

# Commission on Wind Energy Regulatory Policy

## **Regulatory Background Research Report**

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## 1. Executive Summary

This report reviews the state and local wind permitting processes in four states, Minnesota, Oregon, New York, and Pennsylvania, that have all sited multiple wind projects and contrasts their processes with Section 248.

Minnesota and Oregon have state boards that permit wind projects using processes based on the general energy facility siting process but tailored specifically for wind power. New York also has a state energy facility siting board, but wind projects have typically been too small to fall under its jurisdiction. Accordingly, in New York, most wind projects are sited at the local level, but need to comply with state environmental requirements. Each of these three states has a formal appeal process. In Pennsylvania, all wind projects are permitted at the local level, but need to comply with certain state and federal requirements.

There are several notable differences between the process in each of these states and Section 248:

- Minnesota has a 180 day time limit for the entire process.
- Minnesota requires information mailings to all interested parties.
- Minnesota and Oregon's processes are based on the general energy facility process but tailored specifically for wind. They have developed specific criteria for wind projects.
- Oregon's visual impact test specifically applies to local and federal plans that designate scenic values. Other visual impacts are evaluated in a less objective and formal manner. The other states also have visual tests that are less developed or formal than Act 250 or Section 248 (i.e., Quechee test).
- Oregon allows for projects that are too small (less than 105 MW) for state jurisdiction to opt out of local siting and into the state siting process. In addition, projects under 300 MW can go through an expedited process.
- In Pennsylvania and New York (for projects less than 80 MW), wind siting is driven at the local level.
- In Pennsylvania, in many instances, public hearings are not a required part of the siting process.

Another key difference is that each of these four states has state policy that directly supports the development of large scale wind power. For example, New York recently enacted a renewable portfolio standard, and Minnesota's wind siting guidelines are based on the assumption that large wind development is good for the state.

This report also highlights the best practices developed by the National Wind Coordinating Committee. Section 248 is fairly in line with the NWCC permitting process principles and permitting criteria. Several areas where they differ include the following:

- **Significant Public Involvement.** The NWCC suggests several measures, such as, mailings to all abutters and stakeholders, and holding public information meetings at the beginning of the permitting process to inform the public of the project, the permitting process, possible issues, and ways they can provide input.

- **Advance Planning.** The NWCC encourages advance planning, e.g., collaborations to identify key issues prior to the permitting process. This is already done by many of the developers in Vermont, but not a formal part of the process.
- **Clear Decision Criteria.** While there are clear criteria associated with Section 248, there is no clear process for how those criteria are applied to the evaluation of wind power and its unique traits (for example, a specific requirement for the wind visual impact study to require detailed visualization and view shed modeling). The NWCC recommends developing a specific and clear set of criteria and evaluation measures for wind projects.
- **Reasonable Timeframes.** Section 248 does not set timeframes for its process. One measure suggested by NWCC is to work with stakeholders to establish timeframes for each component of the process and to actively communicate those timeframes to stakeholders.

## 2. Purpose and Methodology

The purpose of this report is to:

- Provide background on commercial wind development processes.
- Compare the current permitting and siting regulations for large wind projects and other developments in Vermont.
- Review permitting and siting regulations of states with wind development and “state” permitting regulations for energy projects (some states handle wind siting at local level, e.g., Pennsylvania).
- Review best practices (i.e., from the National Wind Coordinating Committee (NWCC)) for permitting and other issues associated with wind development.

The information provided in this report is drawn from a combination of literature reviews and interviews. Interviews were performed with stakeholders at the state level, including regulators, developers, and others (e.g., local stakeholders, such as opposition groups) to learn more about the efficacy of each state’s wind permitting process and lessons learned. Stakeholders involved in NWCC deliberations were also interviewed.

This report does not provide a critical review of the adequacy of Section 248, but is intended to provide background information to inform the Commission’s deliberation and review of Section 248.

## **3. Wind Power Overview**

### **3.1 Large vs. Small Scale Wind**

Wind turbines are typically categorized into two broad categories based on their rated capacity and application. Small wind turbines are generally less than 50 kW in size, but may be as large as 250 kW. In contrast, large wind turbines have capacities ranging from 660 kW to 1800 kW (1.8 MW) and are used to generate wholesale bulk electricity for delivery to the local transmission grid. They are most commonly developed in large arrays of multiple turbines, although large turbines can also be installed in distributed applications consisting of a single or a few turbines connected directly to a distribution line.

Although overlap exists, most of the technical issues, permitting requirements, and operational procedures are different for small versus large wind turbines. Large wind turbine applications are more likely to have a real or perceived widespread community impact. The development and permitting process for large wind turbines is the focus of this report.

### **3.2 Large Wind Development Process**

In regions without a history of wind energy development, large wind projects typically require two to six years to proceed from the initial site-prospecting phase through the development process to construction completion and operation. The most time-consuming elements of the development process are the wind resource assessment and the permitting tasks. Permitting timelines vary widely by location and the need for environmental assessments. A brief discussion of the key steps in the large wind development process is provided below.

#### **3.2.1 Site Selection**

There are three primary steps involved in the site selection process: prospecting; validation; and micrositing. Prospecting refers to the identification of potential sites with good wind resources and investigating the development potential of those sites for wind projects. Validation involves more detailed investigation and analysis, which frequently includes installing wind-monitoring stations to verify the magnitude and other characteristics of wind resources at a given site. Obtaining permission from landowners to install monitoring stations and negotiating land lease options is a key component of this stage. Micrositing is the process of collecting detailed wind data for purposes of identifying potential turbine locations and optimizing project layout.

#### **3.2.2 Permitting**

Virtually all wind projects are required to obtain permitting approval from appropriate government agencies. In the discovery process, developers must become familiar with relevant town, county, state, and in some instances, federal rules and regulations that may impact the wind project. The agencies and levels of government involved in a project may be affected by: the location of the wind turbines (as well as transmission lines, substation, access roads, etc.); the installed capacity of the facility; ownership of the land; and ownership of the project.

### **3.2.3 Financing**

Most wind developers require some form of project financing. Usually a developer is required to demonstrate to potential financiers that all necessary permitting approvals have been obtained, that the project design and energy production estimates are based on sound technical analysis, and that a market for the energy exists. Financiers often will require a power purchase agreement to be in place.

### **3.2.4 Construction**

Most large wind projects are built in 5 to 12 months, depending on size, location, and weather conditions. In addition to standard excavators, graders, and dump trucks, construction of large wind projects requires a large capacity crane to install the various sections at the top of the wind tower. As many as 7 trailers may be required to transport the components for one turbine, and the crane itself may require as many as 15 trailers for transport. As a result, local roads leading to the project sites must have a large bearing capacity and sufficient access.

### **3.2.5 Operation**

With a control system that automatically makes operational adjustments, monitors turbine performance, and initiates alarms when warranted, wind turbines operate automatically and independently. As a result, the bulk of site operation is handled remotely via computers. For maintenance, projects typically require one operator for every 10 to 20 turbines. Maintenance and repair work is typically performed inside the turbines, which requires significant climbing.

### **3.2.6 Repowering/ Decommissioning**

The design life of a typical turbine is 20 years. As turbines approach the end of their useful life, repowering turbines with new and improved technology may be a worthwhile investment for the owner of a wind project. To date, repowering in the U.S. has only taken place in California, where wind turbines have been installed since the 1980s.

Decommissioning refers to the removal of all evidence of a wind power project after it has reached the end of its design life. Decommissioning includes the removal of all turbines, towers, foundations (to some reasonable depth below grade) underground cables, power poles, substation equipment, met towers, and O & M buildings. Some permit requirements may require project owners to restore land to its original conditions as part of the decommissioning process.

## 4. Other State and Local Wind Permitting Processes

The following reviews the state and local wind permitting processes in four states, Minnesota, Oregon, New York, and Pennsylvania. Each of these states has experienced recent wind development as summarized in the following table:<sup>1</sup>

State	Existing (MW)	Announced (MW)
Minnesota	579.73	110.5
Oregon	260.06	0
New York	48.45	637.05
Pennsylvania	129.03	84.8

Minnesota and Oregon have state boards that permit wind projects using processes based on the general energy facility siting process but tailored specifically for wind power. New York also has a state energy facility siting board, but wind projects have typically been too small to fall under its jurisdiction. Accordingly, in New York, most wind projects are sited at the local level, but need to comply with state environmental requirements. In Pennsylvania, all wind projects are sited at the local level, but need to comply with certain state and federal requirements.

### 4.1 Minnesota

#### 4.1.1 Overview

The Minnesota Environmental Quality Board (MEQB) has permitted eight large wind energy conversion systems (LWECS) greater than 5 MW since 1995. Minnesota law stipulates that a site permit granted by the state Environmental Quality Board must be obtained prior to construction of a LWECS, defined as any combination of wind turbines and associated facilities with capacity of 5 MW or higher (Minnesota Session Laws 1995, chapter 203, codified at Minnesota Statutes sections 116C.691 to 116C.697). The permitting requirement was borne out of recommendations provided to the MEQB by a citizens' advisory task force in 1994. The task force, comprised of county commissioners, interested citizens, and others, was appointed by the MEQB following completion of an Environmental Assessment Worksheet for the state's first proposed wind energy installation (25 MW) in 1994.

The Minnesota wind siting act declared it to be the policy of the state to site LWECS in an orderly fashion compatible with the objectives of environmental preservation, sustainable development, and the efficient use of resources. The MEQB wind permitting process stipulated in the Minnesota wind siting act generally proceeds as follows:

1. The project developer submits a permit application that must contain, among other things: an analysis of potential environmental impacts; proposed mitigation measures; and any adverse environmental impacts that cannot be avoided.
2. The chair of the board makes a decision to accept, conditionally accept, or reject the application.
3. Within 45 days after acceptance of the application, the chair makes a preliminary determination of whether a permit should be issued or denied.

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<sup>1</sup> American Wind Energy Association. August 2004.

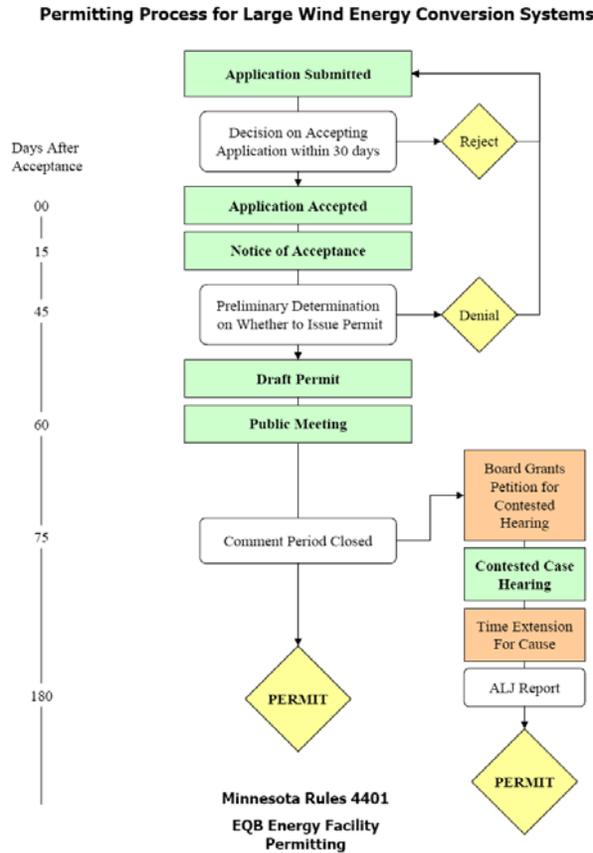
4. If the determination is to issue a permit, a draft site permit is prepared and made available for public review.
5. Public notice is made and a public information meeting is held.
6. The board makes a final decision within 180 days of the acceptance of the application. If the project is approved, a permit is issued with any conditions the board considers necessary to protect the environment, enhance sustainable development, and promote the efficient use of resources.

The permitting process is outlined in Figure 1.

Overall, key features of the Minnesota wind siting act include:

1. EQB authority to issue site permits for all wind energy facilities larger than 5 MW.
2. A streamlined regulatory and review process.
3. Issuance of a permit within 180 days (60 to 90 days is typical).
4. Environmental review as part of the permitting process. (no specific methodology for visual impact assessment)
5. MEQB rulemaking authority that establishes, among other things: uniform and consistent review procedures; conditions in the site permit for turbine type, design, site layout, and construction; and MEQB site permitting authority as the only site approval required.

**Figure 1: Minnesota Permitting Process Map**



## **4.1.2 Lessons Learned**

Wind projects permitted in Minnesota have been well accepted by the general public and residents, and have encountered few issues during the review and permitting process. In general, they have been sited in rolling or flat farm and pasture lands, where the landowners are eager to receive revenue for hosting turbines. Those issues that have arisen have been raised primarily by other wind developers, and have been in response to questions about topics such as wind rights acquisition and requirements for proceeding with a project. There has been some concern with sting wind projects without taking into consideration the proximity of other projects.

According to groups like the NWCC, Minnesota's site permit requirements have established high standards for wind farm projects and the protection of the interests of counties, communities, and residents. Importantly, the process also provides an environmental review for developers that is flexible, timely, and efficient, but is also capable of resolving issues proactively.

## **4.1.3 Minnesota Wind Siting Act vs. the Section 248 Process**

The Minnesota process is similar to section 248 in that authority rests with a state board and that decisions can be appealed through the courts. Differences include the following:

- A key element of the Minnesota wind permitting process is its streamlined timeframe. With a 180-day time limit for the entire process, and a 45-day maximum for initial acceptance by the board, the Minnesota process is unique from Vermont's Section 248 process and other states' permitting processes as well.
- The Minnesota process also requires the inclusion of sufficient information in the initial application to evaluate environmental impacts of the proposed project, thereby eliminating the need for additional environmental review at a later point in the permitting process.
- Minnesota does not require applicants to demonstrate the economic need or benefit of the proposed project. However, under the Minnesota process, construction is not authorized until power purchase agreements are obtained, and Minnesota state policy has determined that wind development is in the public good.
- Minnesota requires notice of public meetings to be mailed to parties known to be interested.
- Minnesota's determination of visual impact is not as evolved as the Quechee test.

## **4.2 Oregon**

### **4.2.1 Overview**

Oregon law requires developers of large energy facilities to obtain a site certificate before constructing or operating a proposed facility. The authority to issue site certificates is granted to the Energy Facility Siting Council, a seven-member board of citizen volunteers appointed by the Governor. The Oregon Office of Energy staffs the siting process and makes recommendations to the Siting Council based on uniform siting standards that apply to all large energy facilities throughout the state. As established under ORS 469.300(9), wind energy facilities with a nominal generating capacity of 105 MW or more (i.e., average generating capacity of 35 MW or more) must apply for a site certificate. Developers of smaller

wind facilities can obtain separate approvals from local land use planning authorities and individual state permitting agencies, but also have the option of obtaining a site certificate to take advantage of the consolidated process at the state level.<sup>2</sup>

Oregon's energy policy provides the context for siting large wind energy facilities in the state. Legislative policy statements that express a statewide preference for renewable energy have been codified for 25 years. Oregon is a state that cares that "future generations not be left a legacy of vanished or depleted resources" as a result of "growth in demand for nonrenewable energy forms" (ORS 469.010(1)). The energy facility siting policy calls for "protection of public health and safety" and "compliance with the energy policy and air, water, solid waste, land use and other environmental protection policies of this state" (ORS 469.310).

Rules adopted by the Siting Council govern the review of the application. The overall process unfolds as follows:

1. Developers of proposed wind facilities with nominal wind generating capacity of 300 MW or more must submit a notice of intent. Projects less than 300 MW can have an expedited review process meaning that they do not need to submit a notice of intent. Among other things, this would be followed by a public meeting at the proposed site.
2. The project developer applies for a site certificate, which provides details about the project.
3. If the certificate is deemed complete and in compliance with siting standards, the Office of Energy prepares a draft proposed order (typically subject to recommended conditions).
4. Comments are solicited at a public hearing. If an issue is not raised at the public hearing, it is waived from later consideration.
5. The Office of Energy presents the draft proposed order to the Siting Council and summarizes any comments from the public hearing.
6. The Office of Energy issues a proposed order, taking into account comments from the public hearing and instructions from the Siting Council. At the same time the Office of Energy issues a contested case notice.
7. If no one opposes the project, the proceeding is closed and referred to the Siting Council for final decision. If an eligible party with a stake in the outcome opposes the project and submits a petition for party status, a substantial contested case proceeding ensues. Following this legal proceeding, the matter is referred to the Siting Council for final decision.
8. The Siting Council may adopt, modify, or reject the proposed orders. The result of the Council's deliberation is a final order. If the council decides that the proposed facility meets the applicable standards, the final order will grant issuance of a site certificate.
9. The Oregon Supreme Court has exclusive authority to hear appeals. Appeals must be filed within 60 days of the final order, and can only be filed by parties in the contested case.

The permitting process is outlined in Figure 2.

Key features of the Siting Council's certificate process include:

1. Except as provided in ORS 469.504 for land use compliance and except for those statutes and rules for which the decision on compliance has been delegated by the federal government to a state agency other than the Council, facility compliance with all other Oregon statutes and

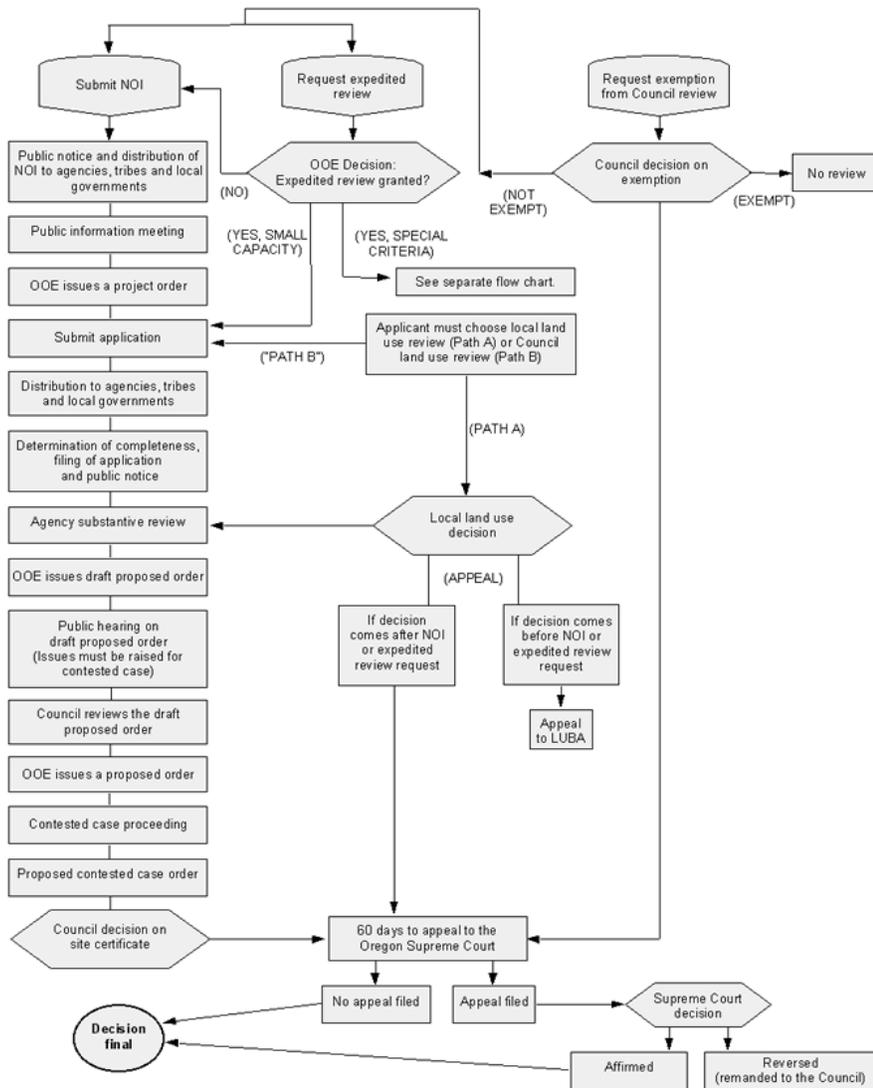
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<sup>2</sup> Additional information about the siting process for locally regulated energy facilities can be found in a draft Oregon Office of Energy handbook available at <http://www.energy.state.or.us/siting/EnergyGuide.PDF>.

administrative rules identified in the project order as applicable to the issuance of a site certificate for the proposed facility.

2. Facility compliance is based on the following specific standards:
  - Does the applicant have the appropriate abilities to build this energy facility?
  - Is the site suitable?
  - Would the facility have adverse impacts on the environment and the community? In making its findings, the Siting Council must answer two questions specifically concerning visual impacts on scenic values: 1) Have the applicable land use plans identified any “significant or important” scenic values? 2) Would the visual features of the facility be likely to result in “significant adverse impact” to those values? If there is a significant impact, the applicant must mitigate the impact through design measures or relocation of parts of the facility.
3. Certification is a "one-stop" process in which the Council determines compliance with specific standards of the Council and other state and local permitting agencies.
4. The process consists of public comment periods at the front end of the process, followed by a more formal contested case proceeding.
5. Appeals go directly to the Oregon Supreme Court for judicial review.

**Figure 2.: Oregon Permitting Process Map**



### 4.2.2 Lessons Learned

The Oregon energy facility siting process has been viewed both positively and negatively with regard to recent wind projects in the state. The value of the process is its ability to provide a deliberative structure in which difficult siting issues can be addressed and resolved. The process enables input from all affected parties, including the public.

Some developers have experienced frustration with the process. Resolution of issues requires the developer to respond to Siting Council staff requests for additional information, which means that developers must be prepared to commit additional resources to the process. In a recent instance, delays in the approval process (due to questions about potential avian impacts of the project), combined with pressure from the developer to complete construction prior to expiration of the production tax credit, put

unusual pressure on the Office of Energy to expedite the process. At the conclusion of its case study on the topic, the NWCC recommends the developer allow a minimum twelve months for completion of the Oregon state siting process.

### **4.2.3 Oregon Siting Process vs. the Section 248 Process**

In many ways the Oregon siting process is similar to the Section 248 process. Both include a state board and allow for appeals through the court. Both processes also require an initial public hearing to review the project, and both processes have a defined means of formal intervention against the project. In addition, there is no defined timeline for the process. Several differences include:

- Oregon siting process has a separate and specific permitting track for wind energy.
- Unlike 248, the Oregon process does not require documentation of public need for the facility. However, Oregon state policy strongly supports renewables.
- Oregon's visual impact test specifically applies to local and federal plans that designate scenic values. Other visual impacts are evaluated in a less objective manner.
- Wind projects that are less than 105 MW can opt out of local siting and into the state siting process.
- Wind projects less than 300 MW can undergo an expedited review process.

## **4.3 New York**

### **4.3.1 Overview**

Although there are no specific siting and permitting processes specifically established for wind energy projects in New York, the state does have a consolidated electric generating facility review process that applies to all types of large generation facilities. NYS Public Service Law, Article X – Environmental Compatibility and Public Need for Major Electric Generating Facilities, establishes the review and approval process for construction and operation of any generating facility with a capacity of 80 MW or more. The responsibility and authority for approval, or otherwise, of such projects belongs to the State's Public Service Commission (PSC). Projects within this size category must obtain a Certificate of Environmental Compatibility and Public Need from the PSC. The consolidated certification process was structured to eliminate the need for obtaining other approvals from state agencies or local municipalities.

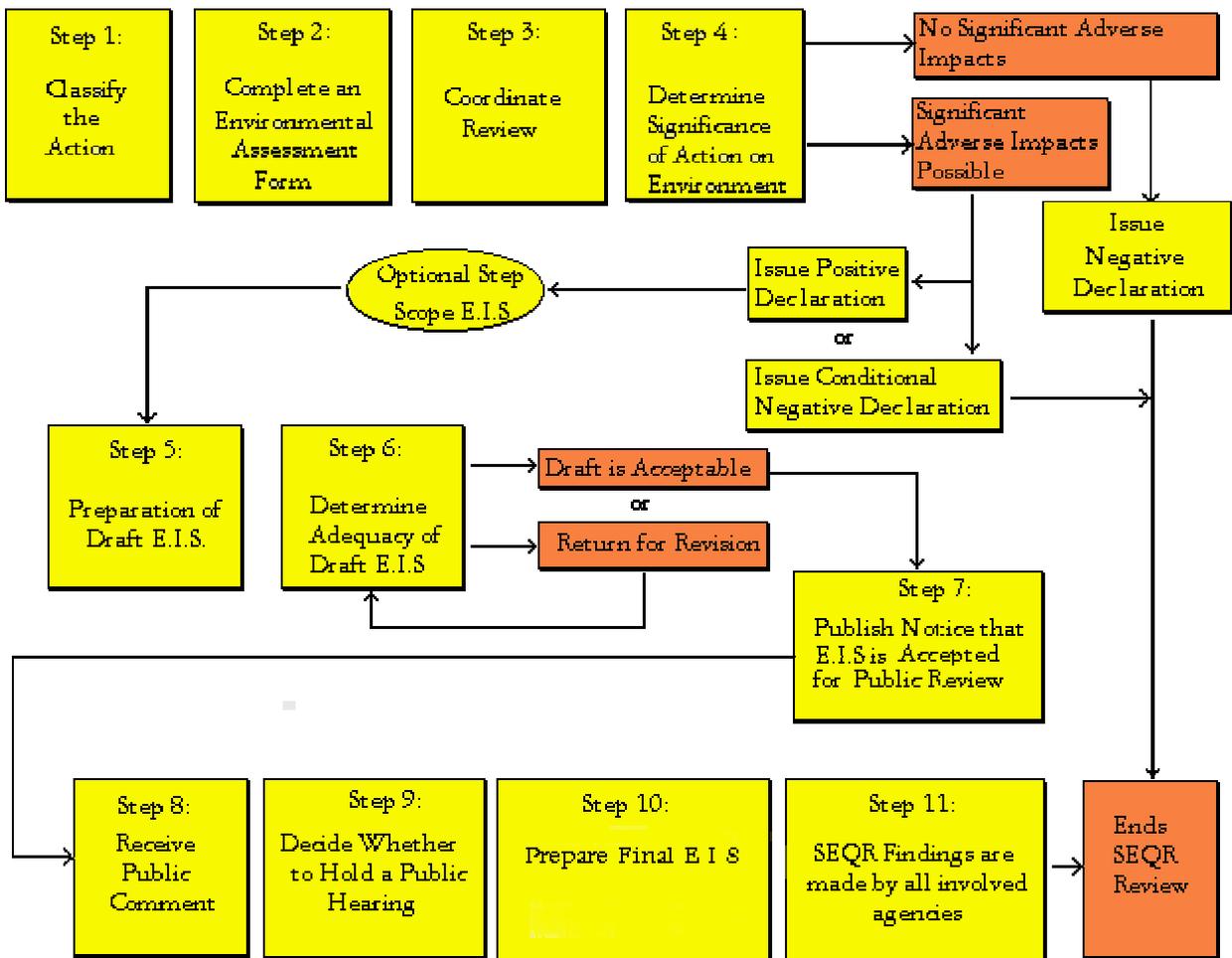
New York State has another consolidated review process, established in NYS Public Service Law, Article VII – Environmental Compatibility and Public Need for Electric and Gas Transmission Facilities. The certificate from this process is required for any electric generating project utilizing a transmission line with a design capacity of 125 kV or more and extending at least one mile. Similar to the Article X certificate process, qualifying transmission facilities are exempt from most other state or local review processes.

Because of the project size capacity associated with Article VII and X, the articles have impacted only a few projects in New York State. Land availability, wind resource variability, and other site-related characteristics generally lead to smaller project sizes (e.g., under 80 MW). Wind energy projects that do not meet the Article VII and X criteria are subject only to local siting and permitting procedures.

In New York State, the environmental impacts of a proposed wind energy project are typically assessed in accordance with the State Environmental Quality Review (SEQR) Act. The act requires that local and

state agencies give equal consideration to environmental protection, human and community resources, and economic factors when considering proposed projects. While the SEQR process does not result in a specific permit or certificate, it must be completed before any agency decides to approve, undertake, or fund the project. As can be seen in Figure 3 below, there are two key submittals in the SEQR process: the Environmental Assessment (EA) form and the Environmental Impact Statement (EIS). It is important to note that if the EA provides the governing agency with sufficient information as to the impacts and mitigation measures to be employed, it may be possible to obtain a *Negative Declaration of Significance*, which means that an EIS is not required.

**Figure 3: New York State Environmental Quality Review Process**



In the absence of PSC review (e.g., under 80 MW), siting and permitting regulation is left primarily to local government, assisted by the mandatory provisions of the SEQR. Town boards, regional planning commissions, county agencies, and other local authorities typically review and evaluate most wind energy projects. Under the “Home Rule” philosophy prevailing over most land use regulation in New York State, local municipalities have the freedom to adopt zoning or other land use law provisions – either of general applicability or applying specifically to commercial wind turbine projects – which may range from prohibitively hostile, to responsibly rigorous, to inapplicable, to unconditionally welcoming. In

areas where local land use or zoning rules do not exist, wind energy projects may only require a local building permit prior to construction.

Some local governments in New York State have established specific criteria for siting and permitting commercial or bulk generating wind energy facilities. Local requirements include adhering to zoning rules; obtaining building, grading, or special use permits; setback requirements; landscaping and screening; scenic view-shed impacts; and compliance with structural, mechanical, and electrical codes. Please see Attachment A for examples of wind turbine permitting requirements that have been established by several New York townships.

In addition, New York has state policy that supports wind development. New York recently enacted a Renewable Portfolio Standard.

### **4.3.2 Lessons Learned**

Articles VII and X both involve lengthy pre-application, application, hearing and decision, and post-certification phases. Several wind developers have indicated that the schedule and cost of the process is prohibitive, and often causes significant delays in pre-development work. However, all three of the largest commercial wind projects up and running in New York State (11.5 MW, 6.6 MW, and 30 MW) fell well below the PSC threshold and didn't require Article VII or X certification. In the case of one proposed project (around 280 MW) that would have been subject to PSC review, local and County government prevailed upon the State legislature to waive the PSC permit and leave permitting to the local and State agencies that would normally decide on land use decisions. The review process has been going on, with delays and developer changes primarily due to the uncertainty over the future of the Federal Production Tax Credit.

The SEQR procedures have proven quite useful in eliciting information and providing a framework for relevant siting issues with regard to local wind turbine permitting. However, it does not apply in cases where there is neither local zoning nor other land use permitting authority, and cannot require a planning or zoning board to go beyond what its local enabling legislation authorizes in terms of making favorable or unfavorable land use decisions.

### **4.3.3 New York Siting Processes vs. Section 248 Process**

The New York PSC process is very similar to Section 248, however, only applies to projects 80 MW or larger. Accordingly most of New York's existing wind projects have been permitted at the local level and only need to comply with mandatory provisions of the SEQR process. Several local permitting entities have developed guidelines for permitting wind.

The New York SEQR process is very similar to the Section 248 Process in that both processes incorporate adequate amounts of time for public response, do not provide a separate and specific track for permitting wind energy, and have defined a legal means of appealing siting decisions. In New York, if an agency makes an improper decision or allows a project that is subject to SEQR to start, without a proper review, citizens or groups who can demonstrate that they may be harmed by this failure may take legal action against the agency under Article 78 of the New York State Civil Practice Law and Rules.

## **4.4 Pennsylvania**

### **4.4.1 Overview**

Pennsylvania does not have a specific state "process" related to the siting and permitting of wind farms. Rather, individual counties and townships are responsible for determining development approval on their own (e.g., through county subdivision and land development or conditional use ordinances, planning commissions, and/or township supervisors). However, while wind turbines do not require special permits on their own, there are several federal and state requirements that may need to be addressed prior to land subdivision and development. Examples include:

- PA Dept. Environmental Protection – water quality permit, etc.
- PA Dept. of Transportation – highway access permits, etc.
- PA Public Utilities Commission – public water supplies.
- PA EPA – wetland encroachment.
- PA Fish Commission – stream changes.
- PA Farmland and Forestland Assessment Act 1974 (Act 319) [Clean and Green].
- Federal Communications Commission – tower height, etc.
- And more.

Since there really is no state agency that has the regulatory authority to specifically permit wind farms, the PA State Energy Program's Wind Working Group is attempting to work together to draft a "model" ordinance based on the Somerset County Ordinance (described below) that other municipalities can base ordinances on, if they choose to do so.

It is also important to note that Pennsylvania state policy supports wind. In addition, due in part to the state's support of wind power, Gamesa, a leading global manufacturer of wind turbines recently announced that it will open its U.S. headquarters and a manufacturing facility in Pennsylvania.

### **4.4.2 Somerset County Ordinance Summary**

In April of 2004, the Somerset County Planning Commission amended the Somerset County Subdivision and Land Development Ordinance of 1998 to establish setback and decommissioning requirements for wind energy towers. The amendment conditionally exempted leases of wind towers from the requirements of filing a subdivision plan, but stipulated filing requirements for a nonresidential development plan and other miscellaneous amendments.

The ordinance was originally amended to adopt appropriate siting and development standards for wind turbines, as long as it was "in the public interest and contribute[d] to the protection of public health, safety and welfare."

Recognizing that conflicts were likely to arise if wind energy development occurred within a certain vicinity of existing off-site residential and commercial developments without the consent of the adjoining property owners, the amendment established a minimum development distance from any adjoining structure. The ordinance established that no wind energy tower could be located within five times the height of the tower (base to hub of rotor) from any off-site occupied residence or occupied commercial structure, unless the owner of the structure executed a non-disturbance easement, covenant, or consent

agreement. The easement, at a minimum, needs to provide a waiver for any damages or losses resulting from higher noise levels, visual impacts or flickering reflections, and/or shadows which may arise as a result of turbine location. As part of the application, the developer/landowner must include the names of the owners of all abutting land and subdivisions.

#### **4.4.2.1 Application Process**

1. Developer files application with County Planning Commission.
2. Planning Commission reviews application.
3. If application has any variances, it is sent to the Commission's Board of Directors for final review.
4. No public hearings are required for subdivision and land development applications.

#### **4.4.3 Waymart Permitting Process**

Similarly, the township of Canaan (which hosts 20 of the Waymart Wind Farm turbines) adopted a Conditional Use Ordinance in 2002 that recognized the development of large-scale wind turbines as a potential development issue. Based on the newly revised ordinance the approval process for wind turbine development is as follows:

1. Wind farm developer files initial application with town zoning officer.
2. Zoning officer originally denies application and sends to Canaan's 5 member Planning Commission.
3. The Commission reviews the application to determine whether or not it is consistent with the above-mentioned Ordinance (e.g., noise levels, location, aesthetics, etc.).
4. In conjunction with the town Planning Commission, the County (Wayne) Planning Commission also reviews the application (similar to Somerset County, developers are subject to other federal and state regulations, including but not limited to, Federal height restrictions, and PA DEP wetlands issues). Proper legal documentation from landowner approving development must also be included in application.
5. Planning Commission then approves or denies the application.
6. If approved, the application is sent to the Canaan Township Supervisors.
7. The Township Supervisors review application and conduct public hearing on results.
8. Final approval/denial given to developer.

#### **4.4.4 Lessons Learned**

In general, Pennsylvania wind farm siting processes (for those counties/townships that have established them) do not include any specific aesthetic criteria and do not rely heavily on public hearings for input on development issues; rather, county or town planning commissions utilize internal review processes to determine project eligibility. There has been some minor public outcry with regard to wind turbine development in specific areas of Pennsylvania (e.g., Somerset County), but for the most part, Pennsylvanians seem to embrace wind development in the state. Most projects have reported minor complaints from neighbors (including the need to install a TV tower in response to the project's impact on reception), but note that communities are generally supportive.

It is the responsibility of the project developer to work with local planning commissions and township supervisors to coordinate the application process and meet any development criteria the county or township may have.

#### **4.4.5 Pennsylvania Siting Process vs. the Section 248 Process**

There really are no distinct similarities between the siting processes established in Pennsylvania and those outlined in Section 248. Obviously, the key difference is that in Pennsylvania land-use decision-making is decided by each jurisdiction (county or township) within the state, and can vary based on the values of the local population. Furthermore, in most instances, public hearings are not an integral part of the development process in Pennsylvania. Pennsylvania also has state policy that clearly supports wind development.

## 5. NWCC Best Practices

These best practices were developed by the National Wind Coordinating Committee (NWCC), a consensus-based collaborative with a fairly diverse stakeholder base that is tasked with identifying and addressing issues surrounding wind development.

### 5.1 Permitting Process Principles

- **Significant Public Involvement (*and Education on Project and Process*).** Providing opportunities for early, significant, and meaningful public involvement is crucial to a successful process, but there is no one simple formula for achieving this.
- **Issue-Oriented Process.** An issue-oriented approach can help focus the debate, educate the public and decision-makers, and ensure an analytic basis for the eventual decision.
- **Clear Decision Criteria.** Decision-making criteria should be clear and consistently applied, and made known from the outset to all participants and interested parties.
- **Coordinated Permitting Process.** Where more than one agency has jurisdiction over permitting, agencies are encouraged to coordinate so that project review can proceed simultaneously and redundant, conflicting, or inconsistent requirements, standards, and processes can be avoided.
- **Reasonable Time Frames.** Delays and associated uncertainties can be minimized if permitting agencies establish reasonable time frames for each of the major phases of the permitting process, and manage the process to stay within those time frames.
- **Advance Planning.** Both developers and agencies should know as much as possible about the project, the process, the participants, and the issues prior to commencing the formal permitting process.
- **Timely Administrative and Judicial Review.** The use of established procedures designed to systematically narrow the issues of concern and produce factually based decisions can significantly limit any administrative or judicial appeals and allow them to proceed more efficiently.
- **Active Compliance Monitoring.** Most agencies include in their permits specific conditions that must be met during construction, operation and maintenance, and project decommissioning. These conditions can best be implemented if they are: specific, measurable, agreed upon by all parties, realistic, set within reasonable time frames, enforceable, and actually enforced.

### 5.2 Permitting Criteria

The following list identifies key issues that the NWCC thinks should be considered during the siting and permitting of a wind project.

- **Land Use.** Depending on the site, size and design of the project, wind development may be compatible with a variety of other land uses, including agriculture, grazing, open space preservation, and habitat preservation for some species. Other land uses and resource values need to be considered when siting large wind projects in remote areas. Stakeholders need to understand the full range of land use issues associated with a site before getting locked into development plans, permit conditions, or other requirements.
- **Noise.** Because noise emitted by wind turbines tends to be masked by the ambient (background) noise of the wind itself and falls off sharply with distance, noise-related concerns are likely to center on residences closest to the site, particularly those sheltered from prevailing winds. Advanced turbine technology and preventive maintenance can help minimize noise during project operation. It may also be useful to characterize other sound sources in the affected area for comparison purposes.
- **Birds and Other Biological Resources.** The potential for collisions between birds and bats and wind energy facilities has been a controversial siting consideration. Biological resource surveys (of birds and other wildlife) can help to determine whether or not serious conflicts are likely to occur. In most cases, biologically significant impacts are unlikely to occur, or can be adequately mitigated; if not, wind development may not be appropriate in a particular location.
- **Visual Resources.** There are a number of ways to reduce the visual impact of wind projects, but there may be tradeoffs to consider. For example, tubular towers may be more attractive at short distances than lattice towers, but they may also be more visible from a distance. Simulations using computer-aided graphics or artists' renderings can be developed to facilitate comparison of what the wind resource area looks like before and after the proposed turbines are installed.
- **Soil Erosion and Water Quality.** Like other construction activities, wind projects are subject to the Clean Water Act. If a project disturbs more than five acres, the developer must prepare a Storm Water Pollution Prevention Plan in order to obtain a National Pollutant Discharge Elimination System (NPDES) compliance permit, which is issued by the state's environmental quality agency.
- **Public Health and Safety.** Most of the safety issues associated with wind energy projects can be dealt with through adequate setbacks, security, safe work practices, and the implementation of a fire control plan.
- **Cultural and Paleontological Resources.** Wind farms, like other developments, are subject to legislation designed to protect important cultural and fossil resource sites. These include: the National Historic Preservation Act of 1966, the Federal Land Policy and Management Act (FLPMA) of 1976, and the American Indian Religious Freedom Act of 1978. Special care may need to be taken to preserve the confidentiality as well as the integrity of certain sensitive resources, or sites sacred to Native Americans.
- **Socioeconomic/Public Services/Infrastructure.** Developers and permitting agencies should coordinate with local public service agencies to determine whether and how the project may affect the community's fire protection and transportation systems, and nearby airports and communications systems.

- **Solid and Hazardous Wastes.** Wind farms, like other developments, are subject to the Resource Conservation and Recovery Act. Normal methods of managing solid waste should be adequate.
- **Air Quality and Climate Change.** Wind projects produce energy without generating any of the conventional pollutants or greenhouse gases produced by fuel combustion. New generation supplied by wind projects results in no additional air pollutant emissions. Temporary local emissions associated with project construction and maintenance can and should be minimized.

### 5.3 Lessons Learned and Next Steps

According to the NWCC, federal, state, and local natural resource, conservation and planning agencies are increasingly developing voluntary and mandatory wind siting guidelines. Development of these guidelines is in response to the growing demand for renewable energy. A variety of policy responses have been developed and a number of state and local jurisdictions are seeking information on what has worked and what has not worked. Until now there has not been an opportunity to discuss the pros and cons of the variety of guidelines being considered

Therefore, NWCC staff is proposing a workshop for December 2004/January 2005 on policy siting issues at the state and regional level. For many states, wind energy development is a new undertaking that gives rise to its own unique issues. The workshop will provide a forum for developers to share their perspectives, and for those states with specific wind permitting policies, such as Washington, Kansas and Minnesota, to share their various experiences. Questions to consider include:

- What agencies need to be involved?
- Who does the actual permitting?
- How does the public fit into the permitting process?
- Is it formulized for the state or county-by-county?
- What are the pros and cons of different approaches?

The audience would include: state fish and wildlife agencies; state natural resource departments; wind developers; community advocates; consumer advocates; and environmental organizations.<sup>3</sup>

### 5.4 NWCC Principles vs. the Section 248 Process

Section 248 is fairly in line with the NWCC permitting process principles and permitting criteria. Several areas where they differ include the following:

- **Significant Public Involvement.** The NWCC suggests several measures, such as, mailings to all abutters and stakeholders, and holding public information meetings at the beginning of the permitting process to inform the public of the project, the permitting process, possible issues, and ways they can provide input.
- **Advance Planning.** The NWCC encourages advance planning, e.g., collaborations to identify key issues prior to the permitting process. This is already done by many of the developers in Vermont, but not a formal part of the process.

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<sup>3</sup> National Wind Coordinating Committee Proposal for Siting Workshop December 2004/January 2005

- **Clear Decision Criteria.** While there are clear criteria associated with Section 248, there is no clear process for how those criteria are applied to the evaluation of wind power and its unique traits (for example, a specific requirement for the wind visual impact study to require detailed visualization and view shed modeling). The NWCC recommends developing a specific and clear set of criteria and evaluation measures for wind projects.
  
- **Reasonable Timeframes.** Section 248 does not set timeframes for its process. One measure suggested by NWCC is to work with stakeholders to establish timeframes for each component of the process and to actively communicate those timeframes to stakeholders.

## 6. Resources

### General Information

[http://www.eere.energy.gov/windpoweringamerica/wpa/state\\_activities.asp](http://www.eere.energy.gov/windpoweringamerica/wpa/state_activities.asp)

### NWCC Wind Permitting Handbook

<http://www.nationalwind.org/pubs/permit/permitting2002.pdf>

### Minnesota Wind Siting

<http://www.eqb.state.mn.us/EnergyFacilities/wind.html>

### Oregon Energy Facility Siting Standards

<http://www.energy.state.or.us/siting/standard.htm>

### New York State Article X

[http://www.dps.state.ny.us/articlex\\_process.html](http://www.dps.state.ny.us/articlex_process.html)

### New York State Energy Research and Development Authority Wind Energy Siting Guide

<http://www.nyserda.org/energyresources/wind.html>

<http://www.nyserda.org/energyresources/windguide.pdf>

### Somerset County, PA Ordinance Amendment and Final Ordinance

<http://www.co.somerset.pa.us/windmill3-24-04.htm>

<http://www.co.somerset.pa.us/suborder.htm>

## **Appendix A: Examples of Township Permitting Procedures in New York**

Town of Martinsburg, Lewis County

# Regulation of Wind Power Generating Facilities

## Town of Martinsburg, Lewis County, NY

Town of Martinsburg Development Law contains regulations for wind power generating facilities. The law allows wind power generating facilities in the rural residential, agricultural and forest districts of the town as an overlay district. This use requires a special use review by the planning board. Below are the relevant sections of the law that address these regulations.

### ARTICLE 2. DEFINITIONS

#### Section 210. General

Except where specifically defined herein, all words used in this law carry their customary meanings. Words in the present tense include the future, words in the singular include the plural and the plural the singular, and the word "shall" is intended to be mandatory.

#### Section 220. Specific Definitions

**Essential Facilities:** The operation or maintenance by municipal agencies or public utilities of telephone dial equipment centers; electrical or gas substations; water treatment, storage and transmission facilities; pumping stations; telecommunications towers and similar facilities. The definition of essential facilities shall not include power generating facilities of any kind.

**Overlay District:** A district that encompasses one or more underlying districts and that imposes additional requirements above that required by the underlying district.

**Wind Power Generating Facilities:** Wind generating facilities which generate original power on site to be transferred to a transmission system for distribution to customers. The definition of wind power generating facilities shall not include individual wind power generating facilities erected and used primarily for private use.

#### Section 310. Types of Districts

For the purpose of this law, the Town of Martinsburg is hereby divided into the following districts:

<b>H – Hamlet:</b>	The areas within this district are now developed to some extent and include low or medium density residential uses with some commercial and industrial uses.
<b>A – Agricultural:</b>	The areas within this district are generally used for agricultural activities. Most of the land is open in character with some scattered spots of forest, wetland, and residential use.
<b>RR – Rural Residential:</b>	The areas within this district are sparsely settled, but generally accessible by highway. Some forest and agricultural use may be present.
<b>F – Forest Resources:</b>	The areas within this district are predominantly covered by dense vegetation and contain many wet areas and stream courses. They are relatively inaccessible by automobile and contain few permanent residences and some seasonal residences.
<b>WPO - Wind Power Overlay:</b>	Area(s) in the Town of Martinsburg where wind power generating facilities are allowed.

### ARTICLE 4. DISTRICT REGULATIONS

#### Section 410. Allowed Uses

All uses shall comply with the requirements as indicated on the following chart:

P = Development Permit Required	NONE = No Permit Required
SU = Special Use by Planning Board Approval Required	NA = NOT ALLOWED

LAND USE	DISTRICT			
	RR Rural Residential	H Hamlet	A Agricultural	F Forest
Wind Power Generation Facilities	SU	NONE	SU	SU

**Section 420. Land Use District Schedule**

District	Specifications for All Uses	
<b>WPO</b>  <b>Wind Power Overlay</b>	<b>Lot Frontage:</b>	same as underlying zone
	<b>Lot Size:</b>	same as underlying zone
	<b>Setback of all wind power generating structures:</b>	from centerline of any road - 100 feet plus height of structure from side and rear lot lines - 300 feet from any existing residential structures - 1500 feet
	<b>Landscaping and Screening:</b>	Appropriate landscaping is required to keep the site in a neat and orderly fashion. Appropriate screening is required to screen accessory structures from adjacent residences.

**Section 425. Wind Power Overlay District Procedure**

1. A Wind Power Overlay may be applied in the Rural Residential District or the Agricultural District upon application to the town board.
2. Any application for a Wind Power Overlay to the town board must be in writing and must be duly signed by the applicant and contain:
  - a. the identity of the parcels to be affected, including tax map numbers and acreage;
  - b. a survey map showing the boundaries of the overlay area;
  - c. the consent of all property owners within the overlay;
  - d. sufficient acreage to comply with setbacks and other requirements set forth in Section 420 of this law;
  - e. distance to nearest residential structures;
  - f. proposal for landscaping and screening;
  - g. the identity of the applicant; and
  - h. an Environmental Assessment Form.
3. The town board shall hold a public hearing on any such application prior to permitting or denying such application. The notice shall be published in the official newspaper of the town at least 10 days prior to the hearing. In addition, written notices shall be sent to:
  - a. all adjoining property owners;
  - b. all other municipal entities within 500 feet of the project site; and
  - c. the Lewis County Planning Board.

The hearing shall be held within 62 days of receiving a complete application.

4. The Town Board shall make its determination within 62 days of when the public hearing is closed.

Town of Fenner, Madison County

## Wind turbine provisions in Town of Fenner Zoning

Zoning Map (District "C")

Zoning Schedule: Table of Dimensions (all setback requirements for wind turbines are in footnote h.)

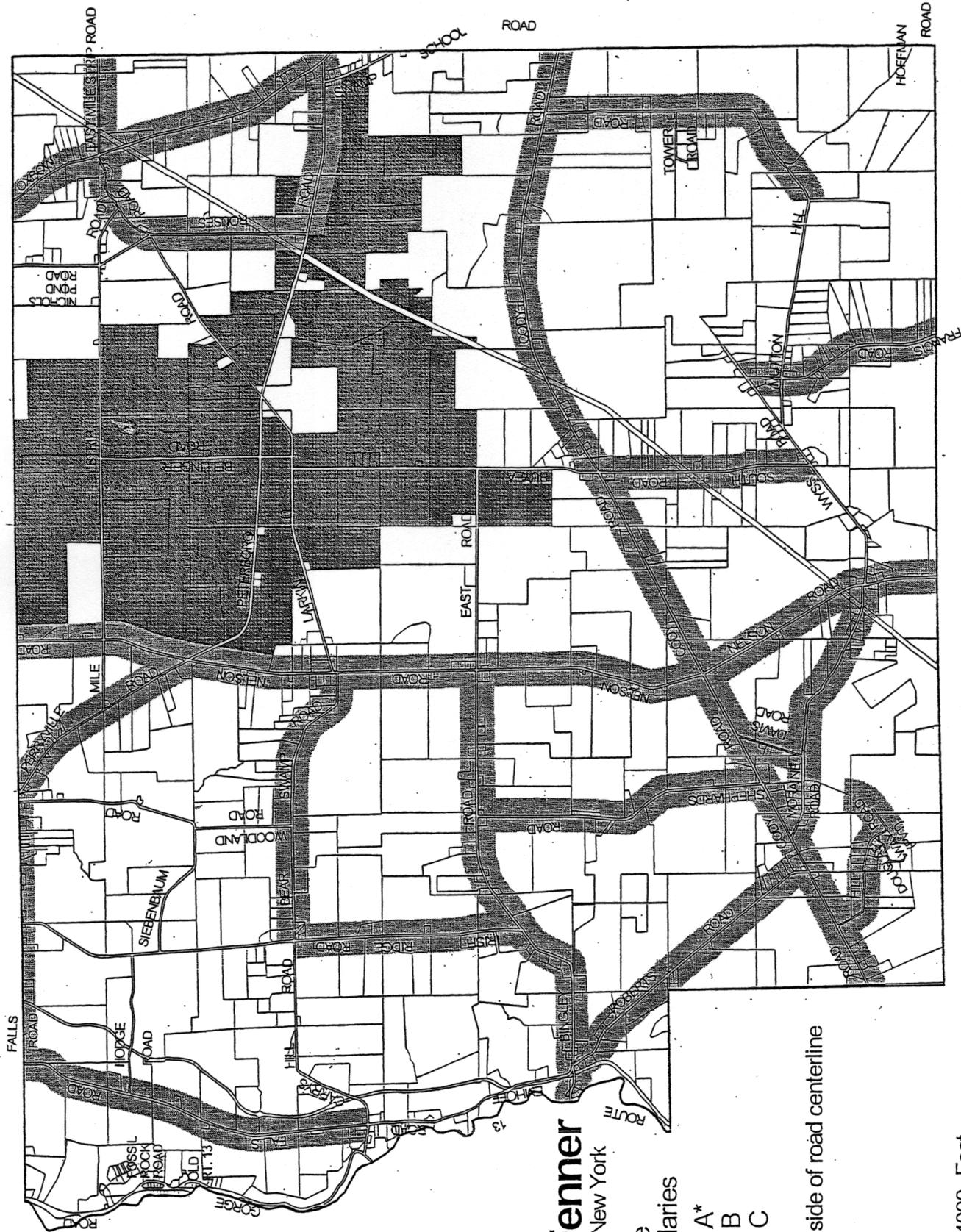
Zoning District "C" Uses Requiring a Special Permit (Sect. 303.3G) ('Wind power electricity generation and transmission facilities')

[Existing general Special Permit and Site Plan Review provisions applying to regulation of wind power electricity generation and transmission facilities Special Permits (Sect. 606.1), Application for Special Use Permit (Sect. 606.2), Standards for Granting Special Use Permits (Sect. 606.3), Submission of Site Plan and Supporting Data (Sect. 606.4), Site Plan Approval (Sect. 606.5)]

Additional Standards for Granting special Use Permits for Wind Power Electricity Generation and Transmission Facilities (Sect. 606.31)

Submission of Additional Supporting Data for Site Plan of Wind Power Electricity Generation and Transmission Facilities (Sect. 606.41)

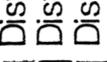
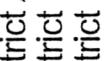
NOTE: A 'public (or 'semi-public') utility' zoning definition that includes, as a necessary part of the definition that the service is licensed by the Public Service Commission does *not* cover a power plant or wind turbine facility generating under 80 megawatts maximum capacity. In the absence of a definition of 'public utility' that covered such a power generating facility, a zoning definition of 'industry' *might* or might not cover it, depending on how it was worded.



# Town of Fenner

Madison County, New York

Land Use  
District Boundaries

-  District A\*
-  District B
-  District C

\*500' on each side of road centerline



0 2000 4000 Feet



1:50,000

TABLE 1

LAND USE SCHEDULE  
Minimum Dimensions

	Lot Area	Lot		Yards*			Maximum Structure Height Ft.	Notes (see Page)
		Frontage Ft.	Depth Ft.	Front Ft.	Side Ft.	Rear Ft.		
"DISTRICT A"								
Single-family unit	1 acre **	200	200	50	40	50	35	a, b
Two-family unit	1.5 acre	200	200	50	40	50	35	b
Multi-family	1.5 acre							
	+ 10,000							
Farm	sq. ft/unit	200	200	50	40	50	45	d, e
	5 acres	200	200	50	40	50	None	c, g
"DISTRICT B"								
All "A", as above								
Mobile dwelling	1 acre	200	200	50	40	50	35	b
Mobile dwelling park *	5 acres	200	300	50	30	50		b, d, e, f
Individual Park Site	@ 10,000							
	sq. ft/unit	70	120	30	20	20	35	f
Business, professional, or industrial, on separate lots	1 acre	200	200	50	40	50	35	b, d, e
"DISTRICT C"								
All "B", as above								h

\* Corner lots are considered to have two front yards along the two roadways and two side yards.

\*\* Acre = 43,560 sq. ft.

\*\*\* Requirement of actual frontage along public highway, or, if applicable, private access easement

All non-farm accessory buildings shall conform to front and side yard requirements of the district in which they are located.

## Notes for Table 1

- a. Measured from the road right-of-way. Applies to each side of a lot that adjoins a public road.

An alternative front yard minimum dimension measurement is permissible from the center of road-ways where neither road right-of-way bounds nor surveys are available: (1) on three rod roads (generally, but not necessarily, Town roads) set buildings back at least 75 feet from the centerline of the road; and (2) on four rod roads (generally, but not necessarily, County roads) set buildings back at least 83 feet from the centerline of the road.

- b. Where community water supply and sewer are used, one-half lot area and smaller bordering yards are permitted. Lot: 100 feet front x 150 feet depth. Yards: 30 feet front x 20 feet sides x 50 feet rear.
- c. Accessory farm buildings (silos, barns, etc.) are exempt from height limits.
- d. Requires a special use permit issued by the Planning Board.
- e. A landscaped screening zone at least 15 feet wide shall be maintained by the owner on those sides of his lot that adjoin any residential property owned by another party.
- f. Each mobile dwelling site shall connect to an access road within the mobile dwelling park, and the front yard of each lot shall be measured from the edge of this access road.
- g. Upon the issuance of a special permit by the Planning Board, not more than two units of supplementary housing for relatives or hired hands employed by the farm; each unit must be provided with an adequate sewage disposal system; does not require separate lots.
- h. The minimum setback distance between each production line commercial wind power electricity generation unit (wind turbine tower) and: all surrounding property lines, overhead utility lines, any dwellings, and any other generation units, above-ground transmission facilities, and separate meteorological facilities, shall be equal to no less than 1.5 times the proposed structure height plus the rotor radius. [The property line setback requirement may be reduced by the Planning Board as an incident of special permit review when the Planning Board finds that the following circumstances apply: the property line in questions a) separates two properties that are both in the "C" District, and b) either, i) both properties on each side of the boundary line in question will have electricity generation or transmission facilities constructed on them as part of the project under review, or ii) the owner of the property for which the reduced setback is sought executes and presents for recording a development easement satisfactory to the Town in which the reduced setback is consented to, and construction within, and use of the easement area is appropriately restricted.

No experimental, homebuilt, or prototype wind turbines shall be allowed without documentation by the applicant of their maximum probable blade throw distance in the event of failure and determination by the Planning Board of appropriate setback distances on the basis of that documentation.

Section VI.

Local Law 1997-1 is hereby amended to add a new Section 303 to read as follows:

Section 303 - DISTRICT C

The purpose of this district is to foster the development of the Town's windpower resource while preserving farmlands and adjoining settlements as compatible adjoining uses.

Section 303.1 - PRINCIPAL USES PERMITTED

- A. One and two-family dwellings built on a foundation, including modular dwellings.
- B. Farms and farm buildings for related agricultural activities.
- C. Mobile dwellings on individual lots.

Section 303.2 - ACCESORY USES PERMITTED

- A. Same as Section 301.2.
- B. Home businesses conducted by the residents.
- C. Accessory buildings necessary to the principal use and which do not include any activity commonly conducted as a separate business.

Section 303.3 - USES REQUIRING A SPECIAL PERMIT

- A. Same as Section 301.3.
- B. Mobile dwelling parks.
- C. All retail sales, eating, service and professional establishments.
- D. Day camps, guest or vacation homes for pay, private clubs and seasonal camps.
- E. Commercial outdoor recreation such as ski runs, snowmobile parks, miniature golf courses, driving ranges, race tracks and hunting and fishing preserves.
- F. More than one residence structure on a lot for a farm (See note (g) to Table 1).
- G. Wind power electricity generation and transmission facilities. (See note (h) to Table 1).

Section 303.4 - USES PROHIBITED

All other uses prohibited in this district.

same time preserve and protect the character of the neighborhood and the health, safety and welfare of the community.

- E. Imposition of conditions. The Board of Appeals shall, in the granting of both use variances and area variances, have the authority to impose such reasonable conditions and restrictions as are directly related to and incidental to the proposed use of the property. Such conditions shall be consistent with the spirit and intent of the Land Use Regulations, and shall be imposed for the purpose of minimizing any adverse impact such variance may have on the neighborhood or community.

## Section 606 - PLANNING BOARD

The Town Board hereby affirms the existence of the Town of Fenner Planning Board consisting of seven (7) members and having all the authority conferred pursuant to Article 16 of the Town law. Specifically, the Planning Board shall have the following powers and duties:

1. To issue or deny Special Permits required by this law.
2. To undertake planning activities allowed by Town Law or as requested by the Town Board.
3. Subdivision Review and Approval.
4. Site Plan Review and Approval.

### Section 606.1 - SPECIAL PERMITS

A Special Permit gives some means of control of proposed new uses of land and buildings which are compatible with land uses permitted by right by the Land Use Regulations as long as the conditions applicable to special permit uses are satisfied. Specifically, it gives the Planning Board the opportunity to determine whether such proposed new development (in the particular location, at the particular scale, and of the particular site design contemplated) will create special problems which can be corrected or effectively minimized by specially devised conditions or which call for denial of permission.

When a Special Permit is granted, the Planning Board may prescribe conditions to be observed in order to ensure adherence to the standards specified in Sections 606.2 and 606.5.

No Special Permit shall be granted with respect to any property or any use on or for which a violation currently exists. (Non-conforming uses as outlined in Section 408 are not considered violations of this local land use law.)

Unless extended by the Planning Board, if a use or construction authorized by a Special Permit has not been started within one year, the Special Permit will expire.

Section 606.2 - APPLICATIONS FOR SPECIAL USE PERMITS

- A. An application to the Planning Board for a special use permit shall be submitted to the Town Clerk and shall be accompanied by three sets of preliminary site plans and other descriptive matter to show clearly the intentions of the applicant. These documents shall become a part of the record to determine if the proposed special use meets the requirements of this local law.

A public hearing shall be held by the Planning Board within sixty-two days from the date any application for a Special Permit is received.

- B. At least 10 days before the date of the public hearing, the Town Clerk shall transmit to the Planning Board a copy of the application, with supporting documents, and notice of hearing. The Planning Board shall render its decision within 62 days, of the date the public hearing is closed.

Section 606.3 - STANDARDS FOR GRANTING SPECIAL USE PERMITS

No special use permit shall be granted unless it is determined by the Planning Board that the proposed use meets all of the following criteria:

- A. The location, size and use of structure, nature and intensity of operations involved, size of site in relation to the proposed structure(s), and the location of the site with respect to roads giving access to it are such that the proposed use will be in harmony with orderly development of the district.
- B. The location, nature and height of buildings, walls and fences will not discourage the appropriate development and use of adjacent land and buildings, or impair their value.
- C. The proposed use shall not conflict with any master plan, or part thereof.
- D. Operations of any special use shall not be more objectionable to nearby properties than would be the operations of any unconditionally permitted use.
- E. A special use permit shall not be issued for a use on a property where there is an existing violation of this local law.
- F. The use shall not have an adverse effect on the agriculture of the area.
- G. The proposed use shall be in strict compliance with the requirements of Article 5, Existing Supplemental Regulations.

Section VII.

Local Law 1997-1 is hereby amended to add a new Section 606.31 to read as follows:

Section 606.31 - ADDITIONAL STANDARDS FOR GRANTING SPECIAL USE PERMITS FOR WIND POWER ELECTRICITY GENERATION AND TRANSMISSION FACILITIES

No special use permit shall be granted for commercial wind power electricity generation and/or transmission facilities unless it is determined by the Planning Board that the proposed use meets all of the following criteria, in addition to those general criteria listed in Section 606.3:

A. No individual tower facility shall be installed in any location along the major axis of an existing microwave communications link where its operation is likely to produce electromagnetic interference in the link's operation.

B. No individual tower facility shall be installed in any location where its proximity with existing fixed broadcast, retransmission, or reception antenna (including residential reception antenna) for radio, television, or wireless phone or other personal communication systems would produce electromagnetic interference with signal transmission or reception.

C. Use of nighttime, and overcast daytime condition, stroboscopic lighting to satisfy tower facility lighting requirements for the Federal Aviation Administration shall be subject to on-site field testing before the Planning Board as a prerequisite to that Board's approval with specific respect to Section 606.3(D) as it applies to existing residential uses within 2000' of each tower for which such strobe lighting is proposed.

D. No individual tower facility shall be installed in any location that would substantially detract from or block view of a portion of a recognized scenic viewshed, as viewed from any public road right-of-way or publicly owned land within the Town of Fenner, that extends beyond the border of the Town of Fenner.

E. Individual wind turbine towers shall be located with relation to property lines so that the level of noise produced during wind turbine operation shall not exceed 50 dbA, measured at the boundaries of all of the closest parcels that are owned by non-site owners and that abut either the site parcel(s) or any other parcels adjacent to the site parcel held in common by the owner of the site parcel as those boundaries exist at the time of special use permit application.

F. No wind turbines shall be permitted that lack an automatic braking, governing, or feathering system to prevent uncontrolled rotation, overspeeding, and excessive pressure on the tower structure, rotor blades, and turbine components.

G. The minimum distance between the ground and any part of the rotor blade system shall be thirty (30) feet.

H. All power transmission lines from the wind generation electricity generation facilities to on-site substations shall be underground.

I. Procedures acceptable to the Planning Board for emergency shut-down of power generation units shall be established and posted prominently and permanently on at least one location on the road frontage of each individual unit site.

J. Prior to issuance of a Building Permit, the applicant shall provide the Town proof, in the form of a duplicate insurance policy or a certificate issued by an insurance company, of liability insurance, of a level to be determined by the Town Board in consultation with the Town's insurer, to cover damage or injury which might result from the failure of a tower or towers or any other part(s) of the generation and transmission facility.

The Planning Board may impose additional standards on the special use to provide adequate safeguards to protect the health, safety, or general welfare of the public, to preserve the general character of the neighborhood in which such proposed special use is to be placed, and to minimize possible detrimental effects of use on adjacent property.

Section 606.4 - SUBMISSION OF SITE PLAN AND SUPPORTING DATA

A site plan and supporting data for a special use permit shall be submitted to the Planning Board. The owner shall submit a site plan and supporting data as required and shall include all or a portion of the following information presented in drawn form and accompanied by a written text. The amount of information will depend on the scope of the proposal.

- A. Survey of the property, showing existing features of the property, including contours, large trees, buildings, structures, streets, utility easement, right-of-way, land use, land use district and ownership of surrounding property.
- B. Site plan showing proposed lots, blocks, building locations, and land use area.
- C. Traffic circulation, parking and loading spaces, and pedestrian walks.
- D. Landscaping plans, including site grading, landscape design, and open areas.
- E. Preliminary architectural drawings for buildings to be constructed, including floor plans, exterior elevations, and sections.
- F. Preliminary engineering plans, including road improvements, storm drainage system, public utility extensions, water supply, and sanitary sewer facilities.
- G. Engineering feasibility studies of any anticipated problems which might arise due to the proposed development, as required by the Planning Board.
- H. Construction sequence and time schedule for completion of each phase for buildings, parking spaces, and landscaped areas.
- I. A description of the proposed uses, including hours of operations, number of employees, expected volume of business, and type and volume of traffic expected to be generated.
- J. A completed Environmental Assessment Form.

Section VIII.

Local Law 1997-1 is hereby amended to add a new Section 606.41 to read as follows:

Section 606.41 SUBMISSION OF ADDITIONAL SUPPORTING DATA FOR  
SITE PLAN OF WIND POWER ELECTRICITY  
GENERATION AND TRANSMISSION FACILITIES.

In addition to the site plan material listed in Section 606.4, the following material shall be submitted to the Planning Board for commercial wind power electricity generation and/or transmission facilities:

- A. Digital elevation model-based project visibility map showing the impact of topography upon visibility of the project from other locations, to a distance radius of three miles from the center of the project. Scale used shall depict 3-mile radius as no smaller than 2.7 inches, and the base map used shall be a published topographic map showing cultural features.
- B. No fewer than four and no more than the number of proposed individual wind turbines plus three color photos, no smaller than 3"x5", taken from locations within a 3-mile radius from it and to be selected by the Planning Board, and computer-enhanced to simulate the appearance of the as-built aboveground site facilities as they would appear from these locations.

Section 606.5 - SITE PLAN APPROVAL

The Planning Board shall review the site plan and supporting data before approval, rejection, or approval with stated conditions as given, and take into consideration the following:

- A. Harmonious relationship between proposed uses and existing adjacent uses.
- B. Maximum safety of vehicular circulation between the site and road network.
- C. Adequacy of interior circulation, parking and loading facilities, with particular attention to vehicular and pedestrian safety.
- D. Adequacy of landscaping and setbacks in regard to achieving maximum compatibility and protection to adjacent residential districts.

Should changes or additional facilities be required by the Board, final approval of the site plan shall be conditional upon the satisfactory compliance by the owner with the changes or additions.

Any owner wishing to make changes in an approved site plan shall submit a revised site plan to the Planning Board for review and approval.

Section 607 - CHANGES AND AMENDMENTS OF THE LAND USE LOCAL LAW

Section 607.1 - PERIODIC REVIEW

From time to time, the Town Planning Board may re-examine the provisions of this local law and the location of district boundary lines and may submit a report to the Town Board recommending such changes, or amendments, if any, which may be desirable in the interest of the safety, health, or welfare of the public.

Section 607.2 - PROCEDURE FOR AMENDMENTS

- A. Regulations, districts and boundaries established by this local law may be amended or repealed after official notice has been given and a public hearing has been held by the Town Board as required by law.
- B. Each petition requesting a change of land use regulations or district boundaries shall be typewritten, signed by the owner, and filed in triplicate with the Town Clerk accompanied by the required fee, which shall be determined from time to time by resolution of the Town Board.

Town of Stockbridge, Madison County

TOWN OF STOCKBRIDGE  
LAND USE LAW

First Draft Amendments: Proposed New Sections (4/18/02)  
(Italics indicate variation from Fenner language)

SECTION 303. – WIND POWER DISTRICT, WP

The purpose of this district is to foster the development of the Town's windpower resources while preserving farmlands and adjoining settlements as compatible adjoining uses.

SECTION 303.1 – PRINCIPAL USES PERMITTED

Same as Section 302.1

SECTION 303.2 – ACCESSORY USES PERMITTED

Same as Section 302.2

SECTION 303.3 – USES REQUIRING A SPECIAL USE PERMIT

- A. Same as Section 302.3
- B. Wind power electricity generation and transmission facilities (See Note H to Table 1)

SECTION 605.10.1 – ADDITIONAL STANDARDS FOR GRANTING SPECIAL USE PERMITS FOR WIND POWER ELECTRICITY GENERATION AND TRANSMISSION FACILITIES

No special use permit shall be granted for commercial wind power electricity generation and/or transmission facilities unless it is determined by the Planning Board, *on the basis of documentation submitted by the applicant or testing required by that Board*, that the proposed use meets all of the following criteria, in addition to those general criteria listed in Section 605.10.

- A. No individual tower facility shall be installed in any location along the major axis of an existing microwave communications link where its operation is likely to produce electromagnetic interference in the link's operation.
- B. No individual tower facility shall be installed in any location where its proximity with fixed broadcast, retransmission, or reception antenna (including residential reception antenna) for radio, television, or wireless phone or other personal communications systems would produce electromagnetic interference with signal transmission or reception.
- C. Use of nighttime, and overcast daytime condition, strobe tube aviation safety lighting to satisfy tower facility lighting requirements for the Federal Aviation Administration *may* be subject to on-site field testing before the Planning Board as a prerequisite to that Board's approval with specific respect to Section 605.10 D as it applies to existing residential uses within 1500' of each tower for which such strobe lighting is proposed *on property belonging to anyone other than the owner of the tower facility in question*.
- D. No individual tower facility shall be installed in any location that would substantially detract from or block view of *the major* portion of a recognized scenic *vista*, as viewed from any public road right-of-way publicly owned land within the Town of Stockbridge [~~delete '...that extends beyond the border of the Town of Stockbridge'.~~]
- E. Individual wind turbine towers shall be located with relation to property lines so that the level of noise produced *by* wind turbine operation shall not exceed 50 dbA, measured at the boundaries of all the closest parcels that are owned by non-owners of turbine sites and that abut either the turbine site parcel(s) or any other parcels adjacent to a site parcel and held in common by the owner of a site parcel, as those boundaries exist at the time of the special use permit application.
- F. No wind turbines shall be permitted that lack an automatic braking, governing, or feathering system to prevent uncontrolled rotation, overspeeding, and excessive pressure on the tower structure, rotor blades, and turbine components.
- G. The minimum distance between the ground and any part of the rotor blade system shall be thirty (30) feet.

- H. All power transmission lines from the wind electricity generation facilities to on-site electrical substations shall be underground.
- I. Procedures acceptable to the Planning Board for emergency shutdown of power generation units shall be established *as a part of any special use permit issued*.
- J. Prior to issuance of a Building Permit, the applicant shall provide the Town proof, in the form of a duplicate insurance policy or a certificate issued by an insurance company, of liability insurance, of a level to be determined by the Town Board in consultation with the Town's insurer, to cover damage or injury which might result from the failure of a tower or towers or any other part or parts of the generation and transmission facility.

SECTION 606.12.1 – SUBMISSION OF ADDITIONAL SUPPORTING DATA FOR SITE PLAN OF *COMMERCIAL* WIND POWER ELECTRICITY GENERATION AND TRANSMISSION FACILITIES

In addition to the site plan material listed in Section 606.12, the following material shall be submitted to the Planning Board for commercial wind power electricity generation and/or transmission facilities:

- A. A project visibility map, *based on a digital elevation model*, and showing the impact of topography upon visibility of the project from *surrounding* locations *out to a radius of three miles* from the center of the project. The Scale used shall depict the three-mile radius as no smaller than 2.7 inches, and the base map used shall be a published topographic map showing man-made features, such as roads and buildings.
- B. *Color photos, no smaller than 3"x 5", taken from locations, selected by the Planning Board, within a three-mile radius from the center of the project and computer-enhanced to simulate the appearance of the as-built site facilities as they would appear, as built, from these locations. No fewer than four, and no more than the number of proposed individual wind turbines plus three, such photo simulations shall be provided, the exact number and locations to be determined by the Planning Board.*

# Commission on Wind Energy Regulatory Policy

## Miscellaneous Information Request

October 28, 2004

### OVERVIEW

The following document provides information in response to various requests from Commissioners on specific wind energy topics, including:

- **Renewable Energy Certificates.** Information on Renewable Energy Certificates (RECs). What are RECs? How are RECs and electricity sold?
- **ANR Wildlife Studies.** Update on ANR's efforts to gather new bird and bat info (study expected this winter)
- **Visual Impact Assessment Information.** More info on visual impacts and assessment techniques and any measures to objectively quantify visual impact.
- **Noise and Low Frequency Noise.** Background and info resources on noise, specifically low frequency noise, and possible public health and environmental impacts.
- **Strobe Effect or Flicker.** Background and info resources on "strobe effect" or flicker experienced in the turbine's shadow.
- **USFWS Update.** Information on the US Fish and Wildlife Services "Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines".
- **European Offshore Project Failure.** Information in response to concerns that offshore wind projects are failing and being dismantled.

### RENEWABLE ENERGY CERTIFICATES

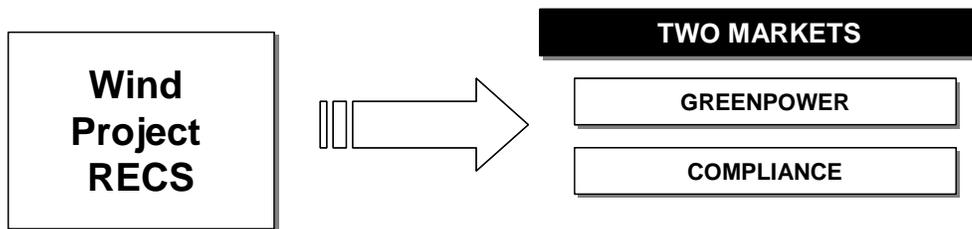
The following discussion is intended to clarify what is meant by the term "renewable energy certificates", or RECs, and to provide information about their value and function in the energy marketplace relative to electricity transactions.

Operational wind projects produce two commodities – electricity and attributes – and therefore have two corresponding revenue streams. Each of these revenue streams is important to a projects economic feasibility. As shown in the figure below, in the electricity marketplace wind power attributes can be transacted separately from their corresponding energy. Energy is sold in the form of kilowatthours (kWh); attributes are sold as renewable energy certificates, or RECs.

The same holds true for all of New England. In collaboration with the operator of the New England regional transmission grid, the New England states have created a regional market for RECs. All renewable electricity available in the region now also has these certificates (RECs) associated with it. Through this system, the renewable attributes are accounted for separately from the actual energy being generated. The additional value of these RECs provides an incentive for new renewable energy plants to be built. In those New England states that require power companies to sell a certain percentage of renewable energy to their customers, ownership of these RECs is how these companies certify what they are providing.

## How are RECs used?

As indicated in the figure below, RECs produced by wind projects can either be sold into green power markets or compliance markets. In the first instance, RECs from a wind project might be sold to a green power marketer that wants to sell wind energy to green power customers in Vermont. Alternatively, RECs from a wind project could be sold to electricity suppliers that need to comply with a Renewable Portfolio Standard (RPS).<sup>1</sup> Although unlikely, RECs could also be sold as a means of compliance with other environmental regulations, for instance to help electricity generators meet air emissions standards for NO<sub>x</sub> and SO<sub>2</sub> emissions.



REC trading maximizes the potential value of a renewable generation project because it allows the market to allocate the RECs and electricity to the buyers that value them most. For example, the most interested buyer of the RECs may have no need of the underlying electricity. The ability to sell the two commodities independently permits greater flexibility in forward contracts.

## What do RECs mean for Vermont?

Given the immature state of renewable energy markets, determining the future value of RECs is challenging. In spite of the current dynamic and nascent marketplace for RECs, one thing remains certain: RECs from a wind project will be sold to the highest bidder that is able to provide a viable long-term contract. At present, wind RECs generated in Vermont would likely be sold either into the green power market, or more likely to electricity suppliers in New England states with the most stringent RPS requirements, and therefore the highest willingness to pay for RECs. In either case, the REC transaction would support the development of wind energy in Vermont.

Some stakeholders have theorized that RECs from Vermont wind projects could be sold into Midwest compliance markets to allow heavily polluting coal-fired utilities to meet their emissions or RPS obligations. However, this is an unlikely scenario. RECs in the New England market are currently valued more highly than either RECs or emissions credits currently traded in Midwest states. The Midwest RPS markets are less developed and Midwest markets have access to lower cost and abundant Midwest wind projects. Other market rules aside (e.g., New England RPS's typically require New England RECs), it is therefore improbable that a Midwest electricity generator would pay a premium for out of region RECs (e.g., New England), when its REC obligation could be met most economically by purchasing RECs available within the region.

## Could electricity from Vermont wind projects be sold out of state?

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<sup>1</sup> In New England, renewable portfolio standards are in effect in Massachusetts, Connecticut, and Maine. A renewable portfolio standard is currently under consideration in Vermont.

In addition, some stakeholders have expressed concern that electricity from new wind power projects in Vermont will be sold to buyers outside of the state. While this is possible, it is more likely that electricity (from at least the first several projects) would be sold within the state, or at the very least, to buyers in New England. Vermont wind developers have indicated that agreements to sell electricity to Vermont utilities are in development. In addition, most major Vermont utilities have included wind in their long-term planning (Integrated Resource Plans), and there are complexities associated with selling electricity from a Vermont wind project to buyers outside of the New England market.

## **ANR'S WILDLIFE STUDIES**

Per a conversation with Forest Hammond, an ANR Biologist, ANR is preparing a new wind project wildlife study. The initial drafts of the study will not be available until this winter. To get a better idea of the scope of ANR's study for wildlife issues, he recommended that we check out ANR's position on wildlife studies from the discussion of wind development on state lands (it could be applicable to other lands as well). In summary, it identifies ANR's key areas of concern regarding wildlife:

- risk of mortality to migrating and resident birds;
- risk of mortality to migrating and resident bats;
- loss of significant wildlife habitat such as nesting habitat for Bicknell's thrush, wintering habitat for moose, or black bear and bobcat feeding habitat and den sites
- fragmentation of habitat and attendant effects on wildlife such as disruption of movement or migration, increased risk of nest predation or nest parasitism to forest interior birds; and
- disruption or displacement of wildlife with low tolerance for human activities and disturbance that might result from increased access to and use of remote forest habitats.

The ANR also finds that wind development sites should be assessed for potential negative impacts using the best science and technology available to identify any wildlife-related issues prior to the initiation of development. These pre-development wildlife investigations should be rigorous and be of up to three years duration with the costs borne by the applicant. Long term (ten year) post construction impacts may also need to be monitored at developed project sites. When detrimental impacts are identified, they should be avoided through appropriate placement and design changes or mitigation measures.

For more information:

[http://www.vermontwindpolicy.org/workingpapers/wildlife\\_impact.pdf](http://www.vermontwindpolicy.org/workingpapers/wildlife_impact.pdf)

## **VISUAL IMPACT ASSESSMENT INFORMATION**

The ANR also prepared a fairly detailed methodology for assessing the visual impact of wind sites (in the context of the Quechee analysis). The methodology included developing answers to various questions associated with detailed visual impact mapping and modeling as well as with the local community (including considerations of regional plans) and recreational visitors.

For more information on the ANR visual impact assessment methodology:

<http://www.vermontwindpolicy.org/workingpapers/aesthetics.pdf>

The following is several examples of the detail involved in visual impact analysis and modeling for wind sites:

<http://www.bwea.com/planning/presentations/hartlepool/Thomson.pdf>

The following is an example of a **quantitative** visual impact assessment of wind that uses calculations based on the visual impact of the turbines and neighboring population (most if not all assessments in the U.S. are **qualitative** based on varying degrees of visual modeling and assessments):

<http://www.uniovi.es/Areas/Mecanica.Fluidos/investigacion/publicaciones/atrpdf/Elservier2004.pdf>

## **NOISE AND LOW FREQUENCY NOISE<sup>2</sup>**

Ambient or audible noise was a serious issue with some early wind turbine designs, but it has been largely eliminated as a problem through improved engineering and through appropriate use of setbacks from residential and recreational areas. More information on wind and general noise issues can be found at:

UMASS. Wind Turbine Noise Issues.

<http://www.ceere.org/rerl/publications/whitepapers/WindTurbineNoiseIssues.pdf>

Low frequency noise has been associated with wind turbine developments, as well as road, rail, sea and air traffic and other industrial applications such as cooling towers. It creates a large potential for community annoyance, and it is most often experienced inside of homes and buildings where resonance amplifies the sound, which is less easily heard outside. Because the frequencies are so low, the noise is often “felt” as a vibration or a pressure sensation. Reported effects include annoyance, stress, fatigue, nausea and disturbed sleep. Low frequency noise can be a factor at much greater distances from the noise source than audible noise. While the phenomenon was originally believed to be associated with the older, down-wind designed turbines, the problem persists with newer wind farms. It has received particular attention in Europe.

Typically, low frequency noise can be addressed within regulations and setbacks. It is particularly important to define a standard for investigation and measurement. One standard was developed for the U.S. Department of Energy in 1987 (see below). Significant setbacks from residences might also be effective. However, it is likely that these setbacks would need to be measured in miles rather than feet. Software exists which can predict noise emissions and low frequency noise from wind developments. For more information see the following:

American Wind Energy Association Answer to Low Frequency Noise Issue. Also Reference to Study on Proposed Metric for Assessing the Potential of Community Annoyance from Wind Turbine Low-Frequency Noise Emissions:

<http://www.awea.org/faq/noise-lf.html>

UK Reviews of Low Frequency Noise and its Effects

<http://www.defra.gov.uk/environment/noise/lowfrequency/pdf/lowfreqnoise.pdf>

<http://www.scotland.gov.uk/library3/environment/lfn-00.asp>

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<sup>2</sup> Summary information on low frequency noise derived from Otsego County (Michigan) Planning Commission White Paper (2004).

Example of Media Coverage of Studies on Impacts of Low Frequency Noise From Wind (none of the references studies were found online):

<http://millennium-debate.org/suntel25jan042.htm>

Riverside, CA zoning ordinances prohibit wind within 2 miles of residents unless developer can demonstrate no low frequency impact:

[http://www.rcip.org/documents/general\\_plan/gen\\_plan/03\\_d\\_16.pdf](http://www.rcip.org/documents/general_plan/gen_plan/03_d_16.pdf)

### **STROBE EFFECT AND FLICKER<sup>3</sup>**

In summary, shadow flicker is caused by the sun rising or setting behind the rotating blades of a turbine. The shadow created by the rotating blades can cause alternating light and dark shadows to be cast on roads or nearby premises, including the windows of residences, resulting in distraction and annoyance to the residents. A related phenomenon, strobe effect, is caused by the chopping of sunlight behind moving blades, similar to the effect of the setting sun behind trees when driving along a roadway in the winter. Both of these phenomena are factors in the visual impact of a wind turbine project, and some argue that they are a threat to health and safety. They could also be considered a nuisance to nearby property owners.

Setbacks are one option for dealing with potential shadow casting problems. Establishing setbacks would still require calculation of “typical” shadow casting to determine appropriate distances unless the setbacks were substantial. Also, with the variability in wind turbine size, the setback distances would need to be based on some sort of formula using rotor diameter and hub height. Shadow casting studies, using existing technology, would be an alternative approach to protecting nearby locations from potential harmful impact. It is relatively straightforward to model and predict flicker and strobe impacts as part of a permitting process. Some additional resources:

Danish Wind Energy Association description of flicker:

<http://www.windpower.org/en/tour/env/shadow/>

Example of flicker modeling and methodology:

<http://www.efsec.wa.gov/wildhorse/deis/apendices/05%20Wind%20Engineers%2011-20-03%20memo.pdf>

### **U.S. FISH AND WILDLIFE UPDATE**

The U.S Fish and Wildlife Service (the Service) recently published interim guidelines to help energy companies avoid and minimize wildlife impacts from wind turbines. The guidelines were established to assist energy companies locate and design wind energy facilities in a manner that ensures protection of wildlife resources, while streamlining the site selection and facility design process and avoiding unanticipated conflicts after construction.

The guidelines primarily focus on three key areas: the proper evaluation and selection of potential wind energy development sites, the proper location and design of turbines and associated structures within sites selected for development, and pre- and post-construction research and monitoring to identify and assess impacts to wildlife.

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<sup>3</sup> Summary information derived from Otsego County (Michigan) Planning Commission White Paper (2004).

Examples of the guidelines include avoiding the placement of turbines in documented locations of any species protected under the Federal Endangered Species Act; avoiding fragmentation of large, contiguous tracts of habitat; using tubular supports with pointed tops to minimize bird perching; and avoiding solid red or pulsating red incandescent lights as they appear to attract night-migrating birds.

The Service is encouraging immediate use of the guidelines by the wind energy industry and soliciting comments on the effectiveness of the guidelines. The guidelines are being evaluated over a two-year period, and will be modified as necessary based on their performance in the field and on the latest scientific and technical discoveries. Comments on the interim guidelines must be postmarked by July 10, 2005.

A detailed copy of the guidelines can be found at:

<http://www.fws.gov/r9dhcbfa/windenergy.htm>

## **EUROPEAN OFFSHORE PROJECT FAILURE**

There has been a series of comments related to the technical problems with offshore wind projects in Europe. Most of this could be related to problems at Horns Reef:

Following a series of problems with the operation of the Horns Reef offshore wind power project in Denmark (flagship large offshore wind project, 160 MW), Vestas decided to dismantle the nacelles installed at the site and transport them to land for testing and repair. Work on the units is completed and reinstallation is almost complete. For more information see:

Power Engineering Editorial:

[http://pepei.pennnet.com/Articles/Article\\_Display.cfm?Section=CURRI&ARTICLE\\_ID=212217&VERSION\\_NUM=1&p=17](http://pepei.pennnet.com/Articles/Article_Display.cfm?Section=CURRI&ARTICLE_ID=212217&VERSION_NUM=1&p=17)

Innovations Report (German Magazine):

[http://www.innovations-report.de/html/berichte/energie\\_elektrotechnik/bericht-31048.html](http://www.innovations-report.de/html/berichte/energie_elektrotechnik/bericht-31048.html)