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WIND PROJECT LIFECYCLE

Overview

New York Energy $mart℠
Public Service Commission — NYSERDA

NYSERDA
New York State Energy Research and Development Authority

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This document is one of a series of reports and guides that are all part of the NYSERDA Wind Energy Tool Kit. Interested parties can find all the components of the kit at: **www.powernaturally.org**. All sections are free and downloadable, and we encourage their production in hard copy for distribution to interested parties, for use in public meetings on wind, etc.

Any questions about the tool kit, its use and availability should be directed to:
Vicki Colello; **vac@nyserda.org**; 518-862-1090, ext. 3273.

In addition, other reports and information about Wind Energy can be found at **www.powernaturally.org** in the on-line library under "Large Wind."

NOTICE

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Wind Project Lifecycle Overview

The major steps associated with the lifecycle of a utility-scale wind energy project can be summarized into the following broad tasks:

- Wind Resource Assessment and Site Selection
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- Decommissioning

In general, it requires two to three years for project development to proceed from initial site prospecting to construction completion and operation in a region or state that does not have a history of wind energy development. The construction activities are fairly short compared to a fossil fuel plant; a 50 MW wind project can be installed in less than a year. The most time-consuming steps of the development process are the wind resource assessment and the permitting tasks. At least a full year of wind data is generally recommended to obtain an accurate representation of the wind resource. Permitting timelines vary depending on location and the need for environmental assessments.

To date, wind energy development has occurred in areas with favorable market conditions or incentives for wind energy. With implementation of the Renewable Portfolio Standard (RPS) in New York State, the potential for wind energy development has increased significantly within the State. Developers focus on identifying potential project sites within states that utilize an RPS since there is a higher likelihood of selling the energy at a competitive price. A brief discussion of the activities and requirements for each step is provided in this document.

Wind Resource Assessment and Site Selection

Developers (and others interested in wind energy) use three basic steps to identify and characterize the wind resource: prospecting, validation, and micrositing. The process of locating sites for wind energy development has many similarities to exploration for other resources such as minerals and petroleum. Prospecting includes identifying potentially windy sites within a fairly large region—such as a state, county, or utility service area—and investigating the development potential and general suitability of these sites for wind energy projects. Wind prospectors are generally trained meteorologists who rely on multiple sources of information such as terrain maps, wind atlases, local wind speed data, and other climatological information to identify good wind sites. Developers also conduct site visits to assess local conditions such as vegetation height and growth patterns (an indicator of high winds), location of residential buildings, quantity and existing uses of land, proximity to transmission lines, identification of potentially sensitive environmental areas, and other factors.

Validation of the wind resource involves a more detailed level of investigation and analysis. Validation is the process of installing monitoring stations to verify the magnitude and characteristics of the wind resource at a promising site. Site-specific wind speed data are critical because a small change in the annual average wind speed at a site can have a significant impact in determining whether or not a project is economically viable.

Upon identifying parcels of land with apparent development potential, developers generally approach the landowners to obtain permission to install monitoring stations and negotiate land lease options[1]. The installation of monitoring stations often represents the first point of interaction between a developer and a local authority, assuming that approval is required to erect the met tower. If the meteorological tower is located in an area that contains a height restriction on buildings or towers, the developer may be required to obtain a special use permit or an area variance[2].

If the wind data confirm the viability of a project at a site, developers pursue land rights for the entire project and begin micrositing. Micrositing is the process of collecting additional wind data for the purposes of 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 met 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 is common to deploy additional met towers. The number of additional towers is dependent on land characteristics, turbine size, potential turbine layouts, etc., but can vary from approximately one met tower for every 10 turbines to every 30 turbines.

Permitting

Almost every wind energy project is required to obtain some form of approval from government agencies. As part of the project planning activities, developers research town, county, state and, at times, federal rules and regulations to become familiar with local requirements and to determine the jurisdiction of the various entities. The number of agencies and levels of government involved depend on a number of factors such as:

- The location of wind turbines, transmission lines, substation, O&M facilities, and access roads,
- The installed capacity of the facility,
- Ownership of the land, and
- Ownership of the project or funding sources.

[1] For more information on leases and land requirements, see the Land Acquisition section of this NYSERDA Wind Energy Project Toolkit.
[2] For more information on local and county governance of wind energy projects, see the Comprehensive Plan and Sample Ordinance Standards sections of this NYSERDA Wind Energy Project Toolkit.

Further discussion of the permitting that may be required in New York is discussed in the Permitting and Approvals section of the toolkit.

Financing

Most wind energy projects require some form of financing to construct the project. To secure financing, a developer is required to demonstrate that all necessary permits have been obtained, the project is properly designed, and energy projections are based on sound technical analysis, a good market for the energy exists, or as is often the case, a power purchase agreement is in place. Local governments are not typically involved in the financing activities that projects perform since financing is typically received from large lending institutions or sources of equity. During the financing process, it is very common for the lenders or equity partners to have an independent engineer review all aspects of the project and report on the project's viability. In this process, the developer may be required to make changes to the project to resolve potential issues of concern raised by the engineer. If changes impact past local approvals and/or environmental assessments, then additional work with the local officials may be required. This is not a very common outcome of project financing, but it is an example of how local governments may be affected.

Construction

Construction of wind energy projects generally requires 5 to 12 months, depending on the size of the project, terrain, and weather conditions. Construction is typically planned for low wind months; however, some projects may require up to 18 months if high winds unexpectedly occur. The type of equipment used is similar to most construction sites with the exception of the large-capacity crane that is necessary to install the top tower sections, nacelle, and rotor. During construction, the project schedule is focused on minimizing the time required for the large-capacity crane due to their high operating costs. Conventional earthmoving equipment such as excavators, bulldozers, graders, dump trucks, and cement trucks are the first pieces of equipment at the site and are used to construct the access roads, foundations, and install power cabling. While the infrastructure is being installed, turbine and tower components are delivered to the site and staged near the foundations. Upon completing assembly of the turbines, electrical and communication connections are made and turbine testing begins. Once the turbines are commissioned, energy production can begin.

Table 1. Estimated Construction Schedule of a 30 MW Wind Power Plant

Task	Subtask	Duration
Site Preparation	Access Roads	2 - 6 Months
	Foundations	
	Power Collection System	
	Substation/Grid Interconnection	
	O&M Building	
Turbine Installation	Receive Tower and Turbine Components	1 - 1.5 Months
	Set Tower Base Sections	
	Complete Tower Assembly	
	Install Nacelle and Rotor	
Construction Completion	Complete Internal Turbine Assembly/Connections	1 - 2 Months
	Energize Project Site	
	Commission and Test Turbine Functions	
Post Construction	Performance Testing to Verify Proper Operation	1 - 3 Months
Note: Assuming fifteen 1.5 MW wind turbines on 65-m towers		

It can take as many as seven trailers to transport the components for one turbine and from five to more than 15 trailers to transport the large-capacity crane. Turbine and crane components are transported in compliance with Federal and various State Department of Transportation (DOT) requirements for both size and weight. However, a common concern in rural communities is that the bearing capacity of local roads may be insufficient to accommodate multiple large loads. A delivery route analysis can determine which portions of the existing infrastructure are to be avoided or modified. Payment of infrastructure modifications required for construction is negotiable, and wind developers often accept paying the improvement costs. An increase in traffic during construction activities is noticeable in most rural communities. Project monitoring to ensure compliance with permit requirements is common during the construction phase. Monitoring may be performed to verify that site work is adequately protecting sensitive environmental areas (if any are present); that road conditions following construction have not degraded; and that the project is in compliance with structural, electrical, and other building codes. The NYS Department of Agriculture and Markets has issued guidelines for protection of agricultural lands during and after wind construction. You can find them at:
http://www.agmkt.state.ny.us/AP/agservices/constructWind.html

Operation

The turbines are designed to operate automatically and independently. The control system manages all necessary adjustments in operation, monitors turbine performance, and initiates alarms when conditions warrant. Much of the site operation is handled

remotely from the O&M office via the use of computers and a high-speed communication network between the turbines.

In general, projects are staffed with one operator for every 10 to 20 turbines, depending on the project and turbine size. Operators are specially trained and apply both electrical and mechanical skills to address turbine faults, troubleshoot operation problems, and perform repairs. Much of the work is performed inside the turbines, which involves a significant amount of climbing.

Decommissioning

Repowering wind energy projects refers to the replacement of old, more costly and typically smaller wind turbines with new equipment. As the turbines approach the end of their design life (i.e., 20 years) or if a significant improvement in technology occurs, a project owner may assess the costs associated with repowering a site. An advantage of repowering is that the site conditions and wind resource are well known. In addition, surrounding communities are familiar with the project's presence. To date, repowering has only occurred in California where wind turbines have been installed since the 1980s. These early wind turbines are significantly smaller in size than the current generation of machines. As a result, project owners can frequently replace numerous small turbines with one large model.

The new wind energy projects in New York are expected to operate for 20 years but some lease agreements between landowners and the project owners may extend well beyond this period. As a result, wind turbines may be present on the land at these sites for many more years if repowering is acceptable to the landowner and local approval is obtained.

Decommissioning involves the removal of all evidence of a wind power project after it has reached the end of its design life. Depending on permit requirements and terms of the land lease agreements, the project owner may also be required to restore the land to original site conditions. Decommissioning includes removal of all turbines and towers, concrete foundations to some reasonable depth below grade, underground cabling, power poles, met towers, substation equipment, and O&M buildings. Site restoration includes regrading and replanting areas where foundations, roads, and buildings were located[3].

[3] More information on decommissioning and repowering is included in the Permitting and Approvals section of the NYSERDA Wind Energy Project Toolkit.