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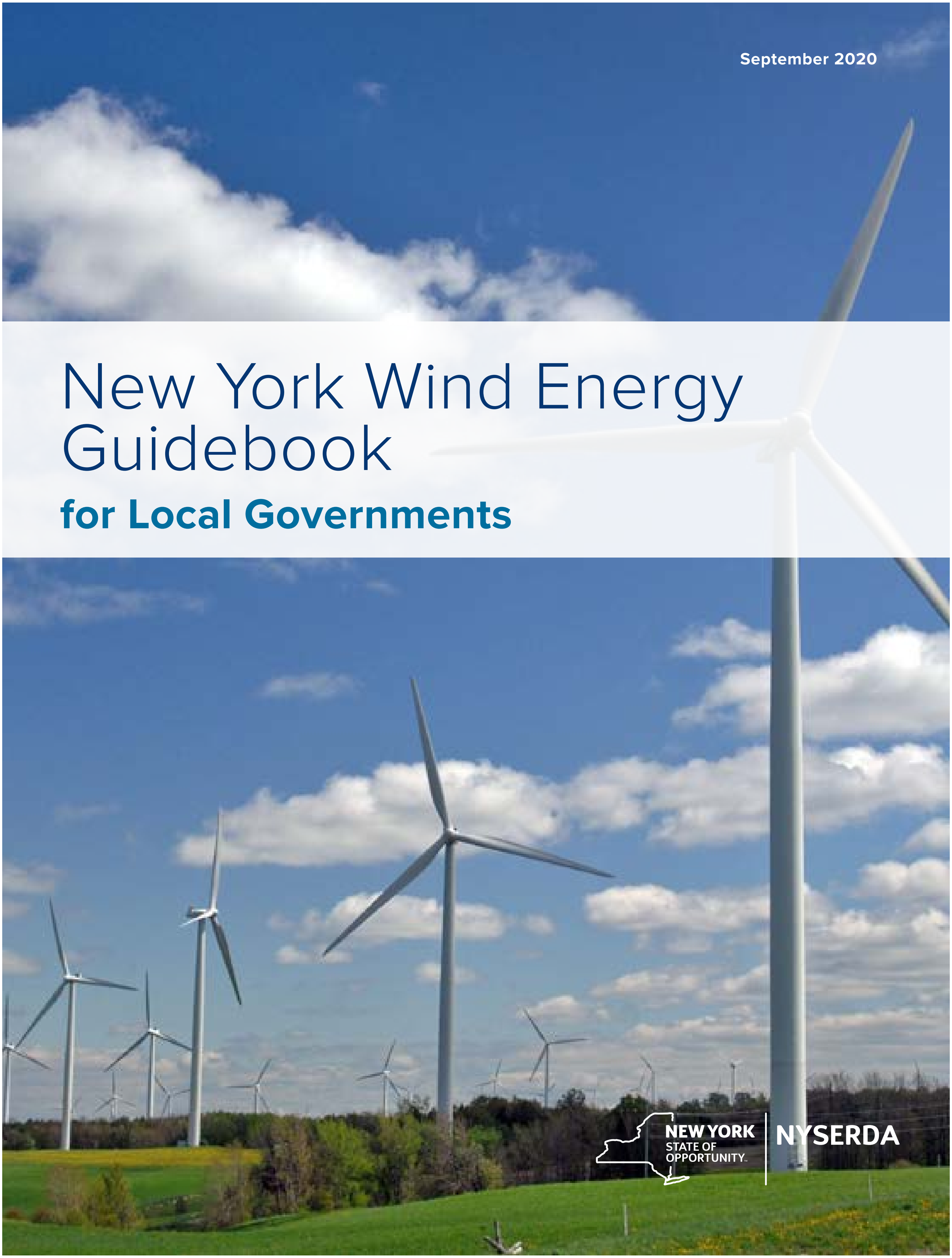

New York Wind Energy Guidebook

for Local Governments

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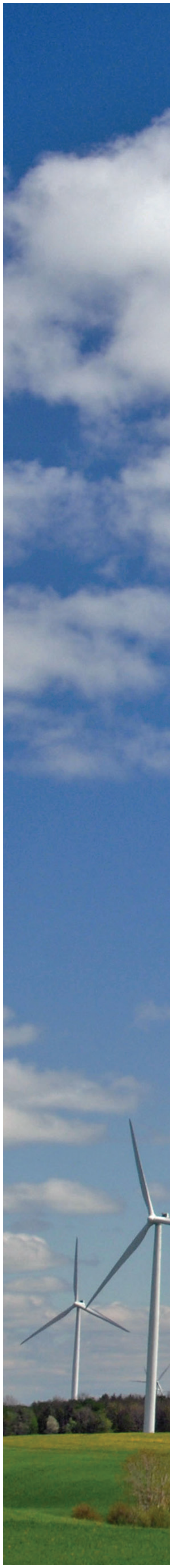

New York Wind Energy Guidebook

Wind energy, both land-based and offshore, is instrumental for New York State to reach its clean energy goals of 70% renewable energy by 2030 and 100% clean electricity by 2040. As wind energy continues to grow, the New York Energy Research and Development Authority (NYSERDA) recognizes the need for guidance to help foster responsible wind energy development in the State.

NYSERDA is working to raise awareness among local officials, developers, and the public by providing accurate, objective information on critical wind energy issues and the processes, regulations, and other important considerations involved in siting wind projects. This Wind Energy Guidebook (Guide) focuses on land-based wind only, and is intended to help local decision-makers and other community members prepare for and understand wind energy development.

As of March 2020, 385 megawatts (MW) of land-based wind capacity have been installed in New York State, and more projects are being considered or have been proposed. In the first three large-scale renewables solicitations issued under the Clean Energy Standard in 2017-19, NYSERDA has awarded renewable energy credit contracts to seven additional wind projects, with a total capacity of 1,202 MW. Additionally, NYSERDA has awarded contracts to three existing wind projects totaling 160 MW that will be upgraded to increase their generation. NYSERDA will issue similar solicitations for land-based renewable generation—including wind, solar, and hydropower —each year through 2030.

Local government officials can request free technical assistance to help further understand the issues addressed in the Guide at cleanenergyhelp@nyserda.gov.

You can download specific chapters of the New York Wind Energy Guidebook at nyserda.ny.gov/WindGuidebook

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NYSERDA offers objective information and analysis, innovative programs, technical expertise, and support to help New Yorkers increase energy efficiency, save money, use renewable energy, and reduce reliance on fossil fuels. NYSERDA professionals work to protect the environment and create clean energy jobs. A public benefit corporation, NYSERDA has been advancing innovative energy solutions since 1975.

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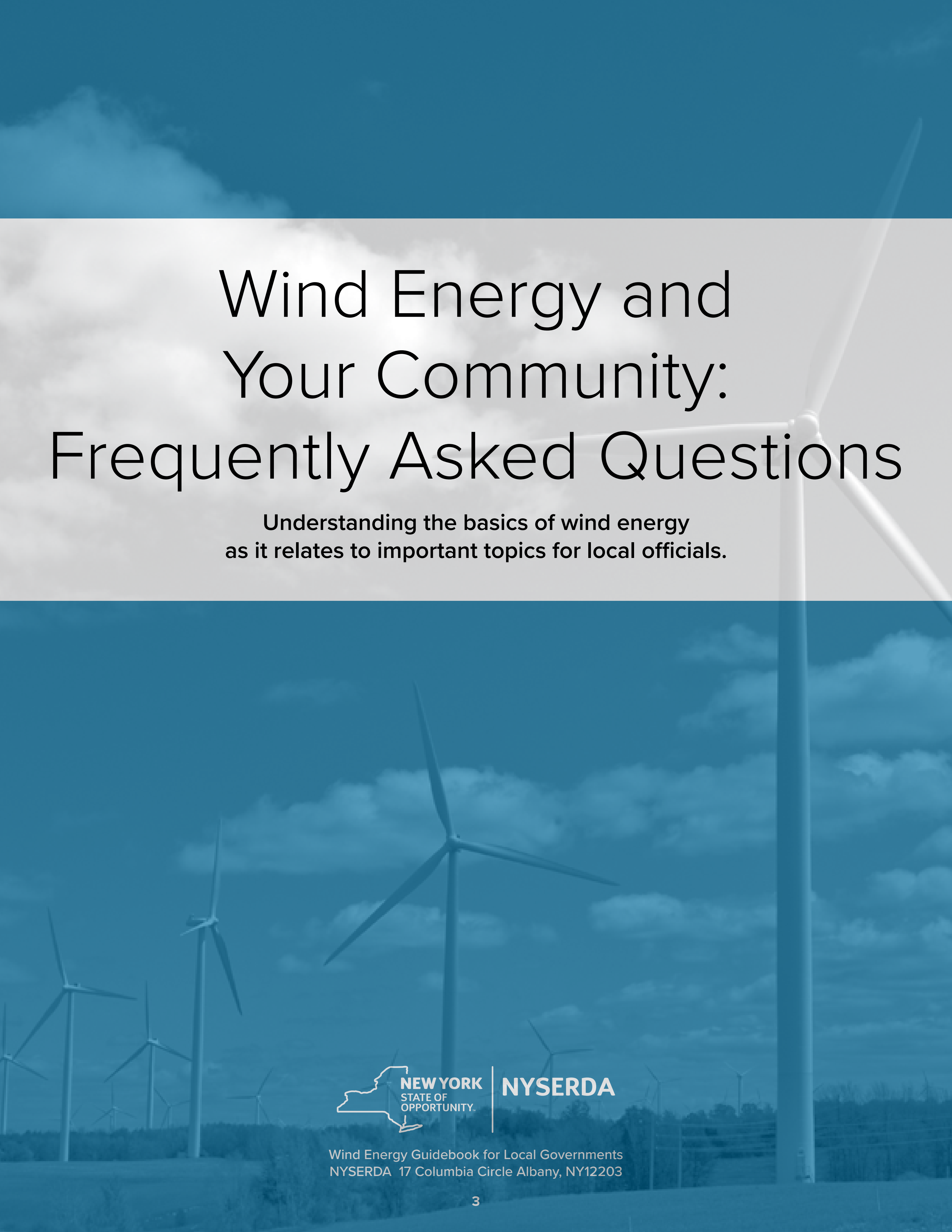

Wind Energy and Your Community: Frequently Asked Questions

Understanding the basics of wind energy as it relates to important topics for local officials.

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Wind Energy Guidebook for Local Governments
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Section Contents

Overview

This section addresses topics that are of great interest to local officials and their community members. Topics covered include local officials' role in planning and permitting, environmental impacts, health impacts, noise, shadow flicker, roads, property value, and visual impact and safety concerns.

More in-depth information and resources may be found in the subsequent sections of the Guide.

1. Local Role in Planning and Permitting

1.1 Who approves the siting and permitting of a wind project?

The majority of wind projects built in New York State will be permitted through one of two comprehensive State-level siting mechanisms: the "Article 10" process, or the Office of Renewable Energy Siting (ORES) review process. Smaller wind energy facilities may be permitted at the local level in accordance with the State Environmental Quality and Review Act (SEQR) and applicable municipal land-use regulations.

Article 10 of New York State's Public Service Law authorizes the New York State Board on Electric Generation Siting and the Environment (Siting Board) to issue certificates approving the construction and operation of major electric generating facilities (equal to or greater than 25 megawatts [MW]), including both renewables and conventionally fueled systems. The Siting Board comprises both permanent members (consisting of State agency heads from the Public Service Commission, Department of Environmental Conservation and Health, NYSERDA, and Empire State Development) as well as ad-hoc appointees from the involved municipality(ies). The Article 10 process is unified instead of requiring separate state and local permits.

Article 10 review requires environmental and public health impact analyses, studies regarding environmental justice and public safety, and consideration of applicable local laws. It also encourages public participation in Siting Board decisions and directs project developers to provide funding for affected municipalities and other parties to hire experts to assist with application review.

ORES, as created by the Accelerated Renewable Energy Growth and Community Benefit Act in April 2020, will serve as the future forum for siting and permitting new large-scale renewable energy facilities larger than 25 MW. Additionally, proposed facilities between 20-25 MW and projects in the early stages of Article 10 review may opt-in to the ORES process in the future. Within a year of its creation, ORES will establish and promulgate comprehensive regulations and uniform permit standards and conditions to ensure that siting decisions are predictable, responsible, and timely.

1.2 What deadlines or important dates must a municipality be aware of?

For wind projects seeking permit approvals through a State-level siting process, there will be deadlines or important dates that municipalities should be aware of to stay engaged and participate fully. Key deadlines and project milestones will vary between the Article 10 and ORES review processes, as detailed below.

Article 10:

The Article 10 application process can be broken down into four key periods, spanning the start of the pre-application process to the Siting Board's final ruling. For reach of these periods, there are deadlines that a municipality should be aware of to remain engaged. These periods are:

1. The Public Involvement Plan (PIP) Process

2. The Pre-Application Process

3. The Application Process

4. The Final Decision

Public Involvement Plan Deadlines

- The applicant must submit a proposed PIP no less than 150 days before submitting a Preliminary Scoping Statement (PSS). This is important because the PIP requires applicants to include a website where the public can learn about project details and events related to the project.[1]
- The Department of Public Service (DPS) must submit written comments no more than 30 days after the PIP submission.[2]
- If the proposed PIP is deemed inadequate by DPS, the applicant shall attempt to comply with DPS recommendations no more than 30 days after comments are received.[3]

Pre-Application Process Deadlines

- A municipality must submit any comments to the applicant and the secretary of the New York State Public Service Commission (PSC) no more than 21 days after applicant submits their PSS.[4]
- The applicant has no more than 21 days to respond to the municipality's comments.[5]
- Requests for pre-application intervenor funds must be made to the presiding examiner no later than 30 days after notice of the intervenor funds.[6]
- A meeting discussing pre-application intervenor funds must be held no less than 45 days, but no later than 60 days, after the PSS has been filed.[7]
- The presiding examiner has no more than 60 days after filing of the PSS to initiate a stipulation process concerning issues relating to the PSS mediation between the applicant and all other interested parties.[8]

Application Process Deadlines

- An affected municipality has the right to be a party in an Article 10 proceeding by filing a notice of intent with the siting board no more than 45 days after the application is filed.[9]
- Requests by a party for intervenor funds must be made to the presiding examiner no later than 30 days after notice of the intervenor funds.[10]

Final Decision Deadlines

- The siting board has no more than one year to make a final decision after the application process has started.[11]
- A municipality has no more than 30 days to appeal the final decision made by the siting board.[12]

ORES:

The ORES application process also includes a number of important deadlines and protocol for municipalities to be aware of:

- Prior to filing an application for a siting permit with ORES, applicants must consult any municipality wherein the project is proposed to be located. No application shall be deemed complete without proof of consultation.[13]
- Within 60 days of receiving an application, ORES must evaluate and determine whether the application is complete and notify the applicant of its determination.[14]
- Once deemed complete, ORES has 60 days to publish draft permit conditions for public comment, and shall notify the host municipality of the commencement of the public comment period.[15]
- The public comment period shall last a minimum of 60 days following public notice.[16]
- Within this period, the municipality shall submit a statement to ORES indicating the proposed project's compliance with applicable local laws and regulations.[17]
- Depending on the received public comments, including any statements from municipalities in which the project is proposed to be located, ORES may promptly schedule adjudicatory or non-adjudicatory public hearings.[18]
- Following the public comment period and any hearings, ORES shall issue a written report addressing the preceding public comments and/or hearings.
- ORES shall issue a final determination on a siting permit application within one year from the date the application was deemed complete, or within six months if the project is to be sited on an existing or abandoned commercial location, such as a brownfield, landfill, or other underutilized site.[19]
- A municipality may seek judicial review of a final permit decision made by ORES within 90 days following the issuance of the final determination.[20]

Note: Within one year of its creation in April 2020, ORES is required to establish comprehensive regulations and uniform permit standards and conditions. NYSERDA will update this Guidebook as needed to reflect any additional key deadlines and dates for municipalities.

2. Environment

2.1 Are there environmental impacts associated with wind turbines?

Wind turbines are environmentally low-impact compared to coal, natural gas, and nuclear power plants. In general, they do not cause air, water, or ground pollution; produce toxic chemicals or radioactive waste; or require mining or drilling for fuel. However, like any other major construction project, wind energy projects introduce the possibility of a variety of potentially harmful environmental impacts, many of which can be prevented or mitigated.

Once operating, wind project sites may also have environmental impacts. To minimize and mitigate potential impacts, developers must meet federal, state, and local guidelines and requirements for project design, construction, and operation.

2.2 Will wind turbines harm birds and bats?

Direct impacts on wildlife including birds and bats may occur as the result of collisions with the turbine blades and towers. There is also the potential for indirect impacts, which may include outright loss of habitat, or a behavioral response resulting in habitat displacement.

Surveys of scientific literature have shown that, overall, the negative impacts of wind energy on wildlife are significantly less than those of fossil fuel and nuclear generation. New York State requires both pre-and post-construction studies of birds and bats in the project area, and mitigating measures when appropriate.

2.3 What is the potential impact to birds and bats?

The rate of bird collisions is subject to a wide range of factors that include weather, seasonality, species, turbine design, and site characteristics. Typically, passerines (perching birds, including songbirds) are the group most impacted by wind turbines.

In North America, most wind facility collision fatality monitoring studies report fatality rates of three to five birds per megawatt (MW) per year, inclusive of all affected species.[21] This impact is significantly smaller than other factors, including predation by cats and collisions with other structures and vehicles. Songbird populations number in the millions, and there is no evidence that fatalities from existing wind facilities are causing measurable changes in bird populations in the U.S.

Nationally, wind facilities have reported bat fatality rates ranging from two to greater than 30 per MW per year. The reasons for differences among sites are not well understood; however, at all sites in the State, bat fatalities are generally highest among migratory species in late summer and early fall. The status of many bat populations is poorly known, and the ecological impact of current bat fatality levels is not yet understood. As a result, many projects have committed to reducing fatality rates by implementing mitigation measures such as curtailing operations during peak migration periods.

2.4 How can potential impacts be mitigated?

New York State law requires the potential environmental impacts of each proposed wind facility be assessed through a public process that includes consultation with State and federal wildlife agencies and other stakeholders. During this process, surveys to assess bird and bat activity in the project area are typically conducted to determine the potential for adverse impacts and how they can be avoided or minimized.

The New York State Department of Environmental Conservation (DEC) has provided guidelines for assessing impacts on birds and bats since 2008. In 2016, DEC released updated Guidelines for Conducting Bird and Bat Studies at Commercial Wind Energy Projects.[22]

The DEC guidelines provide useful information for developers to help determine potential impacts to wildlife, including the following:

- Consistent and predictable methodologies, based on the latest scientific knowledge, to assist developers in the planning, development, and monitoring process
- Standards for rigorous pre-construction surveys and impact studies to estimate potential impacts in the project area
- Guidelines for post-construction studies to estimate direct and indirect impacts during operation, and help in identifying operational methods or technologies to reduce impacts as much as possible

Significant impacts are often avoided through effective wind turbine siting practices that discourage development in locations with highest risk to wildlife; for instance, locations in close proximity to bat hibernation sites should be avoided.

In some cases, operational mitigation may be implemented to limit impacts to acceptable levels. For example, bats are known to fly more frequently on nights with lower wind speeds, and the potential for bat fatalities can be reduced by increasing the cut-in speed (the wind speed at which the turbines begin to operate) at night during peak periods of bat migration (summer and fall). This low wind speed curtailment has been shown to reduce bat mortality rates by 40 to nearly 90%.[23]

Ongoing research, supported by the U.S. Department of Energy (DOE), wind turbine manufacturers, conservation organizations and others, is leading to the development of innovative technologies that can deter birds and bats from approaching operating turbines,[24] or curtail operations when their presence is detected.[25] While these technologies are not yet fully developed, they offer the possibility of better wildlife protection while minimizing lost clean energy production.

2.5 What happens to the land after the end of the wind turbine's life cycle?

When a wind project reaches the end of its useful life, the equipment may be repowered (replaced with newer equipment) or decommissioned (removed). Responsibilities for equipment salvage and removal and landscape restoration are addressed before the wind project is built.

Typically, the developer must post a bond for the cost of decommissioning. If turbines are decommissioned, the bonding will ensure the structures are removed, and the land is returned as close to its original condition as possible.

However, since the wind resource remains, and related infrastructure (roads, transmission lines, etc.) is already in place, wind project owners may prefer to repower. In repowering, old turbines at the end of their lifespan are upgraded or replaced with new ones, often in the same locations.

3. Health Impacts

3.1 Are there health impacts associated with wind turbines?

Numerous government health organizations from around the world have studied the potential health impacts of wind turbines, including the DOE, the Massachusetts Department of Public Health and Environmental Protection, Minnesota Department of Health Environmental Health Division, National Health and Medical Research Council of Australia, the UK Health Protection Agency, and the Council of Canadian Academies. These and other researchers have produced more than 80 peer-reviewed studies on the health impacts of turbines.

The general conclusion from these studies is that living near wind turbines does not pose a risk to human health. Some studies have found that individuals living in very close proximity to wind turbines can find them annoying; annoyance may lead to sleep disturbance and other effects that can adversely affect health. Studies show that a combination of measures, such as establishing responsible wind turbine siting standards, early and strong public participation, and providing benefits to the host community, resulted in greater public acceptance and less annoyance by residents.

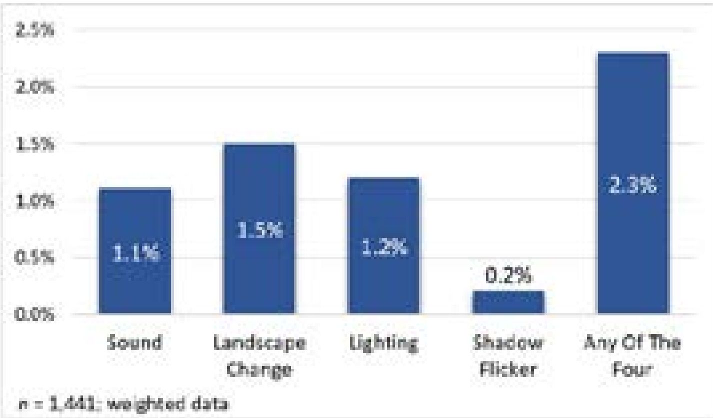
3.2 How common is annoyance for residents near wind development, and what are the main causes and considerations?

Lawrence Berkeley National Laboratory (LBNL) published a survey[26] of 1,700 residents across the country who live within five miles of one or more wind turbines. The study found that people living near wind turbines had more positive attitudes toward the development when they perceived the planning process as fair and are generally favorable toward wind technology. When asked about their attitude toward their local wind power project post-construction, 8% of the responses were very negative or negative, while 34% were neutral, and 57% were positive or very positive. Attitudes of those who lived within 0.5 miles were slightly less positive than those living between 0.5 to 3 miles away.

In the LBNL study, residents' annoyance levels increase with proximity to turbines, and the source of annoyance varied among respondents. Amongst the residents living within three miles of a turbine, 2.3% were strongly annoyed; if further broken down by source of annoyance, 1% of respondents attributed the source of annoyance to sound and 1.5% to landscape change. This is also represented in Figure 1-1.

People may be more annoyed by noise with fluctuating characteristics, such as that from wind turbines, than by a louder, more constant sound. One study found that people were more annoyed by noise from wind turbines than by transportation noise at similar decibel levels.

Figure 1-1. Source of annoyance
(Source: LBNL 2018)



3.3 What is wind turbine syndrome?

It has been suggested that wind turbine effects such as shadow flicker, audible noise, low frequency noise, and infrasound could cumulatively contribute to wind turbine syndrome. There is no scientific or medical evidence for a set of health effects from exposure to wind turbines that could be characterized as wind turbine syndrome.[27]

3.4 What is the nocebo effect?

The nocebo effect can occur when an individual expects some aspect of their environment to produce an illness or symptoms. The individual may then start to look for these symptoms and self-report signs of the illness. This effect is the opposite of the placebo effect.

In the case of wind turbines, increased exposure to misinformation seems to increase the likelihood that certain individuals will report negative health effects such as headaches, nausea, or sleep disturbance. Whether caused by wind turbines or not, the effect on the individual can be real and is best counteracted by establishing responsible wind turbine siting requirements (especially with respect to noise and setbacks), encouraging early and strong public participation, and ensuring benefits accrue across the host community.

4. Noise

4.1 What sounds do wind turbines produce?

Wind turbines produce some mechanical sound from the operation of turbine components, such as the generator and gear box. However, the aerodynamic sound resulting from air passing over rotating blades is generally the subject of regulation and concern.

While improvements in turbine design have greatly reduced the sound emitted from modern wind turbines, unwanted sound remains an important consideration in wind turbine siting, especially in rural landscapes.

4.2 How loud is a wind energy facility?

Sound is characterized by its loudness, expressed as decibels (dB) and by its tonal quality and frequency, measured in Hertz (Hz). Of primary concern are sound impacts as perceived by the human ear, which are measured using an A-weighted scale, or dB(A).

The level of noise or sound pressure level produced by a wind turbine depends on its design, wind speed, and how sound travels across the landscape. The sound pressure level decreases or attenuates as sound spreads out and travels over distance through the air.[28] Attenuation results from distance, atmospheric absorption, building materials, and terrain effects. Typically, an operating wind energy project at a distance of 1,300 feet emits sounds at 40 dB(A)—a level comparable to a kitchen refrigerator or moderately quiet room.

Wind turbines may create more sound as wind speed increases, until the wind turbine nears its maximum electricity output at around a wind speed of 10-12 meters per second at which point it levels out. Background sounds may also increase with wind speed, as the wind blows through trees and past buildings, power lines and other objects. In some cases, it may be hard to distinguish between these background sounds and the sound from operating wind turbines.

In addition to sound pressure level, other sound qualities matter. Sound from wind turbines often has a regular fluctuating quality caused by the rotation of the blades. The resulting sound can be as benign as a swish, although under certain conditions it can become a more intrusive thump.

4.3 Should there be a minimum distance between wind turbines and homes for noise regulations?

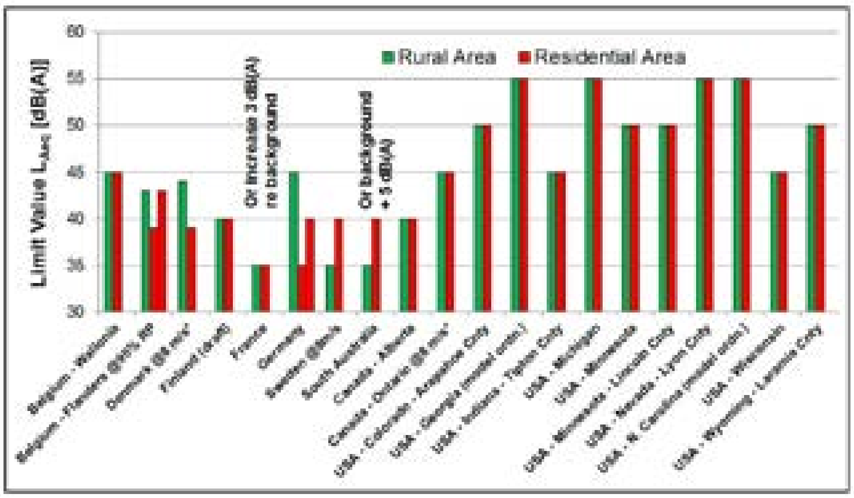
There is no simple relationship between distance and the wind turbine sound impact. As previously noted, many factors affect how sound from a wind project is perceived from any given location. Establishing a legally defensible and publicly supported noise limit is a more appropriate way to regulate noise.

4.4 What is an appropriate wind energy facility noise limit?

Since the response to noise varies by individual perception and is a subjective matter, it's difficult to define objectionable noise. One person may regard a wind turbine as noisy and disruptive while another person may not, even under the same conditions. So, while sound pressure levels can be measured and compared to regulatory limits, individual perception of sound makes control and mitigation of concerns difficult. Sound levels at locations within or around a wind energy facility may vary considerably depending on factors such as the layout of the wind energy facility, the make, model, and operating state of the turbines, the topography of the land, vegetation cover, time of year, atmospheric conditions, background noise, and the speed and direction of the wind. An effective noise standard must take all these factors into consideration.

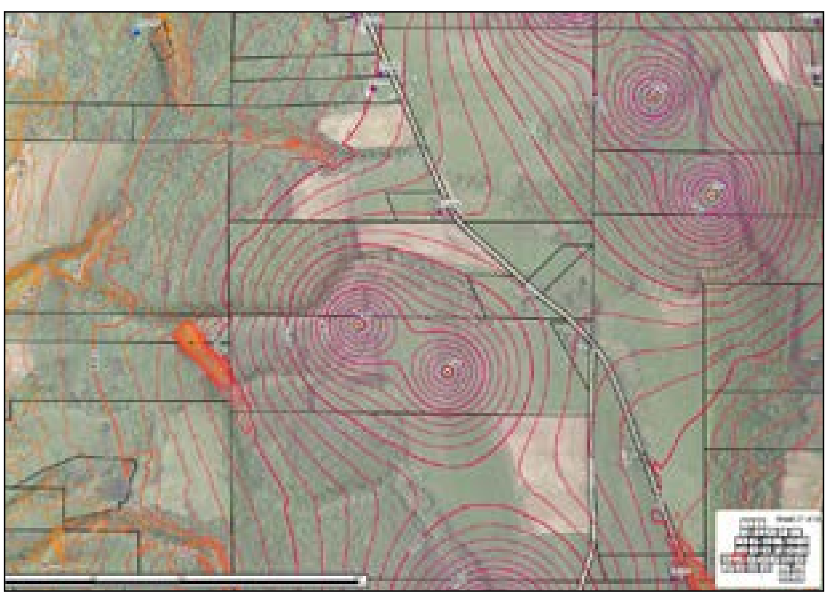
Noise standards often incorporate varied acceptable levels of sound based on the time of day (or night) and on existing land uses and background sounds (e.g., residential or industrial zones). Figure 1-2 shows a range of noise level limits from around the world.

Figure 1-2. Rural and Residential Nighttime Noise Limits Around the World
(Source: Koppen and Fowler, 2015[29])



4.5 How is noise from a wind energy facility predicted and monitored?

Figure 1-3. Cassadaga Wind Project, Sound Propagation Modeling Results, 2016
(Source: Department of Public Service, Case 14-F-0490)



A wind energy facility must operate within noise limits imposed through applicable local laws or the State-level review process through which it is permitted (Article 10 or ORES).

A wind project developer must conduct noise modeling studies using a standard methodology to predict sound levels from a wind energy facility in surrounding areas. Models are based on reasonable assumptions regarding turbine output, landscape, and weather conditions to ensure impacts are appropriately accounted for.

Pre-construction sound surveys are conducted to determine the normally occurring background noise levels at surrounding locations, and to later determine whether the wind project has added to those levels.

A wind project developer must conduct sound compliance tests once the wind energy facility is fully operational. The developer must have a process for receiving and addressing complaints from nearby residents during both construction and operation.

4.6 What is infrasound, and can it cause negative health impacts or annoyance?

Similar to many sound sources in the environment, sound from turbines includes low frequency and infrasound, which are defined as sound that is between 20 and 200 Hz and below 20 Hz, respectively. These levels are usually so low that they lie below the threshold of perception.

While health problems have been anecdotally attributed to infrasound generated by wind turbines, to date, expert panels reviewing research on this topic have found inadequate evidence linking infrasound to adverse effects on a person's health.

4.7 How does amplitude modulation impact nearby residents?

The fluctuating nature of sound produced by wind turbines, even at low decibel levels, may contribute to annoyance for nearby residents. This can be the primary cause of complaints about wind energy facilities.

Amplitude modulation is a characteristic of wind turbine sound resulting from the change in amplitude (loudness) occurring at the blade passing frequency, commonly described as a swish, thump, or whoosh. Multiple turbines operating within an area can have an amplifying effect on the modulation. The effect is typically most pronounced at night, when atmospheric conditions stabilize to create a temperature inversion. An increase in amplitude modulation under these conditions, though not always present or prominent at all sites, can result in higher levels of annoyance and sleep disturbance.

This issue can be mitigated through responsible siting standards, identifying worst-case scenarios in sound models, and in some cases, limiting turbine operations during periods of highest noise occurrence.

4.8 Do wind turbines produce tonal sound?

Tones are individual sound frequencies that can be discerned from the rest of the sound in a given spectrum. Examples of tones include notes on musical instruments, a flying mosquito, and an emergency siren.

Modern turbines incorporate noise control measures to avoid producing prominent tones that are distinctly noticeable in the community. Noise standards typically include limits on tonality to ensure that operating wind turbines do not exceed acceptable levels.

5. Shadow Flicker

5.1 What is shadow flicker?

Shadow flicker can occur when rotating turbine blades come between the viewer and the sun, causing a moving (flickering) shadow.

Shadow flicker usually occurs close to sunrise and sunset. Factors that determine how often a wind turbine will cast a shadow on a residence or other structure include turbine height and length of blades, site topography, distance between turbine and structure, season and time of day, wind direction and speed, and cloud cover. For instance, there is no shadow flicker on cloudy days or when the wind is not blowing. Shadow flicker becomes weaker with distance and is not likely to be noticeable farther than one mile from a wind turbine.

5.2 How does shadow flicker affect people?

Some residents living in close proximity to turbines have reported experiencing headaches and dizziness. Some residents also raise complaints because they find the moving shadows bothersome.

Concerns have been raised that flickering shadows could trigger epileptic seizures. However, studies have shown flicker-induced seizures are highly improbable because the frequency of blade rotation on utility-scale turbines is significantly lower than the flashing frequency that could trigger seizures.[30] No case of a seizure caused by shadow flicker from a wind turbine has been documented to date.

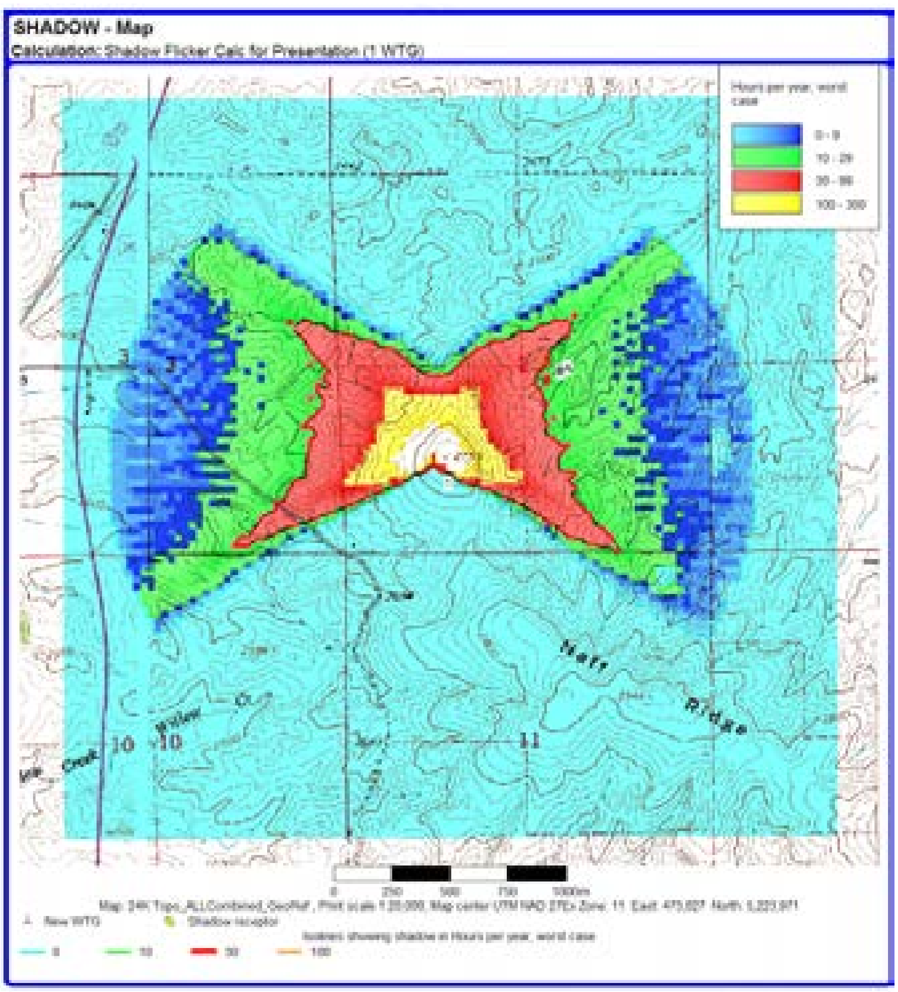
5.3 How can shadow flicker be predicted?

The impact of wind turbine shadow flicker on homes, roads, and populated areas can be reliably predicted using modeling software that calculates when and how long the sun will be directly behind a turbine from a given location.

A typical shadow flicker analysis will show the worst-case scenario, or the maximum amount of shadow flicker that could occur in each area. A second analysis will be conducted to estimate the expected amount or real-case scenario by factoring in variables such as expected hours of operation, wind direction, and cloud cover, all of which will lower the expected hours of shadow flicker. Shadow flicker analysis is typically conducted in the area within 10 times the rotor diameter of each wind turbine, which equates to roughly 3,000 ft for a typical 3 MW wind turbine. The analysis encompasses all times of day and all seasons during which the effect may occur.

Each turbine's affected area has a characteristic butterfly shape, oriented toward the rising and setting sun (Figure 1-4). Higher amounts of flicker occur nearest the turbine, with a diminishing effect at greater distances.

Figure 1-4. Modeled Shadow Flicker Map
(Source: (c) 2017 CH2M. Used with permission.)



The colored areas in Figure 1-4 indicate how many hours per year each location may experience a shadow flicker effect. The pattern will vary for each specific site and is mainly influenced by the topography of the land and the dimensions of the turbine. This example shows the difference between the expected worst-case and real-case at a specific site.

5.4 What are typical shadow flicker limits?

There are no specific federal or New York State regulations regarding shadow flicker from wind turbines. Figure 1-5[31] summarizes allowable shadow flicker guidance from various locations around the world.

Figure 1-5. Shadow Flicker Guidance

Limit Values		Country / State
Worst Case	**30 hours/year and 30 minutes a day**	Australia (Queensland, Tasmania, South Australia), Austria, Belgium (Walloon Region), Brazil, Canada, Germany, India, Serbia, Sweden, UK (England, Wales, some US states
	30 hours/year	Australian (New South Wales, Victoria), Ireland, Japan, Poland, US states Connecticut and Wisconsin
Real Case	**8 hours/year**	Belgium (Flanders Region)*, Germany, Sweden
	10 hours /year	Austrialia *Queensland, Tasmania, South Australia), Denmark
	Mac. 17/days/year more than 20 min.	Netherlands

**Plus 20 minutes/day*

5.5 How can shadow flicker be mitigated?

When proper planning and standards are implemented during the design process, the occurrence of shadow flicker can be minimized or entirely avoided.

The impact of shadow flicker on homes, roads, and populated areas can be mitigated through the use of appropriate setbacks, planting trees for screening, or window treatments to minimize concerns. Shadow flicker can also be limited by pausing the operation of a turbine during periods when unacceptable flicker is expected to occur.

6. Roads, Property Value, and Visual Impact

6.1 Will the construction of a wind project damage public roads?

Construction of a wind project typically involves the transport of turbine towers, blades, and other components on specialized trucks, as well as the use of large cranes and other heavy equipment to erect the turbines. Sometimes roads must be reinforced or widened to accommodate turning radiuses for oversized trailers and trucks. These changes are permanent. In addition, wind projects often require the construction of new access roads on private property.

Trucks and other heavy equipment can damage existing public roads. To ensure there is no permanent damage to existing roads, a host town and developer typically establish a Road Use Agreement. This specifies the developer's responsibility for road upgrades, repairs, or post-construction restoration.

6.2 Will wind development have an impact on my property value?

Most studies have found that well-sited wind projects with reasonable setbacks from residences do not measurably reduce property values. While these studies are valid for showing the overall average effect, they cannot be relied upon to predict the effect on individual homes.

6.3 Will a proposed project drive down property values?

Some experts theorize that a decrease in property values can occur during the period after a project is announced but prior to construction, before the actual effects on properties are known. This has prompted research into changes in property prices during each phase of a wind facility's development: pre-announcement, post-announcement/pre-construction, and post-construction.

Overall, there is some evidence for an effect termed anticipation stigma. Lawrence Berkeley National Laboratory's (LBNL) 2013 study examined home sales from more than 50,000 homes, near 67 wind facilities across nine states.

This study found that home prices dropped by 8% after the wind project announcement but before construction. Home prices subsequently returned to normal after the wind project was constructed and commenced normal operations.[32]

6.4 Have any studies considered the distance to the project?

LBNL's 2013 study is the most comprehensive on the subject to date. Of the 50,000 home sales studied, 11,900 occurred across seven New York counties. The large data set helped account for non-wind project related factors on home sale prices such as house age, square footage, condition, and lot acreage.

Although this study found no statistical evidence that home prices near wind turbines were affected, it also indicated that the margins of error were +/- 4.9% within a mile of existing turbines, and +/- 9.0% for homes within a half-mile. In other words, prices of homes not near wind turbines may vary up to 4.9% and still be within the model prediction.

6.5 What can be done to mitigate the visual impacts of wind development?

Aesthetics and visual impacts are among the greatest concerns raised about proposed wind projects. Because wind resources in the Northeast tend to be best at high elevations or near large bodies of water, turbines can sometimes be visible for long distances and may alter scenic vistas. Therefore, it's important to consider ways to minimize and mitigate unavoidable adverse aesthetic and visual impacts during the preconstruction planning and permitting process.

Wind projects subject to Article 10 are required to conduct an assessment of the project's visual impact. As part of the study, developers must seek community input in identifying important features of the surrounding landscape that contribute to the visual quality of the community.

Modern software can digitally simulate the view of a wind energy project from a variety of locations and in different light conditions. This tool helps communities understand the visual impact and helps project developers identify areas that may need a mitigation plan.

Examples of mitigation measures include changing a project's turbine layout, minimization of glare, and lower-impact nighttime lighting. Turbine layout may be adjusted to best fit the landscape; for example, an orderly or linear arrangement may be preferable to some communities. Due to the use of low-reflective materials on the blades and towers, glint or glare is rarely an issue with wind turbines.

The nighttime impact of lighting for aviation safety is often of concern to the community. The Federal Aviation Administration requires structures above 200 feet to have red or white obstruction lighting.[33] Recently developed technology now allows for lighting on wind turbines to be radar-activated. As a result, the obstruction lights turn on only when an aircraft is detected nearby. Such systems allow lighting to remain off up to 98% of the night.

As options to minimize visual impacts of wind turbines are limited, a developer may be required to develop and implement a cultural resource mitigation plan in consultation with the NYS Historic Preservation Office. This plan provides for developer funding of offset projects that provide benefits for local cultural resources, historic properties, and public appreciation of historic resources.

7. Safety Concerns

7.1 What are the safety concerns related to wind development?

Safety concerns most commonly expressed by the public with respect to large-scale wind turbines include ice throw, blade throw, and tower collapse. The frequency with which any one of these events occur is extremely rare.

7.2 What is the best way to ensure my community's safety?

Many concerns associated with safety can be addressed by placing distance between wind turbines and people, property lines, roads, or scenic areas. Each municipality can determine and establish their own setback distance. Setback distances are commonly defined in terms of a multiple of the turbine structure height (e.g., 1.5 times the turbine structure height).

The setback distance is measured as a straight line from the vertical centerline of the wind turbine tower to the nearest point of an occupied building, property line, or private or public way. The total height of the turbine is measured as the tip of the upward-pointing vertical blade at its fullest upward extent.

7.3 What are examples of safety setbacks around the country?

Required setback distances vary across the country. Ohio, Wisconsin, Wyoming, Pennsylvania, Illinois, and Utah recommend a setback distance of 1.1 times total turbine height; while Connecticut and Maine have established a setback of 1.5 times total turbine height. Most ordinances will allow setback requirements to be waived or modified under the terms of a legal agreement between an adjacent property owner and the wind development company.

7.4 What other factors contribute to safety?

Commercial wind turbines are generally certified in accordance with International Electrotechnical Commission Standards (IEC). The IEC is a global nonprofit organization that provides third-party certification of a turbine's safety systems. IEC standards certify that a wind turbine can operate for 20 years under testing conditions. Meeting these standards helps to ensure turbine reliability and public safety.

Safety concerns are most relevant during extreme weather events that have the potential to cause damage to property and harm to residents nearby. Under the most extreme weather conditions, automated controls shut turbines down and orient blades to minimize wind resistance. Turbines are typically connected to a remote operations center and monitored 24 hours a day.

8. Radar and Communications

8.1 Will wind development impact communications and radar?

Wind turbines, like many structures, may have an impact on communication and radar signals. Turbine towers and blades can cause TV and radio signal interference as well as interference with aviation and weather radar systems.

The impacts of a wind energy facility on telecommunications are influenced by factors including blade composition, location of the turbine, distance from the transmitter or receiver, and antenna or receiver type. The likelihood of interference may increase with turbine size and the number of turbines.

The two types of radar interference are: (1) direct interference that can produce false images or shadow areas, and (2) doppler interference that creates false targets and can impact airborne and fixed radar.

8.2 How can these impacts be mitigated?

During wind project development, modeling methods are used to identify and mitigate potential issues. In most cases, radar interference is either not present, is not deemed significant, or is readily mitigated. There are several strategies to reduce impacts on radar including infilling radar, replacement and upgrading radar technology, or modifying operations to correct for the presence of turbines.

Occasionally, operating wind turbines may interfere with television signals or other communications. Developers are aware and often provide community solutions, such as placement of repeater antennas or offering alternatives to over-the-air television, like cable.

8.3 What is the potential impact to military bases?

Wind developers must follow federal guidelines and undergo rigorous reviews to ensure radar issues potentially affecting public safety and national security are satisfactorily resolved. Both the Department of Defense (DOD) and Federal Aviation Administration (FAA) conduct reviews of all wind turbine installations that exceed height thresholds. A range of siting, software, and hardware solutions have led to successful coexistence of wind and military bases.

The DOD and base commanders review all proposed projects near bases and if military concerns cannot be addressed, the project will not be built in that area. The DOD states that no military operations have been adversely impacted by wind facilities.

To better understand and mitigate radar impacts, the U.S. Department of Energy collaborates with DOD, FAA, and the National Oceanic and Atmospheric Administration to address potential issues on an ongoing basis. As wind energy advances, this interagency program[34] is developing hardware and software solutions to mitigate potential impacts on existing radar systems. In addition, they are developing the next generation of radar systems to be resistant to potential wind turbine interference.

Questions?

If you have any questions regarding wind energy and your community, please email questions to cleanenergyhelp@nyserda.ny.gov or request free technical assistance at https://www.nyserda.ny.gov/Siting
The NYSERDA team looks forward to partnering with communities across the State to help them meet their clean energy goals.

Section Endnotes

[1] 16 NYCRR § 1000.4(d)

[2] 16 NYCRR § 1000.4(e)

[3] Id.

[4] 16 NYCRR § 1000.5(e)

[5] Id.

[6] 16 NYCRR § 1000.10(a)(3).

[7] 16 NYCRR § 1000.10(a)(4).

[8] NY Pub Serv § 163(5).

[9] NY Pub Serv § 166(1)(j).

[10] 16 NYCRR § 1000.10(b)(3).

[11] NY Pub Serv § 165(1).

[12] NY Pub Serv § 165(4)(a).

[13] EXC § 94-C (5)(b)

[14] Id.

[15] EXC § 94-C (5)(c)(i)

[16] Id.

[17] EXC § 94-C (5)(c)(ii)

[18] EXC § 94-C (5)(d)

[19] EXC § 94-C (5)(f)

[20] EXC § 94-C (5)(g)

[21] "Bats and Wind Energy: Impacts, Mitigation, and Tradeoffs" American Wind and Wildlife Institute, November 2018. https://awwi.org/wp-content/uploads/2018/11/AWWI-Bats-and-Wind-Energy-White-Paper-FINAL.pdf

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[30] "Wind Turbine Health Impact Study: Report of the Independent Expert Panel." Massachusetts Departments of Public Health and Environmental Protection. 2012. https://www.mass.gov/files/documents/2016/08/th/turbine-impact-study.pdf

[31] Arcadis, 2017. *International Legislation and Regulations for Wind Turbine Shadow Flicker Impact*. Presented at Wind Turbine Noise Conference 2017. Erik Koppen (Netherlands), Mahesh Gunuru (Netherlands), Andy Chester (UK).

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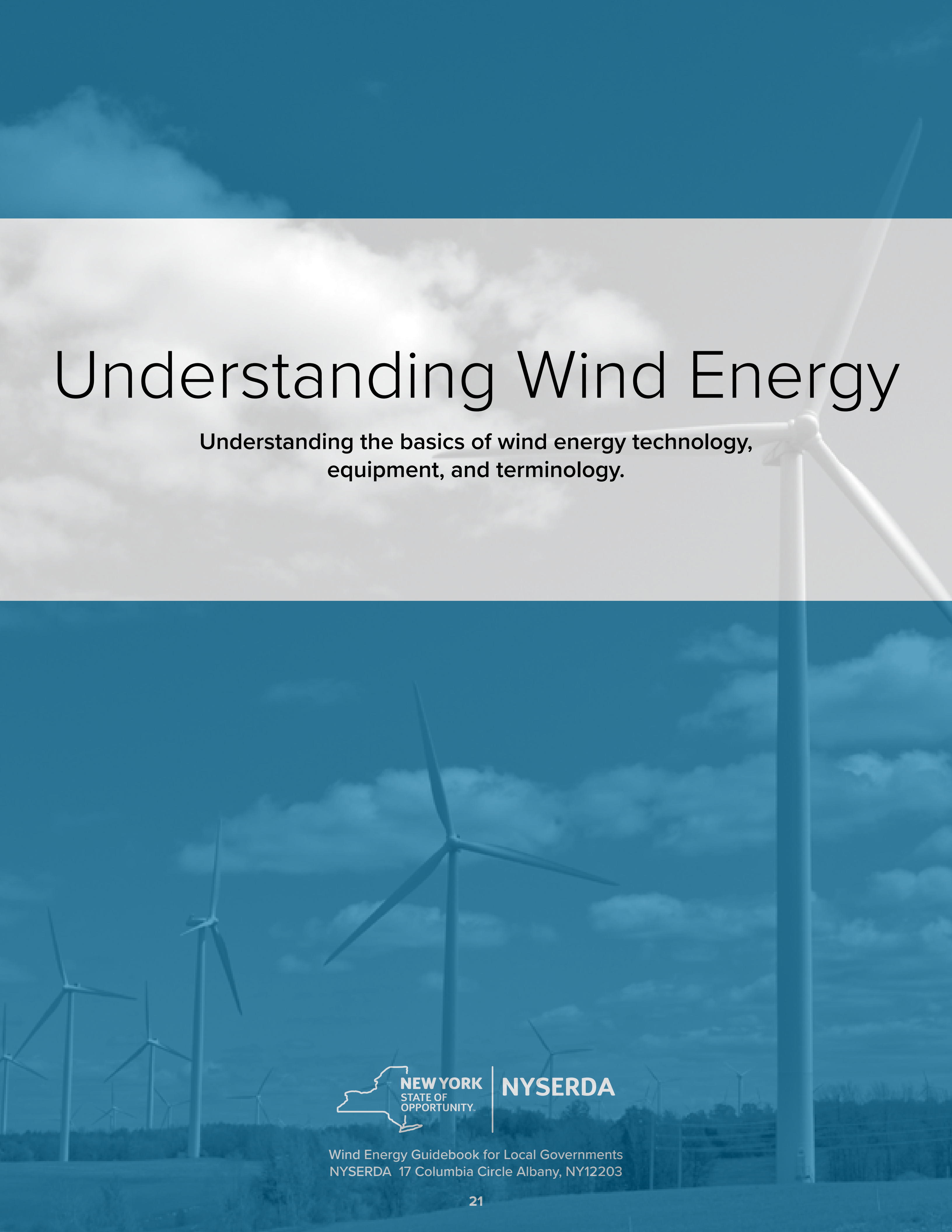


Understanding Wind Energy

Understanding the basics of wind energy technology, equipment, and terminology.

Section Contents

Overview

In the United States, most wind energy is commercially generated for delivery and sale on the grid. Wind projects vary in size, configuration, and generating capacity depending on factors such as the wind resource, project area, land-use restrictions, and turbine size.

While wind turbines are most commonly deployed in large groups, they may also be installed as a single turbine or with just a few others connected directly to a distribution line. Common examples include installing one large turbine to offset electric purchases at a school, municipal building, or manufacturing facility.

Because wind is a variable resource with changing speeds, power production levels can vary. The energy output of a facility can be measured over time; however, expected yearly electricity production can be estimated. While turbines generate power, all other components of a wind plant aid in the transfer of that power to the grid.

1. Wind Turbine Technology

The major visible components of a utility-scale wind turbine are a rotor, nacelle, and tower; these and other components are illustrated in Figure 2-1.

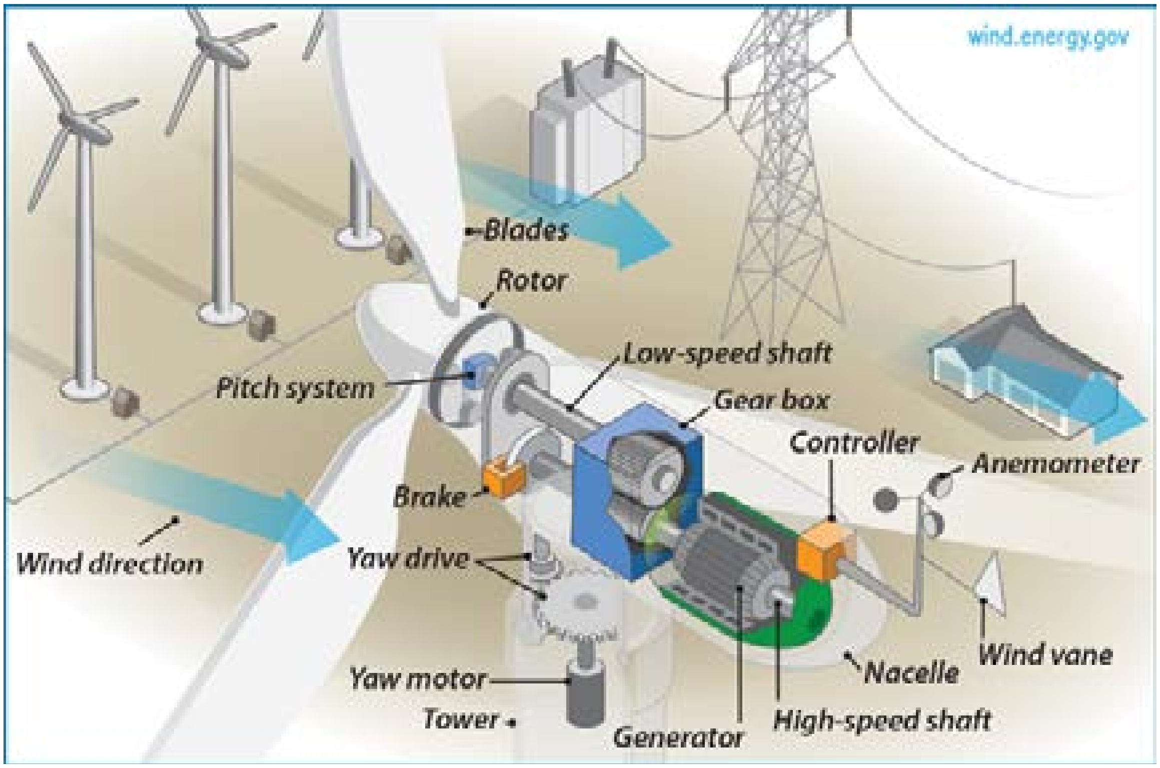
The **rotor** consists of blades (usually three, though some turbines feature two) and a hub (the mechanical link between the blades and the low-speed shaft). The turbine blades capture the kinetic energy from the wind and convert it into torque that is transmitted to the gearbox through a rotational shaft. A yawing mechanism allows the turbine to rotate on its vertical axis to orient the rotor into the direction of the wind, maximizing energy capture.

The **nacelle** houses major components, including a gearbox and generator. A low-speed shaft connecting the rotor to the gearbox and a high-speed shaft connecting the gearbox to the generator make up the turbine's drive train. Using a series of gears, the gearbox converts the low-speed, high-torque input from the rotation of the blades to a high-speed, low-torque rotational force that's transmitted to the generator. A transformer increases the voltage from the generator voltage level to the on-site collection-system voltage.

The rotor and nacelle sit atop a steel or concrete **tower** that is typically around 80 m to 110 m (262 ft. to 360 ft.) tall.

Distinct from the tower height, the vertical distance from the ground to the centerline of the rotor is often referred to as the turbine's **hub height**.

Figure 2-1. Major Turbine Components
(Source: www.wind.energy.gov)



2. Energy Production

2.1 Nameplate Capacity

The **nameplate capacity** (or rated capacity) of a wind turbine is the amount of energy the turbine would produce if it ran 100% of the time at optimal wind speeds. Wind turbines range in nameplate capacity from less than 1 MW to more than 4 MW.

2.2 Capacity Factor

To compare output across different generating facilities, **capacity factor** is used as a measure of the actual energy produced over a specified period of time, divided by the nameplate capacity. In other words, while wind turbines typically generate electricity during most hours of the day, they produce a varying percentage of the nameplate capacity in any given hour. Capacity factor represents the average generation over time. Capacity factors of wind plants may vary from 20% to 50% depending on the turbine type, location, and wind regime (see Power Curve).

Capacity factor can also be used to estimate the expected electricity production of a wind project, by multiplying nameplate capacity times 8,760 (the number of hours in a year) times capacity factor. For example:

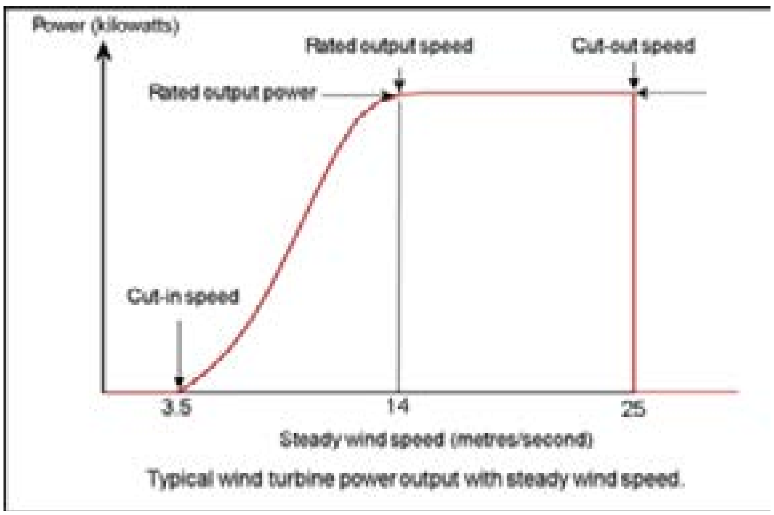
100 MW nameplate capacity x 8,760 hours x 35% capacity factor = 306,600 MWh expected annual generation.

2.3 Power Curve

Power production from a wind turbine is a function of wind speed. The relationship between wind speed and power is defined by a **power curve**, which is unique to each turbine model, and in some cases, unique to site-specific settings. Figure 2-2 illustrates a typical wind turbine power curve. Wind speeds are listed on the horizontal axis, in mph or meters per second (m/s). The turbine's power output is along the vertical axis in kilowatts (kW).

The cut-in speed, at the lower end of the curve, is the threshold that the hub-height wind speed must reach for the turbine to begin generating electricity. In general, wind turbines begin to produce power at wind speeds of about 6.7 mph (3 m/s). A turbine will achieve its nominal, or rated, power at approximately 26 mph to 30 mph (12 m/s to13 m/s); this value is often used to describe the turbine's generating capacity (or nameplate capacity). The turbine will reach its cut-out speed at approximately 55 mph (25 m/s). When wind speeds exceed this, the turbine will stop power production to protect itself from potentially damaging speeds. Variability in the wind resource results in the turbine operating at changing power levels. At good wind energy sites, this variability results in the turbine operating at approximately 35% to 40% of its total possible capacity over a year.

Figure 2-2. Relationship of Wind Speed to Power Production
(Source: U.S. Department of Energy)



2.4 Trends in Nameplate Capacity and Hub Height

Over time, increasingly taller towers and longer blade lengths have helped wind turbines achieve economies of scale and higher capacity factors. Most new projects in the U.S. use turbines with a nameplate capacity between 2 MW and 3.6 MW—more than twice the average turbine capacity in 2000. At the same time, rotor diameters have nearly doubled, averaging close to 100 m. Hub heights have increased as well, ranging between 80 m and 110 m today versus 50 m to 70 m in 2000. The use of taller towers is driven by two factors: the accommodation of larger rotors, and the desire to tap stronger winds. In general, every 10 m increase in tower height means capturing winds that are 2% - 3% faster, yielding more energy. Wind manufacturers are developing even larger turbines, although their use in the Northeast may be limited by logistical and transportation challenges.[1]

3 Wind Project Layout

To achieve optimum exposure to the prevailing winds, while taking into account terrain variations, turbines are placed in groups or rows. Inter-turbine spacing (the space between the turbines) is chosen to maximize production while minimizing exposure to damaging rotor turbulence. Inter-turbine and inter-row spacing vary depending on the rotor diameter and the wind resource characteristics. Factors, such as cost and constructability, must be considered when designing the layout of a wind project. Wide spacing between wind turbines generally maximizes energy production but increases infrastructure costs (e.g., land, transmission, and road building). There is a trade-off between optimizing the turbine location for energy production (through wider spacing) and maintaining reasonable turbine interconnection and road costs, which increase with wider spacing. There is an additional tradeoff between the project's total capacity and the capacity factor. Experience, mathematical analyses, and cost are considered to determine the optimum configuration for the site conditions and proposed equipment.

4 Balance of Plant – Other Necessary Components

Wind turbines generate power, but several other components are needed to get the power from the turbine to the electric grid. These components are often referred to as **balance of plant** and typically address all aspects of the wind plant that are not the turbine itself.

4.1 Foundations

Having a properly constructed foundation is critical to the longevity of a wind plant. Foundations are designed specifically for each project, depending on the load and the type of soil at the site. Most foundations are made of concrete and are spread footing design. If the soil is loose, anchors may be used to further secure the turbine.

4.2 Electrical Power Collection System

Energy produced from turbines is generally collected in a medium-voltage (approximately 25 to 35 kilovolt) system consisting of underground cabling (wiring) and overhead power lines to a main substation. The point of interconnection (POI) with the utility line can be co-located in the substation or it can be physically separated and located adjacent to the utility line. In general, wind energy projects are positioned within 10 miles of a high-voltage transmission line to minimize the costs associated with interconnection. Greater distances may be economically feasible if the wind resource is sufficiently high. With some turbines, a pad-mounted transformer, generally located immediately adjacent to the base of each tower, is used to transform the low-voltage power produced by the turbine to the medium-voltage of the on-site electrical collection system. Some turbine designs incorporate the transformer into the nacelle, rather than placing it at the base of the tower.

4.3 Substation and Interconnection

For most wind energy projects, electrical energy produced by the turbines passes through a substation where it is metered, and the voltage is increased to match the voltage of the utility grid. Plant isolation breakers, power quality monitors, and protective equipment are present in the substation to protect both the electrical grid and the wind turbines. A system of switches and overhead infrastructure is used to connect the substation to the utility's power lines.

4.4 Control and Communications System

In addition to individual turbine control systems, a wind project typically includes a Supervisory Control and Data Acquisition System (SCADA). SCADA systems consist of a central computer with management capabilities for individual turbines and the ability to collect, analyze, and archive time-series data. Communication cables connecting the central computer with the individual turbine controllers are commonly buried in the same trenches as the electrical collection system.

4.5 Access Roads

Access roads to each turbine location are usually crushed rock, and often wider than normal roads. In hilly or complex terrain, access roads are constructed to manufacturer specifications. Specific slopes and turning radii are necessary to allow delivery of large components, such as blades and tower sections. During the construction phase of a project, crane pads (flat, well-graded and compacted areas constructed of crushed rock) are installed along the access road and adjacent to the tower foundations. These serve as a base for specialized construction cranes to lift the tower sections and turbine parts. The crane pads remain in place during operation in the event a crane is required to replace large components that cannot be handled by the service crane in the turbine.

4.6 Operation and Maintenance Facility

Operation and Maintenance facilities for wind power plants generally consist of an office and maintenance shop. These spaces can be located on-site or off-site and may be in separate locations. An office houses plant-management staff, control computers, and communication systems. The maintenance shop is used to store vehicles and spare parts and provides a work space for component repair.

5 Transmission and Interconnection

Energy from generating plants is interconnected to the transmission system and subsequently travels to the distribution system, where it is delivered to end users. The bulk system of transmission lines and distribution lines in North America is referred to as the grid. The grid consists of high-voltage transmission lines that transmit large quantities of power; substations that convert electricity from one voltage to another; lower-voltage distribution lines that serve neighborhoods and individual customers; and safety and control systems to keep the grid operating safely.

Most of the power delivered to the grid comes from large, central power stations, such as coal- and natural gas-burning plants, with capacities of roughly 50 MW to 2,000 MW. The transmission system does not differentiate between electrons generated at a wind power plant and any other type of generating plant.

5.1 Intermittency and the NYISO Balancing Authority

The transmission system is balanced to match production with consumption. When a customer is using electricity, the adequate amount of production must be simultaneously occurring to balance the system. At any time, an instantaneous balance between production and consumption must be met. The New York Independent System Operator (NYISO) acts as the balancing authority for the New York State transmission system.

Wind energy is intermittent in nature, meaning wind power plants only produce power when the wind is blowing. By contrast, fossil-fueled power plants can control how much power they generate by increasing or decreasing how much fuel they burn. Integrating the intermittent nature of wind energy generation into the transmission system requires additional steps that aren't needed in balancing energy from central power stations, such as coal or natural gas. As with all transmission system operators, NYISO is constantly studying and improving the system to integrate non-dispatchable resources, such as wind energy. NYISO's requirements for wind energy plant interconnections ensure fair and open access to the transmission system while maintaining system reliability.

Wind energy plants interconnecting to the NYISO system are required to share meteorological data with NYISO to help forecast wind generation. The most accurate forecasting is available from permanently installed meteorological towers that track data at the same height as the operating turbines and from meteorological equipment on each operating turbine.

5.2 Interconnection

Because of the interconnected nature of the grid, proposed new facilities must undergo a series of grid impact studies before obtaining an Interconnection Agreement from NYISO and delivering energy. Improvements or protections to the transmission system may be required for the project to interconnect—usually paid for by the project developer. Proposed generation facilities of 20 MW or smaller are designated small generating facilities by NYISO and go through a streamlined interconnection application process. Regardless of project size, developers must also contact the local utility to complete the New York State Standardized Application for Attachment of Parallel Generation Equipment, and they must also comply with local utility requirements for interconnection.

Additional Resources

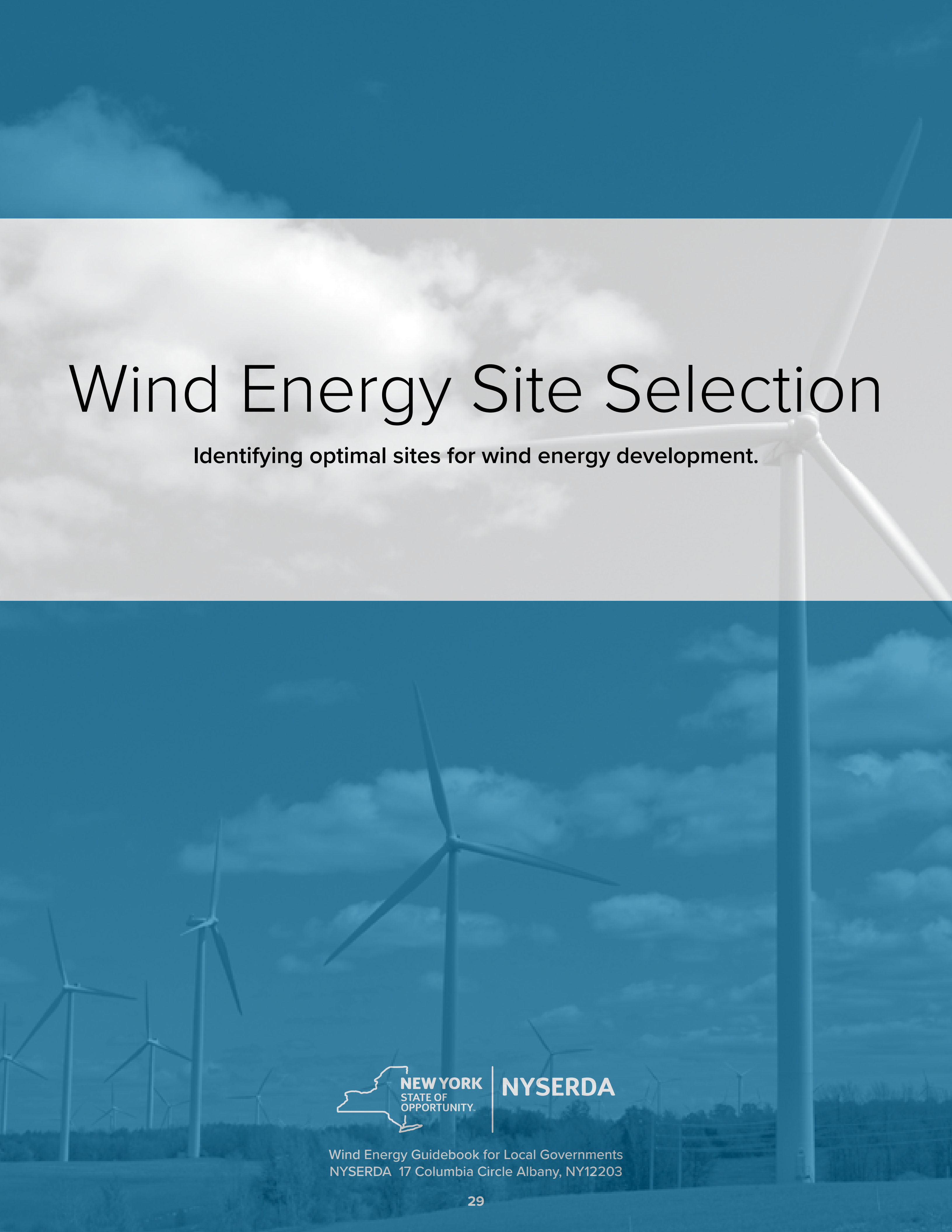
- NYISO 2020 Power Trends report: https://www.nyiso.com/documents/20142/2223020/2020-Power-Trends-Report.pdf/dd91ce25-11fe-a14f-52c8-f1a9bd9085c2

Questions?

If you have any questions regarding wind energy, please email questions to cleanenergyhelp@nyserda.ny.gov or request free technical assistance at nyserda.ny.gov/Siting. The NYSERDA team looks forward to partnering with communities across the State to help them meet their clean energy goals.

Section Endnotes

[1] "Supersized Wind Turbine Blade Study: R&D Pathways for Supersized Wind Turbine Blades" Lawrence Berkeley National Laboratory. 2019. https://emp.lbl.gov/publications/supersized-wind-turbine-blade-study



Wind Energy Site Selection

Identifying optimal sites for wind energy development.

NEW YORK STATE OF OPPORTUNITY | NYSERDA

Wind Energy Guidebook for Local Governments
NYSERDA 17 Columbia Circle Albany, NY12203

Section Contents

Overview

A wind project's energy production and life-cycle economics depend on the strength of the wind on site. Therefore, developers must seek windy locations when prospecting for potential development sites. Sites with annual average wind speeds of 14.5 mph (6.5 meters per second) or stronger at turbine hub height may be considered attractive for project development. Some projects may require stronger average winds to realize economic viability.

To find windy sites, developers use topographic maps (with terrain contours, political boundaries, populated areas, roads, parks, transmission lines, and other relevant siting features); wind resource maps (including predicted wind speeds and prevailing directions); and the expertise of meteorological consultants.

Developers can use software tools to estimate the wind resource at a specific project site and begin the process of designing the turbine layout. A layout can be optimized to produce the most energy or be most cost efficient. Once the layout has been created, developers calculate how much energy will be created on an annual basis. Project investors rely on an accurate estimate of generation in deciding how to finance a project.

1. Meteorological Towers

Once an ideal site is identified, the developer will install meteorological towers and remote sensing equipment to record weather information, such as wind speed, wind direction, gusts, and temperature. This information, in combination with regional climatic reference station data, can be used to characterize the long-term wind resource at the site. Onsite measurements are necessary to greatly reduce the uncertainty in predicting a project's eventual energy production. Developers are interested in reducing a project's energy uncertainty because most wind projects are financed by third-party investors. Reducing the uncertainty in the energy estimates reduces the risk perceived by the investor, which increases the likelihood for investment and more favorable investment terms.

Figure 3-1. Examples of guyed tubular meteorological mast and guyed lattice meteorological towers
(Source: AWS Truepower)

Meteorological masts or towers are typically 60 or 80 meters tall and have monitoring equipment at multiple heights. These towers use anemometers, wind vanes, and temperature sensors to measure the wind speed, wind direction, and temperature. This wind resource data is collected and stored by a data logger for later analysis.

2. Remote Sensing

Remote sensing equipment can be used as a complement to meteorological tower data collection to quantify the wind resource. The most commonly utilized remote sensing equipment is sonic detection and ranging (SODAR), but light detection and ranging (LIDAR) may also be used during the assessment process. SODAR and LIDAR are similar to radar technology, except they use sound and light instead of radio waves. In the future, remote sensing may be able to provide wind resource assessments of high enough quality to replace current met tower assessment practices.

3. Micrositing

If the wind data confirm the viability of a site for a project, developers pursue land rights for the entire project and begin micrositing. Micrositing is the process of collecting additional wind data for the purposes of determining the most appropriate turbine for the site, identifying potential turbine locations, and optimizing the project layout. Wind can be highly variable, being influenced by terrain features, vegetation, and local atmospheric conditions. Experience has shown that limiting the number of meteorological towers can result in erroneous energy production estimates. Therefore, once developers have determined that a specific area has the right mix of wind (based on initial met tower data), land, local support, and energy market, it's common to deploy additional meteorological towers. The number of additional meteorological towers is dependent on land characteristics, turbine size, potential turbine layouts, etc., but can vary from approximately one tower for every 10 to 30 turbines.

4. Land Area Requirements

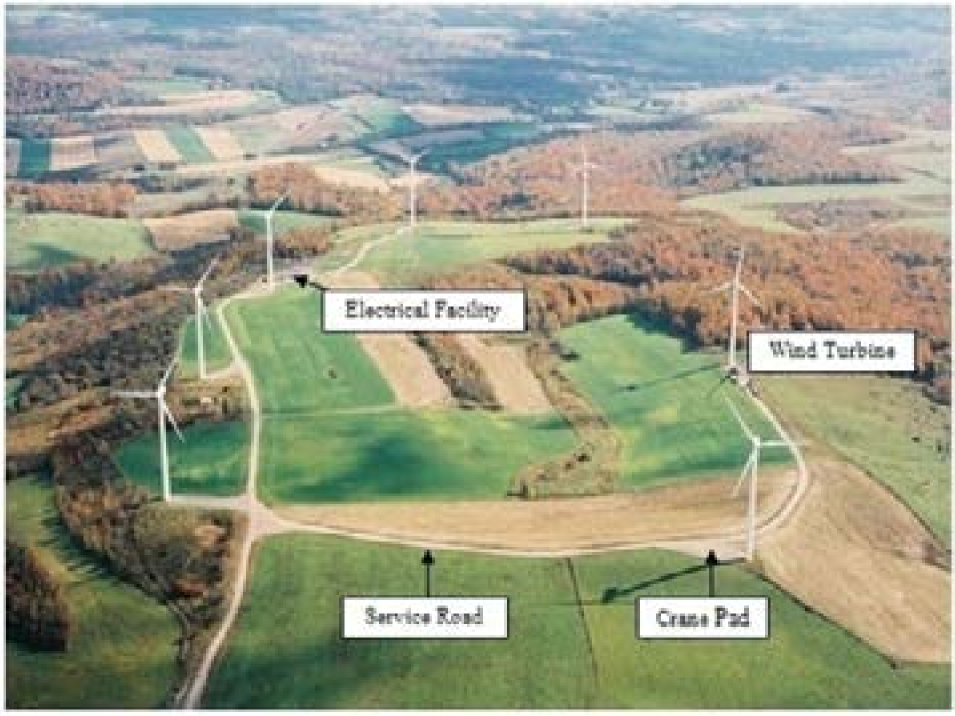
Wind turbines are typically arranged in single or multiple rows, depending on the size and shape of the landform. A single row is most often found on ridgelines and hilltops where the amount of well-exposed land is very limited. Broader and flatter land features can accommodate multiple rows of turbines. In both cases, rows are laid out to be roughly perpendicular to the prevailing wind direction.

The interference of one wind turbine on the airflow experienced by a downwind turbine is called the wake effect. The wake generated by a wind turbine reduces the velocity of the downwind airflow and causes it to be much more turbulent. Turbines that are closely spaced will experience higher wake-induced energy losses, increased loading (from turbulent airflow), and a shorter operational life. Wide spacing between wind turbines generally maximizes energy production but increases land and infrastructure requirements, such as cabling, roads, etc. Cost considerations must be analyzed before finalizing turbine locations. Developers strive to optimize the balance between the higher wake effects and the lower costs of tighter spacing, while considering underlying land uses and environmental conditions.

The acreage required for a wind power project can be defined either as the overall area containing the entire project, including the open spaces between turbines, or as only the area occupied by the project's facilities (turbines and their foundations, service roads, crane pads, electrical equipment, associated buildings).

Figure 3-2 is an aerial view of a small wind project in Madison, NY, with the facilities labeled. In general, a project's facilities occupy only about 5% of the total project area. This means the majority of the space within a project area can be used for traditional purposes, such as agriculture.

Figure 3-2. Aerial View of a Wind Power Project in Madison, NY
(Source: Photo by Chris Milian)



Questions?

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Land Agreements

Understanding common land agreements for wind energy projects.

Section Contents

Overview

To develop a wind project, developers must obtain legal rights to the land. A right can be in the form of a purchase, lease, or easement. The type of agreement depends on the infrastructure intended for the land, the developer's business model, and the type of arrangement acceptable to the landowner. The process of securing land rights for wind energy projects usually occurs early in the development stage and may begin with an option agreement—an exclusive right to conduct due diligence on the wind resource, property conditions, and energy market until the developer is ready to move forward with project development.

The most common land agreement for a wind energy project is a lease, which allows the developer to spread the payments over the life of the project to minimize upfront costs. Since the wind project facilities occupy only a small portion of the land, landowners can continue existing land uses, while adding an additional revenue source with a wind energy lease.

It's common for a utility to require land ownership of property where a utility-owned substation will be located. Therefore, if the project includes construction of a new utility-owned substation, depending on the arrangement with the utility, either the developer or the utility will negotiate a purchase agreement directly with a landowner.

Because different agreements can have very different legal and tax implications, landowners should always have an attorney carefully review all agreements.

1. Easements and Rights-of-Way

A wind project developer may seek to secure land rights that do not necessarily require a lease or purchase of land, including the following:

- The right to install underground cables (collector system) or overhead transmission lines connecting the wind turbines to substations and, ultimately, to the power grid
- The right to cross non-leased land for construction, operation, and maintenance of the turbines and related equipment
- The right to prevent obstacles (buildings, trees) from interfering with the free flow of wind across the turbines
- The right to produce noise, shadows, or other minor nuisances
- The right to use property for off-site mitigation to address assumed impacts within the leased area that cannot be mitigated on site

An easement is a right to use property for a defined use. Easements are commonly used for project development needs on land that will not include wind turbines, substations, or other major project construction and operation features, but that provides rights to adjoining land. An easement is a nonpossessory property interest that gives the holder—in this case, the developer—a right of use over the property, or that prevents landowners from doing something that is otherwise lawful, but that would be detrimental to the wind project. For instance, an easement might prohibit landowners from putting up a grain silo directly upwind of a turbine. Because easements convey property rights, they must be in writing and filed with the proper municipality or county recorder. The easement will run in perpetuity (forever) unless the instrument granting the easement provides for a term of years. Developers usually offer a one-time, lump-sum payment for the easement.

A right-of-way (ROW) is an easement that allows a developer to cross land with project features, such as access roads, transmission lines, or underground cabling. ROWs are also a nonpossessory property interest that gives the holder rights, for a set term or in perpetuity, to access or cross the land. As with a standard easement, the ROW must be in writing and filed with the proper municipality or county recorder. Any rights to alter the property within the ROW at a future date must be negotiated with the ROW holder. Developers usually offer one-time, lump-sum payments for ROWs; however, for transmission line ROWs, leases are not uncommon.

1.1 Neighbor Agreements and Variances

Neighbor agreements - or participation agreements - are written agreements between developers and landowners whose property is directly adjacent to a project. Like easements and ROWs, neighbor agreements usually involve compensation to a landowner and are considered mitigation for a quantifiable impact to the landowner. Quantifiable impacts typically addressed by neighbor agreements include noise, visual, and general construction nuisances. Landowners are not typically compensated for their general dislike of a project; however, public involvement and testimony is a standard part of the land-use process in New York State and provides an opportunity for a landowner to share concerns about a project and shape the decision process.

Note: Please see the Local Role in Planning and Permitting Section for more information (p. 43).

Variances are used to address a land-use regulation when a developer wishes to get an exception to plan a project. Examples include when turbines or other project features are sited within a setback zone, or when a noise limit is exceeded at a residence due to a turbine's placement. If the local jurisdiction has a variance process for the applicable regulation, a developer may seek a variance from the zoning board. A local jurisdiction may require a developer to show evidence of all applicable variances when a land-use application is submitted, or before it issues a land-use decision. For participating landowners (those under lease or other property agreements with the developer), the compensation for a variance may be assumed in the lease agreement. For non-participating landowners, a developer may request that a neighbor agreement or some other form of agreement be executed to document the agreement and the associated compensation. Compensation for variances and neighbor agreements are typically one-time, lump-sum payments.

2. Lease Agreements

Under a lease arrangement, the developer rents a portion of the property for a term of years. The lease is a written contract between the landowner and developer, spelling out the landowner's rights and obligations, and the rights and duties of the developer. This document will govern the relationship between the landowner and developer over the life of the wind project. From the standpoint of the developer, the most important aspect of the lease is that it secures the exclusive right to use defined sections of the property for development, installation, operation, and maintenance of wind turbines and related equipment. To most landowners, the critical elements of the lease include provisions dealing with payments (how much, when, and under what conditions) and the owner's right to continue to use the property for farming, hunting, or other purposes that aren't in conflict with the project. A well-crafted lease will deal with all facets of the wind operation from its inception to its decommissioning. It will address the duration of the agreement, the total acreage affected, ownership of the wind project equipment, responsibility for taxes and utilities, indemnity and liability insurance, access, the developer's right to install signs and give tours of the facility, and every other aspect of the relationship between the landowner and developer. Several of these issues are covered in more detail in the sections that follow.

2.1 Option Agreements

In the early stages of project development, a developer may want to assess the feasibility of developing a project prior to executing a lease. This can be done under an option to lease agreement or option agreement. The option agreement may allow the developer access to the land to install wind energy measurement devices, such as meteorological towers and SODAR equipment. An option agreement may also be secured with a landowner within the project area where no equipment will be installed, merely to secure the right to future development. An option period established in the agreement can vary in length, depending on how advanced the development project is and the business plan of the developer. Typical option periods last from two to five years, allowing a developer adequate time to assess project feasibility. During an option period, a developer is not only testing the feasibility of the wind resource, but also assessing potential environmental impacts and construction feasibility, and marketing the anticipated power output. It is common for the option agreement and lease agreement to be negotiated concurrently, where the option agreement expires at a certain date and the developer either decides to execute a lease agreement or cancel any rights to the property. As with long-term leases and easements, option agreements usually include payment according to a set schedule and may include incremental increases, which encourages a developer to act quickly to determine the project's feasibility instead of tying up land for an indefinite amount of time. A developer is not inclined to make significant investments in real estate until they are confident with the feasibility of the project; therefore, option agreements typically include modest fees.

3. Lease Agreement Terms

Leases should be carefully developed so they clearly address issues important to the project developer and landowner at the time the lease starts, during the full life of project operations, and during project decommissioning. In some cases, the original parties to a lease will change throughout the life of the project, so it is important that all potential issues are clearly spelled out to prevent future misinterpretation.

Following is a summary of the typical lease terms that both parties tend to be most concerned with during negotiation.

3.1 Developer's Lease Goals

- Long-term with clearly defined amendment rights and extension options
- Well-defined, unimpeded rights to access and use of the property for all potential project development, construction, and operation activities
- Well-defined payment structure that spreads the real estate costs over the life of the project and is tied to predictable metrics, such as land acreage and wind project power output
- The ability to transfer the lease without approval from the landowner

3.2 Landowner's Lease Goals

- Fair and adequate compensation for use of the property and loss of certain rights
- Well-defined, clearly established rights for continuing uses on the property
- Default terms and responsibilities of the developer at the end of the project
- Indemnification
- Clearly established measures for reducing unintended impacts

3.3 Term

Wind power leases generally have terms of 20 to 40 years, often with an option for extending the lease. A typical utility-scale wind power project has a useful life of 20 years. Developers will typically want an agreement that can be extended without significant negotiation and risk to the project, so options to extend may be written into the contract. Some contracts include clauses specifying the conditions under which either party has the right to terminate the contract. These termination clauses need to be reasonable so the risk of installing the wind turbine equipment and then having the lease terminated is low and manageable.

3.4 Area Leased

The lease should clearly state where facilities planned for the project are to be located. It is common at the early stages of development for a developer to be unsure about the exact location of infrastructure; however, areas of development can be established, and a landowner can exclude certain areas from development. Any desired setbacks from residences and property lines should be stated. Because construction and major repairs require more activity on the land than routine operations, the lease should include a provision for temporary land use during such periods for equipment storage, cranes, and other construction, operations, and maintenance activities.

A typical lease would give the sole discretion to the developer to determine the size, type, manufacturer, and exact location of wind turbines, but would exclude the developer from locating certain infrastructure within setback areas established during the lease negotiations.

3.5 Landowner's Approved Uses

The lease should clarify what uses the landowner reserves for land not developed as part of the wind project. The landowner typically reserves the right to continue to grow crops, raise cattle, or otherwise use the land. Most rural land uses are compatible with wind power projects; however, there can be some restrictions. For example, a developer may ask that hunting be restricted in the area around the turbines, for fear of damage to expensive equipment and compliance with insurance clauses. In these cases, it is possible that the income a landowner can earn from leasing their land for wind power project development can more than offset any income lost by switching to another land use. Developers will also be concerned with any uses that could affect the wind in the area of the turbines. For example, tree crops or large structures could be restricted. The landowner's access to their property should not be limited; however, a developer may want notification when a landowner plans to harvest crops or repair roads in proximity to project facilities, so no conflicts arise with regularly scheduled project maintenance.

3.6 Upwind Blockage

Developers have an interest in protecting the project site from any future upwind development that could adversely impact the wind resource on the project site. If the same landowner owns the upwind land, the lease may include provisions addressing this issue. The developer may want an easement to prohibit any development within the upwind property that might impact the wind at the turbine sites. The extent of this potential problem depends on factors including the topography of the land, wind characteristics, and the proximity of upwind development to the wind project. While properties more than two kilometers away are not usually of concern, the appropriate distance of concern depends on the size of the upwind project and atmospheric conditions.

3.7 Crop Protection

Normally wind turbines can operate in productive fields with minimal interference. However, crop damage may occur in some situations, and the lease should address how this will be handled. Typical lease provisions require developers to use best efforts to minimize damage but allow for the possibility that damage may occur and subject the party causing the damage to paying appropriate compensation. Typically, a landowner would receive payment from the wind power project for such crop damage. Damage is calculated as the lost amount of product multiplied by the market price for the crop in the season the crop was damaged or destroyed. Impacts to fallow fields are usually not compensated.

3.8 Road Maintenance

The lease should identify responsibilities for maintenance of existing and new access roads on private property. Generally, the wind power developer is responsible for this maintenance. The provisions should protect the property owner by allowing for penalties if maintenance is not performed after a reasonable request and time passage.

3.9 Decommissioning

Leases should include provisions for decommissioning the project at the end of its useful life. This includes removing wind turbines, transformers, wiring, and foundations to the required depth below-grade—and returning the land as close to its original condition as possible. The lease should also address the timely removal or disposal of damaged equipment. As part of the land-use permitting process, it is common for land-use authorities to require a developer to execute a decommissioning agreement and establish a bond, naming the county Industrial Development Agency, or similar economic development organization, as the benefactor. Landowners should not rely on the Industrial Development Agency to cover their costs of decommissioning in the event a developer defaults on a contract and leaves equipment in place. Instead, landowners should ensure provisions are written into the contract to adequately protect them in such an instance.

3.10 Taxes

Responsibility for payment of property taxes and any potential land-use conversion penalties should be clearly specified in the lease. The wind power project developer generally assumes responsibility for any increases in property taxes associated with the wind power project.

4. Typical Payment Structures

It's important to understand that a property's location within a proposed project area doesn't necessarily guarantee that a turbine will be placed on the property. There are many factors that contribute to the design of a project layout, and the distribution of turbines across the project area is not determined until the later phases of project development. Some developers do, however, compensate landowners who are adjacent to turbine installations.

4.1 Royalties

A common compensation structure is the royalty payment. In royalty arrangements, the developer pays the landowner a percentage of the revenue received from the electricity produced by the turbines. This percentage is negotiated between the landowner and the developer. Royalties ensure an ongoing economic relationship between the developer and the landowner, and guarantee benefits for the landowner, provided the turbines generate the expected power. Royalties fluctuate with project revenue. Revenue is based on both variable production and variable energy prices. Revenue can be measured by gross receipts or metered production multiplied by the price of power paid to the project. One well-accepted option is for the wind power project operator to provide a summary of gross receipts along with each royalty payment (quarterly, annually, or other payment period agreed to in the contract), with project operators allowing landowners access to the data upon request. The landowner does not have a say in the price of the electricity that is sold.

Today in the United States, wind power project land-leasing royalties tend to be within the range of 1% to 4% of gross revenue, with the majority being between 2% and 3%. This royalty payment can be expressed in terms of a percent of production (MWh). In most cases, the percentage is a fixed number throughout the term of the lease.

Royalties are paid on a per-turbine production basis based on the average turbine production across the project (overall project generation divided by number of turbines in the project). The advantage of this arrangement versus payment on output of a specific turbine is that the pooling arrangement takes into account the production of the entire project and reduces the effects of variability of individual turbine production or the possibility that one turbine could suffer from operations problems.

Often, lease payments based on a percentage of gross revenue are supplemented by a guaranteed minimum payment. Minimum payments essentially serve as a floor price and guarantee that landowners receive some revenue, even if the wind turbines experience more than typical maintenance outages or if winds are lower than expected in any given year, producing less energy and generating less revenue.

4.2 Flat- or Fixed-Fee

In a flat- or fixed-fee arrangement, the developer and landowner agree on a fixed fee—per turbine, per unit of land, or per MW of installed capacity—to be paid by the developer on a monthly or yearly basis. The payment reflects the total amount of land made available by the landowner for meteorological towers, turbines, turbine spacing requirements, access roads, and control and maintenance buildings. This ensures transparency and clarity of understanding and provides both the landowner and project developer with certainty about future income or payment streams.

4.3 One-Time, Lump-Sum Payment

This type of contract is the least common arrangement but may be satisfactory to both parties if the landowner is in need of immediate cash and willing to forego the prospect of a steady income stream, and the developer has the ability to release a large amount of cash up front. This arrangement is most common for easements and ROWs.

4.4 Typical Payment Range

In a study conducted by Windustry in 2009, lease details were summarized to provide landowners with an idea of the current market rate for wind energy leases. Due to the fluctuating energy market and changes in methods for financing wind energy projects, prices noted in the 2009 study are not necessarily representative of what a landowner should expect today. Additionally, landowner payments may vary both within and across projects based on several factors. It is advised to have a real estate attorney, with an understanding of the current energy market and typical wind energy lease structure, review lease proposals from developers to assess what a landowner is being offered.

Lease rates are likely to be highest in regions and states with a more competitive renewable energy market; for example, in states with Renewable Portfolio Standard laws and/or financial incentives. Additionally, the price of energy varies across markets, so the price of renewable energy will also vary. The Windustry study summarized lease prices from 1998 through 2008 and found a trend of increasing lease rates as the wind energy market matured. Data was not available beyond 2008, so it can't be confirmed that the trend toward increasing lease payments continued. In fact, it's likely that lease prices leveled off, and in some places, were reduced to reflect the lower prices of wind energy in the current market. The study found the average per-turbine per-year lease payment in 1998 was $1,650 and the average per-MW per-year payment was $2,300. In 2008, the average per-turbine per-year lease payment was $5,400 and the average per-MW per-year payment was $3,500. The per-acre payment for temporary impacts and leases for infrastructure other than turbines (including access roads, easements, and ROWs) varies across regions as well. Typically, the price reflects the value of the crop or land that is impacted. Market value for land should be considered, as well as the value of any crop or livestock displaced or affected by installed infrastructure, in determining the appropriate per-acre cost.

Additional Resources

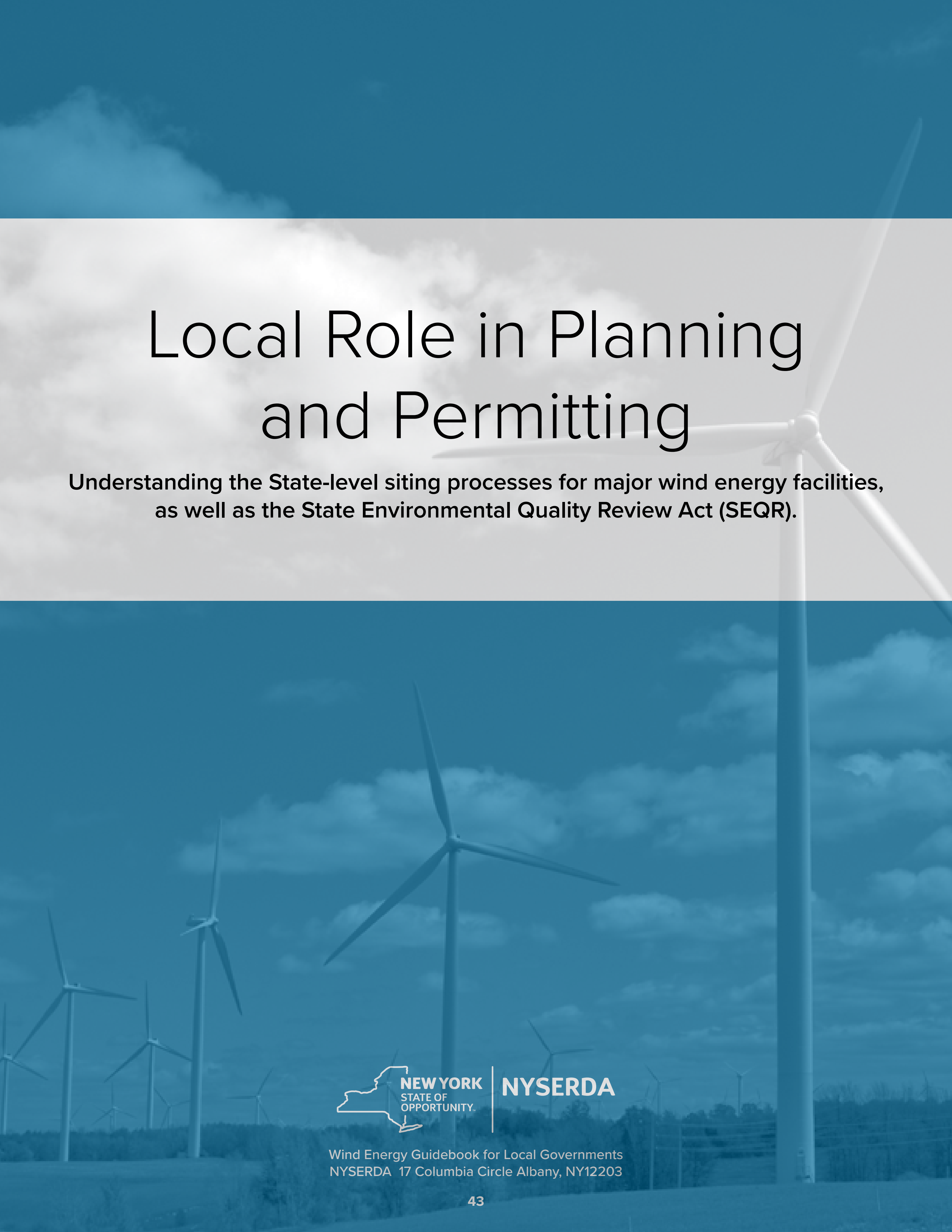
- Guidelines for Agricultural Mitigation for Wind Power Projects - New York State Department of Agriculture and Markets https://agriculture.ny.gov/system/files/documents/2019/10/wind_farm_guidelines.pdf
- Windustry - Wind Energy Easements and Leases: Compensation Packages http://d3n8a8pro7vhmx.cloudfront.net/windustry/legacy_url/944/Compensation-2009-07-06.pdf?1421782808

Questions?

If you have any questions regarding land agreements, please email questions to cleanenergyhelp@nyserda.ny.gov or request free technical assistance at nyserda.ny.gov/Siting. The NYSERDA team looks forward to partnering with communities across the State to help them meet their clean energy goals.

Local Role in Planning and Permitting

Understanding the State-level siting processes for major wind energy facilities, as well as the State Environmental Quality Review Act (SEQR).



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Section Contents

Overview

The process through which a wind energy facility will be permitted – and therefore the local municipality's role in approving the project – can vary depending on the project size. Major renewable electric generating facilities equal to or larger than 25 megawatts (MW) are required to seek permit approvals through one of two comprehensive State-level review mechanisms: the Article 10 process, and the Office of Renewable Energy Siting (ORES). Most wind projects under 25 MW will instead be subject to the State Environmental Quality Review Act (SEQR) and will be permitted at the local level.

The well-established Article 10 process will continue to serve as the main vehicle for siting major wind projects in New York State, given the many existing applications under the purview of the New York State Board on Electric Generation Siting and the Environment (Siting Board). ORES, as created by the Accelerated Renewable Energy Growth and Community Benefit Act in April 2020, will serve as the future forum for siting large-scale projects once up and running.

This Guide provides an overview of the Article 10, ORES, and SEQR processes in order to help local officials understand and distinguish between the three review mechanisms. It is important that municipalities familiarize themselves with these processes in order to remain engaged and participate fully, in the event that a project is proposed in their community.

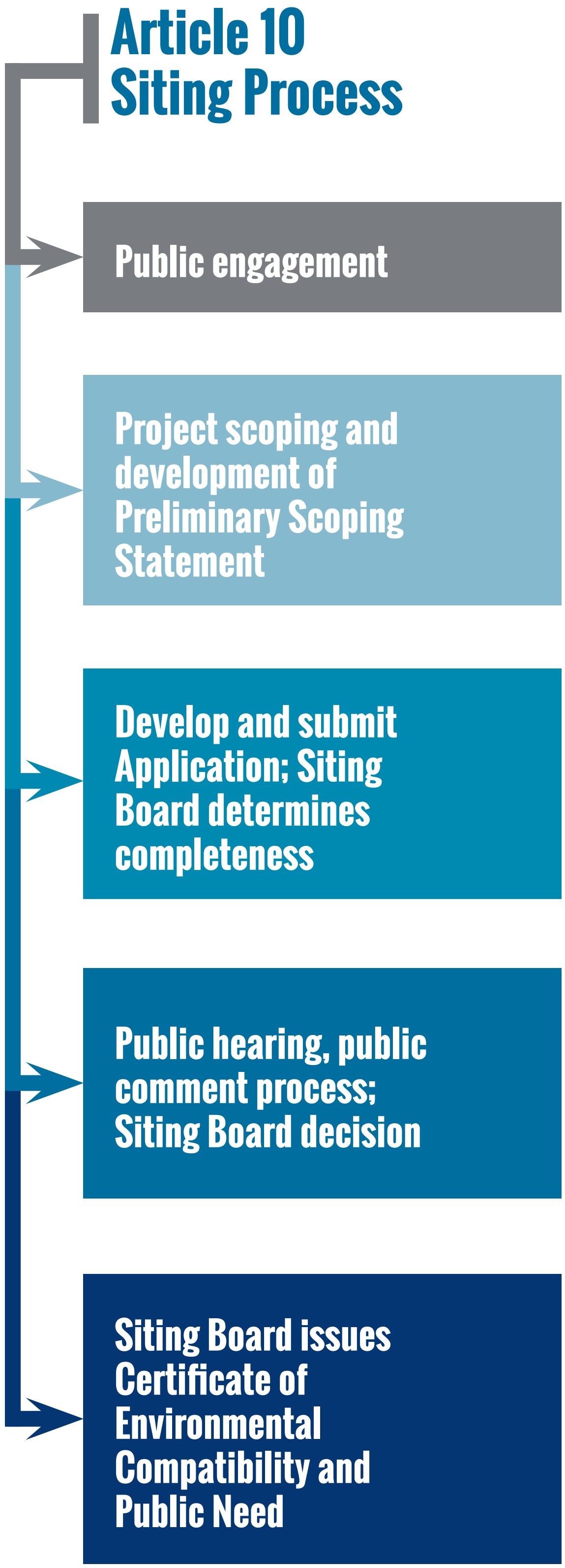
1. Article 10 Siting Process

In 2011, the process for siting wind projects underwent a major revision. By Chapter 388 of the Laws of 2011 (Article 10 of the Public Service Law, or PSL Article 10), the Legislature created a new State-level permitting process under the auspices of the Siting Board. The Legislature gave the Siting Board exclusive authority to certificate—authorize building, repowering, or operation—all electrical generating facilities of 25 MW or more, and existing electric generating facilities seeking to increase capacity by more than 25 MW. Through the Siting Board, Article 10 established a single forum to evaluate the environmental impacts and need for such electrical generating power plants, including wind projects that meet or exceed the threshold. Additionally important for local governments, Article 10 preempts the requirement for local land-use approvals with some important caveats.

While Article 10 applies to the certification process for all electrical generating units of 25 MW or more, the focus of this discussion is on the local role in planning and certificating wind projects under Article 10.

Before the new siting law took effect, all wind projects, regardless of the amount of electricity they proposed to generate, were subject to local land-use jurisdiction (e.g., Article 16 of the Town Law and Article 7 of the Village Law) and coordinated review under New York's State Environmental Quality Review Act ([SEQR]; Article 8 of the Environmental Conservation Law). The lead agency authority under SEQR (the agency or board leading SEQR) for those projects was most often the local planning board. Generally, the State's role in approving the siting and construction of wind projects was specific to the jurisdictions of individual agencies (e.g., natural resource permits from the New York State Department of Environmental Conservation and certificates of Public Need and Convenience from the New York State Public Service Commission). Wind projects proposing to generate less than 25 MW remain subject to local land-use jurisdiction and SEQR—rather than Article 10.

While projects undergoing review under Article 10 are exempt from SEQR, Article 10 was in many ways modeled on SEQR. Despite the preemptive effect of Article 10 on the local land-use process, the Siting Board is required to give effect to local laws. The Siting Board must find (in certificating a wind project under Article 10) that the facility will operate in compliance with local laws concerning the environment and public health and safety. The Siting Board has power to override local laws; however, where it finds their application may be unduly burdensome, the Siting Board must explain its decision to override a local law. To ensure local voices are heard, the Legislature provided for local representation on the State's Siting Board, intervenor funding for local governments and others, and public participation throughout the siting process. In the hearing process, which follows the pre-application process, both the potential wind project host community and neighboring municipalities that may be affected can participate as parties.



The Article 10 process has multiple steps as illustrated.

In general, the Article 10 process differs from SEQR in that it contains extensive filing and public outreach requirements that precede the filing of an application. Once an application is filed, the application has a one-year time clock for a decision. Therefore, affected local governments should involve themselves at the pre-application phase.

Generally, the Article 10 certification process has the following phases: the pre-application stage, the application stage, the administrative hearings stage, the decision-making stage, and the compliance stage. Local governments have a unique role to play in each of these stages.

1.1 Local Participation on the Siting Board

Article 10 guarantees local membership on the Siting Board. The Siting Board is composed of the department heads or chairs of various State agencies and two ad hoc (temporary) public members, both residing within the municipality of the proposed wind project. As to the two ad hoc local representatives, the president pro tem of the New York State Senate (the majority leader) appoints one member and the speaker of the New York State Assembly appoints the other—both from a nominating list provided by chief executive officers of the town, village, or county. If the project is located in a town, the chief executive officer of the town and the chief executive officer of the county both nominate four people. If the project is located in a village within a town, the mayor of the village, the town supervisor, and the chief executive officer of the county would each nominate four people. The ad hoc members serve until the Siting Board makes a final determination on the application. An ad hoc member cannot hold another state or local office, and must be 18 years or older, a citizen of the United States, a resident of New York State, and (for towns) a resident of the municipality of the proposed wind project. Ad hoc members are compensated two hundred dollars per day that they are engaged in the performance of their duties pursuant to Article 10, plus related expenses.

Siting Board Members

- Chair of the Department of Public Service (DPS) — serves as Chair of the Siting Board
- Commissioner of the Department of Environmental Conservation (DEC)
- Commissioner of the Department of Health (DOH)
- Chair of the New York State Energy Research and Development Authority (NYSERDA)
- Commissioner of Economic Development (Empire State Development)
- Two ad hoc public members who reside within the municipality of the facility's proposed location

1.2 Local Participation in the Article 10 Process

1.2.1 Public Involvement Program

The Article 10 process also differs from SEQR in that the first step in the overall process requires applicants to engage in public outreach regarding the project. The Legislature constructed the Article 10 process to encourage local government and public participation in the siting process. "The primary goals of the citizen participation process shall be to facilitate communication between the applicant and interested or affected persons." Well before an application can be filed, a Public Involvement Program (PIP) Plan must be filed at least 150 days prior to the submittal of any preliminary scoping statement. The PIP Plan encourages the applicant to speak directly with the community and affected agencies. The applicant can then consider the potential issues raised in these discussions in the early stages of project planning and development. This program will include a written plan addressing:

- Consultation with local affected agencies and interest groups (including municipalities and boards)
- Pre-application activities to encourage stakeholders to participate at the earliest opportunity in the process
- Activities designed to educate the public to specifics of the Article 10 review process
- Activities designed to encourage participation in the certification and compliance processes

PIP Plans are subject to a 30-day Department of Public Service comment period followed by a 30-day period for submittal of a revised PIP Plan by the developer. Local governments should familiarize themselves with the draft PIP and provide comments as necessary. The Siting Board published a guidance[1] on preparing PIPs, which local officials may also use in evaluating a particular PIP.

The Siting Board also established an office of Public Information Coordinator[2] within the Department of Public Service to provide assistance with public participation. The Public Information Coordinator's job includes ensuring full and adequate public participation in matters before the board and responding to inquiries from the public for information on how to participate in matters before the board.

1.2.2 Intervenor Funding (Pre- and Post-Application Stages)

An intervenor is a third party that joins an ongoing case or proceeding. Local governments and other intervenors can be at a disadvantage in their ability to pay for experts and legal assistance in the siting process. The issues in an Article 10 proceeding are scientific, technical, and sometimes legal, making it costly for municipalities to hire experts and lawyers to represent their views in the siting process. Under SEQR, municipalities can charge applicants the cost of preparing or reviewing an environmental impact statement, but because Article 10 projects are exempt from SEQR, municipalities do not have this ability. In place of SEQR funding, the Legislature created, as part of Article 10, an intervenor fund referred to in the Article 10 regulations (16 NYCRR §1000.10) as the "Fund for Municipal and Local Parties."

At the time a preliminary scoping statement (PSS) is submitted, the applicant is required to create a fund amounting to $350 for each proposed MW of generating capacity, up to $200,000. The Siting Board may disburse monies from the intervenor fund to enable local governments and other parties to hire consultants, experts, and legal counsel to participate in the scoping phase (as well as in the application phase). The notice and summary of the PSS must state the amount of pre-application funds available for municipal and local parties, and the process for applying for such funds. The presiding examiner must reserve at least 50% of the funds for potential awards to municipalities.

Potential intervenors requesting funds must submit their requests to the presiding examiner within 30 days after the issuance of the notice by filing the request with the secretary to the Siting Board and submitting a copy to the presiding examiner and other parties to the proceeding. The Siting Board has posted an application form[3] for intervenor funding on its website. Potential intervenors are encouraged to consider consolidating their requests with similar funding proposals made by other parties.

Potential intervenors can find more about intervenor funding in the form of a FAQ and guidance on the Siting Board's website. Applicants for intervenor funding should consult the FAQ and guidance before submitting an application for funding.

Potential intervenors should be prepared to discuss their funding applications and the award of funds at the pre-application conference. The presiding officer must convene a pre-application meeting no less than 45 days but no more than 60 days from the filing of a PSS. At that time, the presiding officer or officers (administrative law judges [ALJs] assigned to the application from the Department of Public Service and the Department of Environmental Conservation) will also discuss the stipulations process. The presiding officers convene the pre-application conference in the community where the applicant proposed to locate the wind project. The presiding officer will award pre-application intervenor funding on an equitable basis so participants can provide early and effective public involvement.

Article 10 provides for a second round of intervenor funding at the application stage, after the stipulations process and with the formal filing of the Article 10 application. At the application stage of the proceeding, an Article 10 applicant is assessed an intervenor fee equal to $1,000 for each MW of generating capacity of the subject facility, but no more than $400,000. The process for noticing and obtaining intervenor funding follows a similar process to the pre-application process. An intervenor may use the application-stage intervenor funds to defray expenses incurred by municipal and local parties for expert witnesses, consultants, administrative costs (document preparation and duplications costs), and legal fees. As with intervenor funding at the pre-application stage, the presiding examiner must reserve at least 50% of the application-phase funds for potential awards to municipalities. With the awarded funds, intervenors can contribute to a complete record leading to an informed decision about the appropriateness of the site and the facility. Prospective intervenors are encouraged to consult the FAQ and Guide to intervenor funding on the Siting Board's website for more particulars of application-stage intervenor funding.

1.3 The Scoping Process

1.3.1 Preliminary Scoping Statement

After the allotted 150-day period for the Public Involvement Program, the applicant will file a PSS with the Siting Board. The PSS sets the stage for detailed analysis to be included in the application. The PSS must include a description of the potential facility and its environmental surroundings; environmental and health impacts expected to result from the construction of the facility; proposed ways to mitigate impacts; appropriate alternatives to the proposed facility; and identification of all federal and State permits and certifications needed to begin construction, operate, and maintain the proposed facility.

To keep track of the process and receive all filing related to a particular wind project, local officials should subscribe to the DMM website and then subscribe to receive notices on a particular matter or to request party status. The DPS PSS notice provides instructions on doing so.

In addition to publishing a newspaper notice of the availability of the PSS (containing a plain language summary of its contents), the applicant must provide the PSS to the chief executive officer of any other agency or local government (village mayor, town supervisor, or equivalent) that would have approval authority absent PSL Article 10. The applicant must also make the PSS available online. The public has 21 days to submit comments on the PSS (counted from its filing with the secretary to the Siting Board) and the applicant has 21 days to respond to those public comments. Comments on the PSS can be filed electronically through the DPS Matter Management (DMM) website or by mail. While 21 days seems like a short period, it's useful to think of the PSS as a synopsis of the application that sets the stage for the stipulations process and the full application. The mayor or town supervisor should seek the input of their boards, building official, and consultants in submitting comments on the PSS within the time period provided.

1.4 The Stipulations Process

After the PSS comment process is complete, the applicant can consult and seek agreement with any interested persons or parties about any facet of the scoping statement and any studies made in support of the application (referred to as the stipulations process). Stipulations are agreements among parties that concern matters before the Siting Board.

Any parties to the proceeding can enter into a stipulation, setting forth an agreement on any aspect of the PSS and the scope of studies or program of studies that will form the basis for the application. Intervenors should consider what needs to be studied. Local governments can focus their queries on the up to 41 exhibits that make up an Article 10 application. (For example, Exhibit 4 covers land use, Exhibit 19 covers noise and vibration, Exhibit 25 covers effect on transportation, and Exhibit 31 covers local laws and ordinances). They may request studies that support the information required to complete these exhibits. Local governments may ask applicants to address such subjects as availability of adequate infrastructure to support construction of the wind project (i.e., roads), a decommissioning plan, and conformity of the wind project with adopted comprehensive plans and zoning. The Article 10 regulations,[4] posted on the Siting Board's website, contain a complete list of exhibits in the appendices. Local governments may wish to review stipulations entered into for previously filed wind projects.

It may be in the interest of applicants and other parties to agree, in advance, to the content and methodology for conducting studies. In addition to the formal project review process, it's common for an applicant to engage directly with wildlife agencies, local governments, and others to address project concerns.

Stipulations may address site-specific or project-specific information not otherwise called for by the regulations.

The applicant may not commence negotiations for agreements on proposed stipulations until the presiding officer has allocated the pre-application intervenor funds. This is to ensure that intervenors have the wherewithal to participate in the stipulations phase of the Article 10 process. Within 60 days of the filing of a PSS, the presiding examiner or ALJs will convene a meeting of interested parties to initiate the stipulation process (and meet on intervenor funding).

Before the parties sign a stipulation, the presiding officer must provide notice of the proposed stipulation to the public and other parties and provide a reasonable opportunity for the public to submit comments on the proposed stipulation. A party that's a signatory to the stipulation may not object to any aspect of the PSS, and the methodology and scope of any stipulated studies or program of studies covered in a stipulation, unless the applicant fails to comply with the stipulation. Non-parties to a stipulation are not so bound.

1.5 Application Phase

After the stipulations process is complete, the applicant completes the analysis required by the Article 10 regulations along with any adopted stipulations and submits the application to the Siting Board's secretary. The applicant is required to publish notice of the filing of an application in local newspapers with directions on how to obtain a copy. The applicant must also post the application online and make it available at local public libraries. The application must include the following elements:

- A description of the site and facility
- An evaluation of the health, safety, and environmental implications of the construction of the facility
- The facility's pollution management systems; a safety plan for the construction and operational phases of the facility
- A study of the significant and adverse disproportional environmental impacts of the facility (if any)
- A detailed economic, physical, and demographic description of the community in the affected municipality

The applicant must additionally prove that the facility will be reasonably consistent with the New York State Energy Plan, analyze its impact on power generation markets, and review its potential impact on birds and other avian species.

As previously noted, an Article 10 application includes up to 41 exhibits—many of particular interest to local governments involved in the siting process. For wind projects, some exhibits are generally not applicable.[5] As indicated, local governments can qualify for intervenor funding to participate in the application phase of the Article 10 process.

1.6 Hearings

The Siting Board's chairperson has 60 days from application submission to determine if the application is complete. To be complete, the application must comply with any previously entered stipulations and filing requirements of the regulations. Once an application is determined to be in compliance with filing and content requirements, the chairperson and hearing examiners will set a pre-hearing conference to identify intervenors, award intervenor funds, identify issues for hearing, and establish a case schedule.

Article 10 uses the term "party" both generally and as a special term for purposes of the hearing. Intervenors should note that to become a party to the hearing (as opposed to a party to the proceeding generally), requires the filing of the notice and determination of the hearing examiners regardless of whether they were referred to as parties during the pre-application proceedings.

Article 10 provides that "Any municipality entitled to be a party herein and seeking to enforce any local ordinance, law, resolution or other action or regulation otherwise applicable shall present evidence in support thereof or shall be barred from the enforcement thereof."

There are three kinds of parties to the hearing: automatic statutory parties; parties with a right to be a party merely by giving notice; and parties that may be permitted to join. Municipalities fall into the second group. The affected municipality, municipalities within a five-mile radius of the wind project, and their citizens may become parties to the hearing simply by filing a notice within 45 days after the date given in the published notice as the date for the application filing. The Siting Board has provided a form[6] to file such notice.

Unless waived by all parties, the initial public hearing must start within 45 days after the prehearing. The presiding examiner must designate the hearing location within two miles of the proposed location of the wind project. The hearing examiners must allow sufficient time for direct comment and rebuttal from residents of the area affected by the proposal. Community members and affected agencies can submit comments at any time up to the hearing. During the hearing, the hearing examiners must give community members and affected agencies an opportunity to submit written or oral comments for the project record. The host municipality should be prepared to place into the record evidence of local laws that apply to the wind project.

After the public statement hearings, the parties can engage in discovery to seek additional information or clarifications and can also proceed to settlement through the preparation of a joint proposal or to an adjudicatory phase.

Except for appeals, the Siting Board must complete all proceedings within 12 months from the date the Siting Board determines the application is complete and compliant with Article 10 provisions (unless parties agree to waive the deadlines). The Siting Board can extend the deadline for six more months in extraordinary circumstances.

1.7 Effect Given to Local Laws in Board Decisions

To grant a certificate to a wind project, the Siting Board must find that the applicant has designed the facility to operate in compliance with applicable State and local laws and regulations on the environment, public health, and safety. An applicant may request a waiver of local zoning laws or ordinances. Upon review, the Siting Board may waive any local law it finds to be unreasonably burdensome: either given the state of current technology (e.g., where technological limitations make compliance impossible or impractical), where costs to consumers outweigh the law's benefits, or where the needs of consumers for the facility outweigh impacts to the municipality. The Siting Board must provide the municipality an opportunity to present evidence in support of its ordinance, law, resolution, regulation, or other local action.

2. Office of Renewable Energy Siting (ORES) Process

In April 2020, New York State passed the Accelerated Renewable Energy Growth and Community Benefit Act (the Act), a landmark piece of legislation in support of the State's ambitious climate, energy, and environmental justice goals. A major component of the Act was the creation of ORES, which would serve as a central forum for siting and permitting new large-scale renewable energy facilities in New York State. Whereas the existing Article 10 review process was charged with permitting all major electric generators greater than or equal to 25 MW, including both renewable and traditional electric generating facilities, ORES was tasked with establishing a comprehensive yet streamlined review process specifically tailored to new renewable energy projects. Within one year of the Act's passage, ORES will draft and finalize regulations and uniform permit standards and conditions for siting these facilities, working with involved State Agencies to consider potential environmental impacts and necessary mitigation efforts.

Until ORES has established and promulgated its rules, regulations, and permit standards and conditions, major renewable energy projects will continue to be permitted through the Article 10 review process.

2.1 Applicability and Timeline

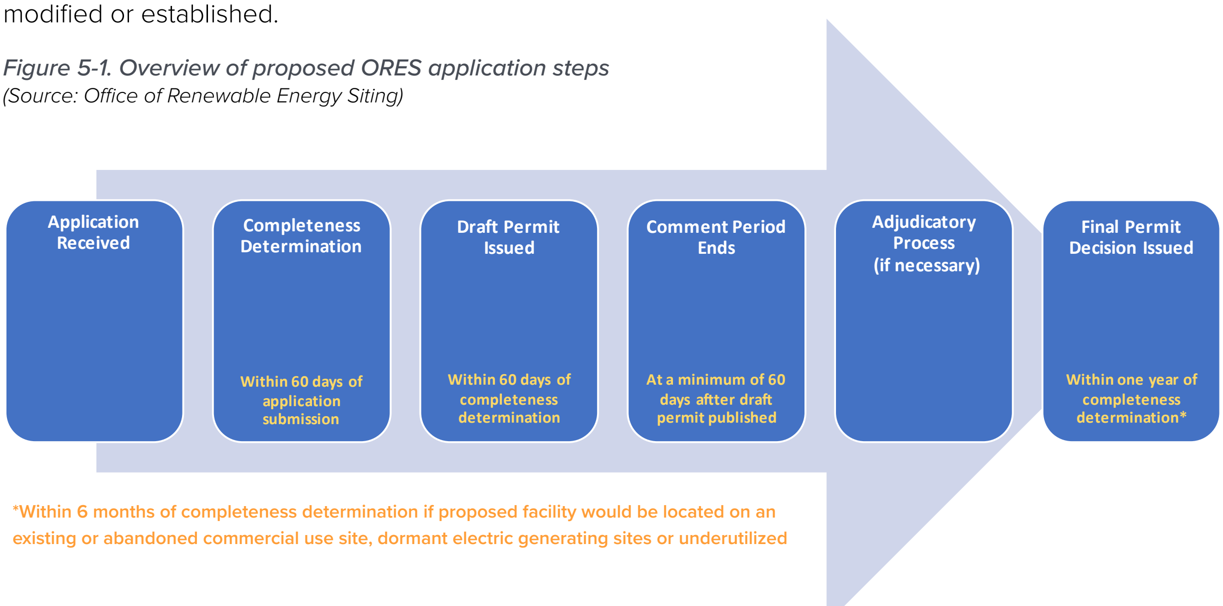
Like the existing Article 10 process, all new major renewable electric generating facilities greater than or equal to 25 MW will be required to seek a permit through ORES. However, there are additional circumstances under which a renewable energy project may opt-in to ORES review:

- New renewable facilities between 20-25 MW may choose to seek permit approval through ORES, rather than being permitted in accordance with otherwise-applicable local laws and the SEQR process.
- Existing project applications in the initial stages of the Article 10 review process may elect to instead seek a permit through ORES.

The ORES review process is designed to accelerate the timeline under which proposed projects are sited, approved, and constructed, relative to the existing Article 10 review process. Once deemed complete, applications for a permit through ORES must be acted upon within one calendar year, or within six months if the proposed project is to be built on an existing or abandoned commercial location, such as a brownfield, landfill, or other underutilized site. Should ORES fail to issue a determination within the required timeframe, the draft permit for the project will be deemed approved, and the project will proceed towards construction and operation. In addition, all final permits issued by ORES shall include a provision requiring the applicant to provide a host community benefit for the municipality.

Figure 5-1 identifies some of the key stages and milestones which make up the ORES process. As ORES continues to draft and finalize the rules and regulations governing its application review process, existing and additional milestones may be modified or established.

Figure 5-1. Overview of proposed ORES application steps
(Source: Office of Renewable Energy Siting)



2.2 Opportunities for Local Participation

There are a number of key opportunities for local engagement throughout the ORES review process, spanning pre-application activities to late-stage participation in any necessary hearings. Figure 5-2 addresses some of these opportunities and indicates where they occur in the various stages of ORES review.

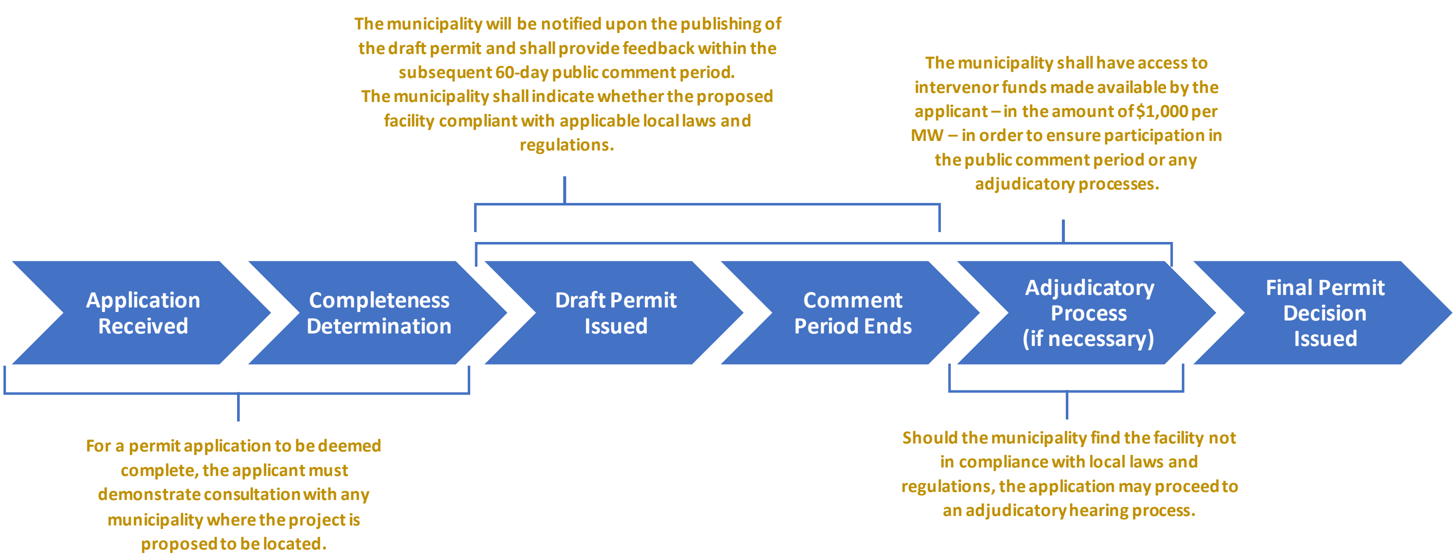
Prior to submitting a permit application to ORES, applicants must demonstrate proof of consultation with the host municipality regarding any procedural or substantive requirements of applicable local laws and regulations. Applications may only be deemed complete if they are able to demonstrate such consultation.

The municipality shall then be notified upon the publishing of an application's draft permit conditions, and shall have an opportunity to provide feedback on these conditions and the proposed facility's compliance with local laws within the subsequent 60 day public comment period. ORES is required to consider any applicable local law when making its determination.

If a municipality's statements raise any substantive and significant issues that require adjudication, ORES may proceed to an adjudicatory hearing process, which could include an evidentiary hearing, submission of expert testimony, or other considerations. If substantive or significant issues are raised and ORES does not hold an adjudicatory hearing, a public hearing will be scheduled in the municipality.

In order to ensure full municipal participation in the process, applicants will supply intervenor funding equal to $1,000 per MW, paid into a local agency account hosted by NYSERDA. This funding will be made available to host municipalities and community members, subject to ORES regulations, and may be used by eligible intervenors for participation in various stages of the ORES review process, including the 60 day public comment period or any adjudicatory hearings.

Figure 5-2. Local participation in proposed ORES application steps



3. State Environmental Quality and Review Act (SEQR) Process

As previously discussed, most proposed wind projects with a capacity under 25 MW are not subject to Article 10 or ORES review. Local governments are entitled to review these projects under their own land-use review authorities (Article 16 of the Town Law, Article 7 of the Village Law and the Municipal Home Rule Law) and in accordance with the SEQR process.[7]

The DEC, which administers the SEQR regulations, provides a considerable amount of information and guidance on the SEQR process on its website.[8] For example, the DEC maintains a SEQR Handbook[9] that contains FAQs on most aspects of SEQR. Local governments should consult the website for detailed information on the SEQR process. The New York State Department of State also provides advice on local land-use authority, training, and technical support.

SEQR requires the consideration of environmental factors early in the planning stages of any actions an agency funds, approves, or will directly undertake. SEQR is both a procedural and substantive law. It requires an agency to follow certain procedures or steps in the environmental review of an action. It also requires agencies to base decisions or conclusions on substantive information developed in the environmental review of a project. The review process may result in an agency requiring project modifications or could even result in a project denial.

3.1 Classification: Type I, Type II, and Unlisted Actions

The lead agency must classify actions under SEQR as Type I or Unlisted. Actions classified as Type II are not subject to SEQR. For wind projects, actions such as placement of a meteorological tower to gather wind data may classify as a Type II action. The classification of an action is important to determine the process an agency must follow to review an action. Type I actions are those projects more likely to require the preparation of an environmental impact statement (EIS) than unlisted actions. The criteria for classifying actions as Type I can be found in DEC's regulations at Title 6 of the Compilation of Codes, Rules and Regulations of the State of New York (6 NYCRR) § 617.4. Type II actions are those that have been determined to not have a significant impact or are otherwise precluded from environmental review under the Environmental Conservation Law (ECL) Article 8. Type II actions are not subject to review under SEQR, and a list of these actions can be found in 6 NYCRR 617.5. All actions not Type I or Type II are considered unlisted actions. However, an involved agency has the discretion to procedurally treat an Unlisted action as a Type I action.

Relevant examples of Type I actions include any project more than 100 feet above ground level in a locality without zoning regulations pertaining to height, as well as any project that involves the physical alteration of 10 acres or more. This would include not only alteration from turbine construction, but also lay-down areas, access roads, transmission lines, and any electrical substation improvements. If a project is in an agricultural district, the threshold for physical alteration is only 2.5 acres. Most commercial wind projects under 25 MW exceed these thresholds. They would, therefore, be classified as Type I actions. As described further, Type I actions require certain procedures to be followed, but do not always require the preparation of an EIS.

SEQR requires a project sponsor to complete Part 1 of the Environmental Assessment Form (EAF). The lead agency, as described in the following section, must complete Parts 2 and 3 of the forms. The Full EAF requires the project sponsor to provide more information about a project than the Short EAF. If the lead agency classifies a proposed wind project as Unlisted, the project sponsor should use the Short EAF and supplement it as necessary. The EAFs are available electronically on the DEC's website. The DEC has designed the forms to be self-completing in terms of any information required from their spatial databases (e.g., wetlands).

If a wind developer submits an application to a local government for a commercial wind project and a State or local agency determines that a project is a Type I action, the Full EAF should be included with the application. The project sponsor may choose to supplement the Full EAF with any studies or analyses related to the particular project. For Type I actions, SEQR also requires that the lead agency conduct a coordinated environmental review. This means that all involved agencies with discretion to approve, fund, or undertake an action cooperate to produce one integrated environmental review. It also allows interested agencies with concerns, but without jurisdiction, to participate in the review.

3.2 Lead Agency

SEQR requires that one of the involved agencies lead the environmental review. The SEQR regulations refer to this agency as the lead agency. Typically, the involved agencies mutually select the lead. Local governments, through their planning boards, have often assumed the role of lead agency. In some cases, local governments have assumed lead agency by default because no other agency had jurisdiction. If the involved agencies cannot agree on a lead agency, the contesting agencies can file the dispute with the DEC Commissioner to resolve the issue.

3.3 Determination of Significance

Once a lead agency is established, it must make a determination of significance. The determination of significance is a declaration of the potential for a project to have significant impacts on the environment. A negative declaration indicates the project will not have a potentially significant impact, whereas a positive declaration indicates the potential for at least one potentially significant adverse environmental impact. A negative declaration ends the SEQR process. A positive declaration requires the preparation of an EIS.

The definition of significance is important. Although a subjective term, the lead agency measures significance by factors such as the magnitude (severity) and importance (relation to its setting) of the impacts. The bigger or more severe the impact, the more a detailed analysis is required. The importance of the impact will depend on the setting and the local community values. A lead agency should consider whether the impacts are short or long term. It should note that a determination of significance is not the point at which to weigh the social and economic impacts of a project. The threshold determination of significance should only be based on whether the action in approving a wind project may have one or more potentially significant adverse environmental impacts. The threshold is low.

For commercial wind projects, the potential environmental impacts can include, but may not be limited to, visual, sound, avian (birds and bats), water quality (wetlands, stream, storm water runoff), historic preservation, agricultural, and community character. The lead agency may regard the construction-related impacts as short-term impacts. Other impacts related to operation of the wind project are long term, such as avian and visual impacts. In either case, the lead and involved agencies must carefully consider them.

SEQR's threshold for requiring an EIS is not based on the number of turbines but on the potential for significant adverse impacts. Therefore, projects with a small number of turbines are not automatically entitled to a negative declaration based on numbers and the reverse is true for larger-scale wind projects (i.e., the lead agency must still assess the impacts enumerated in the EAF).

In its determination of a positive or negative declaration, the lead agency must consider all relevant impacts, not just those within its jurisdiction. The reasons for the decision must be documented in writing. A negative declaration must contain a reasoned elaboration of why the project will not have significant impacts on the environment. The lead agency must base any negative declaration on information obtained at the time of the decision and not on future studies or conditions.

DEC prepared workbooks[10] for both the short and full EAFs and organized them in a way that corresponds to the questions in the EAFs. They provide detailed guidance on answering the questions that lead to a determination of significance. Lead agencies should be sure to use the workbooks in completing parts 2 and 3 of the EAFs.

3.4 Environmental Impact Statement Process

If the lead agency determines at least one potentially significant impact may occur due to the proposed project, a positive declaration must be issued and an Environmental Impact Statement (EIS) must be prepared. Procedurally, the EIS process adds additional steps, with the outcome of a more thorough environmental analysis.

The EIS also provides formal opportunities for public participation throughout the process. These include scoping of the draft EIS and a 30-day (minimum) public comment period on the draft.

A key component of the EIS is the requirement to consider alternatives. For wind projects, these alternatives may include different turbine locations, a reduction in the number of turbines, and must include review of the no action alternative. An EIS does not have to address every possible impact. The process is set up for the lead agency to identify those potentially significant adverse impacts and the EIS should focus on those impacts. Through the process of scoping a draft EIS, the lead agency can limit the issues to be addressed.

3.5 Findings

The EIS process ends with the preparation of a findings statement following acceptance of a final EIS. A findings statement is a written document that identifies the social, economic, and environmental considerations of the lead agency in approval or disproval of an action. A positive findings statement means that, after consideration of the final EIS, the lead agency can approve the project or action, and the action chosen is the one that minimizes or avoids environmental impacts to the maximum extent possible. An agency's findings statement must articulate the balancing of adverse environmental impacts against the needs for and benefits of the action. If the action cannot be approved based on analyses in the final EIS, a negative findings statement must be prepared to document the reasons for the denial.

Each involved agency, not just the lead agency, must prepare its own SEQR findings following acceptance of a final EIS. Findings provide "the teeth" in the SEQR process because they articulate the basis for each agency's decision, including supporting any conditions that the agency may impose. Whether findings support approval or denial of an action, the agency must state its reasoning in the form of facts and conclusions derived from the final EIS.

3.6 SEQR Fees

A lead agency has the option to require the project sponsor to provide money to assist in the SEQR process for the project. Project sponsors can establish a fund to allow the lead agency to hire its own consultants, who report directly to them and not the project sponsor. The lead agency cannot require the project sponsor to pay for both the preparation and review of an EIS; however, typically the project sponsor prepares the draft EIS, subject to the lead agency's acceptance, and then provides review fees to the lead agency. The SEQR regulations contain guidelines for how much money the lead agency can charge for a particular project.

Additional Resources

- SEQR
  http://www.dec.ny.gov/permits/357.html
- Board on Electric Generation Siting and the Environment
  http://www3.dps.ny.gov/W/PSCWeb.nsf/All/1392EC6DD904BBC285257F4E005BE810?OpenDocument
- New York State's Process for Considering Sites for Wind Farms
  https://www.nyserda.ny.gov/-/media/Files/EERP/Renewables/Wind-Siting-Fact-Sheet.pdf
- The Next Generation of Wind Farms on Tug Hill
  https://www.tughill.org/wp-content/uploads/2011/09/2016-UpdateThe-Next-Generation-of-Wind-Farms.pdf
- Model Ordinances:
  - Columbia Law School model wind siting ordinances
    http://columbiaclimatelaw.com/resources/model-laws-and-protocols/model-municipal-ordinances/model-wind-siting-ordinance/
  - US Department of Energy wind energy ordinance database
    https://windexchange.energy.gov/policies-incentives

Questions?

If you have any questions regarding local role in planning and permitting, please email questions to cleanenergyhelp@nyserda.ny.gov or request free technical assistance at nyserda.ny.gov/CleanEnergySiting. The NYSERDA team looks forward to partnering with communities across the State to help them meet their clean energy goals.

Section End Notes

[1] http://www3.dps.ny.gov/W/PSCWeb.nsf/All/6FD11CE8DB088A2785257E200054A99B?OpenDocument

[2] http://www3.dps.ny.gov/W/PSCWeb.nsf/All/D43928A8EE8BD47585257E200054A998?OpenDocument

[3] http://www3.dps.ny.gov/W/PSCWeb.nsf/ArticlesByTitle/0729A9B325D6EB9585257E200054A999?OpenDocument

[4] http://www3.dps.ny.gov/W/PSCWeb.nsf/All/143595FA3BE36AEA852579D00068B454?OpenDocument

[5] These include: Exhibits 7 (gas fired plants), 16 (pollution control facilities), 17 (air emissions), 30 (nuclear facilities), 36 (gas interconnection), 37 (back-up fuel), 38 (water interconnection), and 39 (wastewater interconnection).

[6] http://www3.dps.ny.gov/W/PSCWeb.nsf/ca7cd46b41e6d01f0525685800545955/0729a9b325d6eb9585257e200054a999/$FILE/Form%20NOIP%204-15-13.pdf

[7] A number of wind projects that were under development before implementation of Article 10 are "grandfathered," and continue to be reviewed under the SEQR process.

[8] http://www.dec.ny.gov/permits/357.html

[9] http://www.dec.ny.gov/permits/6188.html

[10] http://www.dec.ny.gov/permits/90125.html

Birds and Bats: Impacts and Regulation

Understanding Federal and State requirements protecting ecological resources

Section Contents

Overview

Heavy construction work, common to development of all power generating facilities and other major structures, may affect ecological resources during construction and operation. Common ecological concerns related to any type of construction include loss or change of habitat for foraging, wintering, migrating, and nesting birds, as well as change in vegetative cover types. Other concerns are specific to wind projects and include injury to or death of birds and bats due to collisions with turbine/tower structures.

From federal laws to State surveillance and monitoring guidelines, there are many requirements in place to protect these ecological resources. Depending on the level and type of wildlife impact estimated for a proposed wind project, appropriate avoidance, minimization, or mitigation strategies can be developed.

1. Bird Impacts

Early wind projects, notably in California, experienced a high number of avian strikes as a result of turbine design and poor siting. Modern-day projects are constructed with turbines designed to reduce the potential for avian perching and collisions, and locations are more intensely scrutinized. In addition, newer turbines are much larger in capacity, requiring fewer turbines to achieve a desired overall capacity.

Still, according to the American Wind Wildlife Institute, (AWWI) "The potential for biologically significant impacts to wildlife continues to be a source of concern as populations of many species overlapping with proposed wind energy development are experiencing long-term declines as a result of habitat loss and fragmentation, disease, non-native invasive species, and increased mortality from numerous other anthropogenic activities." (American Wind Wildlife Institute, 2016). Since the early experience with bird fatalities, the wind industry, scientists, and state and federal agencies have been working together to understand the relationship of birds to wind turbines and how to better site and operate turbines while still receiving an adequate wind resource. Lessons learned from that time are being applied to today's proposed and operating projects. Bird collision rates are subject to a wide range of factors that include weather, seasonality, species, turbine design, and site characteristics. Typically, passerines (perching birds, including songbirds) are the group most impacted by wind turbines.

Bird mortality due to human activity is not limited to wind turbines. Studies show that wind turbines, on average, are less harmful than some other human-made structures or predators (Figure 6-1). It is not the intent of this graphic to diminish the impact wind turbines have on local bird populations in light of the expansion of wind power development, but rather put the impact in perspective.

Figure 6-1. Top Common Human-Caused Threats to Birds (U.S. only. Ordered by Median Estimate of Bird Mortality Annually. As of 2017)
(Source: U.S. Fish & Wildlife Service, https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds.php)

Hazard/Type	Min Range	Max Range	Median/Avg. Estimated
Habitat Loss/Conversion	N/A	N/A	N/A
Collision - Building Glass	365,000,000	988,000,000	599,000,000
Collisions - Communication towers	-	-	6,600,000
Collisions - Electrical lines	8,000,000	57,300,000	25,500,000
Collision - Vehicles	89,000,000	340,000,000	214,500,000
Collisions - Land-based Wind Turbines	140,438	327,586	234,012
Collisions - Offshore Wind Turbines	N/A	N/A	N/A
Collisions - Solar Panels	N/A	N/A	N/A
Electrocutions	900,000	11,600,000	5,600,000
Burning -Solar Towers	N/A	N/A	N/A
Poison	-	-	72,000,000
Cats	1,400,000,000	3,700,000,000	2,400,000,000
Oil Pits Trail 2006	500,000	1,000,000	750,000
All	1,863,540,438	5,098,227,586	3,324,184,012
All (excluding cats)	463,540,438	1,398,227,586	924,184,012
Industry only (excludes cats and vehicles)	374,540,438	1,058,227,586	709,684,012

** N/A: Not Available*

In reviewing 170 North American wind facility collision-fatality-monitoring studies, the AAWI reports that most studies show fatality rates of three to five birds per megawatt (MW) per year, inclusive of all affected species (American Wind Wildlife Institute, 2016). The highest fatality rate reported was 14 birds per MW per year.

2. Bat Impacts

Bat fatalities have also been associated with wind turbines, typically caused by collisions. Some earlier evidence suggested that rapid changes in air pressure near the rotating blades may be responsible for bat deaths, but more recent studies have suggested that such occurrences are not very common (American Wind Wildlife Institute, 2016). Like birds, bats are also known to collide with other man-made structures, such as lighthouses, television towers, communication towers, large windows, tall buildings, power lines, and barbed-wire fences. The numbers of bats killed from specific incidents at these types of structures appear to be small.

A 2013 review of 75 North American post-construction studies found the highest mean bat fatality rates have been documented at wind power projects in the Midwest and the Eastern Forest Region (Hein, 2013). Although many of these documented fatalities were at wind power projects associated with long treed ridgelines in the Mid-Atlantic Appalachian Mountains, the high rate of bat mortality in the East may be attributable, in part, to other factors (Arnett, 2008). According to the AWWI, there have been no consistently established patterns of mortality related to landscape types; however, on average, fatality rates have been lower at wind farms located in the Western U.S. (American Wind Wildlife Institute, 2016).

Studies identified several other patterns associated with bat fatalities, without definitively identifying any one factor. The fatalities were found to be skewed toward migratory bats and consistently peak in midsummer through fall. The studies found that the fatalities were not concentrated at any one turbine location (they were distributed across the facility), and FAA lighting (red strobe lights) did not seem to have any influence on the collisions (American Wind Wildlife Institute, 2016).

Studies are underway to determine the effectiveness of taking mitigation actions, including curtailing blade rotation at low wind speeds and use of ultrasonic transmitters to deter bats from the blade area as a means of mitigating bat fatalities.

3. Federal Laws and Requirements

3.1 Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act

The Federal Migratory Bird Treaty Act (MBTA) has been in place for more than a hundred years. It prevents the harm or disruption of any migratory bird without a permit. The Bald and Golden Eagle Protection Act, enacted in 1940, provides additional federal protection to these two important species. This Act established that a "take, possess[ion], purchase, or barter," except pursuant to federal regulations, will result in criminal penalties.

The U.S. Fish & Wildlife Service (FWS) is in charge of enforcing both of these Acts and is responsible for issuing permits under them. These policies and their application to wind energy development are further described in the FWS Land-Based Wind Energy Guidelines[1] (U.S. Fish & Wildlife Service, 2012). Developers are required to follow these guidelines and must get the appropriate permits for the "take" of these species before projects being operating. More information on permits is available at Eagle Permits: Eagle Incidental Take and Take of Eagle Nests.[2]

3.2 Endangered Species Act

Species categorized as endangered or threatened by the federal government are protected under the Endangered Species Act, which "ensure[s] that [federal agencies'] actions are not likely to jeopardize the continued existence of these species or destroy or adversely modify their critical habitat." Guidelines for developers to abide by this Act are also listed in the FWS Land-Based Wind Energy Guidelines (U.S. Fish & Wildlife Service, 2012).

As of 2007, the Bald Eagle is no longer included on the Endangered Species Act (ESA) list of threatened species.

4. State Surveying and Monitoring Guidelines

Environmental assessments of wind energy projects commonly require pre- and post-construction monitoring of the project area to determine the project's impact on avian and bat species. Surveys include researching the biological resources within the project area, migration patterns of birds/bats passing through the project area, and the protective status of migratory and nesting/resident species in an area where turbines are being considered. Bird and bat surveys are often conducted during the spring and fall seasons to identify the migratory patterns of birds and/or bats as they pass through the project area.

In 2008, the New York State Department of Environmental Conservation (DEC) implemented guidance for assessing the potential impacts of commercial wind projects on bird and bat species. In June 2016, the DEC released the updated Guidelines for Conducting Bird and Bat Studies at Commercial Wind Energy Projects.[3] The guidelines are comprehensive and include measures for conducting both pre- and post-construction impact surveys. They outline the recommendations proposed by DEC for commercial wind developers, including characterizing bird and bat populations at site locations, documenting bird and bat mortality rates, and identifying other indirect effects. By recommending consistent protocols and methodologies, the guidelines will allow for comparison of data across different sites and years, which "may contribute to a statewide understanding of the ecological effects of wind energy generation" (NY Department of Environmental Conservation, 2016).

The implementation of the 2008 guidelines resulted in the completion of more than 20 post-construction monitoring surveys submitted to the DEC. Department staff reviewed the data to assess impacts of the operating commercial wind projects on avian and bat species. The results of the surveys were utilized to update and revise the guidelines in 2016. The post-construction reports regarding the impacts on avian species from operating New York State commercial wind farms are consistent with the 2016 results collected by AWWI. The results of the post-construction studies regarding bat mortality are also consistent with the AWWI 2008 review of projects throughout North America; bat mortality at projects in New York State is greater than at projects located in the western part of the U.S.

5. New York State Threatened and Endangered Species Listings

The FWS maintains a list of all threatened species, endangered species, and critical habitats by the state in which they occur. As of August 2016, 13 animals and eight plants found in New York State are listed as either threatened or endangered by the USF&WS (U.S. Fish & Wildlife Service, 2015). New York State maintains its own list of endangered and threatened species that contains additional species to the FWS list (NY Department of Environmental Conservation, n.d.). It is important that project sponsors consult these lists early on during site selection of their wind project. An environmental consultant can refer to these lists and advise the project sponsor about the likelihood of potential impacts. Ultimately, it is the responsibility of the agencies to determine whether any of the species on either list may be at risk of being impacted and what level of surveys and analyses are required to identify that risk.

The New York State Natural Heritage Program maintains a database[4] on the locations of rare plants and animals, and significant natural communities found within New York State (NY Department of Environmental Conservation, n.d.). Proposed development sites should be screened against the database. The screening focuses on identifying rare species and significant natural communities at or in the vicinity of the proposed project site as well as rare species of birds and bats within a larger area around the site. DEC staff can also provide useful insight on the occurrence of listed species or species of concern in a proposed development area. Local birding groups may also provide information on migrant and resident bird species in a local area.

6. Habitat Impacts

Loss of habitat and vegetation can occur during the construction process as a result of increased human presence, noise, motion, and alteration of the terrain for roads, buildings, foundations, or other permanent site-infrastructure elements. Although developers generally try to select sites with minimal tree cover, tree removal does occur at most projects for construction needs and access roads. Selective tree removal to improve wind exposure can also result in a loss of forested habitat.

Site topography and project layout have the largest impact on loss of habitat issues. Construction in steep areas can produce more disturbances due to the need for more cut-and-fill excavation work. Loss of habitat can be mitigated through revegetation actions or setting aside other sections of land from development. Plans for site work should be reviewed to ensure sufficient soil and water quality control measures, like those required for other construction projects, are in place.

Surveys of habitat and vegetation often focus on:

- Landcover types and condition of the habitat
- Whether any threatened or endangered vegetation exists in the proposed development area
- Whether the area is already fragmented
- What species are thought or known to require that habitat or vegetation for survival (critical habitat)

7. Strategies for Lessening Bird and Bat Impacts

Depending on the level and type of wildlife impact estimated for a proposed wind project, appropriate avoidance, minimization, or mitigation strategies can be developed. Examples of these strategies include the following:

- Relocate turbine (depending on topography, wind resource, and access to land) or remove from the proposed project layout if there are no suitable alternatives.
- Minimize impacts of electrical wires on birds by burying cable when practical and installing bird diverters on overhead lines.
- Minimize lighting at operation and maintenance buildings, substation, and interconnection facilities.
- Prevent birds from flying into guy wires on meteorological towers by using bird diverters (not applicable for turbine towers).
- Alter operations, such as shutting down turbines during certain times (e.g., bird migration and bat activity seasons) to reduce turbine strikes.
- Replace or rehabilitate lost habitats in nearby areas.

The FWS Land-Based Wind Energy Guidelines[1] include general guidelines for mitigation of and compensation for adverse impacts (U.S. Fish & Wildlife Service, 2012). In addition, the Bats and Wind Energy Cooperative (BWEC), formed in 2003, is "an alliance of state and federal agencies, private industry, academic institutions, and non-governmental organizations that cooperates to develop solutions to minimize or, where possible, prevent mortality of bats at wind power turbines." BWEC's research includes ongoing studies on new techniques, such as operational mitigation and deterrents, that hold promise to lessen harm to bat species (Bats and Wind Energy Cooperative, n.d.).

References

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Arnett, E. (2008). Patterns of Bat Fatalities at Wind Energy Facilities in North America. Journal of Wildlife Management. Retrieved August 3, 2016 http://batsandwind.org/pdf/arnett2008patbatfatal.pdf

Bats and Wind Energy Cooperative. (n.d.). Operational Mitigation & Deterrents. Retrieved August 3, 2016 http://batsandwind.org/research/operational-mitigation-deterrents/

Hein, C.D., J. Gruver, and E.B. Arnett. 2013. Relating pre-construction bat activity and post-construction bat fatality to predict risk at wind energy facilities: a synthesis. A report submitted to the National Renewable Energy Laboratory. Bat Conservation International, Austin, TX, USA. Retrieved August 3, 2016 http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7B3CDA8C52-7C2F-406F-AF59-5333185D8F82%7D

Erickson, W., Johnson, G., & Young, D. (2005). A Summary and Comparison of Bird Mortality from Anthropogenic Causes with an Emphasis on Collisions. Retrieved August 3, 2016 http://www.wingpowerenergy.com/wp-content/uploads/2012/07/birdmortality.pdf

U.S. Fish & Wildlife Service. (2012). Land-based Wind Energy Guidelines. Retrieved August 3, 2016 https://www.fws.gov/ecological-services/es-library/pdfs/WEG_final.pdf

U.S. Fish & Wildlife Service. (2015, February 13). Listed species believed to or known to occur in New York. Retrieved August 3, 2016 https://ecos.fws.gov/ecp0/reports/species-listed-by-state-report?state=NY&status=listed

Additional Resources

- Behavioral Responses of Bats to Operating Wind Turbines
  http://batsandwind.org/pdf/hornetal2008.pdf
- NY Natural Heritage Program
  http://www.dec.ny.gov/animals/29338.html
- List of Endangered, Threatened and Special Concern Fish & Wildlife Species of New York State
  http://www.dec.ny.gov/animals/7494.html
- Bat and Wind Energy Cooperative
  http://batsandwind.org/
- Biodiversity and Wind Siting Mapping Tool (interactive map)
  https://www.nature.org/en-us/about-us/where-we-work/united-states/new-york/stories-in-new-york/working-with-wind, and direct link at: http://www.ebd.mapny.info/
- Annual Report for the Maple Ridge Wind Power Project Post-construction Bird and Bat Fatality Study
  https://tethys.pnnl.gov/sites/default/files/publications/Jain-et-al-2007.pdf

Questions?

If you have any questions regarding birds and bats impact and regulations, please email questions to cleanenergyhelp@nyserda.ny.gov or request free technical assistance at nyserda.ny.gov/Siting. The NYSERDA team looks forward to partnering with communities across the State to help them meet their clean energy goals.

Section End Notes

[1] https://www.fws.gov/ecological-services/es-library/pdfs/WEG_final.pdf

[2] https://www.regulations.gov/document?D=FWS-R9-MB-2011-0094-1838

[3] https://tethys.pnnl.gov/sites/default/files/publications/NYSDEC-2016.pdf

[4] http://www.dec.ny.gov/animals/29338.html

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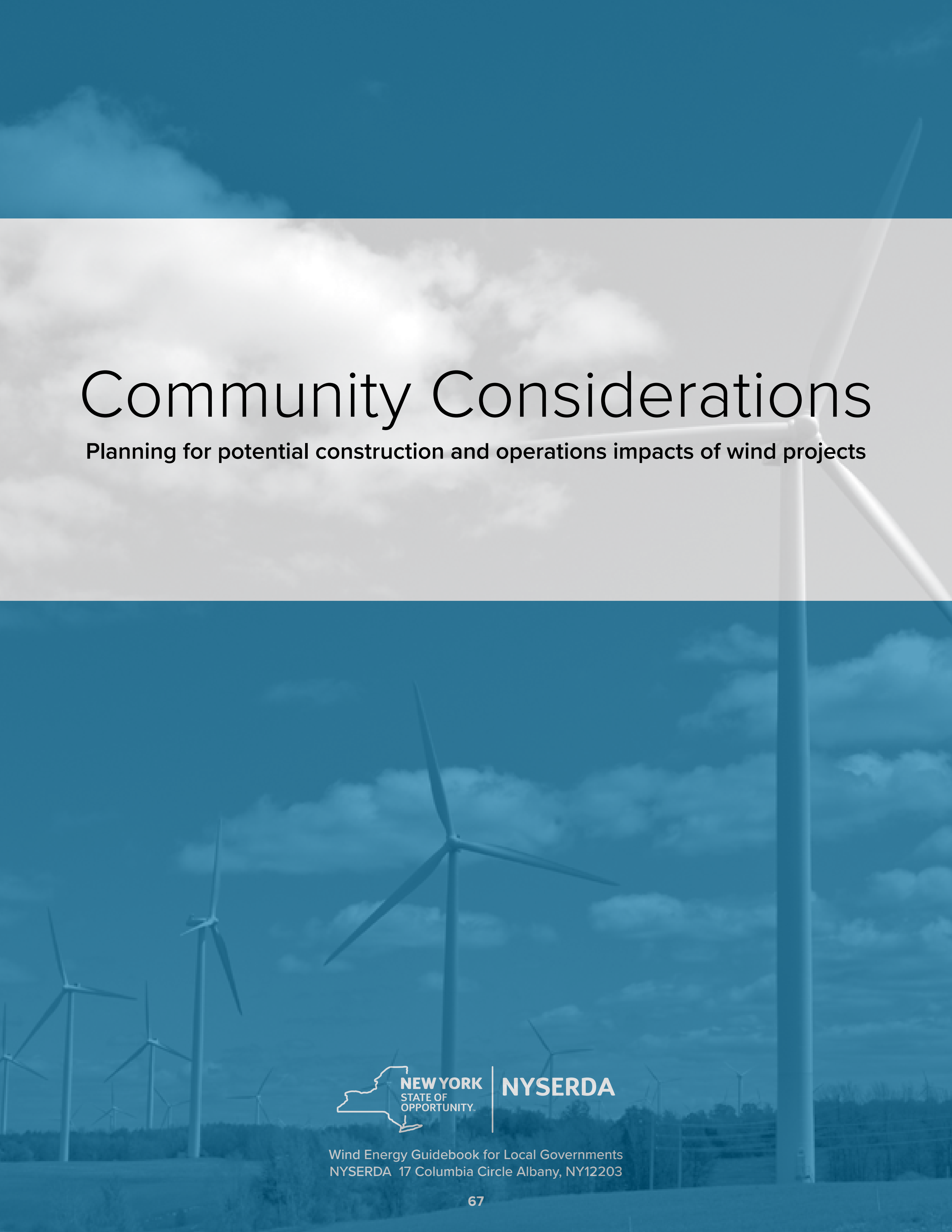


Community Considerations

Planning for potential construction and operations impacts of wind projects

Section Contents

Overview

Wind turbines are environmentally low-impact compared to coal, natural gas, and nuclear power plants. In general, they don't cause air, water, or ground pollution; produce toxic chemicals or radioactive waste; or require mining or drilling for fuel. However, when potential environmental impacts present themselves during project planning, they are thoroughly reviewed as part of the Public Service Law Article 10, Office of Renewable Energy Siting (ORES), or State Environmental Quality Review (SEQR) processes.

Environmental impacts must be taken into account for the following:

- Site Construction and Operations
- Cultural and Archaeological Resources
- Socioeconomic Impacts
- Telecommunications
- Aesthetics and Visual Impacts
- Shadow Flicker
- Sound Emissions

Note: For environmental impacts related to birds and bats, please see the Birds and Bats: Impacts and Regulation section (p. 57).

Note: For more on Article 10, ORES, and SEQR, please see the Local Role in Planning and Permitting section (p. 43).

1. Site Construction and Operations

Like any other major construction project, wind energy projects introduce the possibility of a variety of potentially harmful environmental impacts, many of which can be prevented or remediated. Operating wind project sites may also have environmental impacts. Wind projects are more complex than just the turbines themselves, and large wind farms will typically include several temporary and permanent components:

- Construction trailer, lay-down yard, and equipment staging area
- Access roads to the turbines (temporary access may be wider than the permanent road that remains after construction)
- Public road improvements (allowing local roads to accommodate heavy construction equipment)
- Wind turbines (foundations, towers, and turbines, plus a temporary construction staging area)
- Interconnection between turbines (temporary clearing prior to the installation of, typically buried, electrical collection-system lines)
- Disposal areas for cleared vegetation, rock, and excess subsoil
- Substation design and placement
- Transmission line and associated access
- Permanent operations and maintenance facilities

To ensure responsible site construction, project developers should follow quality assurance standards that meet federal, state, and local environmental permit requirements.

1.1 Common Construction-Related Concerns

Some of the most common construction-related concerns are listed as follows. A construction quality-assurance plan should address these concerns.

- Are all construction activities properly approved by the appropriate agencies prior to the start of construction?
- Are construction activities and access occurring only in approved areas and along approved routes?
- Has the work area been properly defined, staked, and fenced prior to construction?
- Is regular notice of road closures or other traffic inconveniences being adequately communicated to police and emergency services, residents, and others?
- Have all underground utilities been identified prior to ground-disturbing activities?
- Are agricultural protection measures being appropriately implemented?
- Have wetland resources been properly delineated and staked prior to construction? Do construction crews know to avoid access through or disposal of debris in wetlands?
- Have sediment and erosion control measures been installed? Are they properly maintained, especially after storm events?
- If there is to be blasting on-site, have all appropriate landowner notifications been made?
- Is dust being properly controlled?

An environmental construction compliance program has several components, which enable projects to be built in compliance with environmental and land-use permits. Such permits typically cover landowner restrictions; sensitive resources (biological, geological, agricultural, and cultural); limits of clearing; proposed stream crossings; location of drainage features; layout of sediment and erosion control features; and post-construction restoration requirements.

The project developer ensures all environmental permit conditions are met, trains construction crew on permit requirements for environmental compliance, and employs an environmental inspector to help develop and implement procedures for environmental compliance prior to and during the construction process, particularly in environmentally sensitive areas.

When the construction phase is completed, the developer will be responsible for restoring the project site according to the conditions of the environmental permits. Permits and bond-release provisions often require project proponents to conduct a multiyear post-construction monitoring program of restoration efforts.

Local and State regulatory agencies may wish to participate in Public Service Commission siting proceedings under Article 10 of the Public Service Law, where applicable, and should be familiar with the requirements of the project's various permits. Sometimes regulatory agencies retain their own environmental monitors to track the project's compliance status. As part of their permit conditions, project developers may be required to submit reports based on the environmental inspectors' daily logs. These reports may be developed weekly, monthly, or quarterly, and submitted to the federal, State, and local agencies with permit oversight. Some regulatory agencies conduct a regular weekly, monthly, or quarterly compliance assessment at project sites. In addition, compliance tours can be periodically arranged for local, State, and federal officials.

1.2 Impacts on Agriculture

Generally, wind energy projects are compatible with agricultural land uses and may help farmers who lease land to wind developers preserve their farms by providing them a supplemental income. Because wind turbines physically occupy only a small fraction of the land, most of the leased land remains available for crops and grazing. However, impacts to the agricultural resources can occur during wind project construction.

Two types of agricultural impact can result from the construction of wind energy projects on agricultural land:

- Permanent loss of productive land as a result of the installation of access roads, turbine towers, and interconnection facilities
- Damage to soil resources, a loss of crops, or displacement of grazing animals in areas disturbed during construction

Both impacts can be minimized with proper planning and communication.

Properly siting access roads and towers can significantly reduce the amount of land permanently lost from agricultural production. Generally, building roads and tower sites along the edges of fields results in the least amount of productive land being permanently lost.

Loss of productive farmland can occur at the point of connection between the wind energy project and the electric transmission line. Good communication is needed between the State Department of Agriculture and Markets (AGM), the project developer, the landowner, and the utility company concerning the transmission line interconnection. All parties need to fully understand the type and location of all facilities required for the interconnection.

Another concern is the potential for permanent damage to the soil. Since the depth of the topsoil layer is generally quite shallow in New York State, it is critical to protect it. Topsoil should be stripped from any areas disturbed by construction—access roads, tower sites, and any other areas where excavation is necessary—and stockpiled. Following construction, the topsoil must be graded to the original depth. Project developers should negotiate adequate work space with landowners to allow for proper topsoil protection. When properly coordinated, farmers can successfully plant crops in close proximity to access roads and towers once the project is complete.

Wind farm construction may cause compaction to the topsoil and subsoil layers, which, if not properly mitigated, can reduce crop production for several years. Deep soil tillage in agricultural areas is recommended during restoration. On average, approximately 3.5 acres per megawatt (MW) are temporarily disturbed during construction. Of that amount, about one acre/MW is used permanently by the project during operation (Union of Concerned Scientists, 2013). The remainder is used for staging, temporary placement of the rotor and tower sections, and the assembly work area. These areas should be subject to soil protections as appropriate to soil characteristics.

Many of the soil types in the areas where wind energy projects have been constructed, or are proposed, are shallow to bedrock or have a high concentration of rock in the subsoil. Extensive excavation in these types of soils can result in a higher-than-normal concentration of rock in the upper subsoil and topsoil layer. If not properly removed or used as appropriate for other project needs (e.g., foundation backfill, access road cover), this rock concentration can create difficulties for the farm operator.

1.3 Traffic and Road Conditions

Wind project construction results in a short-term increase in the number and size of tractor trailers present on rural roadways. Like any large construction project, there are many deliveries of supplies, tools, and construction materials, including cement for foundations and gravel for access roads. Transportation of tower sections, nacelles, blades, and large-capacity cranes requires multiple deliveries using specialized transport vehicles.

The increased truck traffic combined with the increased loading on the roads is a concern for transportation departments responsible for road maintenance and repair. Wind energy project developers recognize that increased traffic may cause damage to roadways and usually include provisions for the turbine supplier and contractors to be responsible for any necessary road repairs.

Town governments, in conjunction with the project developer, should document local road conditions in the vicinity of the project prior to construction. Project developers should be required to restore any road damage to the documented preconstruction conditions (or better).

Sometimes roads must be reinforced or widened to accommodate oversized trailers and trucks. These changes are permanent. While some residents welcome the upgrades, others may object, fearing an increase in traffic or traffic speeds after construction is completed.

1.4 Erosion and Sediment Control

Stormwater runoff during construction can be a significant issue, and both State and local governments have codes for addressing it. During construction, as soils are disturbed, stormwater runoff may carry away sediment and pollutants to surface waters.

Approaches to prevent or minimize soil erosion for wind energy projects are similar to requirements for other forms of construction projects. Road, building, and foundation construction are the principal wind project construction activities of concern. The potential for soil erosion at a wind project is examined during the permitting process. Any project that results in the disturbance of one or more acres of land (or 5,000 square feet in the New York City East of Hudson watershed) must seek authorization under the State Pollutant Discharge Elimination System (SPDES) General Permit for Stormwater Discharges from Construction Activity prior to beginning construction. In addition, the local municipality may also have review authority of the erosion and sediment controls under the SPDES General Permit for Stormwater Discharges from Municipal Separate Storm Sewer Systems (MS4s). Design professionals should refer to the New York State Standards and Specifications for Erosion and Sediment Control for the selection and design of erosion and sediment controls to be used for the project. The erosion and sediment controls must be identified in the Stormwater Pollution Prevention Plan (SWPPP) required by the Construction General Permit.

1.5 Drainage and Post-Construction Stormwater Runoff

Natural surface and subsurface drainage patterns can change as a result of final site grading and construction of permanent impervious cover, such as permanent gravel access roads and support buildings. Stormwater runoff impacts need to be considered during the planning/design phases of the project and properly addressed by post-construction stormwater management controls designed in accordance with the SPDES General Permit for Stormwater Discharges from Construction Activity and the New York State Stormwater Management Design Manual. The post-construction controls to be used for the project must be identified in the SWPPP required by the Construction General Permit.

An SWPPP must be filed as part of Article 10 or SEQR; however, authorization for implementation of the SWPPP is granted under the SPDES Stormwater General Permit (previously described) separately from the Article 10 certification process.

1.6 Wetlands and Stream Crossings

If a part of the project (e.g., access road, transmission line, or turbine) is located in or adjacent to a wetland or will disturb the bed or banks of a stream, river or other waterbody, requirements for compliance with applicable regulations will be incorporated into the Article 10 review and certification process. These regulations may include: Clean Water Act Section 401 Water Quality Certification (WQC); ECL Article 15, Protection of Waters; and ECL Article 24, Freshwater Wetlands and associated State regulations (NYCRR Parts 608 and 663). If the project will have a generating capacity of less than 25 MW, the developer must apply for approval of the referenced permits from New York State Department of Environmental Conservation (DEC). Impacts to federally delineated wetlands require approval from the U.S. Army Corp of Engineers.

The DEC maintains information about the Protection of Waters[1] and Freshwater Wetlands Permit[2] Program. The following agencies are also involved in protecting freshwater wetland and stream resources and may be involved in issuing permits associated with impacts to those resources:

- U.S. Army Corps of Engineers
- NYS Department of State
- NYS Office of General Services
- Adirondack Park Agency
- Local governments

These permit programs define the allowed work in a particular location, as well as any required mitigation measures. Wetlands are typically identified by field delineation early in the project development process and developers make significant efforts to avoid disturbing these areas. Impacts to wetlands are assessed prior to project construction. Both temporary and permanent impacts to wetlands and waters of the U.S. are assessed and appropriate permitting is obtained depending on the extent of calculated impacts, including mitigation for those that are unavoidable.

1.7 Solid and Hazardous Waste

As a part of permitting review, any solid or hazardous waste from construction or operation of the wind energy project must be addressed. Waste from wind energy projects primarily consists of general solid waste associated with the shop office, packaging material from equipment and supply shipments, spent lubricants, and small components that have failed, but also includes hazardous wastes, such as solvents used for cleaning turbine parts. Project operations and maintenance buildings have conditions typically found within automobile or boat repair facilities. Leaks of hydraulic fluids or lubrication oils from components within the nacelles or shop handling of lubricants represent the most common places for accidental releases of hazardous material into the environment. All projects are required to handle and store lubricants in accordance with local, State, and federal requirements.

Minor equipment leaks can occur with turbines, pad mount transformers and the main power transformer, which all contain oil lubricants. Pad mount transformers and main power transformers will have spill control countermeasures in place as well as a hazardous material handling plan to address spills as they occur, as required by the DEC. Occasionally, small amounts of lubricant can leak from a turbine nacelle. The amount of material that can potentially be released, however, is less than the amount regulated by environmental agencies and rarely poses an environmental concern because the materials don't usually extend beyond the turbine components.

The use of hazardous materials is typically minimal during the operation of a wind energy facility, which makes complying with solid and hazardous waste permit requirements relatively straightforward. Solid waste is typically managed through a solid waste removal service contract. Lubricant suppliers have established programs for collecting waste lubricants and oils generated during routine maintenance activities, such as gearbox or hydraulic station oil changes, and large components that are replaced can be returned to the manufacturer for refurbishment. These programs allow developers to comply with requirements and maintain the health of the environment.

1.8 Additional Resources

- Stormwater Management Design Manual
  http://www.dec.ny.gov/docs/water_pdf/swdm2015entire.pdf
- Stormwater Permit for Construction Activity
  http://www.dec.ny.gov/chemical/43133.html
- New York State Standards and Specifications for Erosion and Sediment Control (Blue Book)
  http://www.dec.ny.gov/chemical/29066.html
- Stormwater Management Guidance Manual for Local Officials
  http://www.dec.ny.gov/chemical/9007.html
- NREL Report on Land Use Requirements of Wind Power Plants
  https://www.nrel.gov/docs/fy09osti/45834.pdf
- Guidelines for Agricultural Mitigation for Wind Power Projects
  https://agriculture.ny.gov/system/files/documents/2019/10/wind_farm_guidelines.pdf
- Freshwater Wetlands Program Guide for Applicants
  http://www.dec.ny.gov/docs/permits_ej_operations_pdf/freshwetprogramguide.pdf
- Wetlands
  http://www.dec.ny.gov/lands/305.html

2. Cultural and Archeological Resources

Historic, cultural, and archeological surveys are typically conducted as part of the environmental assessment for a proposed project. Because wind projects include vegetation clearance, disturbance of ground surface, excavation below the ground surface, and aesthetic impacts, they have the potential to affect archaeological and historic resources that may be present in the area. Negatively impacting a historic site does not necessarily automatically halt a project; instead, mitigation or offset measures may be considered before determining whether a project goes forward.

Federal and New York State preservation legislation includes the following:

- **National Historic Preservation Act 1966, Section 106.** If a project uses federal funds or requires federal approval or permitting, the involved federal agencies consult with the State Historic Preservation Office (SHPO), which is housed within the State Office of Parks, Recreation and Historic Preservation, regarding efforts to identify and manage historic and cultural resources within the area of potential impact. Sometimes the recipient of federal funds will be required to consult with the SHPO on behalf of the federal agency, although this does not remove the federal agency from ultimate Section 106 compliance responsibility.
- **New York State Historic Preservation Act of 1980, Section 14.09.** State agencies are required to consult with the State Office of Parks, Recreation and Historic Preservation for undertakings that could impact historical and archeological resources that are listed or eligible for listing on the State Register of Historic Places. Undertakings by a State agency include funding, approval, and/or physical activity conducted by the state agency.
- **SEQR, Article 8.** This establishes a set of uniform procedures by which all State, county, and local governmental agencies incorporate consideration of environmental impacts into their planning, review, and decision-making processes. Historic and archeological resources are components of the environment and must be assessed during the SEQR process, or during Article 10 review.
- **New York State Public Service Law Section 1001.20** of the regulations implementing Article 10 of the Public Service Law also identifies a process for identifying and addressing potential impacts on cultural resources.

2.1 Cultural and Archeological Surveys

Archeological surveys, which contain cultural surveys, are often needed when a project involves ground disturbance in areas known to contain archeological sites or have conditions favorable to finding such sites. Many wind energy project developers conduct cultural, historic, and archeological resource surveys as part of their environmental assessment. Surveys in New York State are conducted in accordance with the federal and state legislation listed above. If historic or archeological resources are found in the survey area, mitigation plans will be developed to preserve those areas.

The New York Archeological Council's Cultural Resource Standards Handbook[3] assists nonarcheologists in understanding the professional standards for cultural resource investigations (NY Archaeological Council, 2000).

The SHPO does not maintain a list of archeological consultants, but has developed guidelines[4] to help select a consultant to conduct a survey.

2.2 Additional Resources

- How to Choose a Cultural Resource Consultant
  https://parks.ny.gov/shpo/environmental-review/resource-consultant.aspx
- New York State Historic Preservation Office Cultural Resource Information System
  https://parks.ny.gov/shpo/online-tools/
- NYS Orthos Online
  https://orthos.dhses.ny.gov/
- Cultural Resource Standards
  https://nysarchaeology.org/wp-content/uploads/2013/12/nyachandbook.pdf

Other information can be found through the following agencies and organizations:

- Society for American Archeology
  https://www.saa.org/
- National Trust for Historic Preservation
  https://savingplaces.org/
- Advisory Council on Historic Preservation
  https://www.achp.gov/
- New York Archeological Council
  https://nysarchaeology.org/
- New York State Museum
  http://www.nysm.nysed.gov/
- US Army Corp of Engineers
  https://www.usace.army.mil/Missions/Civil-Works/Regulatory-Program-and-Permits/Obtain-a-Permit/
- New York State Office of Parks, Recreation and Historic Preservation
  https://parks.ny.gov/shpo/

3. Socioeconomic Impacts

Development of a wind power project can have socioeconomic impacts on a community or region. The local workforce, infrastructure (e.g., water, sewage, waste removal, traffic/roads, housing), emergency personnel and systems, and schools may be affected. The extent of potential impacts depends on the scope of the industry and the project(s).

Examples of socioeconomic impacts include the following:

- Temporary or permanent job creation creating demand for short-term housing
- Increased demand for municipal and emergency services (police, fire, medical care)
- Increased enrollment in local school system

4. Telecommunications

Construction of wind turbines and other structures may impact microwave communications, point-to-point, off-air television reception, radar, land mobile radio (LMR), cellular and PCS telephones, AM radio coverage, and amateur radio operations. The potential impacts on telecommunications can be studied during development of a project and mitigated, when necessary.

The operation of wind turbines can interfere with all modes of communication previously listed. Remedies vary based on the severity of the impact, the modes impacted, and when the impact is discovered (pre-construction versus post-construction). Developers are aware and often provide community solutions, such as turbine relocation, placement of repeater antennas for LMR and base station antennas for cellular and PCS service, and offering alternatives to over-the-air television, like cable.

5. Aesthetics and Visual Impacts

Aesthetics and visual impacts are among the greatest concerns raised about proposed wind farms. Because wind resources in the Northeast tend to be best at high elevations and near large bodies of water, turbines can sometimes be visible for long distances and may alter scenic vistas. Therefore, it's important to consider ways to minimize and mitigate unavoidable adverse aesthetic and visual impacts during the preconstruction planning and permitting process.

Developers typically perform a visual impact analysis to quantify the potential visual impact of a proposed project. The analysis contains the following steps:

- Determine turbine locations and heights
- Determine the viewshed
- Identify key viewpoints
- Assess existing conditions
- Document project changes
- Analyze changes
- Develop mitigation where needed

Community concerns about visual impacts can be addressed by a project development process that includes the following:

- Open, early, and frequent communication
- Proactive community outreach to educate and involve the community
- Continued support of public involvement throughout the process
- A final project design that addresses visual impacts through turbine location, spacing, and setbacks
- A financially beneficial arrangement for the community

These steps will generally be taken as part of the initial site-selection process. The zone of visual influence, or viewshed, is determined based on the existing environment and land uses. Key points within this viewshed are then determined by field inspection and discussions with local officials or stakeholders. These key viewshed points may include historic monuments or markers, scenic views, local landmarks, high traffic routes, dwellings adjacent to the project, schools, sports fields, recreation areas, or business districts.

The process of assessing and mitigating visual impacts for wind turbines is the same as for any other highly visible structure, such as cell phone, radio, and television transmission towers. The following is a brief summary of the responsibilities of the applicant and permitting parties as defined by the DEC, as well as the tools available when considering visual impacts. For complete information, refer to the DEC Program Policy Assessing and Mitigating Visual and Aesthetic Impacts[5] (NY Department of Environmental Conservation, 2019). Project developers generally provide all the information necessary for the host communities to understand what is being proposed; where it's being proposed; and what is being done to avoid, minimize, and mitigate visual impacts of the project.

The community should review the information provided by the developer and ensure that project impacts have been minimized to the maximum extent possible consistent with social, economic, and other essential considerations.

5.1 Influences on Visual Impact

Visual impacts vary from different viewpoints surrounding a project site. In areas with hilly terrain, the surrounding topography can hide turbine views from many locations. Turbines may also be more visible during different lighting conditions and during winter when surrounding trees are bare.

Turbine spacing can also have an impact on the aesthetics of a wind project. Spacing between turbines is primarily determined to optimize the energy output, but topography can also dictate turbine spacing. Sufficient space between turbines is necessary to optimize winds and reduce turbine-to-turbine turbulence (which could affect long-term turbine life). The use of larger turbines can reduce visual impact because fewer turbines are used and the space between them is greater.

The color of the turbines can also influence the magnitude of visual impacts. Local ordinances may require that nonreflective, unobtrusive colors be used to paint the tower and blades. Most wind turbines are painted either a light gray or off-white to minimize contrast against the sky when viewed from the ground yet remain visible to pilots when viewed from the air.

Wind turbine visual impacts may include lighting. Federal Aviation Administration (FAA) requirements may include strobe, red flashing, or steady red lights. Depending on the lighting requirements, a project's nighttime visual impact may be greater than the daytime impact.

Uniformity of color, structure types, and surface finishes can mitigate the visual impact. Local ordinances sometimes specify uniformity requirements.

5.2 Visualization Modeling

Modern software can digitally simulate the view of a wind energy project from a variety of locations and in different light conditions. Such software is used prior to construction, during the design and permitting phase of development. This tool helps communities understand the visual impact and project developers identify areas that may need a mitigation plan. In areas with differing seasonal vegetation and lighting, such as New York State, it could be valuable to see proposed turbine location area summer and winter photo simulations. In addition, topographic maps can be incorporated into the software to develop a map overlay that estimates the number of turbines visible from any location within a region. Communities can request submittal of visualization maps and simulated project views to help assess the impacts.

Visualization modeling tools help communities understand how a turbine or turbines would look to the unaided eye in a landscape. Photos are taken from populated spots, such as a shop, residence, or school, and from locations that have been identified by concerned citizens. To model the maximum impact, pictures are taken on a clear day. The time is recorded so the shading of the turbines and surrounding landscapes can be modeled accurately.

Visualization programs contain digital pictures of most major manufacturers' turbines, so an accurate picture can be developed of the turbines planned for the particular site. Figure 7-1 shows a simulation as compared to the same view once the turbines were constructed.

Figure 7-1. Wind farm simulation (left) and photograph (right).
(Source: EDR)

Several other methods of evaluating the visual impact of a project can be used. For example, a developer may float a large balloon to help assess visibility at the proposed tower height and location.

5.3 Mitigation Strategies

Once visual impacts have been quantified, mitigation techniques can be employed. The potential changes to the viewshed at key points are documented through visualization modeling and then analyzed. The analysis should provide answers to the following questions:

- To what extent is the project or specific turbines visible?
- When is the project or turbine visible (season or time of day)?
- Who sees the project or turbines and under what circumstances (season, light conditions, or during what activities)?
- To what extent does the visibility of the project alter the character and quality of the viewshed?
- What is the relationship of visual impacts to the policies and values in that location?

Questions like these attempt to quantify what often is a qualitative problem. For example, the project may be visible along a stretch of road, but the impact of that visibility depends on the surrounding environment and land uses (e.g., if the road is a scenic byway or the view is already dotted with homes, business, or other structures). It also depends on the length of time the project is visible (e.g., as the viewer travels in a car), and at what time the project is visible (e.g., only visible on sunny to partly cloudy days but not at night, or the turbines are visible all day and the required FAA lights are seen at night). Understanding impacts at this level helps quantify the potential impact on the community and helps developers create a project layout that is sensitive to these issues yet optimizes energy production.

The following is a list of mitigation strategies for wind energy facilities:

Downsizing

Downsizing or eliminating certain turbines may significantly reduce visual impacts. A project developer may be encouraged by the community to eliminate turbines with the greatest visual impact. However, tower sites with greater visual impact may be more economically productive. Thus, downsizing mitigation strategies are most successful where benefits exceed costs (in reduced income) to project developers.

Relocation

Project components with the greatest visual impact may be moved to other locations of less impact, where the screening effects of topography and vegetation may be taken advantage of. As with downsizing, proposed relocation may encounter a similar tradeoff of productivity versus visual impact.

Lighting

Minimize off-site lighting, glare, and light pollution. However, FAA lighting criteria must be met. Some projects employ a radar-based detection system that turns lighting on only at the approach of airplanes.

Nonspecular materials

For overhead electric transmission facilities, cables that do not shine should be employed.

Screening

Visual barriers, like trees, earthen grassy berms (with or without trees and or shrubs), or fences, may be employed in suitable locations.

Camouflage

Utility substations are usually screened using landscape architectural treatments, such as coniferous shrubs and trees. The substations can also be designed to blend in with the background.

Offsets

If negative impacts cannot be acceptably minimized, offsets can be employed (e.g., removing an existing chronic eyesore within the project viewshed).

5.4 Additional Resources

- Assessing and Mitigating Visual and Aesthetic Impacts
  https://www.dec.ny.gov/permits/115147.html
- Visual Impact Assessment Process for Wind Energy Projects
  https://cesa.org/assets/2011-Files/States-Advancing-Wind-2/CESA-Visual-Impacts-Methodology-May2011.pdf
- Visual Impact Assessment
  https://www.macalester.edu/windenergy/visualimpact.html

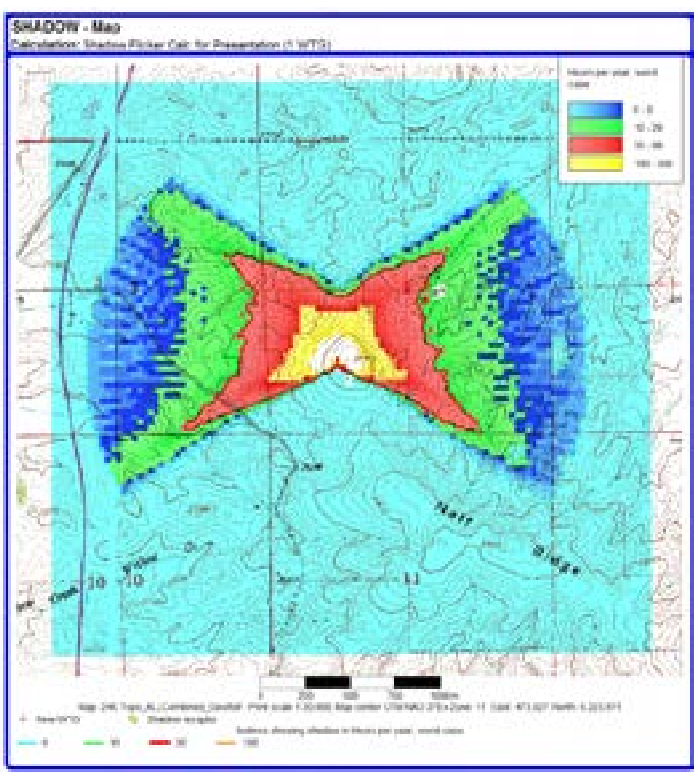
6. Shadow Flicker

Shadow flicker can occur when the blades of the wind turbine cast a moving shadow on a residence or other structure within 1400 m of a turbine (Massachusetts DEP and DEH, 2012). The pulsating light effect caused by the frequent movement of the shadows across a window may be unpleasant for the occupants. Shadow flicker is most likely to occur at sunrise or sunset, when shadows are cast over the longest distance. Factors that determine how often a wind turbine will cast a shadow on a residence or other structure are unique to a given project site and include turbine height and blade length, site topography and distance between turbine and structure, season and time of day, wind direction and speed, and cloud cover.

Some residents living in close proximity to turbines have experienced occasions when shadow flicker occurs and reported experiencing headaches and dizziness (CLF Ventures, 2011). Some residents also raise complaints because the moving shadows are bothersome. Concerns have been raised that flickering shadows could trigger epileptic seizures. However, studies have shown flicker-induced seizures are highly improbable because the frequency of blade rotation on utility-scale turbines is significantly lower than the flashing frequency that could trigger seizures (Massachusetts DEP and DPH, 2012). No case of a seizure caused by shadow flicker from a wind turbine has been documented to date.

There is no conclusive scientific evidence that indicates shadow flicker from industrial wind turbines causes negative health effects, although it can be annoying to nearby residents (Massachusetts DEP and DEH, 2012). For this reason, it's important to study and mitigate shadow flicker when siting and designing turbines.

Figure 7-2. Modeled Shadow Flicker Map
(Source: ©2017 CH2M. Used with permission.)



The occurrence of shadow flicker is easily calculated, and computer models can be used to determine the appropriate setbacks necessary to minimize impacts. When proper planning and mitigation strategies are implemented during the project design process, the occurrence of shadow flicker can be greatly minimized or avoided entirely.

Visualization models can calculate the shadow zones or flicker zones around wind turbines during different times of the day and different seasons to calculate the affected areas. Figure 7-2 is an example shadow flicker map. The colored areas indicate how many hours per year each location may experience the shadow flicker effect. The maps will vary for each specific site and are mainly influenced by topography and turbine demensions. This map shows the worst-case scenario, or the maximum amount of shadow flicker that could possibly occur in each area. The actual amount of shadow flicker that a location would experience is also determined by operational hours, wind directions, and cloud cover, which lowers the expected total hours of flicker effects (Priestley, 2011).

There are no specific federal or New York State regulations regarding shadow flicker from wind turbines. State and local rules in other parts of the country vary but tend to be ambiguous and lacking quantitative requirements. Some require that developers make reasonable efforts to minimize flicker on neighboring properties, while others require shadow flicker projections or estimates accompany applications (Oteri, 2008). Without binding regulations, some states have published guidance or model ordinances that address shadow flicker. Some local governments specify a setback requirement to reduce shadow flicker or specifically limit the number of hours per year shadow flicker is permitted to occur at nearby residences. When specific numbers are mentioned, the standard limit for shadow flicker on occupied buildings is set at 30 hours per year (Lampeter, 2011). Other local governments require studies on shadow flicker but lack strict guidelines for mitigation techniques.

6.1 Additional Resources

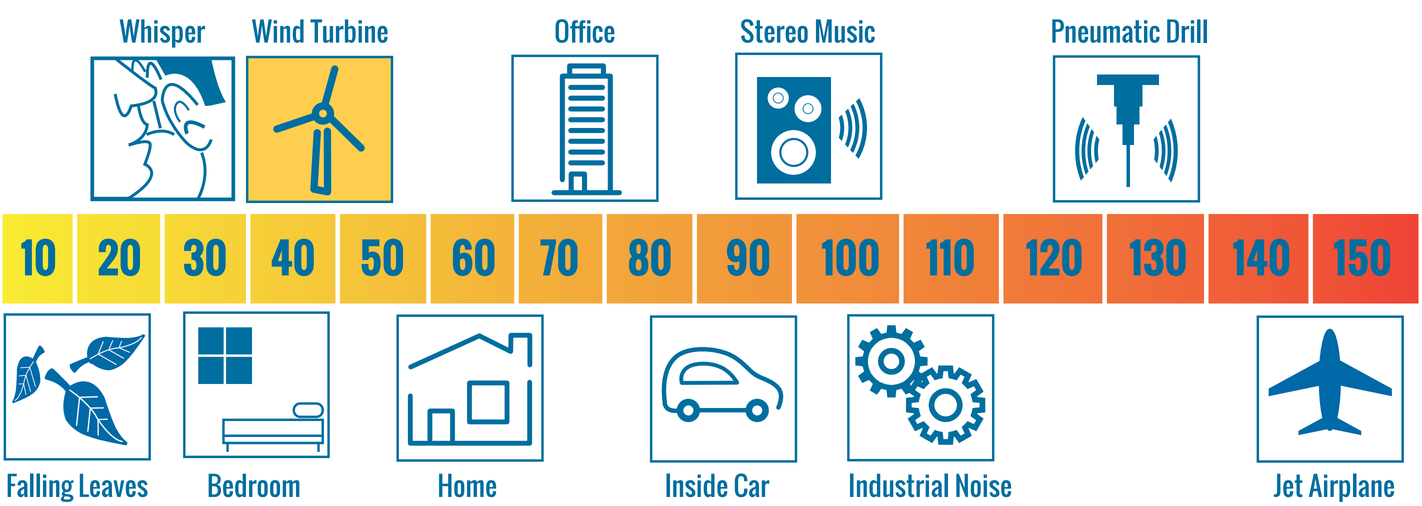
- Evaluating Shadow Flicker in the Current Regulatory Environment
  https://www.umass.edu/windenergy/sites/default/files/downloads/mwwg/20131030/RichLampeter%20MassWindWorkingGroup-Fall2013-Flicker-RL.pptx
- The European View and Practical Mitigation Methods
  https://www.umass.edu/windenergy/sites/default/files/downloads/mwwg/20131030/K2_Management-shadow%20flicker_30-Oct-13.pdf

7. Sound Emissions

Wind turbines produce sound when they operate. Communities, regulators, and the developers of production facilities of all types have been dealing with the impacts of man-made sound on humans for decades. As wind projects increase in number, the sound emissions from wind turbines are an often-cited concern during the siting and permitting process. Because of the unique characteristics of wind turbine sound, communities, local decision-makers, and their residents have questions about the sound a wind project makes, sound limits for wind projects, ways to reduce exposure to the sound, and whether sound emissions from wind turbines can cause adverse health impacts.

Figure 7-3 shows the relative decibel (dB) levels of common sources of sound. Typically, an operating wind energy project at a distance of 400 meters (1,312 feet) emits sounds at 40 dB(A)—a level comparable to a kitchen refrigerator or a moderately quiet room.

Figure 7-3. Common sources of sound, dB(A)



7.1 Brief Background on Acoustics

The field of acoustics provides the parameters by which wind sound is measured. There are several qualities to sound that, in combination, determine whether sound is audible, tolerable, annoying, or harmful. These components of sound are briefly described as follows. For more background on acoustics, please see the resources listed at the end of this section.

Sound Pressure

The loudness of sound is most typically quantified according to the relative atmospheric pressure using the decibel (dB) scale. This scale is logarithmic and quantifies sound from the entire range of audible frequencies. A-weighting, noted as dB(A) is the most common method of expressing sound pressure, as it takes human sensitivities to certain frequencies into account. Importantly, sound pressure varies by the distance between the source of sound and the receptor.

Frequency

The pitch of sound comes from "a repeating cycle of compressed and expanded air. The frequency of the sound is the number of times per second, Hertz (Hz), that the cycle of sound transmission repeats. Sound at a single frequency is called a tone while sound that is a combination of many frequencies is called broadband." (DPH, 2012). "Higher frequencies tend to be reduced more indoors and with increasing distance. Lower frequencies are more likely to be transmitted indoors." (Council of Canadian Academies, 2015)

Amplitude

The height of the sound wave is described in terms of its amplitude. Sounds with greater amplitude will produce greater dB changes (changes in atmospheric pressure from high to low) (Hass, 2003).

Amplitude Modulation

When the height of a sound wave varies, the sound pressure it produces also varies from quieter to louder back to quieter.

Low-frequency sound

Low-frequency sounds have fluctuating cycles that occur within a range of 10 to 200 Hz. The range of audible sound goes up to 20,000 Hz. "The sound pressure level of low-frequency sounds declines less with distance than the level of high frequencies" (Council of Canadian Academies, 2015).

Infra-sound

The term infra-sound describes sounds with a frequency below 20 Hz. Examples of man-made sources of infra-sound include sonic booms, explosions, machinery, diesel trucks, and subwoofer speakers. There are also many natural sources of infra-sound, such as surf and wind. Infra-sound can be heard and felt at relatively high amplitudes over 100 dB to 110 dB (DPH, 2012). Infra-sound and low-frequency sound are distinct terms.

7.2 Sound, Noise, and Subjectivity of Perception

Unwanted sound is considered noise. Since the response to noise varies by individual perception and is a subjective matter, it's difficult to define objectionable noise. One person may regard a wind turbine as noisy and disruptive while another person may not, even under the same conditions. While sound pressure levels can be measured and compared to regulatory limits, the individual perception of that sound pressure level cannot. Because determination of sounds as noise is a subjective matter, control and mitigation of concerns is difficult.

7.3 Components of Wind Turbine Sound Emissions

Wind turbines produce two types of sounds: mechanical and aerodynamic. Mechanical sounds come from the operation of turbine components, including the gearbox, the generator, drives, and fans. Mechanical noise is typically not a major factor due to additions of soundproofing, insulation, and use of direct-drive technology. Generally, aerodynamic sound is the subject of regulation and concern. The majority of aerodynamic sound is caused by the flow of air over the surface of the wind turbine blades, especially at the blade tip. Aerodynamic sound transmits (or propagates) differently for every wind farm.

Depending on the size and configuration, turbines may emit up to five types of sounds during operation.

- **Tonal** sounds emanate at discrete frequencies (e.g., meshing gears).
- **Broadband** (multitonal) sounds characterized by a continuous distribution of sound pressure with frequencies over 100 Hz.
- **Low-frequency** sounds range from 20 to 160 Hz.
- **Amplitude-modulated** sounds are short acoustic impulses (e.g., swishing or thumping sound).
- **Infra-sound** sounds are below 20 Hz.

Environmental conditions can significantly affect the type of sounds emitted from a turbine as well as the distance sounds travel from the turbine. Several factors determine whether a wind project emits any of these five types of sounds—turbine design, hub height, distance between turbine and receptor (building), wind speed and direction, surrounding terrain and vegetation cover, atmospheric conditions, and background noise.

Because several of these factors change over the course of a given day or season, the amount and type of sound from wind turbines experienced by receptors can vary. For example, sounds from turbines are typically more perceptible in low-to-moderate wind conditions since the natural background sound of the wind masks turbine sounds in high wind-speed conditions. Likewise, background noise is lower at night, making wind turbine sound more noticeable.

7.4 Wind Turbine Sound and Health Effects

Turbine sound is a persistent public health interest. Some residents living in close proximity to operating wind farms have reported a number of health issues attributed to the sound emissions. The health concerns raised by these residents include headaches, migraines, nausea, dizziness, insomnia, fatigue, ringing in ears, cardiovascular diseases, and diabetes.

While advances in wind turbine technology, sound testing, and sound regulation continue to evolve to address concerns, studies have not yet provided conclusive empirical evidence linking sound from wind farms and negative effects on human health.

Several broadly accepted comprehensive studies (such as those conducted by the Massachusetts Departments of Public Health and Environmental Protection and the Council of Canadian Academies) have recently examined all scientific peer-reviewed data and reached similar conclusions that there is:

- Inadequate evidence to link sound from properly sited wind turbines to negative impacts on human health
- Limited evidence to link exposure to wind turbine noise and disturbed sleep
- Sufficient evidence to link exposure to wind turbine noise and annoyance

Health problems have been anecdotally attributed to infra-sound generated by wind turbines. While wind turbines do produce infra-sound, it's below the audible threshold, and to date, expert panels reviewing research on this topic have found inadequate evidence linking infrasound and adverse effects on a person's health (Council of Canadian Academies, 2015).

These studies also concluded that the amplitude-modulated noise (rhythmic whooshing or thumping) is perceived to be more audible at night, which is a contributing factor to annoyance. In turn, this "annoyance may be associated with some self-reported health effects (e.g., sleep disturbance) especially at sound pressure levels greater than 40 dB(A)." (Knopper, et al., 2014).

Because the advent of wind turbines and exposure to their unique sounds are relatively recent phenomena, most experts agree there are gaps in the current knowledge. Additional studies using long-term epidemiological methods, particularly on sensitive populations, may provide better data on whether infra-sound and wind turbine noise either directly or indirectly (due to annoyance, for example) increases stress or interferes with sleep.

World Health Organization Guidelines

The World Health Organization (WHO) published guidelines to protect human health, specifically from community noise and night noise exposure. In 2009, the World Health Organization recommended a limit on general nighttime absolute sound pressure in residential areas of 40 dB(A). In 2018, the WHO Regional Office for Europe developed "Environmental Noise Guidelines for the European Region". The main purpose of the WHO-2018 guidelines is to provide recommendations for external noise levels for protecting human health from exposure to environmental noise originating from specific sources: transportation (road traffic, railway and aircraft), wind turbine, and leisure activities. WHO-2018 recommended a long term 45 dBA Lden, an annual average limit, for wind turbine noise specifically. This recommendation was rated as "conditional" as it "requires a policy-making process with substantial debate and involvement of various stakeholders," and there may be circumstances or settings in which it will not apply (WHO, 2018).

WHO recommendations described here are health-based guidelines for noise; they are not noise modeling standards. Although some guidelines refer to recognized international standards and European directives that include a few modeling considerations, the intent of the WHO guidelines is to provide recommendations about noise levels for the protection of human health.

The WHO-2018 guidelines identify annoyance as the only "health effect" of wind turbine noise. The wind turbine noise limit was established as the level at which approximately 10% of people hearing the noise would be highly annoyed, based on an assessment of four studies examining the association between annoyance and wind turbine noise for exposed populations in several different countries. The WHO-2018 guidelines found no evidence of increased ischemic heart disease, increased hypertension, hearing impairment, or reading skills or oral comprehension in children. It also found no "consistent results about effects of wind turbine noise on sleep." WHO-2018 states, "As the foregoing overview has shown, very little evidence is available about the adverse health effects of continuous exposure to wind turbine noise."

It is important to note that WHO-2018 contains no research of its own and it is based on literature review. At the time of developing the WHO-2018 guidelines, only four publications passed WHO-2018's strict criteria for the wind turbine noise recommendation and the quality of their evidence on health outcomes of wind turbines was very low. It was challenging to dissociate noise impacts revealed in the body of evidence from other considerations such as visual aspects, infrasound, amplitude modulation, etc. Given the very low quality noise impacts revealed in the body of evidence, it was only feasible for WHO to propose a conditional recommendation for wind turbine noise.

7.5 Regulation of Sound from Wind Projects

Because environmental noise above a certain level is a recognized factor in a number of health issues, as well as a factor in overall well-being and freedom from annoyance, many jurisdictions have implemented siting restrictions to limit noise exposure.

All proposed electric generating facilities of 25 MW or greater, including wind projects, are subject to State-level review through either Article 10 or ORES, and must conform to applicable noise requirements. When applying for certification under Article 10, project developers must submit a sound study meeting the requirements in Section 1001.19, which specify what the sound study must contain. The study requirements include identifying any sensitive sound receptors, preconstruction measurement of ambient baseline noise, estimates of future noise levels during operations, design of the approach to comply with local noise standards, possible noise abatement measures, post-construction noise studies, and mitigation measures to address post-construction complaints.

As part of the SEQR process, which applies to most wind projects smaller than 25 MW (projects between 20-25 MW may opt-in to the ORES review process), all potential environmental impacts must be assessed, including the potential sound emission impacts. Projects subject to SEQR may refer to the DEC's Assessing and Mitigating Noise Impacts[6] policy and guidance issued in 2000. The document "presents noise impact assessment methods, examines the circumstances under which sound creates significant noise impacts, and identifies avoidance and mitigative measures to reduce or eliminate noise impacts." The developer may perform a site characterization analysis that includes an evaluation of sound characteristics, receptor locations, and thresholds for significant sound pressure level increases.

During the siting and permitting process, the developer should conduct sound emission studies to determine how the sound will propagate to surrounding residences, outdoor public facilities and areas, hospitals, and schools, thereby providing a sound emission constraint in the project design process.

Sound emission modeling software programs may be utilized to simulate the built wind farm and potential sound emissions. These models may take the turbine type, layout, and site characteristics into account to help estimate the project's potential impact. These models may also be useful in determining the impact a project will have on multiple towns and communities in the vicinity of the project.

Most turbine manufacturers provide turbine sound data, determined in accordance with IEC international standards. These standards are referenced to an eight meters per second (m/s) wind speed at 10 meters above the ground. The measurements are usually taken at ground level, using a microphone, and then normalized to IEC standards. The levels given by wind turbine manufacturers allow a direct comparison between turbines and facilitate sound studies.

States, counties, and municipalities have used a combination of noise limits and setback requirements to limit exposure to wind turbine sound. Noise requirements can come either in the form of an absolute limit on sound levels (background plus turbine sound) or a limit on the exceedance over measured background levels as a threshold. Typically, the absolute limits are in the range of 40 dB to 55 dB. The limit on exceedance over background level can vary from 5 dB to 10 dB (Consensus Building Institute, 2013).

The 2012 Massachusetts DEP/DPH Wind Turbine Health Impact Study looked at promising practices from around the world related to nighttime sound pressure levels for residential and sparsely populated areas. Nighttime limits for these areas ranged from 37 dB(A) to 45 dB(A), depending on the wind speed and development density.

Setback requirements may be established to reduce sound exposures because the propagation of some types of sound diminishes over distance. Common setback requirements and guidelines can set an absolute distance between the turbines and property boundary or occupied building or a distance determined by the hub height of the turbines. Because distance is the most effective measure for addressing sound from wind turbines, setbacks that specify a combination of a certain sound level at a certain distance from the turbine may offer an effective approach to addressing the annoyance associated with wind turbine noise.

Mitigation of Wind Turbine Sound

The presence of operating wind projects may occasionally give rise to complaints about noise from community members, or less often, documented exceedances of permitted sound limits (Cummings, 2012). In cases where there is a need to mitigate the sound from wind turbines to address complaints or exceedances, permitting agencies, local decision-makers, community members, project developers, and other stakeholders have a range of options available.

- **Curtailment** by reducing rotation speed or shutting down under certain conditions (wind speed or direction), or times (night)
- **Turbine relocation**
- **Retrofitting turbines** with modifications that reduce sound
- **Retrofitting homes** with soundproofing, double-glazed windows, or air conditioning systems
- **Purchasing the homes** of residents impacted by noise (rarely done)

7.6 The Future of Sound from Wind Turbines

Manufacturers of wind turbines and blades are focused on producing components with greater energy generating potential and less sound. Technological advances in mechanical components, direct drives, and sound insulation have all effectively reduced mechanical sound and manufacturers are researching the benefits of a range of sound reducing designs, including (Cummings, 2012):

- **Pitch control optimization** – Changing the angle that wind hits the leading edge of the blade
- **Load control** – Sensors along the blade that can instantaneously relieve transient pressures by triggering small flaps along the trailing edge of the blade
- **Blade designs (such as trailing edge modifications)** – Adding serrations or brushes to reduce sound production
- **Turbine array positioning** – Minimizing turbulence and turbulence wakes that contribute to sound production

Another area with room for future advancement is the measurement of sound. There are multiple challenges around measurement of sound from wind turbines. For example, current measurement protocols and equipment may not fully measure low-frequency or infra-sound. This is because most measurement protocols are based on long averaging times, while amplitude modulated sound occurs in shorter intervals. Acoustic scientists are examining ways to improve both sound measurement equipment and measurement protocols to better predict sound emissions from wind projects and fully capture sound emissions once projects are operating.

7.7 Other Recommended Community Efforts

Both the Massachusetts DPE/DHP study and the Canadian Bodies study found that residents of communities where wind projects are being proposed who perceive the process as unfair are more likely to be annoyed. The authors of the Wind Turbines and Human Health, 2014 study found that subjective variables, such as attitudes and expectations, are also linked to annoyance.

The authors of these studies concluded that communities and developers can moderate annoyance levels by investing considerable effort in conducting a transparent process of assessing a wind project's noise impacts and enabling a high level of early community engagement and empowerment throughout the development and operation of a wind project.

7.8 Additional Resources

- Consensus Building Institute: An Introduction to Sound and Wind Turbines
  https://windexchange.energy.gov/files/pdfs/workshops/2010/webinar_neweep_wind_turbine_sound_bastasch.pdf
- NYS Public Service Law: 1001.19 Exhibit 19: Noise and Vibration
  https://govt.westlaw.com/nycrr/Document/Ib622aac80ba911e2b7d00000845b8d3e?

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Questions?

If you have any questions regarding community considerations, please email questions to cleanenergyhelp@nyserda.ny.gov or request free technical assistance at nyserda.ny.gov/Siting. The NYSERDA team looks forward to partnering with communities across the State to help them meet their clean energy goals.

Section End Notes

[1] http://www.dec.ny.gov/permits/6042.html

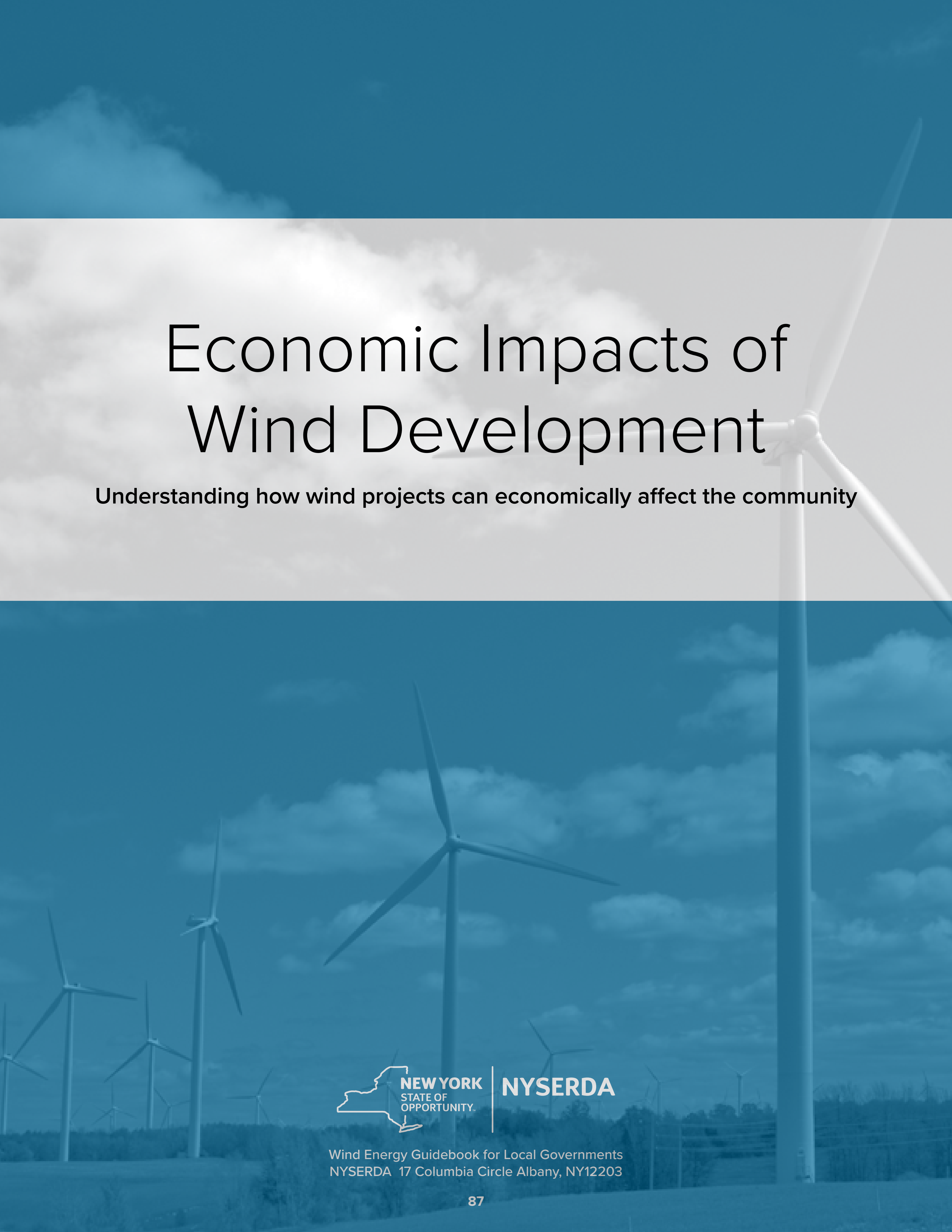
[2] http://www.dec.ny.gov/permits/6058.html

[3] https://nysarchaeology.org/nyac/professional-standards/

[4] https://parks.ny.gov/shpo/environmental-review/resource-consultant.aspx

[5] https://www.dec.ny.gov/permits/115147.html

[6] http://www.dec.ny.gov/docs/permits_ej_operations_pdf/noise2000.pdf



Economic Impacts of Wind Development

Understanding how wind projects can economically affect the community

NEW YORK STATE OF OPPORTUNITY | NYSERDA

Section Contents

Overview

Any business development will have economic impacts on the local and regional economies, and wind energy projects are no different. Typically, a proposed wind project will affect a community in several ways. Whether any single impact is viewed as a benefit or a drawback depends on the perspective of the stakeholder.

In considering whether to support the development of a wind farm, it's up to the community to decide if the positives outweigh the negatives. To do that, the community must understand the potential economic impacts of wind projects and issues related to local economic activity, land revenue, property taxes, and property values.

1. Local Economic Activity During Planning, Construction, and Operation

Significant economic impacts of the wind industry include payments to local landowners, short- and long-term job creation, and spending on goods and services in supporting industries. All phases of wind development bring increased economic activity to the local area. During the planning stage, this may include easement and lease payments to residents, legal services, and environmental and engineering work. The construction phase usually brings a large number of short-term jobs; increases in hotel and restaurant use by nonlocal workers; purchase of materials, including cement and gravel; and services, such as equipment rental. Some long-term jobs may be created during operation, with ongoing spending on everything from turbine maintenance to plowing access roads in winter.

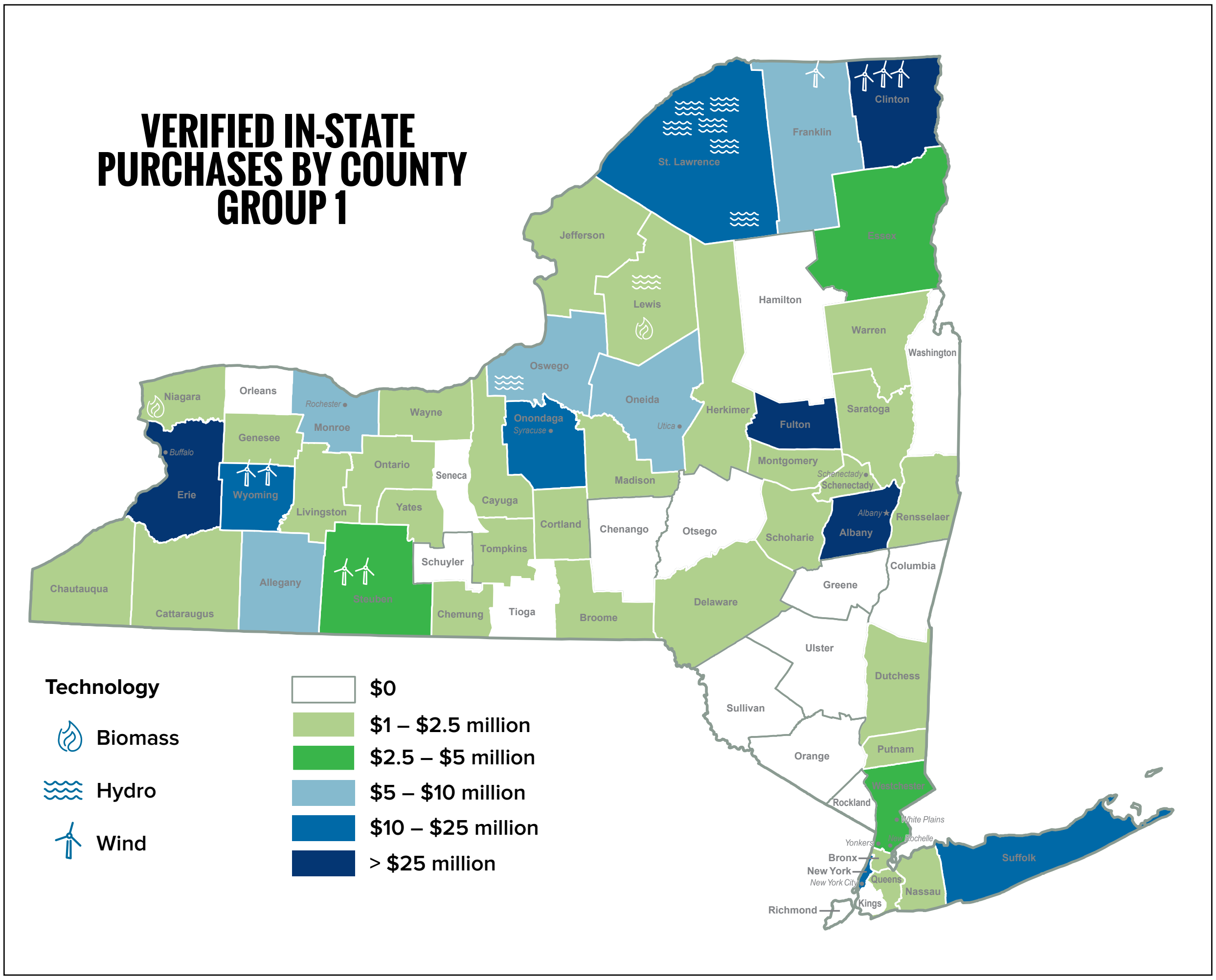
Wind power projects can help diversify, strengthen, and stabilize local economies at the municipal, county, and State level. Increased economic diversification helps improve economic stability by minimizing high and low financial cycles associated with a specific industry. This effect can be particularly important in rural areas, which tend to have a one-dimensional economy, such as agriculture. Additionally, due to the high labor-to-capital ratio, wind projects can add value to the local economy without creating a substantial burden on local and State infrastructure, such as the existing water and sewer system; transportation network; or emergency, education, and other public services.

In 2013, the New York State Energy Research and Development Authority (NYSERDA) released a study[1] that analyzed the economic benefits resulting from New York State's Renewable Portfolio Standard (RPS). This study analyzed three years of spending from 18 renewable energy facilities under contract to NYSERDA (including two biomass facilities, eight hydroelectric facility upgrades, and eight wind farms) and extrapolated direct investments over the lifecycle of the project. The research examined verified spending on jobs; payments to public entities; in-State purchases; and land leases for these facilities, from development and construction through the first three years of operation.

As shown in Figure 8-1, the geographic and economic impacts of these projects are often concentrated around the project location, but also extend beyond the counties where the projects are located. More than 1,000 in-State businesses spread over 44 counties benefited from the development, construction, and operation of these 18 facilities.

The study found that every megawatt-hour (MWh) of renewable energy generated under the RPS resulted in approximately $27 of direct investment (NYSERDA 2013). The bulk of the energy production and spending came from the wind farms, which included direct investment of $1 million/megawatt (MW) installed and $24/MWh for the eight projects analyzed.

Figure 8-1. Map of verified in-state purchases by county for 18 renewable energy facilities.
(Source: NYSERDA Renewable Portfolio Standard Main Tier 2013 Program Review)



1.1 Job Creation

As with most construction and commercial development, wind energy projects create jobs. According to the 2016 Clean Jobs New York report, there are 85,197 clean energy workers in New York with 15% (12,400) in renewable energy. Of that 15%, approximately 1,360 jobs are in the wind industry. New York's clean energy jobs are expected to see a 6% increase in the future (Environmental Entrepreneurs, 2016). Wind projects produce jobs in different ways: direct, indirect, and induced. Direct jobs refer to the labor created directly by the construction, operations and maintenance of the wind farms. Indirect jobs include supporting industries, like manufacturing; component suppliers; and jobs, like attorneys and analysts. Induced jobs include those created by the investment and reinvestment of earnings locally, such as hotels, restaurants, retail, real estate, etc. (National Renewable Energy Laboratory, 2016).

1.2 Short-Term Job Creation

Construction Jobs

Construction-related employment for a wind power project usually involves short-term assignments that vary depending on size and location of the project. Typical construction lasts anywhere from six months to more than a year.

Construction jobs comprise the majority of wind-related job creation. In the United States, a 50 MW wind project will create 40 full-time equivalent jobs during the construction period.[2]

Typically, the wind developer will hire a general contractor to manage the project. The general contractor will then subcontract to specialists in civil work (grading, excavation, concrete etc.), electricians, mechanics, etc. Typical construction jobs may include construction managers, heavy equipment operators, and general laborers.

Professional Services

Supporting jobs include environmental professionals who can carry out environmental impact assessments, lawyers who support the siting and permitting process, and bankers who structure and support the financing of projects. During the predevelopment and construction phase there are many jobs created in supporting roles. Depending on the project, some of these roles may also continue into the operation and maintenance phase.

This work may be provided by local workers depending on their skillset and experience. This is especially relevant for any jobs that require localized knowledge, such as conducting environmental impact assessments and navigating local processes, such as siting and permitting.

Manufacturing Jobs

Manufacturing occurs before, during, and after the construction phase of a wind project. The majority of the manufacturing takes place during the early stages, when the wind turbines and their components are manufactured and assembled. Once the project is installed, there will be some part and component manufacturing over the lifetime of the project to repair or replace parts as needed.

Wind turbine and component manufacturing is a growing industry in the United States. The majority of commercial wind turbines sold in the U.S. are manufactured domestically or in Europe. The employment resulting from component manufacturing can be significant. Studies have shown that as a state's wind market grows, so do manufacturing jobs (Halvatzis & Keyser, 2013) (See Box 1).

As of 2020, the American Wind Energy Association (AWEA) found more than 500 wind-related manufacturing facilities across almost every state in the U.S. Manufacturers sometimes source individual components—cabling, transformers, concrete—locally, depending on local skills and resources. New York State has twelve active manufacturing facilities that produce products for the wind industry (AWEA, 2020).

Box 1. Examples of Job Creation from Wind Power Projects

- A study by National Renewable Energy Laboratory (NREL) looked at job creation in Iowa, which ranked second in wind capacity of U.S. states. From the first 1,000 MW (out of 4,525 MW) of wind capacity installed, 2,300 full-time equivalent (FTE) jobs were added during construction. The industry also created 270 permanent jobs, including 75 on-site positions, 105 equipment and supply jobs, and the remainder in other sectors (Halvatzis & Keyser, 2013). The study also found that, while in-state manufacturing was fairly low during this period, it grew rapidly as wind capacity increased, resulting in the addition of 2,000 wind manufacturing jobs.
- As of 2020, New York hosts nearly 2,000 MW of windpower, and ranks 15th in the nation for installed capacity (AWEA, 2020). NYSERDA's 2019 New York Clean Energy Industry Report found the State's wind industry supported nearly 3,500 jobs.[3]

1.3 Long-Term Job Creation

Operations and Maintenance Jobs

Operations and maintenance are required for the duration of the life of the wind project, which ranges from 20 to 30 years.

The number of people employed by a wind power project during commercial operation depends primarily on the project size and administrative structure. Small projects are generally remotely operated and only bring in maintenance personnel when required. Larger projects will have a full-time operations and maintenance staff, the size of which depends on the project size, turbine type, and local labor practices. Approximately two wind technician jobs are created for every 10 to 20 turbines.

Operation and maintenance jobs usually require skilled professionals. Operators are usually project managers who have computer, inventory management, job and equipment scheduling, record-keeping, and data-processing and analysis skills. Maintenance workers often have mechanical and/or electrical proficiency, and are able to perform extensive physical labor, such as climbing and lifting.

Wind projects are often staffed with local personnel with an experienced supervisor or facility manager supporting the employees. Local workers with relevant skills and training, such as experience in the mechanical or electrical trades, can readily be trained in wind power mechanical and electrical systems and maintenance of equipment. Specialized turbine training is often provided by the turbine manufacturer.

2. Land Revenue

The development of a wind project can provide an additional source of income to rural land owners from leasing and royalty agreements. Since only a fraction of this land is utilized by physical plant structures and roads, the previous use of the land (e.g., farming or dairy operations) can continue alongside the wind power facility.

Depending on the placement of turbines on one or more properties, the project may directly benefit one or more landowners through lease payments and production royalties. In addition to these direct benefits, the broader community may benefit. This is due to multiplier effects associated with the increased income of the host landowners and long-term stability of those landowners, who have diversified their sources of income.

Note: For more on land-use agreements and revenue, please see the Land Agreements section (p. 35).

3. Property Taxes and Host Community Agreements

Wind energy projects typically contribute to local government revenues through tax collections or other local benefit agreements. When considering the different approaches or mechanisms used to establish payments to local governments, the magnitude of the payments should be comparable to the costs associated with additional services required by the project, while providing a reasonable benefit to the larger community. For many small towns, payments from wind energy projects result in a significant increase in revenue compared to other local revenue sources.

Some jurisdictions have limited or exempted local taxation of wind energy projects to induce development and increase economic diversity. Other forms of stimulus may include business or corporate incentives for establishing manufacturing or company headquarters in a region or state.

3.1 Wind Project Exemption

Payment of additional property taxes on improvements associated with wind turbines is exempt for a period of 15 years, unless opted-out by the local taxing jurisdiction (New York State Real Property Tax Law, §487). The current exemption law is set to expire on December 31, 2024. The exemption is at the discretion of the local taxing jurisdiction—while local taxing districts have generally granted the exemption, this has not always been the case.

The operating life of the wind turbine may exceed the 15-year tax exemption period. Municipalities should plan ahead for revenue beyond the fifteenth year of the project and determine if the project will be decommissioned or upgraded after 15 to 20 years.

This exemption applies to county, city, town, village, and school taxing jurisdictions but does not apply to special-use districts, such as fire districts.

Any county, city, town, village, or school district[4] may actively retract this exemption by adopting a local law or school district resolution to disallow it. This tax exemption has become a significant negotiation issue between project developers and local taxing jurisdictions. Taxing jurisdictions that have not disallowed the exemption can do so at any time prior to the turbines being constructed, making the project pay its full tax burden. Local governments can use this provision as leverage to negotiate a voluntary payment with the developers.

3.2 Payments-in-Lieu-of-Taxes

County, city, town, village, and school district taxing jurisdictions that do not retract the exemption may enter into an agreement for payments-in-lieu-of-taxes (PILOTs) with the owner of the wind turbine equipment (project owner). PILOT agreements are common practice in all types of development projects, not just wind energy. Several taxing jurisdictions can be parties to the same agreement—each taxing jurisdiction does not have to enter into its own PILOT with the project owner. If multiple jurisdictions are parties to the agreement, the PILOT agreement defines the amount the project owner pays each taxing jurisdiction. Frequently, the county Industrial Development Agency (IDA) negotiates the PILOT on behalf of the relevant taxing jurisdictions. The agreements may be written by the county or local taxing jurisdiction's tax counsel.

The payment amount is paid in lieu of property taxes due on the equipment and improvements to the land. PILOT amounts cannot exceed the amount that would be due if property taxes associated with the improvement were not exempt and the agreement cannot continue for more than 15 years. PILOT agreements negotiated through the county IDA can exceed this 15-year term. PILOT agreements cover the amount to be paid and how it is distributed among the different parties to the agreement, but do not include language on how these funds may be expended. After the agreement expires, the wind project owner is responsible for paying the property tax assessment required by the taxing jurisdictions. Wind project developers and taxing jurisdictions may want to estimate the potential future property taxes after the agreement expires, so wind developers and taxing jurisdictions can plan accordingly.

Common PILOT Payment Structure

Specific guidelines for determining the magnitude of PILOTs do not exist, except for the provision that payments may not exceed what would have been owed had the equipment been assessed under ordinary tax provisions. A common structure is a dollar-per-installed-capacity amount, often in megawatts (MW).[5] Box 2 provides two examples of wind power project PILOTs in the State.

Box 2. Examples of Wind Power Project PILOTS in New York State

- **According to publicly available information, the town of Fenner receives approximately $150,000 per year for 15 years, or approximately $5,000 per installed MW for the Fenner Wind Power Project.**
- **The 77.7 MW Jericho Rise Wind Farm, a more recent project, finalized a PILOT[6] with the IDA of Franklin County for the Towns of Chateaugay, Bellmont, and Franklin County and the Chateaugay Central School District to share payments of $4,000 per megawatt per year, approximately $310,000 in total. The school district will receive the majority of the PILOT money, 59%, or about $183,000, with the county receiving 13%, about $40,000, and the towns splitting the remaining 28%, which equals about $87,000.**

Host Community Agreements

Oftentimes the project's full financial contribution to the host community is split between the PILOT agreement and a Host Community Agreement (HCA). HCAs are a mechanism by which the local jurisdiction and developer agree on each party's rights and obligations during the construction, operation, and decommissioning of a wind energy project. HCAs may govern items such as liability, inspection and monitoring during construction, road use and reconstruction, emergency preparedness and fire prevention, complaint management, and turbine decommissioning. HCAs typically direct a financial contribution to a local governing body in excess to the amount received solely through the PILOT. HCAs can be structured in several ways to direct benefits to the locality but typically include an annual payment set on a dollar per installed capacity basis. The sum of the PILOT rate per MW and the HCA rate per MW reflects the total financial contribution the project is making to the local community. Therefore, in situations where an HCA is utilized, the PILOT rate will be lower than situations in which no HCA is in place.

4. Property Value

Property owners often want to understand how a wind project will impact their property value. Depending on their involvement with a wind project, property owners usually have different concerns:

- **Properties on which the wind project will be developed.** Property owners usually lease their land to the wind developer and receive lease payments over the lifetime of the system. These payments can increase property values.
- **Properties neighboring or in proximity to the wind project.** Property owners are often concerned that the wind project will decrease their property values.

Property values can also be impacted during different periods of a wind project's development, including post announcement, preconstruction, and post construction.

In general, only limited research on the impact of wind farms on property values is available. Such research examines trends in sales transactions. Data and studies for homes that are adjacent or are less than 0.5 miles from a wind project are rare. Because most large-scale wind farms are subject to setback requirements ensuring they are built a certain distance from neighboring properties, wind facilities are generally sited in areas with relatively few homes, limiting the number of sales transactions that are available for research (Hoen, Wiser, & Cappers, 2013).

The existing research examining the property values of residential homes located near or with views of wind turbines provides little or no evidence that home values are affected (positively or negatively) before or after the construction of facilities. For example, a study conducted by Hoen et al. in 2013, analyzed data from more than 50,000 home sales across 27 (mostly rural) counties in nine states including seven counties[7] in New York that were within 0.5 to 10 miles of wind facilities. The study found no statistically significant evidence that home prices near wind turbines were affected in post-announcement, preconstruction, or post-construction periods. The study concluded that if effects do exist, the average impacts are relatively small (within the margin of error for the report, which was +/- 4.9% for homes within 1 to 10 miles, and +/- 9% for homes within .5 miles from a wind facility) and/or sporadic, impacting only a very small subset of homes.

A similar 2014 study examined 122,000 homes sales near 41 turbines located in more densely populated areas in Massachusetts within five miles of wind facilities. The study concluded there were no net effects on property values due to wind turbines. The study found only weak statistical evidence that the announcement of a wind facility had a modest adverse impact on home prices, and such impacts were no longer apparent after turbine construction and operation commenced (Hoen & Atkinson-Palombo, 2014).

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Additional Resources

- Economic Development Impacts of Community Wind Projects: A Review and Empirical Evaluation https://www.nrel.gov/docs/fy09osti/45555.pdf
- Law of the Wind: A Guide to Business and Legal Issues https://www.stoel.com/legal-insights/special-reports/the-law-of-wind
- Undertanding the Property Tax Exemption for New York https://www.youtube.com/watch?v=A3UrlI1-T0k
- Recently Asked Questions About the Real Property Tax on the Topic of Solar Energy Systems https://www.tax.ny.gov/pdf/publications/orpts/legal/raq2-18.pdf
- Solar and Wind Energy Systems: Definitions and Guidelines for Property Tax Exemptions https://www.tax.ny.gov/pdf/publications/orpts/manuals/vol4/solar_report.pdf
- New York State Real Property Tax Law §487 https://www.tax.ny.gov/research/property/assess/manuals/vol4/pt1/sec4_01/sec487.htm
- Exemption Administration Manual - Part 1. Residential - Other Than Multiple Dwellings https://www.tax.ny.gov/research/property/assess/manuals/vol4/pt1/sec4_01/sec421_b.htm
- Analysis: Economic Impacts of Wind Applications in Rural Communities https://www.nrel.gov/docs/fy06osti/39099.pdf
- Research Brief: Property Tax Exemptions in New York State https://www.osc.state.ny.us/localgov/pubs/research/propertytax_exemptions.pdf
- Host Community Agreements for Wind Farm Development https://www.albanylaw.edu/centers/government-law-center/about/publications/past-publications/Documents/Host%20Community%20Agreements%20for%20Wind%20Farm%20Development.pdf

Questions?

If you have any questions regarding economic impacts, please email questions to cleanenergyhelp@nyserda.ny.gov or request free technical assistance at nyserda.ny.gov/Siting. The NYSERDA team looks forward to partnering with communities across the State to help them meet their clean energy goals.

Section End Notes

[1] https://www.nyserda.ny.gov/-/media/Files/EDPPP/Energy-and-Environmental-Markets/RPS/RPS-Documents/2013/2013-RPS-investments-NYS.pdf

[2] As construction jobs may be less than full year, these estimates under-represent the total number of people hired.

[3] https://www.nyserda.ny.gov/About/Publications/New-York-Clean-Energy-Industry-Report

[4] With the exception of the city school districts of New York, Buffalo, Rochester, Syracuse, and Yonkers, which cannot retract the exemption.

[5] An alternative method would be to base payments on the electric generation from the project (measured in MWhs). Wind energy generation will vary from year to year, and the project could temporarily go off line for repairs or due to damage. Under this alternative arrangement, payment amounts will vary every year. This alternative method places production risk on the municipality and makes year-by-year PILOT payment amounts less certain.

[6] http://www.franklinida.org/files/public/pdf/Jericho_Rise_Wind_Farm_LLC/Memov4-Impact_Analysis-JerichoRise.pdf

[7] The seven counties included Clinton, Franklin, Herkimer, Lewis, Madison, Steuben, and Wyoming.

Public Safety and Setbacks

Understanding key safety considerations associated with wind energy projects

Section Contents

Overview

This section addresses common safety concerns associated with wind energy facilities, recognizing the importance of protecting public safety while promoting responsible clean energy development. The issues covered herein highlight areas of interest to local officials and community members, while offering mitigation strategies to limit conceivable risks to public safety. Topics covered include uncommon but potential hazards, emergency response plans, and risk mitigation through setbacks.

1. Public Safety Considerations

Public health and safety issues associated with wind energy projects are different from many other forms of energy generation, as wind facilities do not require combustible fuel sources or fuel storage, and do not generate toxic or hazardous materials. However, wind energy projects do require similar electrical infrastructure compared to conventional power generation facilities, such as medium- to high-voltage power lines and substation equipment.

Many of the unique concerns associated with wind turbines – such as blade throw, tower collapse, or ice shedding – are related to the configuration of the wind energy facility's equipment. While these events are extremely unusual and rarely occur, public agencies generally address potential occurrences by establishing reasonable setbacks from residences and public corridors, proportional to the size of the turbine and blades. Further, commercial wind turbines are generally certified in accordance with International Electrotechnical Commission Standards (IEC), which help to ensure turbine reliability and public safety.

1.1 Blade Failure

A turbine blade can break due to improper design, improper manufacturing, improper installation, wind gusts that exceed the maximum design load of the turbine structure, impact with cranes or towers, or lightning. The distance a blade piece might be thrown from a turbine depends on its mass, shape, speed at the time it breaks from the machine, orientation of the blade at the time of failure, and the prevailing wind speed.

Although a few instances of blade failures were reported during the early years of the wind industry, these occurrences are now rare, due in large part to better testing, design, and engineering of commercial wind turbines. In February 2016, one of the turbines at the Fenner Wind Farm in Madison County, NY suffered a blade failure, and one of its three blades detached and fell into the field below. No people were hurt and no property was damaged. It is believed that the problem resulted from a bolt failure (Doran, 2016).

1.2 Fire

Wind turbines rarely catch fire. If a fire were to occur, it is best practice to allow the fire to burn itself out while fire personnel maintain a safety area around the turbine and protect against spot ground fires. In addition, power to the section of the project with the turbine fire is disconnected to protect the remaining array turbines, the substation, and the power grid itself. As the public typically does not have access to private land on which turbines are usually located, public wellbeing should not be at risk.

Some municipalities require project developers to file plans for the prevention and control of fires in wind turbines. These plans and protocol may be created in consultation with the local fire department and/or relevant county officials. Some fire departments in jurisdictions containing wind farms choose to hold turbine-specific fire training sessions.

1.3 Tower Collapse

Although turbine tower collapses are rare, a few instances of tower collapse have been reported nationwide. Known tower collapse causes have included blade strikes, rotor over-speeding, mechanical brake failure, cyclonic winds, foundation failure, and poor or improper maintenance. In cases where information is available, the majority of the major components (rotor, tower, and nacelle) have fallen to within one to two hub-height distances from the base, and vertical collapse of the tower onto itself is typical. As with turbine fires, members of the public do not typically have unsupervised access to the private lands where wind farms are located, and therefore are not at risk. In March 2009, a turbine collapsed at a wind farm in Northern New York State; no one was injured in this incident. The manufacturer attributed the collapse to improper wiring during installation, which allowed the turbine to over-speed during high-wind-speed conditions (NYS Public Service Commission, 2010).

1.4 Ice Shedding or Throw

Ice can accumulate on the blades, nacelle, and tower during extreme cold weather conditions. Turbines include control systems that will automatically shut down in icing conditions. Control systems can detect when power production is reduced by ice formation and will subsequently halt turbine operation. As the ice melts, it will fall to the ground in the vicinity of the turbine. Early detection and prevention of ice formation is key to ensuring safety.

During operable wind speeds, and when the turbine has not yet been shut down automatically or manually, ice can break off the blades and be thrown from the turbine. The distance a piece of ice travels depends on a number of variables, including position of the blade when the ice breaks off, blade speed, and location of the ice on the blade. The people most at risk from falling ice are site personnel; most ice falls from the blades, nacelle, and rotor near the base of the tower. Most project developers have strict rules for personnel and operations during icing events to prevent worker injury and protect the public.

Blade manufacturers continue to research materials and methods to reduce the possibility of ice accumulation and subsequent throws. Best practices include:

- Turbine Controls. Control systems detect icing on the blades resulting in reduced performance, unusual loads, or vibrations. These trigger an automatic stop. The turbine remains off-line until an operator inspects and manually restarts the turbine. If the turbine is not operating, ice from the blades, nacelle, and tower falls to the ground in the immediate vicinity of the machine.
- Operator Intervention. Project operators can halt operation of certain turbines or the entire project during icing events to prevent ice throws and equipment damage.
- Safety Zones and Signage. Adequate setbacks from inhabited buildings, roads, and power lines significantly reduce the risk of injury or damage in the event of ice throws. Researchers have developed models that predict the distance ice can be thrown from a wind turbine (Renström, 2015). Posting signs warning passersby of the risk of falling ice is another prudent measure.

The power grid is also impacted by ice formation, and power to the project may be interrupted by the utility due to repair work or outages. Turbine operations stop immediately when grid power is lost, reducing risk of ice throw.

1.5 Vandalism

While not unique to wind turbine installations, the potential for vandalism or trespassing can cause safety concerns. Permits may require fencing and postings at project entrances to prevent unauthorized access. Other requirements intended to reduce personal injury and public hazards include locked access to towers and electrical equipment; warning signs, including 24-hour emergency telephone numbers; and fenced storage yards for equipment and spare parts. Some communities have established roadside information kiosks to channel curious sightseers out of road traffic and into an area that is a safe distance from the turbines.

2. Working with Local Emergency Response Teams

Project developers commonly work with local emergency response teams to provide information, guidance, or training on tower rescues and other wind-specific concerns, and to develop emergency response plans as part of project development. Falls, injuries from heavy or rotating equipment, and injuries from electricity are a few examples of the types of events that can occur. The height of the nacelle as well as the confined working space can provide additional challenges for medical responders. Federal Occupational Safety and Health Administration (OSHA) regulations, in addition to state worker safety regulations, cover all of the worker safety issues associated with electricity, structural climbing, and other hazards present in a wind farm.

3. Mitigating Safety Concerns Through Setbacks

Many safety concerns can be addressed by placing distance, or a setback, between wind turbines and members of the public, property lines, roads, or scenic areas. Although no consensus on appropriate distances or types of setbacks exists, common themes appear in wind energy regulations in New York State and elsewhere.

Most local government requirements include setback specifications for the distance between the wind turbine and structures (residences and other buildings), property lines, and roads. A few agencies have defined setbacks from railroads and overhead transmission lines. The most common way to define a setback distance is in terms of a multiple of the turbine structure height (e.g., 1.5 times the turbine structure height). Other options are to specify a fixed distance or a combination of a fixed distance and a multiple of the turbine height. When specifying the structure height, it is important to define whether the height is the top of the nacelle (also known as hub height) or the highest point reached by the rotor blade (maximum tip height [MTH] or total height).

For setbacks from structures and residences, some permitting agencies differentiate between houses and buildings on property leased for the project, and houses and buildings on adjacent non-participating parcels. The implication is that a greater distance is appropriate from structures on non-participating parcels, since those properties have less control or investment in project development than the landowner. Often, a waiver of setback requirements may be granted if written permission is provided from the non-participating neighboring landowner.

Setbacks from property lines may vary for side and rear lot lines but are generally specified in the same way as setbacks from residences. The community may wish to exempt turbines from property-line setbacks if the adjacent property contains a wind turbine from the same project, or the adjacent property is a participant in the project through a land lease and/or wind easement. This is an important consideration particularly in New York State, since turbine layouts and plant infrastructure can result in many parcels of land being utilized for one project.

Setbacks from roads are typically greater for major highways than for local roads. In some cases, scenic setbacks have been required from particular state highways, local roadways, and trails in close proximity to designated wind development areas.

When establishing setback policies, communities will be faced with striking a balance between the zoning and characteristics of the area and the potential economic impacts of the requirements on wind development.

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