technologies are being developed and improved to increase efficiency and reduce impacts. A range of new turbines (wind energy conversion systems, or WECs) enable wind power to be harnessed in a much wider variety of settings than ever before, including in urban and suburban settings.

Many local governments that have never processed an application for a wind turbine permit may find themselves needing to review one in coming years. In fact, most of these communities are unprepared to review these permits and lack the standards to ensure safe installation in compatible locations. This can result in lengthy, costly public review processes that yield mixed results.

SMALL WIND

"Small wind" refers to turbines rated 100 kW or less that can be used to power farms, homes, or businesses. The vast majority of nonrural applications for wind are small WECs, sited as accessory uses to a primary business or residential use. The photo on the left shows a 100 kW WEC located at the offices of the International Brotherhood of Electrical Workers Local 103 in Dorchester, Massachusetts—this is as big as "small" wind gets. A WEC used at a residence (such as that shown on page 4) is typically smaller—up to 10 kW and about 50 to 80 feet high (depending on a number of factors, as will be discussed). Even smaller WECs may be used for targeted applications, such as the systems shown on page 5, which are mounted on light poles to offset power used by the lights in a shopping center parking lot in Lakewood, Colorado. Rooftop models, often used in rows, are a newer type of small wind that is growing in popularity for commercial applications and urban areas.

URBANIZED SETTINGS

This article focuses on incorporating small WECs in urbanized settings. The science of small wind is the same across urban and rural settings, and the discussion here may also be useful for planners in rural areas. However, this article does not specifically address rural settings. Within urbanized settings, there are a variety of zoning districts in which WECs may be appropriate, including industrial, commercial, and even residential neighborhoods, as the images in this article depict. Successful integration of WECs in densely built environments requires careful examination of potential impacts and thoughtful standards that balance mitigation against the cost effectiveness of installing a turbine.

POWER FROM SMALL WECS

Planners often ask if small WECS produce enough energy to justify both installation

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Go online from August 18 to 29 to participate in our "Ask the Author" forum, an interactive feature of Zoning Practice. *Erica Heller will be available to answer questions about this article. Go to the APA website at www.planning.org and follow the links to the Ask the Author section. From there, just submit your questions about the article using the e-mail link. The author will reply, and* Zoning Practice *will post the answers cumulatively on the website for the benefit of all subscribers. This feature will be available for selected issues of* Zoning Practice *at announced times. After each online discussion is closed, the answers will be saved in an online archive available through the APA* Zoning Practice *webpages.*

About the Author

Erica Heller is an associate with Clarion Associates based in Denver, Colorado. She has six years of experience working on community and neighborhood plans, development codes, and airport land use plans. Prior to joining Clarion, she was a long-range planner for Lakewood, Colorado. Heller recently presented at the APA National Conference in Las Vegas on the topic of zoning standards for wind turbines.

costs and potential land-use impacts. Because WECs can be controversial, it is reasonable to ask if they are effective. The answer depends partly on planners and local officials. A small WEC can produce impressive amounts of power, but only with access to good wind, which is largely a function of proper siting and adequate height—factors that zoning regulations impact mightily.

UNDERSTANDING LOCAL WIND RESOURCES

The U.S. Department of Energy (DOE) and National Renewable Energy Laboratory (NREL) provide state-level wind resource maps for nearly every state in the U.S., and some state governments provide more detailed maps. Wind resource maps show the average strength of the wind at 50 meters, with a ranking between 1 (weakest) and 7 (strongest). Most utility wind developers today look for areas with steady Class 4 or 5 winds, but Class 2 or 3 winds, which are found in much of the U.S., can power small WECs.

Large-scale wind maps are a free resource that can help a community understand generally if wind energy potential is likely to exist. To determine the actual wind power generation potential of a given site, a site-specific wind resource assessment by a qualified professional is needed. Site-specific assessments are typically the responsibility of the property owner.

FACTORS THAT INFLUENCE ENERGY PRODUCTION

How much energy a WEC will produce depends primarily on three factors:

(1) The engineered design of the turbine, which determines efficiency of power transfer. Modern WECs are highly engineered and most are very efficient.

(2) The size of the rotor. Capacity increases with "swept area," meaning the total area of the spinning rotor blades. Area, and thus capacity, increases geometrically with blade length.

(3) The speed and consistency of the wind. Power output increases exponentially with wind speed, but gusty or turbulent winds can damage turbines. Variations in topography and obstructions such as buildings and trees slow the wind and add turbulence near the ground. Therefore, adequate height is a critical factor in WEC effectiveness. In order to function well, the lowest part of the rotor blades must be a minimum of 25 to 35 feet higher than surrounding obstructions. Height regulations that do not achieve such separation eliminate the benefits of investing in a WEC.

The National Renewable Energy Laboratory provides estimates of yearly energy generation potential for small wind turbines. Using these figures, it is possible to estimate the power generation potential for various turbine sizes and wind classes and to gauge the number of average U.S. homes that can be powered. The table below illustrates the variation by wind speed and rotor size (assuming good wind access). Depending on such factors, a residential turbine can often supply about one-third to one-half of an average U.S. home's energy demand and a substantially greater percentage if the home is energy efficient. Larger "small" WECs can supply consumers with higher energy demand, such as commercial or public facilities.

CARBON EMISSION REDUCTIONS FROM WIND-GENERATED ENERGY

Using 100 percent wind-generated energy versus typical utility energy can reduce annual carbon emissions by eight tons for a U.S. home with typical energy demand. This is equivalent to the carbon emissions produced annually by 1.4 typical U.S. passenger cars. Thus, for an average two-car household, converting the

MEDIAN NUMBER OF HOMES POWERED BY SELECTED WECS SIZES AND WIND CLASSIFICATIONS

	Wind Strength					
Rotor Diameter	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7
3 m	0.3	0.3	0.3	0.4	0.4	0.5
5 m	0.7	1.0	1.2	1.3	1.5	1.9
7 m	1.4	2.0	2.3	2.6	3.0	3.7
10 m	2.9	4.1	4.8	5.4	6.1	7.5
12 m	4.1	5.9	6.9	7.7	8.8	10.8

Estimated NREL median yearly energy production figures, expressed as kWh per square meter of swept area, are multiplied by swept area, then divided by U.S. national average annual home energy usage to estimate the number of average homes powered.

used to encourage WECs, standards should ensure that this money is well spent.

Robin Wilson

A small 10 kW residential turbine in San Francisco's Mission District.

home to 100 percent wind power reduces carbon emissions as much as driving one car 40 percent less and not using the other car at all! If we take the need to reduce carbon emissions seriously—as many studies and recent global events strongly suggest that we should—then incorporating WECs into our communities may be a more practical approach than radical changes to our driving behavior. Communities should seriously consider how and where to allow WECs to ensure that regulations are not so strict as to eliminate their potential for effective energy production.

THE CASE FOR LOCAL ACTION

In addition to reducing CO_2 emissions, there are several important reasons that local governments should draft reasonable standards for WECs:

(1) *Respond to community desires.* Ultimately, permitting decisions are local decisions. Permitting takes public time and resources, especially when uses must be approved through discretionary approvals. Good zoning standards that address potential impacts can allow WECs to be permitted as by-right uses, at least in some districts, reducing public cost and NIMBY battles.

(2) *Maintain local autonomy.* In several windy states, state legislatures have restricted the ability of local governments to deny permits for WECs. By proactively adopting reasonable, locally appropriate standards, local governments reduce the likelihood that states will override local control.

(3) *Protect local resources.* Many states offer incentives such as rebates or buy-down programs for WECs. Where public funds are used to encourage WECs, standards should ensure that this money is well spent.

(4) *Diversify energy supply.* Small-scale WECs can help diversify energy supply. Many small WECs are less vulnerable to attack than a centralized plant. If a storm, system overload, or terrorism event shuts down energy grids, small WECs can provide dispersed backup power.

One of the least expensive alternatives for small increases in grid energy capacity is to allow small-scale producers, since they, rather than the utility, purchase and maintain the infrastructure. Such investments may delay or reduce the need for major capital investments by the utility.

COMMUNITIES ALLOWING TURBINES IN SUBURBAN AND URBAN SETTINGS

- Brewster, Massachusetts (www.town.brewster.ma.us)
- Centennial, Colorado (www.centennialcolorado.com)
- Chicago (www.cityofchicago.org)
- Duluth, Minnesota (www.duluthmn.gov)
- Fairfield, California (www.ci.fairfield.ca.us)
- Mason City, Iowa (www.masoncity.net)
- Saco, Maine (www.sacomaine.org)
- San Francisco (www.ci.sf.ca.us)

Note: Not all communities fully conform to the recommendations in this article.

LAND-USE IMPACTS AND RESPONSIVE STANDARDS

Wind turbines can have impacts on surrounding property owners and land uses. Permit requests for wind turbines may be controversial—particularly in residential areas—due to both real and perceived impacts. Impacts can be grouped in four categories: noise impacts (normal and storm conditions); safety impacts (electrical and structural safety, potential for climbing, and avian impacts); aesthetic impacts (appearance and visibility); and property value impacts. Each of these categories is discussed below, along with zoning tools and standards to address them.

In this discussion the assumed goal is to adequately address impacts in a way that is responsive to realistic concerns but not onerous to the turbine owner. Time and cost requirements for permitting are among the biggest hurdles for many potential turbine owners and can quite easily determine whether a WEC is cost effective. For this reason, local governments should strive to keep requirements to the minimum necessary to address impacts.

NOISE IMPACTS AND STANDARDS

Although noise is often a first concern of neighbors, small WECs are less noisy than most people expect and rather easy to regulate. The noise from a modern small WEC that would be used in a residential setting (up to about 10 kW) can be compared to a flag flapping in the wind. To further illustrate, the noise level measured 50 feet away from a WEC on an 80-foot tower is approximately 45 decibels—quieter than standing next to a kitchen refrigerator. When operating in extremely

Due to variation in noise performance of different turbine models, standards to address noise that specify turbine size may produce varied results, and local governments should adopt a standard for noise measured at the property line.

windy conditions, noise levels may be slightly higher, but so will ambient wind-related noise, such as that made by wind in trees. Noise levels are reduced by a factor of four for each doubling of distance (as measured from the turbine to the listener). Thus, off-property noise intrusion from a residential WEC is typically very limited.

Due to variation in noise performance of different turbine models, standards to address noise that specify turbine size may produce varied results, so local governments should adopt a standard for noise measured at the property line. In general, it is appropriate to use the same standard for "nuisance noise" that the community applies to all other activities in the zoning district. Adding the caveat "or 10 decibels above ambient noise levels" gives some leeway to turbine owners during very windy conditions when ambient noise levels rise and neighbors are less likely to be outdoors. This caveat also helps if the neighborhood is already impacted by another noise source, such as a freeway. By measuring noise at the property line, the turbine owner can limit it by using a quieter model, increasing setbacks, adding a fence or hedge along the property line, or other techniques.

Belmar, a large mixed use redevelopment in Lakewood, Colorado, has wind turbines on top of street lights, solar-powered parking meters, and some of the most energy-efficient commercial buildings in the Denver area.

SAFETY IMPACTS AND STANDARDS

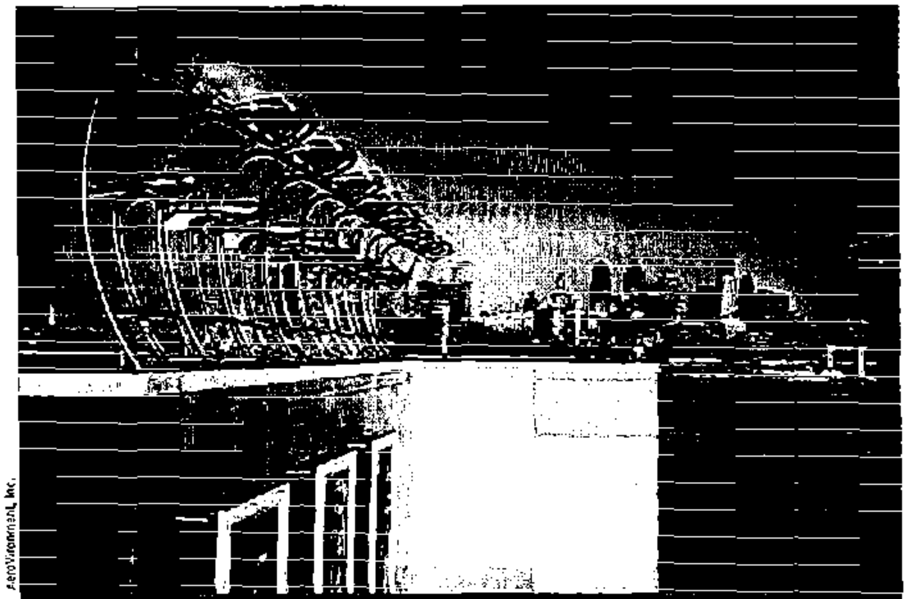
Safety is, of course, an important concern. Local governments should address three main issues when writing zoning and permitting standards for WECs: structural failure, electrical failure, and climbing potential. This section concludes with a brief discussion of safety-related issues associated with windfarms. Although risks for small wind are minimal, opponents often raise safety concerns, and planners should be aware of these concerns and be prepared to respond.

Structural Failure

One concern with wind turbines near property boundaries is that the supporting pole or tower could fall down. However, structural failure in a WEC is extremely unlikely. A turbine is a significant investment, as are the engineered towers and poles on which they are installed. WECs are not sold as do-it-yourself appliances. Rooftop models must be installed on structures that are engineered to accommodate the additional weight and stress. The likelihood of structural failure in a properly installed WEC is not more likely than for a flag pole, and is much less likely than for trees. Even so, a setback requirement of 1.1 to 1.5 times the total height of the WEC (i.e., tower or pole height plus rotor radius) is a reasonable requirement. Such setbacks address a range of potential impacts including safety, noise, and aesthetics, and can give neighbors peace of mind.

In most cases the local building inspector can verify that installation conforms to approved plans. It is not necessary to require an engineer to certify installation, except in cases where a reduced setback is to be approved with recorded consent of the adjacent property owner.

Because WECs are installed by professionals, additional certifications add unnecessary expense for a small WEC owner. Soil testing is generally unnecessary and is often cost prohibitive; it should only be required if soils are so weak as to merit testing for



AeroVironment, Inc.

The Adventure Aquarium in Camden, New Jersey, uses a modular, rooftop-mounted turbine system that eliminates the need for stand-alone support towers.

similar structures, such as flag poles or cell towers.

Finally, it is reasonable that, as for billboards and cell towers, local regulations require an owner of an abandoned WEC to remove it from the property. Over time, an abandoned system might become a structural hazard.

Electrical Failure

Electrical failure is highly unlikely in a modern WEC. Like individual furnace units, these systems are factory certified by engineers for electrical integrity, and thus third-party inspection for an individual turbine is unnecessary. Modern systems also come equipped with manual override brakes so that in the event of an electrical outage the turbine may be shut down. To make sure that the property owner installs a WEC that meets modern standards, local governments should require a permit applicant to submit the manufacturer's electrical drawings and require that the system is equipped with manual braking.

Climbing Potential

WECs on towers may raise the concern that children will try to climb supporting structures and fall, causing injury or death. Many pole-mounted turbines lack climbable features (they are designed to be lowered to the ground for servicing) or have removable climbing features below 12 feet. Local governments should only require fences around WECs if equivalent regulations apply to similar uses; designs that lack climbing features should be exempt.

Safety and Nuisance Issues of Large WECs

Neighbors may express the following concerns that are associated with large, utility WECs. Planners should be ready to respond.

- *Effects on birds.* The effects of WECs on birds has received much attention due to documented bird kills at a windfarm in Altamont Ridge, California, which is located in a major raptor migration corridor. A small WEC kills fewer birds than a single domestic cat or sliding glass door. Except perhaps in critical endangered bird species habitats, where even very small population losses are unacceptable, WECs should not be restricted based on avian impacts.
- *Acoustical interference.* The slow-spinning blades on large WECs can cause thumping vibro-acoustical effects or cast flickering shadows. Faster rotating, smaller WECs do not cause the same effects. Radio signal interference is also associated with some large turbines. Modern small-scale wind turbine blades are not metal, so they are "invisible" to radio frequency transmissions.
- *Ice buildup.* A concern about turbines in northern climates is that they can accumulate and then throw off ice. This has been observed occasionally in windfarms. However, chunks of ice on the surface of the lightweight blades of small WECs alter aerodynamics so much as to slow or stop the blades from turning until most ice has melted. English and German scholars in a 1998 study used physics to calculate that the risk of personal or property damage from flying ice from a small WEC is lower than the risk of being hit by lightning.

AESTHETIC IMPACTS AND STANDARDS

The appearance of wind turbines is a serious issue in many communities. Opinions vary widely about whether WECs are attractive, based largely on personal taste. Urban environments are not visually pristine, and many of the concerns about aesthetics may sound familiar to planners who have already dealt with aesthetic opposition to satellite dishes, cell towers, and even modern archi-

RESOURCES

- American Wind Energy Association (AWEA). 2006. Advice from an Expert: Home Sized-Wind Turbines and Flying Ice. Available at www.awea.org/faq/sagrillo/ms_ice_0306.html.
- Morgan, Colin, Ervin Bossanyi, and Henry Siefert. 1998. "Assessment of Safety Risks Arising From Wind Turbine Icing." BOREAS IV, Hetta, Finland. Available at: www.renewwisconsin.org.
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- Sterzinger, George, Frederic Beck, and Damian Kostiuk. 2003. *The Effect of Wind Development on Local Property Values.* Renewable Energy Policy Project. Available at www.crest.org/articles/static/1/binaries/wind_online_final.pdf.

tecture. Visibility and appearance are two major issues related to wind turbine aesthetics.

Visibility

WECs are usually quite visible because they must be placed high enough to access good wind. Sometimes, height can actually decrease their visibility from the street. More often, though, a community has to decide if the aesthetic impact is serious enough to enforce height standards that would compromise a system's functionality. Small WECs must be mounted at least 25 to 35 feet above surrounding objects—between 50 to 120 feet (the higher the better) in order to perform well. At lower heights, even if there is a lot of wind, it will be so turbulent that the turbine will wear out quickly, before installation costs can be recouped. In densely built environments, where there are many objects at varying heights creating turbulence, height becomes even more important. A local jurisdiction with standards that allow WECs but severely restrict heights can inadvertently undermine the effectiveness of the system, its potential sustainability benefits, and the substantial investment of the turbine owner.

Appearance

The appearance of a turbine is an aesthetic issue, and one that is readily and easily controlled without impacting effectiveness. Sound responses to appearance issues include the following:

- *Color.* Do not require special colors to blend with trees. Studies show that the light gray factory color of most turbines is the best for blending into a range of sky conditions.
- *Signs.* Clarify that WECs cannot be used as, or used to support, signage that is not otherwise approved through the sign ordinance.
- *Removal.* Require removal of abandoned WECs. If a system is not productive, the visual impact should be eliminated.
- *Lighting.* Do not require special lighting except in airport districts. Structures less than 500 feet in height are not considered flight hazards unless located in close proximity to an airport.
- *Restrictions.* Consider restricting WECs in specific unique areas. The aesthetic impact of wind turbines may be unacceptable in historic and character districts or in special view corridors.

PROPERTY VALUE IMPACTS

One concern that resonates with local officials is the potential impact of wind turbines on surrounding residential property values. Although there have been no statistical studies of the impact of small WECs on property values, most available evidence suggests that adjacent property values and sale prices do not decrease. In fact, values may *increase* because the WEC signals a positive community attitude toward renewable energy and because adjacent owners recognize the potential benefits of a turbine on their own property. The likely effect from small systems can also be inferred from studies of large WECs. The only longitudinal study of property values near windfarms shows that on average, after an initial dip during the farm's construction, the value of properties within sight of a windfarm actually increased faster than similar properties.

On properties where windfarms had detectable nuisance impacts (such as noise), value does decrease. It is important that local standards protect against any nuisance impacts of small WECs, but communities should not assume that aesthetic impacts alone lower adjacent property values.

A community has to decide if the aesthetic impact of a WEC is serious enough to enforce height standards that would compromise a system's functionality.

SUMMARY

While turbines can have a variety of potential impacts in urban areas, most are easily remedied through reasonable standards. Local standards should strive to protect neighbors from nuisance or safety impacts without restricting property owners who wish to install WECs. Performance standards such as permissible noise levels, setback requirements, height limitations, and exceptions can ensure that one man's turbine is not another man's migraine.

Local standards and requirements should consider the impacts of permit costs or regulations that substantially reduce the ability of WECs to effectively serve their purpose. The aesthetic impact of turbines is a real concern for many residents, but aesthetics alone do not appear to have a measurable effect on neighboring property values. The impacts of WECs should be compared to similar structures that are allowed to create visual impacts in our urban settings, particularly those associated with power generation and transmission. Ultimately, each community will need to decide if the benefits of clean, local power generation are valuable enough to justify the visual impact of turbines in some zoning districts.

Cover photo: Small wind turbines like this AIR 403 from Southwest Windpower can be used to recharge recreational vehicle batteries or reduce residential energy. Courtesy of DOE/NREL—Southwest Windpower

VOL. 25, NO. 7

Zoning Practice **is a monthly publication of the American Planning Association. Subscriptions are available for $75 (U.S.) and $100 (foreign). W. Paul Farmer, FAICP, Executive Director; William R. Klein, AICP, Director of Research.**

Zoning Practice (ISSN 1548–0135) is produced at APA. Jim Schwab, AICP, and David Morley, Editors; Julie Von Bergen, Assistant Editor; Lisa Barton, Design and Production.

Printed on recycled paper, including 50-70% recycled fiber and 10% postconsumer waste.

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IS YOUR COMMUNITY READY FOR SMALL WIND?

7

ZONING PRACTICE APRIL 2010

AMERICAN PLANNING ASSOCIATION

APA

⊕ ISSUE NUMBER 4

PRACTICE SOLAR DESIGN

Solar Access: Using the Environment in Building Design

By Mary-Margaret Jenior, AICP

More new buildings are energy efficient that at any time in our history.

Yet most do little to use the environment in order to reach their real performance potential.

About 40 percent of our end-use energy demand and over two-thirds of electricity demand is for buildings. A significant portion of that demand can be met using the sun if we learn to design and renovate buildings to take advantage of access to solar energy. Further, buildings now produce about 40 percent of U.S carbon emissions, another reason to take advantage of solar power.

We know that more solar energy falls on our roofs than is required to meet the U.S. demand for electricity. However, our land-use policies and regulations discourage the use of this valuable resource. We need to do everything we can to encourage decision makers, the building industry, and building owners to think of buildings as energy producers. For our future well-being it is essential that we consider energy production and use as an integral part of building design for new construction and renovations alike. We need to encourage builders, developers, designers, engineers, and owners to use the environment to heat, cool, ventilate, daylight, and power our buildings. As planners we need to help educate and promote changes in how we design and renovate buildings and to use land-use controls to enable that to happen.

It can no longer be an either-or choice between environmentally sensitive building design or dense development to achieve viable transit systems. It can and must be both. We cannot favor one approach to reducing energy use over another in making recommendations to decision makers. That is because the dominate fuel sources for buildings and for transportation differ. At present, most energy for transportation comes from oil or biofuels. In contrast, coal is the primary energy source for buildings—with some natural gas, hydroelectric, nuclear, and wind supplementing the grid. Of these energy sources, only hydroelectric, nuclear, and wind energy do not contribute carbon emissions. Concentrated solar thermal plants may begin providing electricity in the near future.

According to Energy Information Administration 2005 survey data, an office building uses about 40 percent of its energy for heating, cooling, and ventilation; 30 percent for lighting; and 16 percent for office equipment and other "plug" loads. A commercial building built to American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 90.1 (a standard commonly referenced in building codes) may use about 20 percent of its energy for heating and cooling, up to 70 percent and sometimes more for lighting, and the remaining for hot water, pumps, and equipment. A typical home may use one-half its energy demand for space conditioning (heating, cooling, and ventilation), 20 percent each for refrigeration and hot water, and the remainder for appliances and electronics.

It is crucial that we use all the opportunities we can muster to design buildings to meet their energy needs. We must begin to think of buildings as being net energy producers—that is, buildings that can put energy into the electric grid instead of just taking it out.

How do we achieve such buildings? We begin by minimizing the energy load of the building itself. This is done by using efficiency measures to conserve energy and passive solar design strategies and other solar technologies to produce energy.

The objective of passive solar—or whole-building—design is to capture the natural environment using elements that are already employed in buildings and to do so at little or no increase in construction or renovation costs. The resulting buildings are more economical to maintain, aesthetically pleasing, comfortable, and healthy. They are light and airy, easier to sell and rent, and pleasant places to live, study, and work. Studies have shown that employee absenteeism is reduced and performance improves when office buildings incorporate elements of solar design. Buildings that take advantage of solar building design are less dependent on fuel cost variations and can maintain comfort during power outages. They may employ any architectural style desired and be of any building type and use required—single or multifamily housing, institutional, commercial, or industrial.

Passive solar buildings use a south-facing orientation (north-facing in the southern hemisphere) and building components (like windows, walls, and floors) to capture the benefits of the sun for heating and daylighting, and they use natural air flows and temperature gradients (the difference between daytime and nighttime temperatures) for ventilation and cooling. They use landscaping and overhangs for shading. In some climates they may use evaporative cooling or cooling towers, and soon, all climates may be able to adopt evaporative cooling technologies because of new research on desiccant technologies (materials capable of removing moisture from the air).

Once the building's energy need is minimized, owners may consider active solar thermal for domestic hot water (DHW) and auxiliary heating and photovoltaics (PV) for electricity. Excess electricity can be fed into the utility's grid for others to use.

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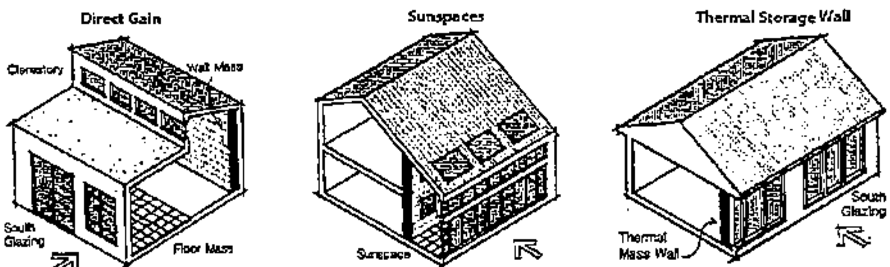
About the Author
Mary-Margaret Jenior, AICP, is retired from the Department of Energy, where she was responsible for the development and management of the passive solar/whole buildings research program. She represented the U.S. government on the International Energy Agency Solar Heating and Cooling Programme Executive Committee. Earlier in her career she was a practicing planner for the City of Cincinnati, the USN Trident Program, and the U.S. Air Force.

The important message is that solar building design can not be achieved simply through "add-ons." The approach discussed above is integral to the building and needs to be considered in the predesign stage, whether for new construction or renovation.



Courtesy of DOE/NREL and the Sustainable Buildings Industries Council

Direct gain is the most common passive solar system in residential applications. Sunspaces provide useful passive solar heating and also provide a valuable amenity to homes. A thermal storage wall is an effective passive solar system, especially to provide nighttime heating.

ELEMENTS OF SOLAR BUILDING DESIGN

Before we see how these ideas can be encouraged through land-use regulations, it is necessary to understand how to incorporate solar concepts into buildings. Keep in mind throughout the following discussion that solar design is location-specific. We'll begin with basic solar building design concepts and technologies.

Latitude. Depending on location, the height and angle of the sun in the sky (the azimuth) throughout the year and climate characteristics (for example, heating and cooling degree days and air-flow patterns) will establish the basis for the design of solar buildings and therefore, solar access requirements. (Specific climate data are available for numerous weather stations nationwide. Even within a given geographic area, microclimate variations must be taken into account. Design tools such as ENERGY-10 and Energy Plus contain the weather data files for numerous U.S. locations).

Energy-efficiency measures. These measures include proper levels of insulation and glazing type, control of air infiltration, properly sized mechanical equipment, efficient appliances and office equipment, and electric lighting systems and controls.

Daylighting. This refers to the use of solar radiation captured through the use of clerestory glazing, sawtooth roof monitors, light shelves (horizontal surfaces over the windows' exterior that reflect daylight onto the ceiling and deep into the building), light tubes, and other means of bringing light into the building. Studies have shown that daylight can reduce electric bills 30 to 50 percent. Skylights are commonly used for daylighting. However, unless they are designed as an integral part of the building, they will likely increase the cooling load. Electric lighting controls are integral to the use of daylighting so that light levels are constant when people are present and fixtures are not on when radiation levels are adequate.

Suntempering. For housing and small nonresidential buildings, suntempering may be a desirable approach. Suntempering is accomplished by simply moving more of the windows to the south and relying on interior finishes and furnishings for thermal or heat storage. However, suntempered buildings will not reduce the use of purchased energy to the degree that solar buildings will.

Passive solar or whole building design. Passive solar is the building itself. A passive solar building makes use of the building's nonmechanical elements and proper orientation to provide daylighting; to collect, store, and distribute solar energy; and to take advantage of natural cooling. These buildings have thermal mass to store and emit heat during times when it is needed and to lessen the need for air conditioning. The amount of thermal storage required is dependent on the area of south-facing glass. Care must be taken in selecting glazing so that the solar gains from the southern orientation are maximized. These buildings also employ means to direct natural airflows (solar-drive convective air movement) into the building using such strategies as operable windows, vents at floor level, and wing walls (walls that project from the building) to bring air into the building. Additional ventilation is provided by whole-house fans and operable clerestory or cupola windows. Passive solar buildings may also use night radiation to flush excess heat. This method involves exposing masonry surfaces to the cool night sky and insulating these surfaces from outside air during the day. As daytime temperatures rise, the cooler surface acts as a heat sink for the living space.

An ideal design will orient the major work, study, and living areas to the south and minimize the east- and west-facing glass. Even the type of glazing selected for each orientation may differ so that solar gains for south-facing glass are maximized and those for east- and west-facing glass are minimized.

Passive solar buildings draw upon at least one of three design strategies to provide heat: direct gain, sunspaces, and thermal storage—or Trombe—walls. Trombe walls are glazed, south-facing masonry or concrete walls with a selective surface that aids in collecting and storing the solar radiation. A thermal storage system is often referred to as an indirect system.

> Passive solar buildings draw upon at least one of three design strategies to provide heat: direct gain, sunspaces, and thermal storage.

passive solar buildings since the collectors are likely to be placed at ground level. Hawaii now requires that all new homes install solar hot water systems.

Photovoltaic (PV) systems. PV systems generate electricity. The PV system might be on the building's roof, integrated into its overhangs, or provide the skin for the building's facade or atrium. Distributed power is a term likely to become part of our future vocabulary. Distributed power is PV-generated power that is fed into the utility's grid. In time, if enough buildings generate more power than they need, we will have less need for additional power plants.

Ventilation air. For nonresidential buildings like institutions, industrial facilities, and warehouses, transpired air collectors

Courtesy of DOE/NREL, Credit—Jim Yost

Courtesy of DOE/NREL, Credit—Keith Simik

Left: This retail complex in Silverthorne, Colorado, features PV, clerestory windows, daylighting, diffusing skylights, and a solar wall. Right: This Federal Express building in Denver uses an absorber wall to help preheat intake air.

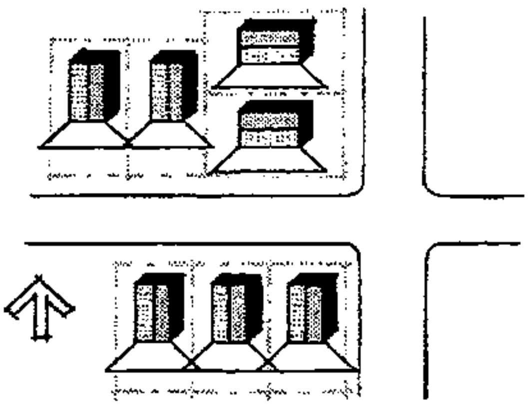
Passive solar buildings depend on proper glazing-to-storage ratios and properly sized overhangs to avoid overheating in spring and fall. Because these buildings use normal building components to meet much of their heating and cooling needs, they require little maintenance. In some climates, a passive solar home or small nonresidential building (e.g., a school or office building) may not require a central heating and cooling system—a major cost saving benefit—and those that do require auxiliary heating and cooling will use smaller systems than conventional buildings.

Buildings of 10,000 square feet or smaller make up the majority of the nonresidential sector. Contrary to popular perceptions, smaller commercial, institutional, and industrial buildings are similar to residential buildings in that they do require heating as well as daylighting, cooling, and ventilation. For larger buildings, daylighting is especially important since lighting is sometimes the biggest user of energy. Many buildings, regardless of size, can benefit from using solar to heat and to preheat ventilation air.

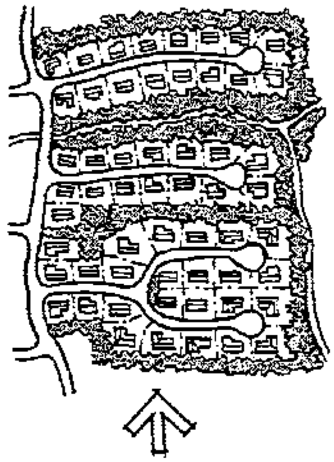
Active solar systems. This refers to the use of collectors, usually located on the roof to collect solar radiation to heat water for domestic uses and possibly, to provide auxiliary heating in the winter months. The systems that provide both hot water and heat are often referred to as combisystems. Some collectors for hot water systems are freestanding, especially when roof orientation is not ideal. For these systems greater solar access is necessary than required for

placed on the south side of buildings have proven to be an effective technique to preheat ventilation air. Transpired collectors are a dark-colored, perforated facade with a fan, or the building's existing ventilation system draws air into the building. The air space between the absorber and the building wall form a plenum. The solar energy absorbed by the dark absorber and transferred to the air flowing though it can preheat intake air by as much as 40°F. The absorbers can be added to or designed as part of the building's facade. Because of fire code requirements, they may not be appropriate for some multistory buildings.

Evaporative cooling. This refers to the use of a water medium to cool air for climate control in dry climates. Not all climates require compressors to cool air and control humidity inside buildings. Materials that remove moisture from the air are known as desiccants. Desiccant technologies are evolving and can be integrated into evaporative systems for use in all climates.



Courtesy of DOE/NREL and the Sustainable Buildings Industries Council



Above: For homes in solar subdivisions, solar access may be provided to the rear, side, or front yard. Short east-west streets tied into north-south collectors is a good street pattern for solar access. Below: This subdivision plan from Deventer in the Netherlands shows how even dense development can be sited protect solar access.

Courtesy of NOVEM. Credit—Netherlands Architecture Institute Rotterdam (Architect Theo Bosch)

Local development controls should encourage subdivision layouts that provide for maximum east-west orientation for residential and smaller nonresidential uses.

Geothermal heat pumps. The ground maintains a relatively constant temperature of 50 to 60°F (10 to 16°C). Thus, the ground temperature is warmer than the air temperature in winter and cooler in the warm months. Geothermal (or ground-source) heat pumps take advantage of the earth's constant temperature to heat and cool buildings. Because the system is outside the building, geothermal requires more land area than the other techniques discussed above.

IMPLICATION FOR LAND-USE CONTROLS

Currently, relatively few communities include provisions in their local development controls that ensure that environmental resources can be used to heat, cool, daylight, and electrify buildings. The discussion that follows outlines a number of considerations for subdivision and zoning standards that would help private developers build and remodel buildings that are better able to take advantage of access to solar energy.

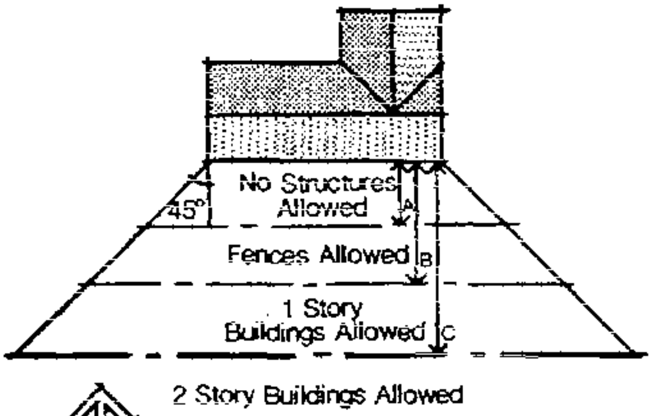
Subdivision design

Local development controls should encourage subdivision layouts that provide for maximum east-west orientation for residential and smaller nonresidential uses. In the northern hemisphere, major living, work, and study areas should face south (north in the southern hemisphere) to the extent possible. It is easiest to protect solar access in subdivisions having streets that run east-west or 25 degrees of east-west. Where streets run north-south, cul-de-sacs or loop streets help provide for solar access. For dense development, creative site design is essential.

Development standards

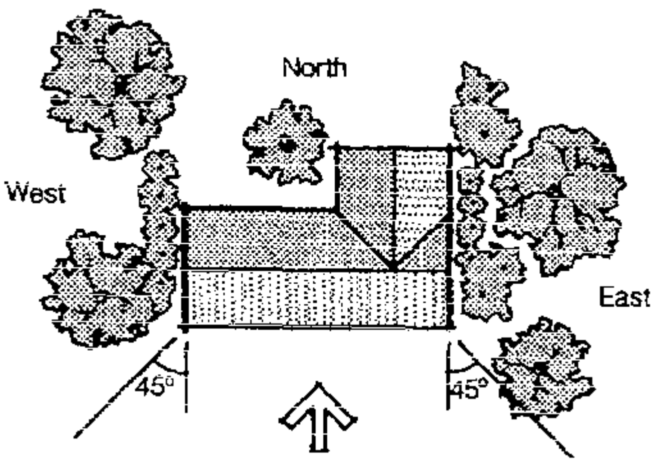
Yard and height requirements of zoning ordinances can be used to ensure solar access. In an ideal situation, south-facing glazing should receive four hours of sun on December 21. That generally means that there should be no obstruction within an arc of 60 degrees on either side of true south. Relatively good solar access will still occur if the glazing is unshaded within an arc of 45 degrees. What the horizontal clear distance needs to be is location-specific and depends on the height of the subject building of interest and the adjacent structures. Boulder, Colorado, for example, includes shadow lengths by height of building for 10:00 a.m., noon, and 2:00 p.m. on December 21 in its development code. Properly sized overhangs will shade the glazing in the summer when the sun is higher in the sky.

Since not all lots are large enough to accommodate optimum solar access, it is important to assess shading patterns in establishing compromises on yard requirements. One possible compromise is a flexible approach to building orientation and yard requirements when streets run north-south. With appropriate side yard



Courtesy of DOE/NREL and the Sustainable Buildings Industries Council

Above: Buildings, trees, or other obstructions should not be located so as to shade the south wall of solar buildings. Below: Trees and other landscaping features may be effectively used to shade east and west windows from summer solar gains.



Courtesy of DOE/NREL and the Sustainable Buildings Industries Council

allowances, buildings that are oriented perpendicular to the front lot line on north-south streets can still take advantage of solar access. In many cases, there is no reason that the main building axis needs to face the street and that yard requirements cannot be varied to allow for solar access.

Obstacles can reduce not only the amount of solar available for winter indoor climate control, they can also limit daylighting and radiation falling on active
solar collectors and photovoltaic surfaces. For example, the limbs of a deciduous tree can reduce solar heat gains in passive solar buildings, and trees on the south side can all but destroy passive solar performance unless they are close to the building, with the lower limbs removed so that winter sun can penetrate under the trees canopies.

When used properly, landscaping can provide for shading and ventilation. The ideal for shading is the use of deciduous trees to shade the east, southeast, southwest and west sides of the building and trellises with deciduous vines to shade the east windows during the summer months. Evergreens and shrubs can be used to block prevailing, cold wind in the winter and shade heat-absorbing paved areas during warm seasons. Also, trees, fences, and shrubbery can be used to channel summer breezes into the building.

Daylighting design tools such as ENERGY 10, available from the Sustainable Buildings Industries Council, provide a simplified means for accounting for select obstacles and can be used to assist in setting yard and landscaping requirements for planned developments. More adequate algorithms for tools such as EnergyPlus are emerging. Planning agencies may wish to draw upon the skills of energy analysts to help them establish yard and landscaping requirements where unique site conditions exist.

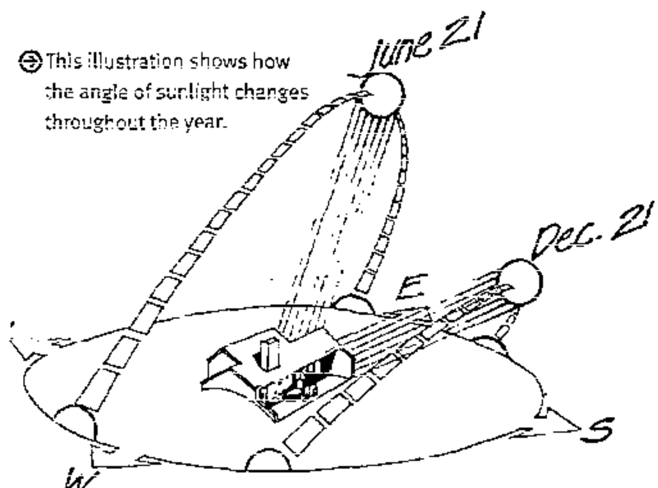
Paved surfaces such as driveways, walks, and patios can reflect heat and glare into buildings through glazings. Development standards should encourage impervious surfaces to be located and designed to minimize these effects.

Because solar building design requires operable windows for ventilation, the location of off-street parking is important. Large parking facilities can be a detriment to indoor air quality if vehicle exhaust is allowed to enter the building through windows or vents. Development standards should keep parking areas away from operable windows and vents and ensure that these areas are located so that prevailing breezes do not carry exhaust into buildings.

Communities may wish to consider the use of overlay zones or planned unit development restrictions to ensure that solar access is adequate. In some instances, it might be possible to apply the principles of form-based codes, although that option needs careful study to determine if it would be feasible.

Aesthetics need not be an issue in solar building design. There is sometimes a preconceived belief that buildings designed or renovated to use solar are "odd" in appearance. This is a misperception. Collectors needed for active solar systems can be roof-integrated and the photovoltaic systems can function as the skin of the building, as roof shingles or standing seam roofing, as glazing for atria and covered walkways, or be integrated into building overhangs or awnings. As for passive solar buildings, they can be of any architectural style. There are no special panels or other special details that announce that a building is passive solar. All its components or elements are designed as an integral whole beginning at the predesign stage.

This illustration shows how the angle of sunlight changes throughout the year.



Courtesy of DOE/NREL. Credit—Ron Judkoff

As more jurisdictions reference HERS Home Energy Rating Systems) or LEED (Leadership in Energy and Environmental Design) in their building codes, they will need to ascertain the extent to which their modified building codes are in agreement with their land-use controls.

CONCLUSIONS

The land-use control considerations outlined above not only are essential to provide for future energy needs and as means to limit global-warming emissions, they need to be looked at as a way to improve the local (i.e., micro) balance of payments. When less money goes to remote power companies, more of that money can remain in the local economy. And the adoption and enforcement of solar access controls provide the proper environment for the creation of new job skills and employment options for residents. According to a study by the University of California, Berkeley, as many as 1.9 million jobs can be created by 2020. The American Solar Energy Society's study projects 4.5 million jobs by 2030 across all regions and sectors of the economy, with the largest growth occurring in construction, farming, and professional services. After all, like energy management, economic development is also an integral part of local planning.

Unfortunately, few cities or counties have recognized the need for solar access requirements. For those that have, the steps taken tend to be very limited. Most cities and counties have limited the focus to subdivision regulations, and have not recognized the need to also adjust zoning standards. Even existing development can use whole-building solar design concepts when renovating. Thus, development standards need to provide for solar design options in developed areas. Because solar design is location-specific, no community's standards should be exactly the same as another's, though all need to address the factors outlined above. Further, even in a given geographical region, there will need to be differences in the specifics of a standard. For example, Denver's requirements and those of Evergreen, Colorado, which is at a higher elevation, will have different provisions.

Some communities have encouraged the use of easements to protect solar access. While these legal mechanisms will work, it is more efficient and beneficial to have requirements that apply to all properties. For a community to reduce its demand for energy, greater benefit will occur when all development and renovation decisions recognize and provide for solar access. This statement is also true in southern climates. Contrary to standard belief, even communities in places like Florida and Arizona can benefit by developing land-use controls that require solar access for the building, as well as for the solar hot water and PV panels. In the sunny Southern states the peak energy demand is during wintertime cold spells, not during summer heat waves as in the North.

Finally, as more jurisdictions reference HERS (Home Energy Rating Systems) or LEED (Leadership in Energy and Environmental Design) in their building codes, they will need to ascertain the extent to which their modified building codes are in agreement with their land-use controls.

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- U.S. Department of Energy, www.eere.energy.gov

Oberlin College's Adam Joseph Lewis Center for Environmental Studies has 4,682 square feet of photovoltaic panels, closed-loop geothermal wells that provide heating and cooling, daylighting, and an engineered wastewater treatment system modeled on natural wetland ecosystems. Photo by Robb Williamson: www.williamsonimages.com. Design concept by Lisa Barton.

VOL. 27, NO. 4

Zoning Practice is a monthly publication of the American Planning Association. Subscriptions are available for $85 (U.S.) and $110 (foreign). W. Paul Farmer, FAICP, Executive Director; William R. Klein, AICP, Director of Research

Zoning Practice (ISSN 1548–0135) is produced at APA. Jim Schwab, AICP, and David Morley, AICP, Editors; Julie Von Bergen, Assistant Editor; Lisa Barton, Design and Production.

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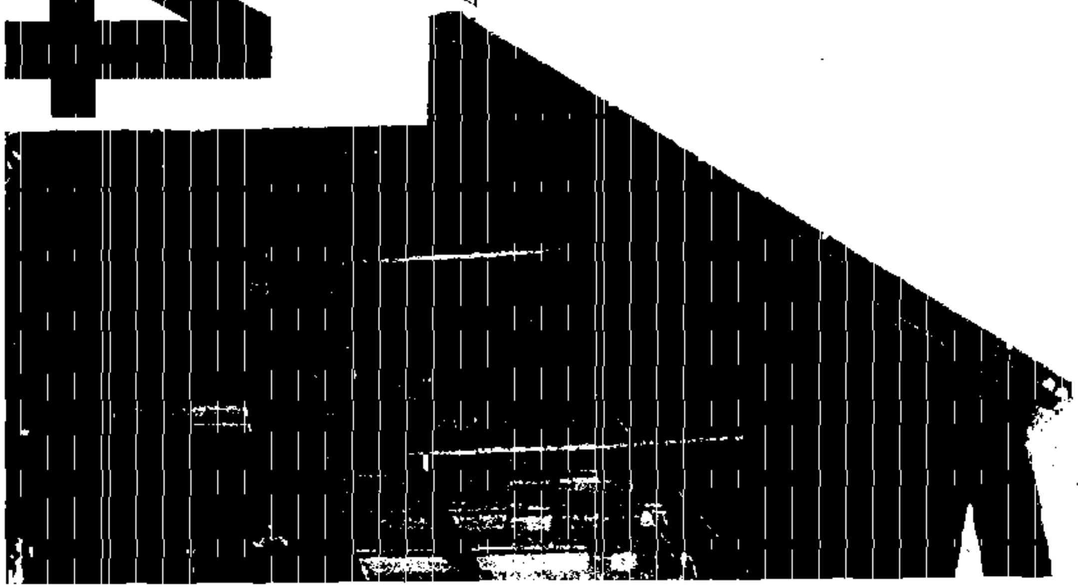

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AMERICAN PLANNING ASSOCIATION

➔ ISSUE NUMBER 4

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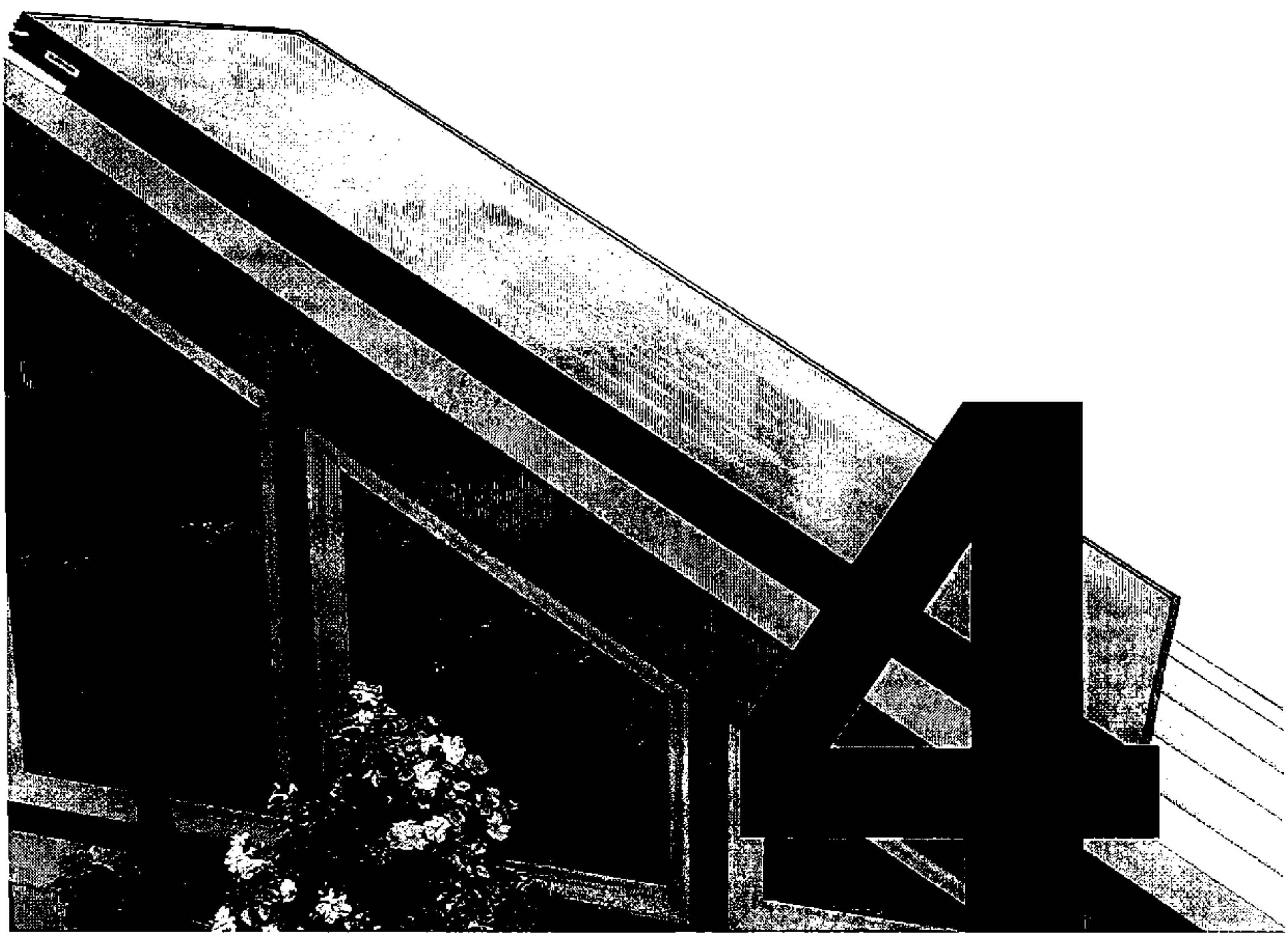


Balancing the Solar Access Equation

By Gail Feldman and Dan Marks, AICP

States, cities, and counties across the country are moving quickly to improve the ability of their communities to "build green" and install solar energy systems on new and existing buildings.

Will solar panels on every rooftop replace the white picket fence as the icon of the American dream? That may depend on how well planners develop policies and permitting processes that encourage solar energy systems and at the same time mitigate inevitable conflicts, such as when policies that protect trees or encourage higher density development interfere with sunlight access. This article explores the growing trend to introduce solar energy in communities and how planners may need to guide land-use policy development to avoid unintended consequences.

SOLAR ENERGY SYSTEM BASICS

The most common solar technologies used on buildings in the United States are solar photovoltaic (PV) panels that generate electricity and solar thermal systems that heat water or air. Solar PV produces electricity through the conversion of direct sunlight. The semiconductor materials in the PV cell interact with the sunlight to generate electric current.

The most electricity is produced when the sun's rays are directly perpendicular to the PV panels. Since PV only works with sunlight, most systems are connected to the utility grid to guarantee around-the-clock electricity. The orientation of a PV system affects its performance; usually the best location is on a south-facing roof. Flat roofs allow the panels to be tilted toward the optimal direction.

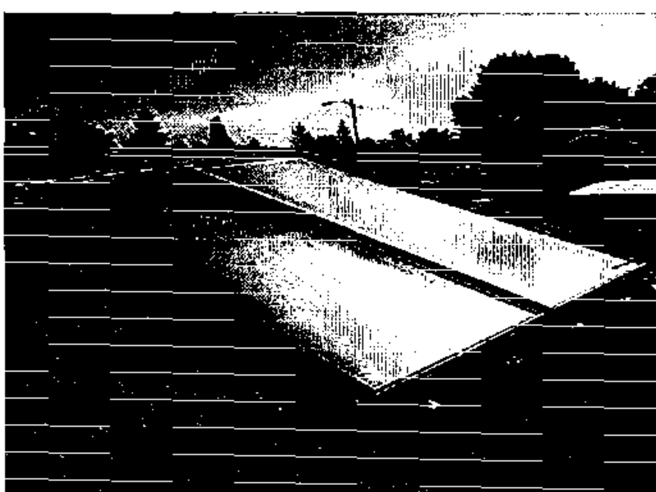
PV systems work best without any obstructions from trees or structures. Because the sun may be higher in the summer or lower in winter, a placement of the PV involves an assessment of these factors. In any specific location, as the surface area of a PV system exposed to sunlight increases, the amount of electricity produced also increases. Depending on site conditions and economic constraints, residential-scale PV systems can range from 100 to 1,000 square feet.

Solar thermal systems use the sun to heat water or heat-transferring fluids, and each system is comprised of two parts: a solar collector (panel) and a storage tank. Systems that use active solar require the use of electricity for pumps and circulation and require flat-panel collectors similar to PV. Passive solar water heaters have no electrical components and rely on direct sun heating the collector panel. Storage tanks have now been developed to be recessed in into the roof, so they are not seen above the roofline. Solar collectors for solar thermal systems require less surface area than PV systems. In locations receiving an average amount of sunlight, flat-panel collectors require approximately one-half to one square foot of surface area per gallon of daily hot water use.

INCENTIVES FOR SOLAR ENERGY SYSTEMS

According to the Interstate Renewable Energy Council, Incentive Programs and Tax Credits resulted in over 26,000 new solar installations nationally in 2007. All but a handful of states now have incentive programs to add solar photovoltaic (PV) systems to residential or nonresidential buildings. These incentives range from $1 to $5 per kilowatt produced. Congress reauthorized the Renewable Energy Tax Credit in 2008 and increased the deduction to 30 percent of the cost of installation beginning in 2009. This makes solar substantially more cost-effective by providing an income tax deduction that, for an average $30,000 residential installation, would be $8,000 to $10,000 in a tax year.

Cities in northern California recorded more than 11,500 new solar PV systems between 1998 and 2007, with many of these



Paul Norton; courtesy DOE/NREL

Solar hot water collectors on a Habitat for Humanity House in Denver.

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Gail Feldman is the sustainable energy programs manager for the City of Berkeley Planning Department—Office of Energy and Sustainable Development, and has recently implemented the Berkeley FIRST solar financing program and Sustainable Energy Tax District. Her public management experience spans 20 years in several California counties and cities and she has a master's degree in Public Administration.

Dan Marks, AICP, is the director of planning and development for the City of Berkeley. The Planning and Development Department includes the Office of Energy and Sustainable Development, the Building Division, and the Planning Division. Marks has been a planner for almost 30 years, including over 20 years in local government.

installed in suburban communities and bigger cities. Over the last few years, the states of New Jersey, Nevada, and Colorado significantly increased PV generation because of state requirements for major utilities to include greater percentages of solar in their portfolios and rebate programs for commercial and residential buildings.

Many local governments now have renewable energy loan programs, and the numbers are expected to increase as more utilities and cities implement programs as part of their overall climate change plans. These programs typically have loan repayment times of between 10 and 30 years, through utility bill savings or property tax bills.

INCENTIVES FOR INSTALLATION

Examples of loan programs that provide financial incentives to lower the upfront cost for the installation of renewable energy systems, particularly solar, are briefly highlighted below. A comprehensive listing of incentive programs can be found through the Database of State Initiatives for Renewables and Efficiency (DSIRE), a website developed by North Carolina State University.

New York

The New York State Energy Resource and Development Authority offers the Energy $mart Loan Fund program, which provides an interest rate reduction off a participating lender's normal loan interest rate for a term up to 10 years on certain energy-efficiency improvements or renewable technology loans. The interest rate reduction for most of the state is up to four percent. Utility customers may be eligible to receive an interest rate reduction up to 6.5 percent off a participating lender's normal market rate. This program is funded by utility rates through a special benefits charge.

Local Leaders

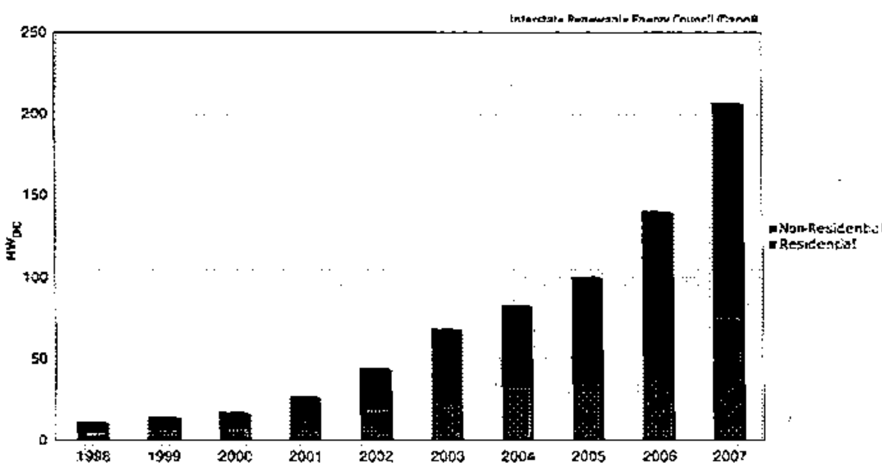
Berkeley, California, has recently established a Sustainable Energy Financing District that leverages private financing through bonds that fund solar photovoltaic systems for residential and commercial properties anywhere in the city. The bonds are repaid by a special tax that is added to the property tax bill of the participating property owner. While still in a small pilot phase of 40 installations, the program could allow up to 4,000 installations if expanded to the total bonding authority of $80 million. Boulder County in Colorado and the cities of San Diego and San Francisco are in the process of developing similar financing programs.

Palm Desert, California, has issued $2.5 million in solar energy and energy efficiency loans through contractual assessments on properties. This is one of few cities that has used its general fund surplus to finance private energy improvements. The city will earn seven percent interest on its investment for the 20-year assessment term.

Florida has at least two programs that provide financing. Tallahassee, through its municipal utility, offers loans of up to $20,000 at five percent interest to install solar photovoltaic systems. The Orlando Utilities Commission also has a loan program for its customers and will provide up to $15,000, which can be repaid through monthly utility bills with interest rates from two percent to 5.5 percent.

STATE AND LOCAL SOLAR ACCESS PROTECTIONS

The development of rights to solar access has basis in English common law. A judicially established doctrine of "ancient lights" provides that if a landowner had received sunlight across adjoining property for a specified period of time, the landowner was entitled to continue to receive unobstructed access to sunlight access across the adjoining property. The first state laws that specifically addressed access for operation of solar energy equipment were



introduced in the 1970s. While not comprehensive, the types of legal protections that developed include solar easements, solar shade prohibitions, and preemption of aesthetic controls for solar installations.

Solar Easements

Many states have enabled the use of solar easements to protect ambient lighting as well as light access for solar energy equipment. This type of easement is a private agreement between property owners that guarantees access to sunlight. Most solar easements are recorded as deed restrictions that run with the land, and procedures for relinquishing easements are generally set forth in state law. Some owners of residential solar energy systems use these easements to restrict any new construction or tree planting which could block light access to sunlight.

Among the many states with provisions for such easements are Alaska, Colorado, Idaho, Kansas, Maine, Montana, Rhode Island, and Virginia. Many of these laws were adopted as early as the 1970s and do not necessarily relate specifically to solar energy systems. Most recently the State of New Jersey (NJ Statute 46:3-24) enacted laws specially allowing solar easements for the purpose of exposure for a solar energy device.

Solar Access Protections

Some recent state laws go much further than voluntary easements. The California Solar Shade Control Act of 1979 as originally drafted prohibited shading of solar collectors that occurs due to tree growth after the solar system was installed. Under the law, no more than 10 percent of the collector can be shaded between 10 a.m. and 2 p.m. The 1979 law also included minimum location standards for the solar collectors, requiring that they be five feet from the property line and 10 feet from the ground.

California's law was amended in 2008 to address issues that stemmed from a court case discussed later in this article. These changes included an exemption to the act if the trees and shrubs were planted prior to the installation of the solar collector. The definition of solar collector was changed to include devices installed on the ground. Additionally the legislation changed a violation from a public nuisance violation to a private nuisance. In other words, under the revisions, enforcement of the law is now a matter between private parties, rather than a jurisdiction treating the matter as a public nuisance and acting to enforce the law.

Wisconsin law (Stat. § 700.41) allows for compensation when a solar energy system is shaded by development on an adjacent property, regardless of whether an easement was granted by the adjacent property owner. Another Wisconsin law (Stat. § 844.22) also states that any structure or vegetative growth that occurs after the installation of a solar or wind energy system and interferes with its function is considered to be a private nuisance.

New Mexico's Solar Recordation Act allows a property owner with a solar energy system to record an easement for sun access, defined by the statute as 9 a.m. to 3 p.m. on the winter solstice. While an adjacent property owner will be notified of the intent to record an easement, permission from the adjacent owner is not required. Under this law, solar easements run with the land and may be bought and sold. If an adjacent project shades the system by more than 10 percent, the owner of the project must purchase the solar easement right and extinguish it (NMSA 47-3-6 to 47-3-12).

At the local level, the County of Santa Cruz, California, has established strong solar access protection in its ordinances. It states that impacts on a solar collector "shall be mitigated to the maximum extent feasible during the view of any permit to construct a building" (12.28.040, Santa Cruz Building Regulations).

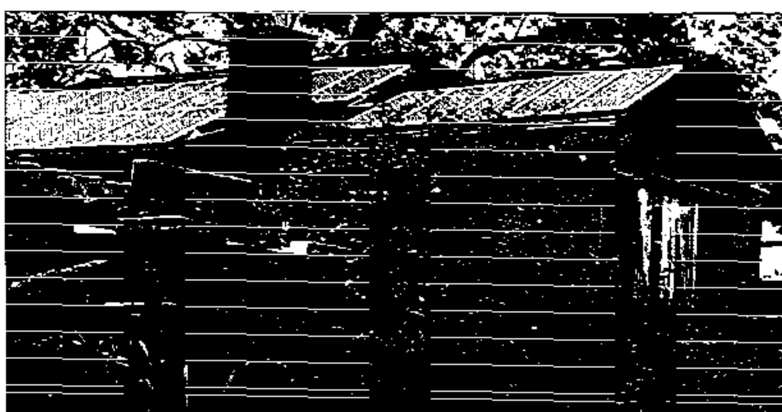
The City of Boulder, Colorado, has strong protections for solar access for the purpose of generating electricity and has divided the city into solar access areas based on zoning. This ordinance provides broad protections in less dense residential neighborhoods. Urbanized commercial districts have no guaranteed protections unless the property has a solar access permit. Solar siting requirements for all planned unit developments and subdivisions are required to ensure that roof surfaces can support 75 square feet of solar collectors for each dwelling unit.

Several other local jurisdictions have adopted guidelines or requirements for solar access in new residential subdivisions.

Preemptions of Local Design Standards

States that have addressed solar access have generally adopted laws preempting local zoning that might limit the installation of these devices based on aesthetic or other grounds. Many of these same laws also preempt private conditions, covenants, and restrictions that might limit a property owner's ability to install a system.

For example, California's Solar Rights Act (AB 2473) of 2004 prohibits provisions in local ordinances that create unreasonable barriers to the installation of solar energy systems, including design standards for solar installations. The law only allows local jurisdictions to require improvements for aesthetic purposes if the cost is less than $2,000.



This south-facing photovoltaic system would be shaded if the neighboring home owner added an additional story.

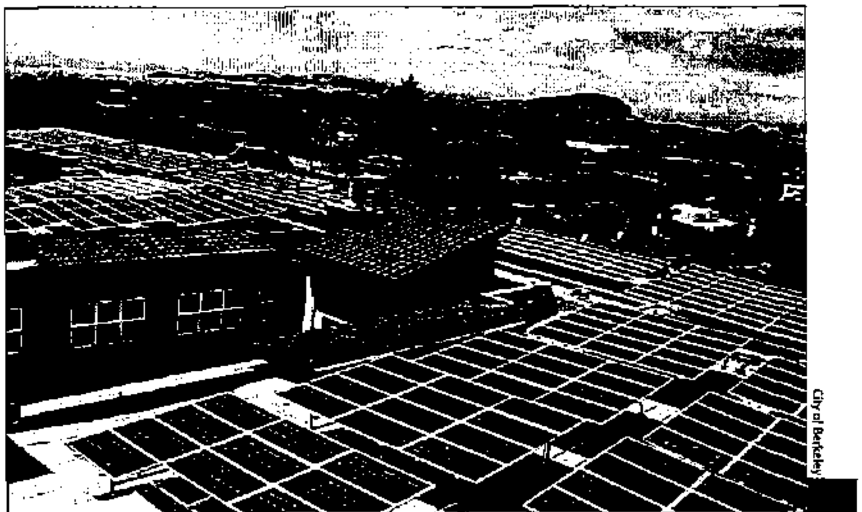
SOLAR CONFLICTS

As one northern California newspaper framed a recent court case pitting the owner of a small grove of redwood trees and a neighboring property's solar PV system: "It can come down to a clash of cherished green values." The state law as written at the time placed higher value on the production of a solar energy system. The conflict grew when the two Sunnyvale property owners could not mediate successfully, and the district attorney filed the case as a criminal violation. The defendants in the case are quoted saying, "We are the first citizens in the state of California to be convicted of a crime for growing redwood trees."

The violation under the California Solar Shade Control Act identified the trees as a public nuisance (as misdemeanor) with a $1,000-per-day fine. However, in the final court ruling the judge determined that only two of the six trees required pruning or removal due to the shade obstruction.

In contrast, a few years earlier the Santa Clara County Court ruled that the trees at a home in another case were not the cause of a shading problem under the law. The trees at issue were on the property of the local government, which was exempt from the law.

In a 1982 case considered by the Wisconsin Supreme Court, the owner of a solar system sought relief from the construction of a residence that obstructed sunlight to his property. The court found in the favor of plaintiff, stating that the construction was a private nuisance, and remanded the case to a lower court. Immediately preceding the hearing, the state legislature enacted a law (WI Statute 700.41) to allow an owner of an active or passive solar energy system or a wind energy system to receive compensation for an obstruction of solar energy by a structure outside a neighbor's building envelope as defined by the zoning restrictions in effect at the time the solar collector or wind energy system was installed.



A PV system on the rooftops of Helios Corner, an 80-unit senior housing development in Berkeley, California.

CONSIDERATIONS FOR PLANNERS

To date, most state laws have focused on removing barriers to the installation of solar systems or have been permissive in allowing property owners to enter into solar access easements. As solar installations become more common—especially in urban areas—the potential for one neighbor to shade another's solar panels will occur more often and conflicts will become more common. Few state or local laws have addressed those potential conflicts.

At first, it may seem that encouraging solar energy systems that produce clean, local energy should be a very high priority, perhaps even preempting an adjacent property owner's right to build in ways that would affect an existing or potential solar system. However, we would caution that, even in the case of greenhouse gas (GHG) emission reductions, maintaining access to solar energy may not always be the most effective strategy.

Ten trees absorb about 0.25 tons of CO_2 per year, and a 300-square-foot solar array [solar panels] can save about three tons of GHG emissions. For comparison, a transit-oriented development (TOD) with a hundred units is estimated to save over 500 tons per year of GHG from reduction in auto use alone. From a GHG benefit point of view, the importance of promoting transit-oriented development cannot be overstated.

Ensuring that solar access protection regulations do not inadvertently prevent or discourage TOD is an important but complicated issue. To illustrate, Berkeley is a densely built community blessed with some of the best transit in the Bay Area. New transit-oriented development will generally occur along major transit corridors and in downtown. However, these transit corridors are immediately adjacent to much lower density residential neighborhoods.

In that way, Berkeley is typical of older cities. The city's General Plan calls for higher density development along these transit boulevards, which invariably means four- and five-story buildings up against neighborhoods with one- and two-story homes. Despite city policy, almost every new higher density residential or mixed use building is bitterly fought by the adjacent neighborhood. As in most communities, the residents of neighborhoods near these corridors are concerned with the traffic, parking, noise, privacy, and other impacts of a higher density, bulkier residential or mixed use project backing up to their neighborhood.

Inevitably, the issues around new construction and solar access will be tested. While Berkeley does not currently have any local ordinances specifically protecting solar energy systems, it does have a solar access ordinance. The current regulations are related to the impacts tree growth may have on the loss of sunlight to homes and are meant as a tool to address neighbor disputes. The law sets forth a process for resolving such disputes, beginning with voluntary mediation or arbitration followed by litigation However, no specific standards are set forth in the ordinance.

Berkeley also requires that the shading impacts on adjacent homes from new development be evaluated, but has no set standards for addressing those impacts. As the city considers the policy issues around solar access, it must also consider the likelihood that an ordinance protecting solar photovoltaic systems could easily give ammunition to those opposed to taller, more intense buildings in general.

If an ordinance establishes a strong right to solar access, or requires very high costs to mitigate impacts on existing or potential solar installations, such ordinances could discourage, delay, or prevent higher density transit-oriented development. Consider the potential conflict created by solar access ordinance in a downtown district that permits tall structures. If one low-rise commercial building puts a solar array on its roof, what happens when a taller building is proposed next door that would shade that panel? How do you value one property owner's access to the sun in relation to the benefits of a taller building that would reduce

The fundamental goal of all zoning is to try and ensure that one owner's use of property does not have a significant detrimental impact on other owners' enjoyment of their property.

or eliminate that access but lead to significant reductions in vehicle miles traveled?

Communities considering a local solar access ordinance need to consider the following issues:

- Who is entitled to solar access?
- Does the local government have to play a role in protecting access?
- How should communities place a value on access?

Solar Access Entitlement

Is there an entitlement to solar access? Solar access is one more element to consider in the bundle of property rights that is the basis of land-use law. The fundamental goal of all zoning is to try and ensure that one owner's use of property does not have a significant detrimental impact on other owners' enjoyment of their property. A property owner does not have an absolute right to use property as he likes. Land-use attorneys talk about the bundle of rights that comes with property ownership, and those rights can be modified by local governments for the health, safety, and welfare of the community.

In Berkeley, as in every developed community, there is little agreement as to how much regulation of private property is acceptable. Is one person entitled to add a second floor to his home if it will shade the bedroom of his neighbor, or block his neighbor's panoramic views? These are fundamental zoning questions. Any solar access ordinance must decide whether access is a "right" that any property owner has, and it must state the degree to which that right may be impinged by the actions of his neighbor. In an urban setting, establishing any absolute right to solar access would clearly be counterproductive relative to other policy goals.

Hands-on or Hands-off

There is no reason why local government must define the terms of the solar access debate. It can, as several states and localities have done, decide that while there may be some level of solar access right, the impact that one property owner has on another and any compensation due as a result of that impact is a matter to be worked out between property owners. If owners fail to resolve their differences, the civil courts become the venue for making these determinations. Other states have allowed property owners to enter into private easements, and allow this matter to be addressed solely as a contractual matter between private property owners.

While this is certainly one approach, the courts are not generally considered the best place for resolving policy issues. The costs of private litigation can be very high and require years to resolve. Courts interpret and apply laws to the facts of a specific case. The legislature or city council is where competing policy objectives can be evaluated. Vague and unclear policies can result in interpretations of law that seem contrary to the intent of the law or result in unintended consequences counter to the underlying policy direction.

Regulating the impacts of one neighbor on another is exactly what zoning ordinances are intended to accomplish. The drafting of zoning ordinances allows for public policy objectives to be openly discussed and for reasonable compromises to be made through a public process. In regard to solar access, there are certainly competing public policy objectives, such as a desire to maximize the local generation and use of solar energy that is potentially in conflict with the desire to maximize development near transit.

SOLAR ACCESS MAPPING

Berkeley is in the development stage of creating a solar map of the city using Google Earth. San Francisco has also developed its own. The online map will allow anyone to view, down to the property level, the roof of any building and the impact of shading directly by another structure. While it won't consider shading impacts by nearby trees, the tools may aid planning efforts in areas where shading may become a conflict. San Francisco's map is available at http://sf.solarmap.org.

Placing Value on Solar Access

Should solar impairment be considered compensable, and how does a community determine the degree of compensation for such a loss? If that access is partially impaired, how does one measure the value of that impairment?

Cities constantly face the claim that the actions of one property owner will reduce the property value of a neighbor. Local governments have traditionally stayed away from trying to place a value on the impact of one neighbor's action on another's, so long as each property owner operates under a consistent underlying set of zoning regulations that apply to everyone. By establishing ground rules, it may be possible for local governments to set the framework for private negotiation, or it could embroil the government in a long, unproductive refereeing of solar rights determinations. At this time, we find little evidence that local or state governments have sought to address the conflicting policy goals of solar energy generation and shading by nearby higher density development. The New Mexico law allowing for recordation of solar easements may have taken this issue into partial account by not allowing an easement to be recorded against a property where the permitted development is taller than of 36 feet. However, local ordinances implementing this law can preempt this provision.

Given the potential impacts of solar access disputes on future development, state and local governments may want to establish guidelines for addressing situations where solar access is affected by adjacent development. Communities considering such guidelines should pay attention to the following variables:

The potential for an effective solar installation. Is backyard shading as important as roof shading? Is the roof orientation conducive to solar power, and how much of the roof is effectively available?

The existing site conditions. Do trees or other existing structures already shade potential solar locations?

The time of year and the time of impact. Is shade in December more detrimental to the operation of the system than shade in June? Is a 20 percent loss at 3 p.m. for an hour at midwinter considered compensable relative to a 30 percent loss for two hours at 9 a.m. in the summer? How do variations in system size affect this determination? Various state and local laws have established 9 a.m. to 3 p.m. on the winter solstice as the threshold for considering when a shadowing impact is occurring. Under the state and local access laws where a time of day or year are established, these times are thresholds below which no impact is assumed to occur, and above which an impact is assumed to occur.

However, the degree of impact and any compensation due are a matter for private negotiation. As a threshold for private party negotiation, such general determinations may be adequate. However, significant additional analysis would be needed if local governments wanted to provide guidelines for resolving disputes.

The percentage of impairment. How much of an existing or potential solar array would be in shadow and for how long? Ten percent at the assigned hour (see above) is a commonly established threshold for solar access impact. Similar to time of year and day, 10 percent may be a reasonable threshold for establishing when there is an impact for purposes of private negotiations, but this guideline is not sufficient if government wants to assist in resolving solar access disputes.

The type of installation. Some types of installations (e.g., a water heating system) may be more feasible in any given situation than another (e.g., solar power generation).

An additional critical issue is how to value potential solar energy relative to an existing solar array. This carries the compensability question to a much more concrete level. If someone has invested in a solar array for whatever purpose, the impacts of an adjacent property owner shading that array has a measurable and immediate impact. Again, we would argue that leaving this solely to private dispute resolution or establishing very high values on solar access may be counter to other policy goals. However, making one property owner responsible for compensating another's reduction in direct income seems an appropriate subject for an ordinance addressing solar access.

As with other ordinances related to compensation, government should probably seek to make determinations of compensation a private negotiation between property owners, bringing government into the picture only in the last resort when private agreement cannot be reached. However, because solar installations have a measurable cost and measurable returns on that investment, and there is usually data on the productivity of the system, there is much more concrete evidence to assist local governments in arbitrating between property owners. It can be expected that initial efforts to resolve these differences will be challenging as governments wrestle with the many variables that need to be considered, such as how to value energy over time or how to amortize the investment in a solar array. However, these determinations should become easier as there is a sufficient record of cases.

ADDITIONAL RESOURCES

Database of State Incentives for Renwables & Efficiency (DSIRE): www.dsireusa.org.

Sherwood, Larry. 2008. *U.S. Solar Trends Market 2007*. Latham, N.Y.: Interstate Renewable Energy Council (www.irecusa.org).

National Renewable Energy Laboratory, Department of Energy: www.nrel.gov.

CONCLUSIONS

The discussion above has focused on the trade-offs associated with taller transit-oriented development that shades potential solar access in adjacent neighborhoods. In that context, the trade-offs between preserving solar access and encouraging TOD are fairly clear. Based solely on a GHG assessment of relative benefit, TOD clearly should not be hostage to solar access protection. The benefit/cost equation is less obvious in a residential neighborhood context when one neighbor simply wants to build a taller house adjacent to a shorter neighbor. Solar access could be one more weapon in the never-ending neighbor wars that occur in some communities as people seek to preserve the perceived character of their neighborhood or simply don't want a taller building next to their home. Under a poorly worded solar protection ordinance, putting solar panels on a home could become a way of preventing a neighbor from adding a second story addition in a situation where it would otherwise be allowed. All of the issues described above need to be fully considered in an ordinance in any community, whether higher density development is part of the picture or not.

NEWS BRIEF

COURT DECIDES SIGN CASE

By Lora Lucero, AICP

In February, the Supreme Court of New Jersey concluded a township's sign code prohibiting a union from displaying a 10-foot-tall inflatable rat violates the First Amendment. "The rat has long been a symbol of labor unrest" and, as part of a labor protest, the union displayed the rat balloon on the sidewalk in front of the business where they were in a labor dispute. The sign code prohibits "balloon signs or other inflated signs (except grand opening signs) . . . displayed for the purpose of attracting the attention of pedestrians and motorists." A police officer warned the protestors to deflate the rat, but found it was reinflated when he returned an hour later and issued a summons. The union official was ultimately found in violation of the sign code and fined. The state's highest court set aside the conviction and held the sign code violates the First Amendment. The sidewalk is a traditional public forum where the government's ability to restrict expressive activity is very limited. The sign code is content-based because the sign code prohibits the union from displaying a rat balloon while allowing balloons as part of a grand opening. The township lacked a compelling governmental interest that justified the restriction. *State v. Wayne DeAngelo*, Supreme Court of New Jersey [highest court], Decided February 5, 2009, Case No. A-73.

Lora Lucero is editor of Planning & Environmental Law *and staff liaison to APA's Amicus Curiae Committee.*

Photo courtesy of groSolar, groSolar.com. Design concept by Lisa Barton.

VOL. 25, NO. 4

Zoning Practice is a monthly publication of the American Planning Association. Subscriptions are available for \$75 (U.S.) and \$100 (foreign). W. Paul Farmer, FAICP, Executive Director; William R. Klein, AICP, Director of Research

Zoning Practice (ISSN 1548–0135) is produced at APA. Jim Schwab, AICP, and David Morley, Editors; Julie Von Bergen, Assistant Editor; Lisa Barton, Design and Production.

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DOES YOUR COMMUNITY ENCOURAGE RESIDENTIAL SOLAR INSTALLATIONS?

4

Small Wind ~~Farms~~ Projects less than 5MW – XXXX Township

DEFINITIONS:

Accessory Structures: Structures such as sheds, storage sheds, pool houses, unattached garages, and barns.

Anemometer: An instrument that measures the force and direction of the wind.

Clear Fall Zone: An area surrounding the wind turbine unit into which the turbine and -or turbine components might fall due to inclement weather, poor maintenance, faulty construction methods, or any other condition causing turbine failure that shall remain unobstructed and confined within the property lines of the primary parcel where the turbine is located. The purpose being that if the turbine should fall or otherwise become damaged, the falling structure will be confined to the primary parcel and will not fall onto dwellings, any inhabited buildings, and will not intrude onto a neighboring property.

Cowling: A streamlined removable ~~metal that covers~~ **cover that encloses** the turbine's nacelle.

Decibel: A unit of relative loudness equal to ten times the common logarithm of the ratio of two readings. For sound, the decibel scale runs from zero for the least perceptible sound to 130 for sound that causes pain.

Nacelle: ~~A separate streamlined metal enclosure that covers~~ **Sits atop the tower and contains** the essential mechanical components of the turbine **to which the rotor is attached.**

Primary Structure. For each property, the structure that one or more persons occupy the majority of time on that property for either business or personal reasons. Primary structures include structures such as residences, commercial buildings, hospitals, and day care facilities. Primary structures exclude structures such as hunting sheds, storage sheds, pool houses, unattached garages, and barns.

Professional Engineer. A qualified individual who is licensed as a Professional Engineer in the State of Ohio.

Megawatt (MW): A unit of power, equal to one million watts.

Small Wind Project: Any wind project less than 5MW which includes the wind turbine generator and anemometer.

Wind Power Turbine Owner. The person or persons who owns the Wind Turbine structure.

Wind Power Turbine Tower. The support structure to which the turbine and rotor are attached.

<u>Wind Power Turbine Tower Height.</u> The distance from the rotor blade at its highest point to the top surface of the **ground at the** Wind Power Generating Facility (WPGF) foundation.

<u>Section XXXX Small Wind Projects ~~Farms~~ less than 5MW</u>

Wind **Projects** ~~Farms~~ of 5MW or more shall be required to submit an application with the Ohio Power Siting Board (OPSB) at the Public Utilities Commission of Ohio (PUCO) and are required to meet OPSB regulations. Small Wind **Projects** ~~Farms~~ less than 5MW and used solely for Agriculture will be exempt from these zoning regulations as an Agricultural Use. Any proposed construction, erection, or siting of a small wind **project** ~~farm~~ less that 5MW including the wind turbine generator or anemometer or any parts thereof shall be a Permitted Use in all **XXXX Township Zoning Districts** ~~the U-1, B, and M Districts and by issuance of a Conditional Use Permit in the R Districts only~~ if the following conditions are met (both as Permitted and Conditional Use):

A. The maximum height of any turbine shall be 125 ft. For purposes of this Resolution, maximum height shall be considered the total height of the turbine system including the tower, and the maximum vertical height of the turbine's blades. Maximum height therefore shall be calculated by measuring the length of a prop at maximum vertical rotation to the base of the tower.

B. Setbacks: the following shall apply in regards to setbacks.

   1. Any turbine erected on a parcel of land shall be setback 1.1 times the height of the tower, or established "clear fall zone", from all road right-of-way lines **and** neighboring property lines. ~~structures, as well as any inhabited structures on the parcel intended for the turbine.~~ A turbine **shall** ~~will need to~~ be erected and placed in such a manner that if it were to fall, whatever direction the fall occurs would be contained solely on the property where the turbine is located at. ~~and would not strike any structures including the primary dwelling, and any inhabited structures.~~

C. Maintenance

   1. Wind turbines must be maintained in good working order. The owner shall within 30 days of permanently ceasing operation of a **wind turbine,** ~~tower,~~ provide written notice of abandonment to the Zoning Inspector. An unused ~~tower~~ **wind turbine** or small wind **project** ~~farm~~ may stand no longer than 12 months following abandonment. All costs associated with the demolition of the **wind turbine** ~~tower~~ and associated equipment shall be borne by the owner. A **wind turbine** ~~tower~~ is considered abandoned when it ceases transmission **of electricity** for 30 consecutive days. **Wind** turbines that become inoperable for

more than 12 ~~24~~ months must be removed by the owner within thirty (30) days of issuance of zoning violation. Removal includes removal of all apparatuses, supports, and or other hardware associated with the existing **wind** turbine.

D. Decibel Levels

1. **Decibel levels shall not exceed those provided by the manufacturer as requested in II Permits, 2., e.** ~~All units shall operate not more than 5 decibels above the established ambient decibel levels at property lines. This information shall be included in the engineering report described below in Section II of this document. This information shall be obtained from the manufacturer of the turbine, and all decibel readings, if necessary, shall be taken from the nearest neighboring property lines. Those turbines not meeting this requirement will be issued a zoning violation and be required to shut down immediately until the required decibel levels are met.~~
   Township should consider adding: Decibel levels shall not exceed 30 dB (as determined by the Township) at any adjoining property line.

E. Wiring and electrical apparatuses:

1. All wires and electrical apparatuses associated with the operation of a wind turbine unit shall be located underground and meet all applicable local, state, and federal codes including the County Building Regulations and Residential Building Code of Ohio.

F. Warning Signs:

1. Appropriate warning signs to address voltage shall be posted (where and meeting sign requirements).

G. Building Permits:

1. All Small Wind **Projects** ~~Farms~~ and parts thereof shall obtain all applicable Building Permits from the State of Ohio and County Building Regulations where required.

II. Permits

A. A permit shall be required before construction can commence on an individual wind turbine **project** ~~system~~.

B. As part of the permit process, the applicant shall inquire with the County Building Regulations as to whether or not additional height restrictions are applicable due to the unit's location in relation to any local airports.

C. Applicant shall then provide the Township Zoning Inspector with the following items and or information when applying for a permit:

1. Location of all public and private airports in relation to the location of the **wind turbine**.

D. A~~n engineering~~ report that shows:

a. The total size and height of the unit

b. **If applicable**, the total size and depth of the unit's **foundation structure** ~~concrete mounting pad~~, as well as soil and bedrock data.

c. A list and or depiction of all safety measures that will be on the unit including anti-climb devices, grounding devices, and lightning protection, braking systems, guy wiring & anchors.

d. Data specifying the kilowatt size and generating capacity **in kilowatts** of the particular unit.

e. The maximum decibel level of the particular unit. This information **shall** ~~must~~ be obtained from the manufacturer of the turbine unit.

~~f. Ambient noise levels at property lines.~~

g. Hazardous materials containment and disposal plan.

2. A site drawing showing the location of the unit in relation to existing structures on the property, roads and other public right-of-ways, and neighboring **property lines** ~~properties.~~

~~3.~~ Evidence of established setbacks of 1.1 times the height of the turbine and "clear fall zone." ~~with manufacturer's recommendation must be attached to the engineering report.~~

4. A maintenance schedule as well as a dismantling plan that outlines how the unit will be dismantled shall be required as part of the permit.

~~**Other items for Consideration:**~~

~~Color~~

~~Conditions for cause for removal for broken parts, disrepair, etc.~~

~~Liability Insurance Requirement~~