

Wind Energy Site Selection

Identifying optimal sites for wind energy development.



NYSERDA

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

Section Contents

1. Meteorological Towers	31
2. Remote Sensing.....	32
3. Micrositing	32
4. Land Area Requirements	32

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

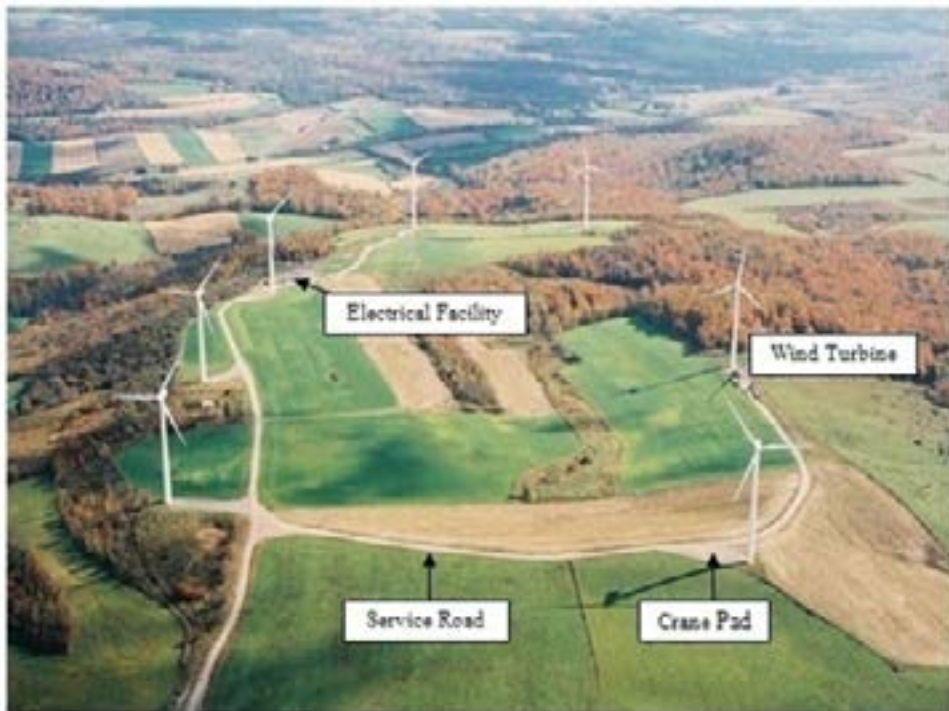
Wind turbines are typically arranged in single or multiple rows, depending on the size and shape of the landform. A single row is most often found on ridgelines and hilltops where the amount of well-exposed land is very limited. Broader and flatter land features can accommodate multiple rows of turbines. 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?

If you have any questions regarding wind energy siting, 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.

This page intentionally left blank.