4-2012

A Maine Guide for Developing Community Wind Projects

Rick Harbison
University of Southern Maine, Muskie School of Public Service

A Maine Guide for Developing Community Wind Projects

University of Maine at Presque Isle, Photo Courtesy of Bangor Daily News

Final Capstone Report

Prepared by: Rick Harbison

Advisor: Charlie Colgan

May 2012

Table of Contents

Introduction and Purpose

In recent decades, wind power has emerged as one of the fastest-growing sources of energy in the United States. By the end of 2011, 46,919 megawatts (MW) of wind power had been installed across the country.[1] A number of factors have driven this growth, chief among them are: technological innovation, increasing public support for renewable energy, and state and federal policies that encourage wind development.

The State of Maine has played an active role in this growth—encouraged in part by former Governor John Baldacci's goal to have 2,000 MW of wind power installed by 2015, and 3,000 MW by 2020. At the time of this writing, there are eight large-scale wind energy projects currently operating in Maine, with a total capacity of 345.5 MW (~17.3% of the 2015 goal). Additionally, a number of large projects are in various stages of development.[2]

While the predominant model for wind development in the United States—and Maine—has been large-scale commercial wind farms, a small but growing sector of wind development, known as "community wind," is beginning to gain a foothold. Community wind is a development model that emphasizes local ownership of wind energy projects. Under this model, projects can vary widely in size and ownership structure, but the common thread is some form of local leadership and ownership stake in the project.

Although community wind is just beginning to emerge in the U.S., it has a long and storied tradition in Europe, where it has been the primary form of wind development for many years. In Denmark, for instance, a 2001 study found that over 175,000 households had an ownership interest in a wind project, and 80% of all wind turbines were either individually or cooperatively owned, with many of these projects quite large in size to capture economies of scale. A similar pattern exists in Germany and several other European countries.[3]

Here in the U.S., community wind began as a grass-roots movement in rural Midwestern states, such as Minnesota, Wisconsin, Iowa, and Illinois, but is quickly spreading to other areas. In New England, Massachusetts has rapidly emerged as a leader in community wind development, with 27 projects installed and over 40 MW of capacity.[4] By contrast, Maine has only a handful of community wind projects, representing approximately 6 MW of capacity.

The purpose of this guidebook is to aid in the development of successful, cost-effective community wind projects in Maine. Since an abundance of information on wind energy project development already exists, this guidebook is not intended to duplicate existing resources.

[1] American Wind Energy Association, www.awea.org
[2] Governor's Office of Energy Independence and Security. March 2012. Maine Wind Energy Development Assessment: Report and Recommendations. Available: http://www.maine.gov/oeis/Wind/Binder1.pdf
[3] Bolinger, Mark. 2001. Community Wind Power Ownership Schemes in Europe and their Relevance to the United States. Available: http://eetd.lbl.gov/EA/EMP/reports/48357.pdf
[4] Massachusetts Clean Energy Center, www.masscec.com

Rather, its purpose is to synthesize the most useful information available in plain, user-friendly terms, while incorporating as much information specific to Maine as possible. This guidebook is not a comprehensive resource, and should not substitute for professional guidance. Furthermore, since some of the information contained in the guidebook is time-sensitive, care should be taken to ensure this information is accurate and up-to-date at the time of reading.

Section 1 of this guidebook begins with basic background information on community wind. It provides a comprehensive definition of community wind, outlines the many benefits of community wind projects, and explains some basic wind energy concepts. **Section 2** focuses on the development process. It walks the reader through all the various steps that are necessary to advance a community wind project from neat idea to reality. While this process varies substantially based on the size of the project and other site-specific factors, the critical development steps are usually quite similar for every project, even if they do not happen in exactly the same order. This section describes these steps in detail—with an emphasis on Maine-based projects—so the reader can gain a better understanding of what challenges they may encounter along the way. **Section 3** provides mini-case studies of successful community wind projects in both Maine and Massachusetts. Finally, **Section 4** provides contact information for experienced professionals in each area of the development process (from wind measurement to turbine procurement), as well as links to useful web resources for more in-depth information.

Overview

Planning a community wind project is a complex process that can require a substantial amount of time and effort. A typical wind project can take several years to complete, depending on its size and location. In some circumstances it may take longer. No two sites are ever the same and each poses its own unique set of challenges and opportunities. Until all permits, financing, and equipment are obtained, there is always a risk the project will not come to fruition.

In all likelihood, if you are interested in developing a community wind project you have the initiative and vision to recognize the opportunity, but lack the range of technical skills needed to fully implement the project. While this guidebook provides some insight into the process, it is important to note *you do not have to be an expert in wind power to successfully develop a project*. In most cases, you will enlist help from a number of qualified experts in various fields. These experts will help you navigate the various stages of development and assess the risks as you go.

While wind energy can be a difficult renewable resource to capture, there are many examples of successful community wind projects both in the United States and in New England. Developing a project will undoubtedly take patience, dedication, a fair amount of optimism, and quite frankly a little bit of luck. But it can be done and the wind is out there! In the words of Maine's most famous poet:

> "Through woods and mountain passes
> The winds, like anthems, roll."
>
> ~Henry Wadsworth Longfellow

Section 1:

Community Wind Basics

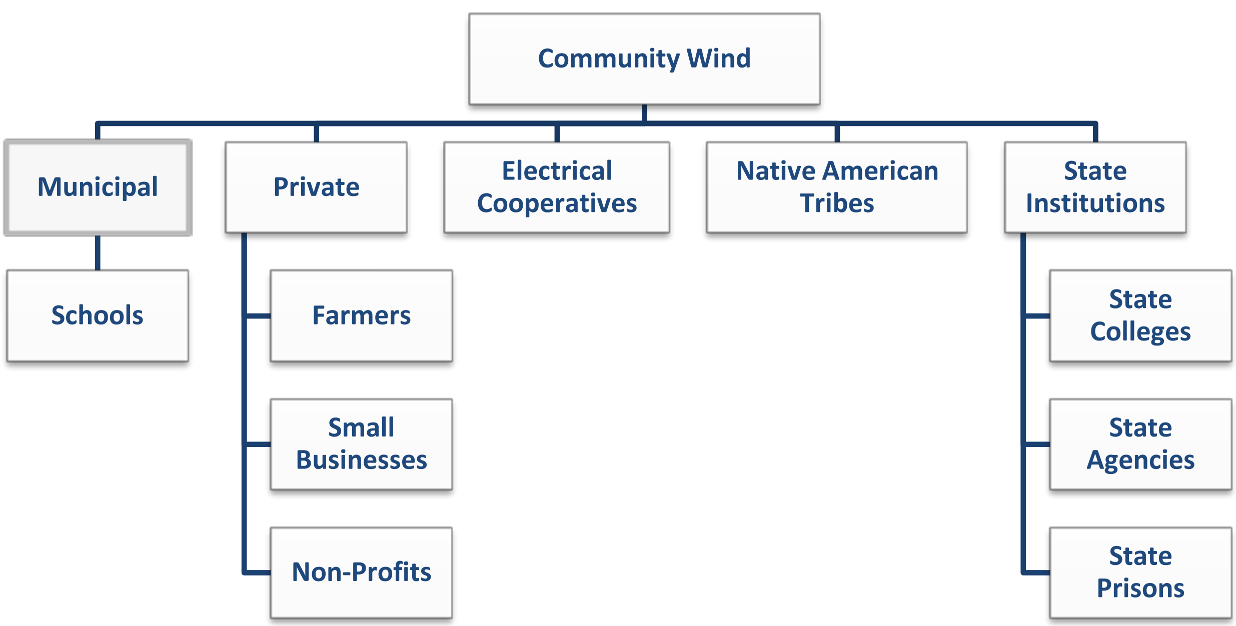
What is Community Wind?

"Community wind" is a growing sector of the wind energy market that promotes local ownership of wind energy projects. A key feature of local ownership is that one or more community members have a significant, direct financial stake in the project beyond land lease payments, tax revenue, or payments in lieu of taxes.

Community wind projects are largely owned by municipalities, k-12 schools, colleges and universities, farmers, small businesses, non-profit organizations, co-ops, Native American tribes, state institutions, or other public or private entities interested in the many benefits associated with wind energy.

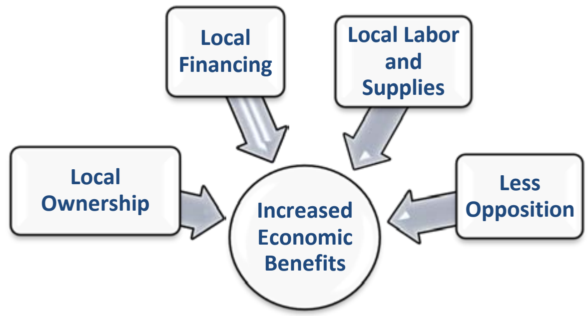
Community wind refers to the method and purpose of development rather than the size of the project. Reflecting recent growth in the size and variety of ownership structures for wind energy projects, community wind does not necessarily mean "small wind," but rather *any wind project that includes a meaningful local or community ownership stake in the project.* By this definition, community wind projects may range in size from a single 10 kilowatt turbine to a large-scale community-owned wind farm using the largest wind turbines available (1.5-3 MW in size). Typically, smaller projects are used to offset the energy load of specific buildings (referred to as "behind-the-meter"), while larger projects are used to generate wholesale electricity for sale.

By maintaining local ownership, it is argued, communities are best able to maximize the economic, environmental, social and educational benefits of wind energy projects. In most cases, community wind projects create a shared sense of purpose that is often missing when the wind developer and owner are from outside the community.



Unique Advantages of Community Wind

"Community wind" refers to a development model that places emphasis on local ownership. The "community" element of the project can be interpreted narrowly so that ownership is concentrated in the municipality where the project is located, or it may be defined more broadly where project investors are simply from the general region where the project is sited. Likewise, the extent of local ownership may range from many investors with a small share in the project, to full ownership by a few select shareholders.



Retention of Local Benefits

While all wind projects represent economic development opportunities, several recent studies suggest community wind projects are better able to retain these benefits for the local area. This is largely thought to be the result of the following key factors:

- **Local Ownership**: Community wind projects provide savings and investment returns to local shareholders who are more likely to reinvest in the area.
- **Local Financing**: Community wind projects often rely on local banks for financial services.
- **Local Labor and Supplies**: Community wind projects that are smaller in size are often able to use local labor and supplies during construction and operations.
- **Less Opposition**: Community wind projects generally experience higher levels of local participation, which typically results in reduced opposition to the project. This can generate savings by shortening the overall development timeline.

A review of existing literature on the economic development impacts of community wind projects by the National Renewable Energy Laboratory (NREL) confirmed that community wind projects generally increase the proportion of economic development impacts that remain in the local economy.

The report found that during construction, community wind projects employ 1.1 to 1.3 times more workers per megawatt than conventional projects, and while operational job impacts are 1.1 to 2.8 times higher. Furthermore, the majority of studies indicate the range of increased economic benefits for community wind projects are 1.5 to 3.4 times higher.[5] It is important to mention, however, these impacts vary considerably based on a number of key variables. These include the size and skillset of the local labor pool, the amount of local ownership in the project, the size of the project, and the productivity of the site.

[5] Lantz, E. and S. Tegen. 2009. Economic Development Impacts of Community Wind Projects: A Review of and Empirical Evaluation. National Renewable Energy Laboratory. Available: http://www.nrel.gov/docs/fy09osti/45555.pdf

Other Benefits of Community Wind

In addition to increased economic development impacts, community wind projects can offer other unique benefits:*

- In many cases, small-scale community wind projects can be a useful tool to gauge whether a site has potential for further expansion.
- Community wind projects are often feasible in areas where large-scale wind projects are not due to environmental or community concerns.
- Community wind projects are often small enough to utilize existing infrastructure. In these instances, community wind projects avoid the need to build costly substations and transmission lines.
- As a network of distributed energy generation (electricity generated from many geographically dispersed small energy sources), community wind projects are less vulnerable to disruption than large, centralized power plants. This helps improve the security of our energy supply, meet local power demand, and delay or eliminate the need for new transmission lines.
- Widespread implementation of community wind projects can offset the variable production of each individual project. This helps maintain a steadier level of productivity overall—when the wind is calm at one site, it is often blowing at another.

* Northwest Sustainable Energy for Economic Development. Community Wind: An Oregon Guidebook. Available: http://www.nwseed.org/Educational%20Resources/publications/Guidebook/oregon_wind_guidebook.pdf

Wind Energy Basics

Power and Energy

The difference between power and energy is an important concept to understand before starting any wind energy project. In physics, power refers to the rate at which energy is used or supplied. A watt is a unit of power—equal to one joule per second—used to describe how quickly energy is generated or used *at any given moment*.

Measurements of Power and Energy	
1,000 watts (W) =	1 kilowatt (ten 100-watt light bulbs)
1,000 kilowatts (kW) =	1 megawatt (larger turbines are often 1.5 MW)
1,000 megawatts (MW) =	1 gigawatt (~one nuclear power plant)
1 kilowatt-hour (kWh) =	A 100-watt light bulb operating for ten hours
1,000 kWh =	1 megawatt hour (MWh)
521 kWh	Average monthly energy consumption of Maine residences (2010)[6]
1,597,367 kWh (or 1,597 MWh) =	Hull, MA's 660 kw turbine in its first year. Enough energy to power ~250 homes for one year.[7]

For most wind turbines, power is measured in kilowatts or megawatts (see table for comparisons). Since wind speeds change from day to day and minute to minute, the power produced by a wind turbine at any given moment will vary based on conditions. In calm weather a wind turbine may produce no power at all, and at very high wind speeds the turbines are designed to disengage and cease operating as a safety measure.

Energy, by contrast, refers to the amount of power that is generated or used over a period of time. A watt-hour is the amount of watts that are generated or used over the course of an hour—the product of power in watts and time in hours.

For example, a 250-watt heat lamp running for 3 hours would use 750 watt-hours. If the same lamp ran for 4 hours, it would use 1 kilowatt-hour of electricity (1,000 watt-hours = 1 kilowatt-hour). If the lamp ran long enough to use 1,000 kilowatt-hours, it would be the equivalent of using 1 megawatt-hour of energy.

For wind development, the amount of energy (typically measured in kilowatt- or megawatt-hours) a turbine can realistically produce in a year is often the most important factor in determining the feasibility of a project.

Nameplate Capacity and Capacity Factor

Nameplate capacity, also known as rated capacity, refers to the maximum amount of power a generator (i.e. wind turbine) can produce. Nameplate capacity is the number registered with authorities who classify power output and is usually expressed in kilowatts or megawatts.

Since no form of energy operates at nameplate capacity all the time, capacity

[6] Energy Information Administration (EIA), www.eia.gov
[7] www.hullwind.org

factor is a common measurement used in the electric utility industry to better understand energy output. Capacity factor, typically measured annually, is the amount of energy generated in a year compared to the hypothetical maximum if the generator had operated at full capacity the entire time.

Since the wind does not blow constantly, the annual capacity factor for wind turbines generally ranges from 15-30% in New England.[8] For renewable energy sources, hydroelectric dams typically have the highest capacity factor, ranging from 30-80% depending on the availability of water, while the capacity factor for solar projects is often below 15% in New England.

Fossil fuel power plants (i.e. coal, oil, natural gas), can operate almost constantly, but must be stopped periodically for maintenance. Some plants may operate at full capacity 90% of a given year, whereas other fossil fuel power plants may be used intermittently to manage excess demand and have much lower capacity factors.[9]

For any wind energy project, it is important to consider nameplate capacity and capacity factor as these measures predict the amount of electricity a project will generate, and the corresponding revenue from the sale or direct use of this electricity.

Example Capacity Factor: Town of Hull, MA

In December 2001, the Town of Hull commissioned a Vestas wind turbine with a nameplate capacity of 660 kilowatts.

If the turbine ran at full capacity 24 hours a day for 365 days it would generate:

(660 kW) x (365 x 24 hrs.) Or,
5,765,760 kWh for one year.

In its first year, the turbine actually produced 1,597,367 kilowatt-hours.

1,597,367 / 5,765,760 = 28%

The generator therefore had a capacity factor of 28% in its first year.

*Information courtesy of the UMASS Renewable Energy Laboratory, www.umass.edu/windenergy
**Photo courtesy of www.hullwind.org

---

[8] Conservation Law Foundation Ventures, Inc, and Massachusetts Clean Energy Center. 2011. Land-Based Wind Energy: A Guide to Understanding the Issues and Making Informed Decisions. http://www.masscec.com/masscec/file/Wind_Guide.pdf

[9] UMASS Renewable Energy Laboratory. Fact Sheet 2a. Wind Power: Capacity Factor, Intermittency, and what happens when the wind doesn't blow? http://www.umass.edu/windenergy/publications/published/communityWindFactSheets/RERL_Fact_Sheet_2a_Capacity_Factor.pdf

Section 2:

The Development Process

Public Engagement

A typical wind energy project is subject to many layers of formal review, from local ordinances to state and federal permitting regulations. Many of these processes include some form of public comment, which can often make or break a project. To better ensure the success of a project, it is important to cultivate local support early on in the planning process. It is also a responsibility of the project developer to provide a reasonable amount of time for people to learn about the project and discuss its implications. As one wind development guide notes, "the time for educating the public and permitting agencies is not at your permit hearing."[10]

Types of Concerns

Concerns about wind energy are wide-ranging, both objective and subjective, and often difficult to predict. While some residents may be concerned about turbine noise, others may be opposed to the visual impact of turbines on the landscape, or wildlife impacts.

Some of the more common concerns associated with wind energy development are shown in the table to the right. Although it is beyond the scope of this guidebook to address each concern in detail, the Conservation Law Foundation's recent publication, "Land-based Wind Energy: A Guide to Understanding the Issues and Making Informed Decisions" is a great resource for more in-depth information on each issue.[11]

Common Concerns Associated with Wind Energy Projects	
Sound	Concerns that the turbines will be excessively noisy and disrupt the quality of life.
Aesthetics	Concerns about the visual impact of turbines on the landscape.
Shadow Flicker	Concerns about the nuisance factor of shadows produced by rotating turbine blades.
Human Health	Concerns about the impacts of noise and/or shadow flicker on human health.
Distribution of Benefits	Concerns that some community members will benefit financially at the expense of others.
Property Values	Concerns that surrounding property values will decrease once the project is developed.
Interference with Communications	Concerns that the turbines will interfere with radar signals and cell towers.
Air Safety	Concerns that the turbines will interfere with commercial or recreational air traffic.
Wildlife Impacts	Concerns that the turbines will endanger bird and bat populations and disrupt habitat.
Wetlands Impacts	Concerns that the turbines will negatively impact wetlands or other sensitive areas.
Infrastructure Impacts	Concerns about the impact of new roads, transmission lines, turbine foundations, etc.
Decommissioning	Concerns that the turbines will not be decommissioned once their useful life is over.

[10] Windustry. Community Wind Development Handbook. Available: http://www.swifoundation.org/documents/CommunityWindDevelopmentHandbook1-31-08.pdf

[11] Conservation Law Foundation Ventures, Inc, and Massachusetts Clean Energy Center. 2011. Land-Based Wind Energy: A Guide to Understanding the Issues and Making Informed Decisions. http://www.masscec.com/masscec/file/Wind_Guide.pdf

Best Practices

Concerns regarding wind projects can often be mitigated through open communication, and carefully siting the project in a way that minimizes impacts.

Ideally, public engagement should begin early, incorporate fact-based discussion, and involve as many local residents as possible. According to the manual "Best Practices for Sustainable Wind Energy Development in the Great Lakes Region,"[12] public engagement can be thought of in two stages: information in, and information out.

Information In

The first stage in a public engagement campaign should be to talk to key stakeholders—local conservation groups, landowners, residents who can inform project planning, etc.—to learn as much about site-specific concerns as possible. This will help project planners discover which aspects of an area are most important to residents before any major decisions are made; it will also help build rapport among community members.

Information Out

Project planners should then engage in a deliberate process to educate residents about the project and address any concerns that might arise. To build credibility among the community, it often helps to have a neutral third party with no financial ties to the project lead the public engagement effort—most literature on the subject suggests that transparency of process is as important as the quality of information being dispersed (i.e., if residents do not feel their concerns are being heard, they may oppose the project regardless of its merits).

Here it is also important to note the distinction between public outreach and engagement. Public outreach is generally limited to one-way communication—the distribution of fact sheets, a website devoted to the project, etc. While this type of outreach is useful, it cannot be considered true public engagement. True public engagement allows for two-way dialogue where community members are allowed to express their concerns and have an active role in shaping the project.

Additionally, public engagement processes may differ depending on whether the site for the project is yet to be chosen, or whether it has been chosen already. Public processes that identify acceptable (or less controversial) sites can be more effective than engagement once a site is chosen and specific development is under consideration.

[12] Great Lakes Wind Collaborative. 2011. Best Practices for Sustainable Wind Energy Development in the Great Lakes Region. Available: http://www.glc.org/energy/wind/pdf/bptoolkit/GLWC-BPToolkit.pdf

Public Opinion for Wind Power in Maine

A number of statewide polls show that Maine residents generally support wind energy development:

- In 2007, a poll by Pan Atlantic SMS Group showed that 85% of Maine people support wind development.[13]
- In 2009, a poll by Critical Insights showed that 90% of Maine people support wind development. Calls to residents in the seven "rim" counties—where most wind power projects are built or planned—showed 83% support.[14]
- In 2010, another poll by Pan Atlantic SMS Group showed that 88% of residents support wind energy in Maine.[15]

Despite general public support for wind energy development in Maine, a vocal minority of citizens are strongly opposed to wind power in general and opposition is common once specific proposals are on the table for consideration. It is important to respect these concerns and create opportunities to address them respectfully and fully.

Principles for Wind-Related Consensus Building

Although unanimous support for any development project is unlikely, seeking as much consensus as possible in the planning process will reduce conflict and other hurdles in the formal permitting processes.

Professional outreach support has successfully been used to enhance engagement in many larger scale projects. The recommendations below have been proven to increase agreement among involved parties in wind siting decisions:

1. Initiate stakeholder involvement process as early as possible and set realistic but firm timetables.
2. Include broad representation of legitimate stakeholder groups (including government agencies, and for site-specific projects, local citizen groups).
3. Consider using professional neutrals to facilitate collaborative decision-making.
4. Do not exclude contentious issues; instead, seek ways to address negative aspects of any proposal (including compensation or contingent agreements that specify a remedy in case of an undesirable scenario)
5. Consider incorporating alternative siting processes (such as voluntary public outreach processes, preapproval for specific sites, competitive solicitations from multiple developers)
6. Structure stakeholder involvement processes to supplement but not supplant a formal process, while modifying formal processes to better accommodate consensus-building opportunities.

*Information courtesy of:
The Conservation Law Foundation, and
Raab, Jonathan and Susskind, Larry (2009), New Approaches to Consensus Building and Speeding up Large-Scale Energy Infrastructure Projects. Presented at the Conference on Transmission and Wind Siting hosted by the German Electricity Regulator, Gottingen University, Germany, June 22-23.

[13] Natural Resources Council of Maine (NRCM). Nov. 13, 2009. "Poll Shows Overwhelming Support for Wind Power. Available: http://www.nrcm.org/news_detail.asp?news=3346
[14] Ibid ^13
[15] Turkel, Tux. Portland Press Herald. June 29, 2010. "Mainers full of gusto for wind power, survey finds."

Initial Site Assessment

The first priority in developing a wind energy project is identifying potentially attractive sites. An initial site assessment is the first step in this process, and is used to gain a rudimentary understanding of the feasibility of a prospective site. Although this stage of development is fairly basic, enlisting the aid of a professional with wind project siting experience is recommended (*see* ***Section 4*** *for a list of site assessment consultants*). If the preliminary evaluation looks promising, a more detailed site assessment can then be justified.

In the initial assessment, a few key factors are evaluated. These include: the wind resource; the availability to connect to the grid; the physical aspects of the property; the project's compatibility with local land use; and zoning and permitting requirements.

Site Characteristics Checklist

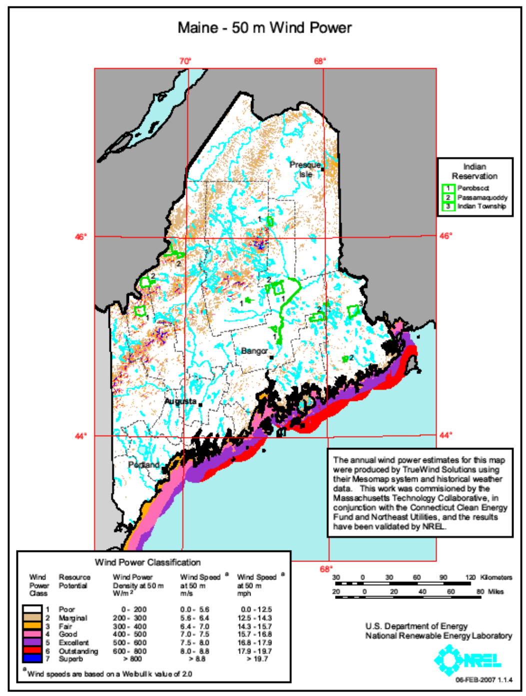
- ✓ **Strong wind resource**
- ✓ **Access to high voltage power lines**
- ✓ **Appropriate zoning for wind turbines**
- ✓ **Minimal environmental concerns**
- ✓ **Favorable attitudes towards wind energy**

*Courtesy of Windustry

The Wind Resource

An essential element of developing a wind energy project is ensuring an adequate wind resource. Just because a site appears to be "windy" is no guarantee that a project will end up being financially feasible. An accurate measurement of the site's wind speeds is thus vital to the success of any project.

A good starting point is the Maine wind resource maps published by the U.S. Department of Energy and the National Renewable Energy Laboratory. These maps show annual average wind speeds at 80 meter and 50 meter heights for the entire state. The maps can be found at:



http://www.windpoweringamerica.gov/windmaps/

Since the wind maps are presented at a spatial resolution of 2.5 square km, it is important to note they are not particularly accurate at the local, or site level. The general rule of thumb is to consider the maps accurate within +/- 10% to 15% of what the actual wind speeds may be at any given site. Additionally, any energy estimate generated using the maps should be considered to be +/- 20% accuracy or greater.[16]

Wind Power Classification (50 meter height)			
Wind Class	**Resource Potential**	**Wind Power Density W/m²**	**Wind Speed m/s (mph)**
1	Poor	<200	<5.6 (12.5)
2	Marginal	200-300	5.6-6.4 (12.5-14.3)
3	Fair	300-400	6.4-7.0 (14.3-15.7)
4	Good	400-500	7.0-7.5 (15.7-16.8)
5	Excellent	500-600	7.5-8.0 (16.8-17.9)
6	Outstanding	600-800	8.0-8.8 (17.9-19.7)
7	Superb	>800	>8.8 (19.7

From these maps, it is possible to obtain a *rough* estimate of the general wind power classification of the site(s). These classifications, created by the Department of Energy, range from 1 to 7, with 1 representing a "poor" wind resource, and 7 representing a "superb" wind resource. Wind speed is expressed in meters per second or miles per hour, and wind power density is expressed in watts per square meter. With recent advances in turbine efficiency, sites in wind power class 3 are considered candidates for large-scale wind farm development, and sites in class 2 offer possibilities for smaller, community wind energy projects.

In addition to the resource maps and wind power classification chart, it is usually possible to find existing data from nearby locations for most sites. Publicly accessible wind data can often be found for meteorological buoys, airports, or other public facilities. Again, caution should be used when interpreting this data as it may be compromised by being in a sheltered area, or collected on short (10 meter) towers.

→The sections **Measuring Wind Speeds** and **Economic Analysis** outline the steps to perform a more detailed site assessment.

Access to the Grid

If the intention of the project is to connect to the power grid, the proposed location should be in close proximity to at least a three-phase power line. High voltage lines can be costly and time consuming to permit and build. An otherwise suitable location may be deemed impractical due to the cost or difficulty of interconnecting to the grid. Additionally, some utilities restrict how close a turbine can be to existing power lines, and some power lines are not equipped to handle the added generation of a wind energy project.

It is therefore necessary to talk to the local electric utility early on to determine the feasibility of connecting to the nearest transmission lines. If the site warrants further analysis, an interconnection study is usually performed to assess the impact it will have on the regional power grid. If modifications or upgrades are needed to accommodate the project, the study will identify the technical and financial requirements to do so. Once this is done, an interconnection agreement must be secured with the utility.

[16] Windustry. 2008. Community Wind Toolbox. Available: http://www.windustry.org/CommunityWindToolbox

→The section Transmission and Interconnection discusses this process in greater detail and includes the requirements for Maine's three investor-owned utilities.

Physical Aspects of the Property

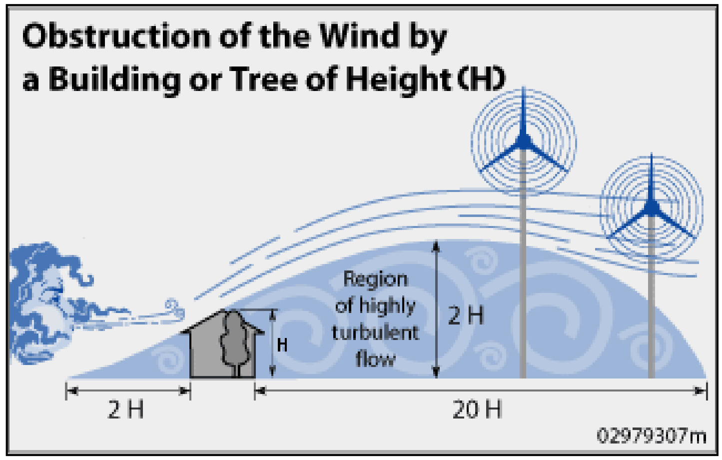
The land surrounding the turbine should be clear of any obstructions. As seen in the diagram to the right, even a small obstruction, such as a house, can have a dramatic effect on the quality of the wind resource in the area.

The general rule of thumb in the wind industry for most obstructions is as follows: an obstruction will result in disturbed air flow at a distance of twice its height in the area in front of it, twenty times its height in the area behind it, and twice its height in the area above it. Thus, when siting turbines, providing enough open space to reduce wind turbulence from nearby trees and buildings is vital. For this reason, turbines are often sited on the highest point of land available (hilltops or ridgelines are often ideal), or waterfront locations to take advantage of unrestricted winds.

Additionally, the land surrounding the wind turbine should be able to support its weight—as well as the construction equipment required to erect it—and be able to accommodate an access road.

Compatibility with Local Land Use

Wind turbines are not allowed in wetlands or other sensitive areas where they will disrupt ecosystems, and they cannot be sited too close to airports. Appropriate siting of wind turbines should include site locations that are an adequate distance



Courtesy of National Renewable Energy Laboratory

from neighboring buildings, businesses, or other potentially conflicting uses. Wind turbines do make some noise, so consideration should be used to not disturb nearby neighbors.

Zoning and Permitting

All wind projects are subject to zoning and permitting requirements. Investigating these requirements early on can help avoid unnecessary delays and determine the overall feasibility of the project.

Zoning occurs at the local level and varies widely by municipality. While some towns may have specific wind ordinances, others may have no zoning at all. It is therefore necessary to consult with the local zoning board, planning commission, or appropriate governing body to determine what requirements are necessary for your project.

At the state level, the Department of Environmental Protection (DEP) has jurisdiction over projects in the organized territories of Maine (the Land Use Regulation Commission, LURC, currently has jurisdiction for wind projects in the unorganized territories. At the time of this writing LURC is undergoing a restructuring and its jurisdiction for wind projects may transfer to the DEP). The DEP's requirements for wind projects in the organized territories vary based on the size of the project:

1. For projects less than 100 kW in size, the DEP does not require any formal review process.
2. For projects over 100 kW in size that are not "grid scale," the DEP has a simplified review process.
3. For projects that are considered "grid scale" (i.e. large wind farms typically 20 acres or more), the DEP has a more stringent review process.

At the federal level, the Federal Aviation Administration (FAA) is often involved in permitting wind projects that are near airports. For projects on federal lands, or involving federal agencies, the National Environmental Policy Act (NEPA) requirements will apply. And lastly, if wetlands are nearby, the project may need to obtain a National Pollutant Discharge Elimination System (NPDES) permit.

Regardless of the size of the project, it is advisable to consult with the municipality right away, as well as with experts knowledgeable in local, state, and federal permitting requirements (see ***Section 4*** *for a list of qualified consultants).*

→ See the **Zoning and Permitting** section for more information on this topic.

Measuring Wind Speeds

Following a positive initial site assessment, the next step in the development process is to verify the wind resource. For this stage, it is essential to hire an expert to assure the wind data is collected and analyzed accurately (*see* ***Section 4*** *for an appropriate list of consultants*). An accurate estimate of the wind resource can make or break the economics of a wind project.

The amount of energy a turbine can produce is highly dependent on the speed and constancy of the wind. Since the power in the wind is proportional to the cube of the wind speed, small changes in wind speed can have a dramatic effect on the amount of power produced at a certain site. For instance, every time the wind speed doubles, the power a wind turbine is able to generate increases by a factor of eight. The two main methods for conducting a detailed wind assessment are meteorological towers and computer modeling.

Meteorological Towers

The conventional approach to obtaining accurate, site-specific data has been to erect meteorological towers, or "met" towers. These towers are used to collect wind speeds, wind direction, temperature, and air pressure for a year or more. Most met towers are of lattice or monopole design and are supported by guy wires. The towers are typically between 100 to 165 feet high (30 to 50 meters), with taller towers generally providing more accurate information.

For the past several years, Efficiency Maine has managed an Anemometer Loan

MET tower used for the Presque Isle project (picture courtesy of Solaya)

Program consisting of eight, 30 meter met towers. However, at the time of this writing, the future of this program is uncertain.

Although met towers have proven to be a reliable method for estimating a wind resource, they are also costly, can require permitting, and take one or more years to complete. A possible and less costly alternative to met towers is computer modeling.

Desktop Assessment: Computer Modeling of a Wind Resource

Recent advances in computer modeling techniques have allowed researchers and private consultants to more accurately estimate a wind resource. Companies specializing in wind resource assessment, such as New England-based Wind Analytics, are able to combine existing historical wind data with local topography (and other weather-related parameters) to simulate complex wind flows. Using this virtual data, it is possible to develop precise, site-specific estimates of a wind resource.

A desktop assessment typically takes 2 to 4 weeks to complete and ranges in price from $5,000 to $10,000. For these reasons, it has quickly become an industry standard and is increasingly widely accepted by both developers and lenders. Depending on the size of the project, computer modeling can be used in place of met towers, in addition to met towers (to further validate the analysis), or not at all.

Ultimately, the measurement program should carry a cost that is consistent with both the scale of the proposed project and the uncertainty of the resource in the area. For smaller projects, under 660 kW for instance, it may make more financial sense to rely exclusively on computer modeling to avoid the upfront costs and time constraints associated with permitting, installing, and maintaining a met tower.

Typical Wind Data

Whether it is obtained from a met tower, computer model, or both, once the wind data is collected a variety of indicators are used to determine the viability of the wind energy project.*

- **Monthly Average Wind Speed**: This metric is used to determine how wind at the site varies over the course of the year. It shows how seasonal variations will affect energy production, and ultimately return on investment.
- **Projected Monthly Production***:* Using the monthly average wind speed, it is possible to generate a rough estimate of how much energy can be produced at the site for various turbine sizes and models.
- **Wind Shear***:* Wind shear is a calculation used to measure the difference in wind speeds at different heights. In general, turbulence decreases and wind speed increases at higher elevations. Using an assumed wind shear coefficient, wind speed can be extrapolated to various turbine hub heights.
- **Wind Rose***:* A wind rose is a graphic representation that shows the frequency and energy potential of the wind resource from each direction. It is used to determine the direction of the prevailing winds for a specific location. A wind rose helps inform the layout of a project and is also used to indicate how much production might be reduced by obstructions or future development.
- **Annual Energy Production for Good and Bad Years**: Since wind conditions vary from year to year. It is often helpful to look at historical wind data (10-20 year period) to see whether the current data set represents a “good” or “bad” wind year. This information can be used to predict what type of fluctuation to expect in turbine output.

*Information courtesy of Windustry

Economic Analysis

Once a professional wind assessment is complete, the next step is to determine the overall economic viability of the project. Although this type of analysis should be performed by an expert, in most cases the consultant used to measure wind speeds can provide economic modeling services as well.

The consultant will develop a pro forma (a financial worksheet designed to display project costs and revenues). This is typically an iterative process that is refined as the project evolves. As with any business endeavor, for a wind project to be profitable its costs must be offset by the revenue it creates. The pro forma will help quantify both costs and revenue in a detailed fashion to gain a better understanding of the risks associated with the project.

Since community wind projects are a relatively new concept in Maine, many local banks and lending institutions are unfamiliar with the development process. It is therefore essential to have a professionally prepared pro forma and a thorough understanding of the risks, costs, and benefits involved in developing a wind energy project.

Costs

In general, the most significant costs associated with a wind project are:

- ✓ Wind resource/site assessment
- ✓ Price of wind turbine(s) including transportation
- ✓ Legal/consultation fees
- ✓ Construction
- ✓ Permitting/interconnection studies
- ✓ Utility system upgrades *if necessary* (transmission lines, metering equipment, etc.)
- ✓ Insurance
- ✓ Operations, maintenance and repair

These costs will vary considerably based on site-specific factors, the size of the project, and the financing terms available.

Revenue

The revenue a wind project can produce is strongly influenced by the wind resource, the size and productivity of the wind turbine(s), and the project's overall capacity factor.

Using detailed wind speed data, a consultant can estimate the amount of energy the project will likely produce in a year. Since wind turbines are designed for different wind speeds and climates, a variety of turbine sizes and models should be tested to determine which ones offer the best return on investment.

Once an estimate is made for how much energy the project will produce, the consultant should be able to help you determine the financial feasibility of the project by considering the following factors:

How much electricity will the project save?

If the electricity generated from the project is used to offset the energy load of a specific building, or buildings, the savings resulting from the project should justify the costs.

If the project is grid-tied, you should be able to take advantage of Net Energy Billing, a program that allows you to credit any excess generation to your next month's electric bill. Net Energy Billing can significantly enhance project economics, but estimating energy and cost savings with this policy can be difficult. Your consultant should be able to help you navigate this process.

If the project is not grid-tied, the cost of the project, and the energy it produces, should be compared to the costs associated with the previous source of electricity used to power the building(s).

→ See the **Net Energy Billing** section of this guidebook for more information on this program.

How much income will the project generate?

If the purpose of the project is to sell electricity to the utility, the amount of income it generates will vary based on the amount of electricity it produces, as well as the price at which it can sell this electricity to the utility (stipulated in the power purchase agreement, PPA).

Once this information is known, it is possible to estimate how much income the project will generate over its lifespan, and compare it to the total costs of the project.

→ See the **Negotiating a Power Purchase Agreement** section of this guidebook for more information on this process.

What is the intention of the project?

While it never hurts to have a project that makes strong financial sense, for some projects, saving—or making—money is not always the most important priority. If the primary goal of the project is to reduce emissions, be more energy independent, or serve as a demonstration project for the community (to name a few), the project does not necessarily need to be justified in economic terms. However, if this is the case, it may be difficult to acquire financing from a bank or lending institution.

Are other financial incentives available?

Most community wind projects are eligible for a variety of local, state, and federal incentives. This type of support can significantly enhance the payback period—and feasibility—of a wind project.

→ See the **Key Financial Incentives** section of this guidebook for more information on grants and incentives your project may be eligible for.

Zoning and Permitting

Once a site for the wind energy project is selected, projects must obtain appropriate permits before proceeding with development. Obtaining permits can take anywhere from a few months to over a year, depending on a number of factors, such as the size of the project, the regulatory process in place in the jurisdiction where the project is located (i.e. municipality, organized territory, unorganized territory), the results of various pre-construction studies, and the attitude of the community towards the project, among other factors.

Local Zoning and Permitting

Each municipality has its own unique set of land use regulations. The following are some typical scenarios a wind project might encounter.*

No Zoning

A few local jurisdictions—predominantly in rural areas—have not yet exercised their authority to regulate land use. In these areas, approval of a wind project should be relatively straightforward and require only building and electrical permits, in addition to compliance with state and federal permitting standards.

Zoning without Wind-Specific Ordinances

In most cases, municipalities have zoning ordinances in place, but since wind energy projects are a relatively rare request, the ordinance fails to identify them as an allowed use. In these cases, the project must apply for a variance, or conditional use permit. The level of review is then negotiated with the planning board, which may host several public meetings to get input from the community.

Zoning with Wind-Specific Ordinance:

If the municipality has a wind ordinance in place, the project needs to comply with the existing review process. The level of review will vary based on the stringency of the wind ordinance.

* Green. Jim, NREL. Jan. 17, 2008. Overview: Zoning for Small Wind Turbines. Powerpoint presentation prepared for ASES Small Wind Division Webinar. http://www.windpoweringamerica.gov/pdfs/workshops/2008/sw_zoning_overview.pdf

State Review

In addition to local zoning and permitting regulations, wind projects may also need to obtain certification from the Department of Environmental Protection (DEP) if located in the organized territories of Maine, or the Land Use Regulation Commission (LURC) if located in the unorganized territories of Maine (LURC's review process and jurisdiction for wind projects is currently under legislative review and is therefore not included in this version of the guidebook).

Department of Environmental Protection (DEP):

Wind projects in the organized territories fall under DEP review. The DEP categorizes wind projects in the following manner:

For projects less than 100 kW in size, the DEP does not require any formal review process. For projects over 100 kW in size that are not "grid scale," the DEP has a simplified review process. For projects that are considered "grid scale" (i.e. large wind farms typically 20 acres or more), the DEP has a more stringent review process. Since most community wind projects are not "grid scale," this guidebook focuses on the DEP review process for wind projects over 100 kW in size not considered "grid scale."

The DEP refers to these projects as "small-scale wind energy developments" and has three main requirements: noise, shadow flicker, and public safety (see text box on next page).

State Review (Cont'd)

1. **Noise**: Project coordinators must provide a full noise study (prepared by a qualified professional), which demonstrates that the project meets the requirements of the noise control rules adopted by the Board of Environmental Protection (projects in remote locations may be granted a waiver from this requirement).

   The DEP noise study must include detailed maps and descriptions of the areas potentially affected by the development, evidence of whether or not the location is a "quiet" area, and detailed information regarding the noise generated by the project, such as the type, source, and location of the noise, sound levels, control measures to mitigate sound, comparison with regulatory limits, and comparison with local limits.
2. **Shadow Flicker**: The project must be designed to avoid unnecessary shadow flicker. Project coordinators must provide a detailed model of the project that demonstrates it is designed to avoid "unreasonable adverse shadow flicker effect." The shadow flicker model must utilize WIndPro software or other modeling software as approved by the DEP.
3. **Public Safety**: The project must be constructed with setbacks adequate to protect public safety. This must be documented in the form a site plan, which demonstrates that the project meets appropriate safety standards. The recommended minimum setback by the DEP is no less than that defined by local zoning ordinances, or 1.5 times the maximum turbine blade height, whichever is greater.

To apply for DEP review, project coordinators must publish a public notice in a "newspaper of general circulation" in the area of the facility, file a copy of a completed application with the city or town clerk of the municipality in which the project is located, and send a completed application form with all supporting documents and fees to the DEP.*

* An application form can be found here: http://www.maine.gov/dep/land/sitelaw/windpower/index.html

Federal Review

At the federal level, the Federal Aviation Administration (FAA) is often involved in permitting wind projects, since every structure over 200 feet, within a certain radius of an airport or critical flight path, must be permitted by the FAA.

If the project is located on federal lands, or involves federal agencies, the requirements of the National Environmental Policy Act (NEPA) will apply.

Finally, if wetlands are nearby, the project may need to obtain a National Pollutant Discharge Elimination System (NPDES) permit. As part of the application process, the project must create a storm water pollution prevention plan (SWPPP) that explains how storm water from the project will be controlled.

Transmission and Interconnection

The electrical grid is widely regarded as one of the most complex systems ever created by humans. In order to ensure that it operates reliably, many layers of rules and regulations exist, which are enforced by federal, state, and local governing bodies.

As a result, the interconnection process for wind projects is quite extensive and often takes a year or more to complete. For this reason, it is advisable to initiate the process as soon as possible, and hire an engineering consultant to help fill out forms, interpret study results, and act as a liaison between the project team and various regulating bodies.

Electrical Grid Basics

The electrical grid is an interconnected network for delivering electricity from suppliers to consumers. It consists of three distinct operations:

Generation: Electricity must first be generated. This is accomplished by combustible fuels (coal, natural gas, oil, biomass), or non-combustible fuels (wind, solar, nuclear, hydro-power). These facilities are usually quite large to take advantage of economies of scale.

Transmission: The transmission network carries high-voltage electricity over long distances to substations—usually operated by the local Transmission and Distribution Utility (T & D Utility).

Distribution: At substations, transformers reduce the voltage so distribution lines can then carry the electricity to its final destination.

Overview of the Interconnection Process

The process of interconnecting a wind energy project to the grid can be summarized in three general steps:

Initial Contact: The first step is to make initial contact with the local utility to see if there is enough capacity in the existing lines to handle the electricity produced by the project. Although determining line capacity is a lengthy and complicated process, the utility should have a rough idea of how much potential there is in a certain area.

In general, projects under 10 MW can usually connect to low voltage distribution lines (under 69 kilovolts), while projects over 10 MW need to connect to high voltage transmission lines (69 kilovolts or higher). In most cases, connecting to distribution lines is an easier, faster, and less costly process.

Interconnection Application: If the project still seems feasible, the next step is to submit an interconnection application/fee. Based on the size of the project, the utility may require a feasibility study, system impact study, and facilities study. This is outlined in greater detail in the next section: Interconnection in Maine.

Execute Agreement(s): The final step is to execute the interconnection agreement—as well as net energy billing, or community-based renewable energy pilot program agreements if applicable—and construct the additional infrastructure needed to get the wind project on the grid.

Interconnection in Maine

For projects under 20 MW, the Maine Public Utilities Commission (MPUC) requires each Transmission and Distribution Utility to use a standard screening process. Projects are separated into four "levels" based primarily on size. The extent of the review then varies based on which level the project falls under, as shown in the table below.

Level	Nameplate Rating	Application Fee
Level 1	Inverter-based generators not greater than 10 kW	$50
Level 2	Generators not greater than 2 MW	$50 plus $1.00/kW
Level 3	Non-exporting generators not greater than 10 MW	$100 plus $1.50/kW
Level 4	All other generators not subject to federal jurisdiction	$100 plus $2.00/kW ($400 max)

Once the project level is determined, an interconnection application/fee is sent to the appropriate utility to set the process in motion. The application form requires the following types of information:[17]

- Basic information regarding the applicant and the electricity supplier(s) involved;
- Information regarding the type and specifications of the customer-generator facility;
- Information regarding the contractor who will install the customer generator facility;
- Certifications and agreements regarding utility access to the customer-generator's property, emergency procedures, liability, compliance, with electrical codes, proper operation and maintenance, receipt of basic information; and
- Other similar information as needed to determine the compliance of a particular applicant.

Once received, the utility will review the application to make sure it is complete. Although utilities are not required to do so, it is usually advisable to request a scoping meeting in which the project team meets with engineers from the utility to discuss the project and outline the steps necessary to connect to the grid. Depending on the size or unique features of the project, the utility may require three studies, each involving more detail and financial commitment than the previous one.

Feasibility Study: This study provides an initial look at the project's point of entry into the grid and identifies potential adverse impacts resulting from interconnecting the project. If the study shows no adverse impacts, the utility may provide an interconnection agreement without further study. Otherwise, a system impact study is required.

System Impact Study: This study explores the issues identified in the feasibility study in greater detail. At the end of the system

[17] MPUC Rules Chapter 324. Available: http://www.maine.gov/mpuc/legislative/rules/part3-electric.shtml

impact study, the project team and utility should have an accurate idea of the facility changes needed for interconnection, as well as the cost and amount of time it will take to correct any problems identified in the study.

Facilities Study: The last step before an interconnection agreement is executed, the facilities study outlines exactly what needs to be done before the project is integrated into the grid. The study will identify the equipment necessary to complete interconnection, construction costs, and the design of the required facilities and upgrades.

It is important to note that all of the above steps are at the discretion of the utility. The initial meetings with the utility will establish the procedure for finalizing an interconnection agreement.

Negotiating Power Purchase Agreements

One of the most critical steps in developing a wind energy project which will sell electricity to the grid is securing a power purchase agreement (PPA) from the utility serving the area. At its most basic, a PPA is a contract that states the price the utility will pay for energy generated by the project.

While price terms are often thought to be the most important element of a PPA, a PPA is a complex legal document that also contains a number of other vital provisions that affect the feasibility of the project. *For this reason, it is strongly advisable to enlist the help of an attorney with experience negotiating power purchase agreements. See* ***Section 4*** *for a list of qualified attorneys.*

The Importance of a Good PPA

A PPA is immensely important to a wind energy project. A PPA is a project's primary source of revenue, and a critical component for negotiating financing terms with a lender. If the project team is unable to secure a favorable PPA from the utility, the project is essentially dead-in-the-water.

Negotiating a PPA in Maine

Maine's Community-Based Renewable Energy Pilot Program, enacted in 2009, encourages locally owned, in-state renewable energy projects. The program helps projects whose intent is to sell power to the grid obtain more favorable power purchase agreements.

For projects under 1 MW in size, the program requires utilities to pay a set price of $.10/kWh. For projects between 1 and 10 MW in size, the MPUC helps conduct long-term contract solicitations with the utility (the average price for these contracts may not exceed $.10/kWh, or the cost of the project plus a reasonable rate of return on investment).

Alternatively, a participant can choose another incentive: the renewable energy credit (REC) multiplier. Under this incentive, the value of the environmental attributes, or RECs, from the project are set at 150% of the amount of electricity actually produced.

Wind projects not eligible for this program must negotiate their own PPAs with the appropriate utility.

→ The next section, **Community-Based Renewable Energy Pilot Program** discusses this program (including eligibility requirements) in greater detail.

Key Elements of a PPA

A PPA is a complex legal document that usually addresses some, or all, of the following topics: [1]

Sale and Purchase: The price a utility is willing to pay for electricity varies based on a range of factors, such as the location of the project, the amount of energy the project will produce, the quality of the wind resource, the project's financial structure, the utility's need for power, and the attitude of the utility towards community wind projects, among other factors.

Prices may remain flat, rise, or fall over time, or be negotiated in another way so long as both parties agree to the negotiation. As mentioned previously, price terms are extremely important to a project's bottom line. If the price a utility is willing to pay for electricity is too low, the project may not be able to earn a reasonable rate of return. Conversely, a utility has a strong interest in keeping price terms low so as to ensure low-cost electricity for its consumers.

Renewable Energy Credits (RECs): Most PPAs include provisions that assign ownership of the RECs produced by the wind energy project.

Length of the Agreement: PPAs are generally long-term contracts. Most PPAs are negotiated for a time period ranging from 15 to 25 years. A typical PPA will also include several provisions that allow for one or both parties to terminate the agreement prior to the operation date.

Curtailment: Most PPAs recognize that there will be times when the utility needs to curtail the production of wind energy from the project. This occurs periodically when the utility needs to manage its available supply, respond to emergencies, or for other reasons. PPA negotiations stipulate which party will bear the financial risk associated with losses that arise when curtailment occurs.

Transmission Issues: A PPA often stipulates which party will be responsible for any equipment upgrades that are necessary to accommodate the project. More often than not, the investors in the wind project are required to cover these costs, but sometimes the utility is willing to cover some, or all of these costs.

Milestones and Defaults: PPAs typically address milestones, or deadlines to be met in order to reach commercial operation. Milestones allow both parties to track the project's development progress. If the PPA includes milestones, the wind project must meet pre-established development goals by a certain date or risk paying damages for the delay.

Events of default are situations where the action or inaction of one of the party jeopardizes the overall project. Events of default, such as "force majeure" (circumstances beyond anyone's control), are usually negotiated in the PPA as well.

Credit: The utility often requires investors to have some form of credit enhancement in place to cover expenses if the project does not meet its milestones, or is not commercially operational by the agreed upon date.

Insurance: Most PPAs require the project to have specific insurance policies.

Commissioning Process: A number of tests, certifications, permits, licenses, and protocols are typically required before a turbine, and its associated equipment, are ready for operation. These are typically outlined in the PPA.

*Information courtesy of Windustry

Community-Based Renewable Energy Pilot Program

In 2009, Maine established the Community-Based Renewable Energy Pilot Program to encourage locally owned, in-state renewable energy projects.[18]

Program Overview

Up to 50 MW of generating capacity is permitted under the program, with individual projects not to exceed 10 MW. Of the 50 MW limit, 10 MW must be reserved for projects under 100 kW, or projects located in the service territory of a community-owned utility (COU). Capacity limits within each utility service area are shown in the table below:

Utility Capacity Limits	
Central Maine Power	25 MW
Bangor Hydro	25 MW
Maine Public Service	4 MW
Projects in COU's* or less than 100 kw	10 MW

*COU's can enter into long term contracts at their discretion.

Financial Incentives

Program participants can choose one of two incentive options:

1. Long-Term Contracts

Eligible renewable energy resources will be offered long-term contracts (not to exceed 20 years) for the electricity they produce.

- ***For projects that are 1 MW to 10 MW in size***, the MPUC will conduct long-term contract solicitations. For these large generators, the average price for each contract year may not exceed $.10/kWh, or the cost of the project plus a reasonable rate of return on investment.
- ***For projects under 1 MW***, the contract price is set at $.10/kWh. Program participants must complete a standard contract developed by the MPUC entitled "Community-Based Renewable Energy Project Power Purchase Agreement," which is then presented to the appropriate utility along with the contract terms.

2. Renewable Energy Credit Multiplier

Renewable energy credits (REC) are the property rights to the environmental, social, and other non-power (external) qualities of a renewable resource. Each REC represents proof that 1 MW/h of electricity was produced from an eligible renewable energy resource. REC's may be sold, traded, or bartered, and the owner can claim to have purchased renewable energy.

If a participant chooses the REC multiplier incentive, the value of the RECs produced by the renewable energy project will be set at 150% the amount of electricity the project produces. Under this option, participants are responsible for negotiating their own transactions with the MPUC and appropriate utility.

→ For more information on RECs, please see the **Key Financial Incentives** section of this guidebook.

[18] More information on the program can be found at the MPUC website. Available: http://www.maine.gov/mpuc/electricity/community_pilot.shtml

Eligibility

To be eligible for incentives, an energy project must be:

- ✓ A renewable resource (qualifying resources include: wind, solar, fuel cell, tidal, geothermal, hydroelectric, certain biomass and landfill gas)
- ✓ 51% locally owned (qualifying owners include: individuals, municipalities, state agencies, federally recognized Indian tribes, and Maine-based nonprofits and businesses)
- ✓ Located in Maine
- ✓ Under 10 MW in size
- ✓ Connected to the grid (an interconnection agreement must be arranged prior to application)
- ✓ In service within 3 years (if the project ceases operation for six months or more, participation in the program will be terminated)

Additionally, any renewable energy project 100 kW or greater must provide documentation of support from the municipality in which the project is located.

Current Program Participants

As of January 2012, five projects totaling approximately 24 MW have been approved for this program (four wind projects and one anaerobic digester), shown in the table to the right.

The program is scheduled to expire on December 31st, 2015 and requires legislative action for an extension.

Current Program Participants	
Fox Islands Wind, LLC	4.5 MW
Jonesport Wind Power, LLC	4.5 MW
Lubec Wind Power, LLC	4.5 MW
Pisgah Mountain Wind, LLC	9 MW
Exeter Agri-Energy, LLC (anaerobic digester)	600 kW
Total	~24 MW

Petitions for Certification

Certification is required by Maine Public Utilities Commission (MPUC) and is determined in 90-days, unless the MPUC decides additional time is needed. Petitions for certification must include:

- ✓ Name, address, phone number and email address
- ✓ Location, or proposed location, of the project
- ✓ Description of project and fuel type, nameplate capacity, and interconnection point
- ✓ List of names and addresses of all owners of the project, percentage of ownership of each, and documentation that owners are qualifying local owners.
- ✓ Documentation of municipal resolution of support (except for projects under 100 kw, or if they will be entirely located in an unorganized or deorganized area)
- ✓ Documentation of tribal support, if applicable
- ✓ Documentation of applicant control over site
- ✓ Documentation of financial/technical capability and experience to develop the project
- ✓ Projected in-service date (within 3 years)
- ✓ Program incentive elected (RECs or long-term contract)

Fox Islands Wind on Vinalhaven Island is one project that took advantage of the Community-Based Renewable Energy Program (photo courtesy of MaineInsights)

Net Energy Billing

Net energy billing is an electricity policy available in Maine to owners of eligible small- to medium-sized wind projects that are connected to the grid (it also applies to other renewable energy facilities).[19] The policy clarifies the terms under which a wind developer can use the electricity generated by their project, and get credit for any excess generation sales to the grid.

Net Energy Billing: Program Overview	
System Capacity	IOU: 660 kW COU: 100 kW, voluntarily up to 660 kW
Net Excess Generation	Credited to customer's next bill at retail rate; granted to utility at the end of 12-month billing cycle
Shared Metering	IOU: required COU: voluntarily offered

Program Overview

Net energy billing measures the difference between electricity used and electricity sold by a renewable energy project. Under the program, if a project generates more electricity than the owner uses, the excess electricity is fed back into the grid, spinning the meter backwards. The amount of excess electricity produced, or "net excess generation" (NEG), is then credited to the following month's bill—at the retail rate—for up to 12 months.

At the end of the 12-month billing cycle, any remaining NEG is granted back to the utility—with no compensation to the user—and a new billing period begins. Net energy billing only applies to usage charges; transmission and distribution are still billed by the utility.

Net Energy Billing Application

In order to qualify for net energy billing, an application must be submitted to the appropriate transmission and distribution provider. Each utility has developed a standard contract and application, but shared net energy billing customers must include the following information to be eligible:

- ✓ **Customer Identities:** contact information for each shared ownership customer
- ✓ **Ownership Interest:** documentation showing legal ownership interests in the facility. Percentages must be "reasonable," but are at the owner's discretion.
- ✓ **Contact Person:** shared ownership partners must have one contact person that can communicate with the utility regarding the project and billing.
- ✓ **Accounts:** a list of accounts or meters (up to 10) that will be included in the net energy billing arrangement
- ✓ **Description of Facility:** including the facility's location, capacity, and fuel type or generating technology

If the utility company wishes to dispute the customers' eligibility for shared ownership, it must file a "Notice of Dispute" within 21 days of the submission of the application.

[19] More information is on the program can be found at the MPUC website under Electricity Rules > Chapter 313. Available: http://www.maine.gov/mpuc/legislative/rules/part3-electric.shtml

Recent amendments to net energy billing statutes have expanded the policy to include shared ownership. This allows up to 10 users with an ownership interest in a renewable energy facility to take advantage of net energy billing (i.e., multiple investors can pool together to develop larger, more cost-effective projects that benefit from economies of scale).

Another feature of this policy is that the renewable energy project does not need to be located in the same place as the customer, or customers. As long as the turbine is located in the same service territory as the owner(s), the project is eligible for net energy billing.

Eligibility

In Maine, all electric utilities—both investor-owned utilities (IOU's) and consumer-owned utilities (COU's)—are required to offer net energy billing to "eligible facilities." An eligible facility is one in which the energy generated offsets part or all of the customers' electricity requirements—*some of which must be on-site*.

Investor-Owned Utilities (IOU)
Central Maine Power Company
Bangor Hydro-Electric Company
Maine Public Service Company
Consumer-Owned Utilities (COU)
Eastern Maine Electric Cooperative
Houlton Water Company
Van Buren Light and Power District
Kennebunk Light and Power District
Madison Electric Works
Fox Island Electric Cooperative
Swans Island Electric Cooperative
Isle-Au-Haut Electric Power Company
Matinicus Plantation Electric Company
Monhegan Plantation Power District

IOU's are required to offer net energy billing to eligible facilities with capacity limits up to 660 kW, while COU's are required to offer net metering to eligible facilities up to 100 kW, but are authorized to offer net metering to facilities with capacity limits up to 660 kW at their discretion. Contract terms for both IOU's and COU's are limited to ten years.

For shared ownership scenarios, IOU's are required to offer net energy billing, while COU's may offer net energy billing at their discretion.

Interconnection Agreement

An interconnection agreement is required before applying for net energy billing. Interconnection agreements typically take 30 or more days to process and the procedures and costs vary based on the size of the project.

→See the **Transmission and Interconnection** section for more information

Key Financial Incentives

The two major incentives for wind development have traditionally been the Production Tax Credit (PTC) and accelerated depreciation. More recently, the American Recovery and Reinvestment Act (ARRA) of 2009 introduced another major incentive program, the Investment Tax Credit, which could be used in lieu of the PTC.

Due to a number of requirements written into these incentives, they are typically limited to corporate or institutional investors who have the ability to apply the tax credits against their business income. As a result, many financing models for community wind development have sought to obtain these benefits indirectly through creative partnerships with large corporate or institutional investors.

At the time of this writing, all three programs are scheduled to expire on December 31, 2012.

The Database of State Incentives for Renewables and Efficiency (DSIRE) website, www.dsireusa.org is an excellent resource for information and updates on both state and federal incentive programs for renewable energy. Much of the information contained in this section was found on this website.

Federal Incentives

Renewable Electricity Production Tax Credit (PTC)

The PTC is a credit against federal income tax liability, currently valued at 2.2 cents per kWh (adjusted for inflation) for the first ten years of production from a wind project.

First introduced in 1992, the PTC is a temporary incentive, and has been extended only in one- and two-year increments. On three separate occasions, it has even been allowed to expire. The short time horizon of the PTC has led to several "boom-and-bust" cycles in the wind industry.[20]

While the PTC is the primary financial policy tool for the wind industry, it is often difficult for community wind projects to use for several reasons:[21]

- To qualify for the PTC, the owners of a wind project must also operate the

[20] American Wind Energy Association, www.awea.org

[21] Environmental Law and Policy Center. 2009. Community Wind Financing. Available: http://elpc.org/wp-content/uploads/2009/11/ELPC-Community-Wind-Book-09.pdf

project and power must be sold to an unrelated third party.

- The PTC requires substantial tax liability to offset its credits; community wind projects are often non-profit and owe no taxes (i.e., a single megawatt of wind energy might generate $65,000 of tax credits per year, which is the equivalent of $185,000 or more in net income after deductions.[22]
- Except for the owner-operator, individual investors in a wind project can only offset "passive" forms of income, which does not include wage or investment portfolio income (examples of passive income are: earnings from a business that does not require active management, rent from a property, royalties, etc.).
- The credits themselves are not transferable independent of project ownership (i.e., a corporate or institutional investor must have an ownership stake in the project to receive tax credits).
- The value of the PTC is often reduced if a project accepts other forms of government aid, such as grants or subsidized financing.

Due to the substantial tax liability needed to take advantage of the PTC, and its many rules and regulations, it is typically limited to large-scale commercial wind farms.

[22] Northwest Sustainable Energy for Economic Development. Community Wind: An Oregon Guidebook. Available: http://www.nwseed.org/Educational%20Resources/publications/Guidebook/oregon_wind_guidebook.pdf

Investment Tax Credit (ITC):

The ITC was introduced in 2009 as part of the American Recovery and Reinvestment Act (ARRA). The program provides PTC eligible projects with two options:

1. To elect a 30% investment tax credit (ITC) for the total installed cost of the project in lieu of the PTC (*available for projects placed in service before December 31, 2012*).
2. To exchange the ITC for a cash grant of equal value (*expired in 2010*).

The ITC is often seen as a more practical incentive for community wind projects for several key reasons:

- Since the ITC is based on the size of investment rather than the energy produced, it favors projects with higher construction costs and below-average energy production. Community wind projects typically fall into this category.
- The ITC does not require the owner and operator to be the same entity, which allows for more creative financing models and ownership structures.
- The ITC does not require a project to sell its power to an unrelated party, which allows self-generation, or "behind-the-meter" projects to qualify.
- The ITC is easier to use in conjunction with other incentives and is less likely to trigger "anti-double-dipping" penalties.

The introduction of the ITC—in particular the cash grant—sparked a flurry of development activity due to its flexible requirements and limited availability.

Efforts are currently underway to renew the ITC along with the PTC. The ITC's cash grant option, however, is unlikely to be renewed since it was a generous incentive offered for a limited time under the Recovery Act. The ITC's fate will most likely be linked with that of the PTC (i.e., if the PTC is renewed the ITC will be too).

Accelerated Depreciation (or Modified Accelerated Cost-Recovery, MACRS)

Under the federal MACRS program, active investors (i.e., private investors, businesses) in a wind project may recover some of their investment through depreciation deductions that are greater than the standard "economic life" of the project would allow.

Most power generation assets depreciate for tax purposes over 20 years. With accelerated depreciation, most wind projects are eligible for depreciation benefits on a five-year schedule. Additionally, for 2012, certain wind projects may also be eligible for a "bonus deprecation" of 50% in the first year.

Similar to the PTC, accelerated depreciation has several constraining factors:

- It is difficult for most individuals to take advantage of this benefit due to the amount of depreciation a project can produce (a single 1.5 MW turbine might generate as much as $900,000 in depreciation in its second year of operation.[23]
- Investors can only use the depreciation tax benefit if they are actively involved in the project or have offsetting passive income.
- The depreciation benefits only apply to the part of the project that has been financed with equity.

New Markets Tax Credit (NMTC)[24]

The goal of the NMTC program is to spur revitalization efforts in low-income and impoverished communities across the United States. For the purposes of community wind, the program is another incentive mechanism that can be used to attract third-party investors to a project.

The program provides tax credit incentives to investors for a Qualified Equity Investment (QEI) in a certified Community Development Entity (CDE). The CDE then channels the investment into a qualifying low-income business—for a wind project, this could be an LLC established to own and operate the project within a NMTC-qualifying census tract.

Since NMTC's are once-removed from a wind project—the investment flows through a CDE—they are less likely to trigger penalties when used in conjunction with the PTC, ITC, or other grant programs.

Due to the level of complexity involved in structuring a NMTC transaction, the program has not been utilized to a great extent in the wind industry, and mostly applies to larger projects. Although the program was established in 2000, it has only recently been used to help finance a community wind project (a 6 MW project in Grayland, Washington built in 2010).

[23] Northwest Sustainable Energy for Economic Development. Community Wind: An Oregon Guidebook. Available: http://www.nwseed.org/Educational%20Resources/publications/Guidebook/oregon_wind_guidebook.pdf

[24] Bolinger, Mark. Ernest Orlando Lawrence Berkeley National Laboratory. January, 2011. Community Wind: Once Again Pushing the Envelope of Project Finance. Available: http://eetd.lbl.gov/EA/EMP/reports/lbnl-4193e.pdf

Nevertheless, should an appropriate opportunity present itself, the NMTC program could provide quite a bit of value.

USDA Rural Energy for America Program (REAP)

The REAP program promotes energy efficiency and renewable energy for agricultural producers and rural small businesses through the use of:

1. Grants and loans for energy efficiency improvements and renewable energy systems, and
2. Grants for energy audits and renewable energy development assistance.

The majority of REAP funding is dedicated to competitive grants and loan guarantees for the purchase of renewable energy systems or energy efficiency equipment. However, some funding is also available to conduct relevant feasibility studies. The maximum incentive for a REAP grant is 25% of the proposed project's cost, and a loan guarantee may not exceed $25 million—the combined amount of a grant and loan guarantee may not exceed 75% of the project's cost.

Renewable Energy Certificates (RECs, "Renewable Energy Credits," or "Green Tags")[25]

RECs represent the environmental and other non-power attributes of a renewable energy project and are sold separately from commodity electricity. Each REC represents proof that 1 megawatt-hour of electricity was generated from an eligible renewable energy resource (The certification process requires third-party verification performed by a certified auditor).

RECs are increasingly seen as the "currency" of renewable electricity and green power markets. They can be sold, traded, or bartered, and the owner can claim that renewable electricity was produced to meet the electricity demand they create

For many grid-tied community wind projects, selling the RECs generated by the project can be a valuable source of income. The price a renewable energy project receives on its RECs can depend on many factors, such as the location of the facility, the balance of supply and demand in the region, and the type of power created, among other factors.

Residential Renewable Energy Tax Credit

Under this program, a taxpayer may claim a credit of 30% of qualified expenditures for a system that serves a dwelling unit located in the United States that is owned and used as a residence by the taxpayer. The turbine must have a rated capacity of 100 kW or less and be in service on or before December 31, 2016.

Expenditures with respect to the equipment are treated as made when the installation is complete. Expenditures include labor costs for on-site preparation, assembly or original system installation, and for piping or wiring to interconnect the system to the home. If the federal tax credit exceeds tax liability, the excess amount may be carried forward to the succeeding taxable year until 2016. At this time, it is unclear whether the unused tax credit will be carried forward after 2016.

[25] More information on RECs can be found at the Environmental Protection Agency's website. Available: http://www.epa.gov/greenpower/gpmarket/rec.htm

Maine Incentives

Net Energy Billing

Net energy billing is an incentive policy available in Maine to owners of eligible small to medium sized wind energy projects or other renewable energy facilities. Under the program, if a project generates more electricity than is used, the excess electricity is fed back into the grid, spinning the meter backwards.

For more detailed information on this program (including eligibility requirements), please see the previous ***Net Energy Billing*** section of this guidebook.

Community-Based Renewable Energy Production Pilot Program

The Community-Based Renewable Energy Pilot Program is designed to encourage locally owned, in-state renewable energy projects. Under the program, eligible participants can choose one of two incentive options:

1. Long-term contracts, or
2. A Renewable Energy Credit (REC) Multiplier.

For more detailed information on this program (including eligibility requirements), please see the previous ***Community-Based Renewable Energy Production Pilot Program*** section of this guidebook.

Efficiency Maine Solar and Wind Energy Rebate Program[26]

Efficiency Maine provides rebates for eligible residential and commercial wind projects.

- The Residential Wind Energy incentive is $500 per 1,000 kWh projected annual production up to a maximum of $2,000.
- The Commercial Wind Energy incentive is $500 per 1,000 kWh projected annual production up to a maximum of $4,000.

To be eligible for the grant, a project needs to be in an area with a minimum available wind speed of class II (4.4 meters per second, or 9.8 miles per hour). The minimum tower height at the turbine hub must be 66 feet for class II wind, and 50 feet for Class III wind. The tip of the blade must be 30 feet above any structure or tree within 250 foot radius of the tower. And the projected energy savings must demonstrate cost effectiveness (cost effectiveness is defined as simple payback, which must be less than 20 years for a project to be eligible—Efficiency Maine provides a rubric for the simple payback calculation).

Before applying for the grant, the applicant is required to obtain a third party site assessment from a wind professional. Once an assessment has been performed, the applicant must reserve the rebate by submitting a rebate reservation form. If the system is installed within 120 days, the applicant can submit a rebate claim form, and the rebate check should be processed within six weeks.

[26] More information on this program can be found at Efficiency Maine's website. Available: http://www.efficiencymaine.com/renerenew-energy/wind

Efficiency Maine Competitive Program[27]

Efficiency Maine periodically issues a request for proposals (RFP) for large electrical efficiency and distributed generation projects.

The Competitive Program allows Maine business, institutions, and governments to compete for project funding for large electrical energy efficiency and distributed generation projects. Funding levels range from a minimum of $100,000 to a maximum of $500,000 per facility up to 50% of the total project costs.

Proposals are scored predominantly on cost effectiveness in reducing kilowatt-hour consumption; and management and resource adequacy and readiness. The most recent RFP was issued on February 1, 2012 and closed March 30, 2012.

[27] More information about the program can be found at Efficiency Maine's website. Available: http://www.efficiencymaine.com/at-work/business-programs/competitive-program

Financing Community Wind Projects

One of the greatest hurdles in developing a community wind project is obtaining financing. To successfully navigate this process, project developers must have a solid understanding of existing state and federal incentives, choose a financial structure that maximizes these benefits, and find a lender to take part in the project. Since this can be an incredibly complex process, it is essential to consult with a qualified tax and financial expert before proceeding down this path. *See* ***Section 4*** *for a list of qualified tax and financial experts.*

Equity and Debt

A project's equity is the amount of capital that is not borrowed, but invested directly into a project upfront. This may come from individual savings or from investment by members of a cooperative, partnership, or limited liability corporation (LLC). Many lenders require a minimum equity contribution of 30% of project costs. Since any size wind project is a significant expenditure, most projects require a loan from a bank or lending institution. Loan terms often vary, but are typically 10-15 years for conventional bank loans, and up to 20 years for bond financings.[28] The interest rate received on the loan is a critical component to project economics and can often make or break a project.

Loan Requirements

The following are examples of requirements a bank may request on a loan application (an actual loan application may require more or less documentation depending on the specific circumstances of the project):

- ✓ A detailed wind resource assessment
- ✓ A feasibility study by a consultant
- ✓ A financial pro forma (including commitments for equity, legal ownership structure, and plans for using state and federal incentives)
- ✓ Background information on majority owners
- ✓ All required contracts, permits and easements—or information on progress towards obtaining them
- ✓ A copy of the proposed power purchase agreement (PPA)
- ✓ An interconnection agreement
- ✓ Insurance coverage and turbine warranties
- ✓ Construction management plans
- ✓ An operations and maintenance (O&M) plan

Requirements for Financing

In Maine, most banks (local and regional) do not have experience financing wind projects. Accordingly, they may be reluctant to loan money to a project for which they do not have a firm understanding of the lending risks. The prospect of acquiring a loan may therefore depend on the size of the project, the size of the loan, the banker's familiarity with wind projects, and the risk aversion of the bank or lending institution.

Acknowledging the difficulty many wind projects have obtaining financing, some smaller turbine vendors (such as Xzeres Wind) have introduced customer finance programs that offer 100% financing for the

[28] Windustry. 2008. Community Wind Toolbox. Available: http://www.windustry.org/CommunityWindToolbox

cost of the turbine, including turnkey installation.

Additionally, some community wind projects have experimented with "crowd funding" websites, such as Kickstarter (www.kickstarter.com) to raise capital for their project. These websites can be a useful tool to attract online donors, especially through social media channels.

To launch a Kickstarter project, the project creator sets a funding goal and deadline. If the project succeeds in reaching its funding goal, each donors' credit card is charged when time expires. If the project falls short, no one is charged.

Financing Models of Community Wind[29]

Without the underlying constraints imposed by the PTC/ITC and accelerated depreciation—set to expire December 31, 2012almost any type of financial model could be used to fund a community wind project. However, In the event these incentives are renewed, or reinstated at a later date, the financial models commonly used to take advantage of them are included in the section below.

Cooperative LLC

In this model, local landowners and investors join to form a special purpose limited liability company (LLC) that owns and operates the project. Since the requirements of an LLC are relatively flexible and allow investors to direct tax benefits to the parties best able to use them, it is the preferred business structure for many wind projects.

In most cases, the local investors pool their equity capital, utilize any state or federal grants that are available, and borrow the remaining capital from local banks or other lending institutions. Depending on the "tax credit appetite" of the individual investors, the LLC may be able to realize some or all of the PTC and accelerated depreciation benefits.

A limiting factor of this structure is that individual investors must have a substantial tax liability gained elsewhere, and tax credits are typically limited to passive income. Additionally, LLC's have limits on the number of accredited and non-accredited investors. If the project has too many non-accredited investors, it will need to file with the Securities and Exchange Commission (SEC), which can substantially increase the complexity and costs of

Accredited Investor

An accredited investor is an individual or entity that meets one of the following criteria:

- A net worth (assets minus liabilities) individually or jointly with a spouse, of at least $1 million
- An individual income in excess of $200,000 or joint income with spouse in excess of $300,000
- A charitable organization, corporation, or partnership with assets exceeding $5 million

*Not a complete list. See the U.S. Securities and Exchange Commission website for more details.

[29] Bolinger, Mark, and Matthew Karcher. Renewable Energy Center at Saint Francis University. 2009. A Review of Feasible Financing Structures for Community Wind Projects in Pennsylvania. Available: http://www.francis.edu/uploadedFiles/Renewable_Energy_(new)/FinancingStructuresCommunityWind.pdf

arranging financing.

Strategic Investor Flip

Under this structure, local landowners and investors have little equity to bring to the project, so they partner with a third-party investor (typically a corporation, wind development company, utility, or other business). This third-party investor provides almost all (99%) of the equity and receives the same proportion of benefits in return—tax benefits and income from the project. The third-party investor owns the project for the first 10 to 12 years of the project's life in order to benefit from production tax credits. When the tax benefits run out and the investor's internal rate of return (IRR) has been reached, project ownership "flips" to the community partner for a negotiated amount. The community partner then claims the majority of the income from the project for the remainder of its useful life.

Institutional Investor Flip

This structure was developed to address some of the limitations of the Strategic Investor Flip; mainly, to provide a model for local developers who *have* capital to invest in a project, but lack the ability to make use of the tax benefits.

Similar to the previous structure, the Institutional Investor Flip also utilizes a third-party investor. However, the allocations of equity and tax benefits are different. With the Institutional Investor Flip, the local developer finances the initial upfront costs of the project (20-40% of the total) before partnering with a third-party investor.

Utilizing a rule in the federal tax code that allows partnerships to allocate income and tax benefits disproportionate to ownership interests, the third-party investor receives all of the tax benefits, while all initial income from the project flows to the local developer. Once the local developer's investment has been recovered, all income is transferred to the third-party investor until its targeted profit is obtained. At this point, income from the project typically flips back to the local developer, although the third-party investor may retain a minority ownership stake in the project.

Sale/Leaseback

With the passage of ARRA in 2009 and the ITC option, leasing became a viable financing structure for wind—*for projects that elected the ITC*. Unlike the PTC, the ITC does not require the owner and operator to be the same entity. This flexibility allowed for a variety of leasing options, the most common of which is known as the sale/leaseback structure.

In a sale/leaseback arrangement, the local developer builds the project and then sells it to a third-party investor (the lessor—typically a tax advantaged corporate investor). The third-party investor then leases the project back to the local developer under a long-term lease.

The local developer is responsible for operating and maintaining the project, and is entitled to use or sell the power it generates. However, the local developer must also make recurring lease payments to the third-party investor. These payments are of a fixed amount, and must be made regardless of how well the project performs. As the owner of the project, the third-party investor receives both the lease payments, and the tax benefits the project generates. If the project is still operational at the end of the lease agreement, the local developer has the option to buy out the third-party investor for the project's fair market value.

Public Sector Structures

The tax exempt status of public entities makes financing community wind projects particularly challenging. Being tax-exempt, public sector projects cannot effectively use the primary tax incentives available to private sector projects: the PTC/ITC and Accelerated Depreciation.

The most common form of raising capital for public sector projects is through the issuance of bonds. The municipality (or tax-exempt government entity), typically hosts the project and finances most of it through low-interest, long-term bonds. The interest income received by the holders of the bonds is then exempt from the federal income tax and from the income tax of the state in which they are issued.

Municipal bonds typically fall into one of two categories:

1. General obligation bonds, backed by the full taxing authority of the municipality, or
2. Revenue bonds, backed solely by the revenue generated from the project (or saved in the case of a behind-the-meter project)

Hull, Massachusetts is one of the earliest and most successful examples of a municipal wind project (photo courtesy of Wicked Local)

Other Ownership Options

The previously mentioned financial models and ownership structures assume the local developer takes the primary leadership role in the project. However, two other options are available that allow a landowner, or public entity, to take advantage of a professional wind developer's expertise and interest in an area.

Land Leasing

If a landowner has a desirable property suitable for wind development, they may be able to enter into a lease or easement agreement with a commercial wind developer.

Under this arrangement, the landowner signs an agreement granting the developer the right to use their land for wind development, and in return, the landowner receives compensation from the developer. The developer typically owns any turbines that are installed, and is responsible for all the operations and management of the project.

Wind leases and easements are complex and binding legal documents. It is important to seek out experienced legal help before negotiating any agreement with a developer.

Piggybacking

Although somewhat rare, there have been instances where a municipality (or other community group) “piggybacks” onto a commercial-scale wind project.

The most well-known example of this model occurred in Lamar, Colorado.[30] In 2004, two municipal utilities—the Lamar Light and Power Company, and the Arkansas River Power Authority—were able to time their wind projects to coincide with a much larger 162 MW development known as Colorado Green.

In doing so, the utilities were able to benefit from the economy of scale of the larger project, and purchase their turbines at a bulk rate—three 1.5 MW turbines for the Lamar Light and Power Company, and one 1.5 MW turbine for the Arkansas River Power Authority. Additionally, the utilities were also able to coordinate with the Colorado Green project to reduce their development, construction, and operations and management costs.

The Piggyback model is an effective way for a community to develop a wind project at a reduced rate, and with less responsibility. However, it is also requires that a commercial-scale wind developer is interested in the area, which is not always the case.

[30] Flowers, Larry. 2009. Community Wind Case Studies. National Wind Technology Center, NREL. Powerpoint presentation. Available: http://www.windpoweringamerica.gov/pdfs/community_wind/case_studies.pdf

Wind Turbine Procurement

To select the best possible turbine(s) for a wind energy project, the turbine(s) must meet the project's needs for price, size, wind resource, climate, reliability, warranty, and availability.

Availability

Under ideal circumstances, turbines would be purchased based on site-specific factors detailed further below. However, in recent years faster than expected growth in the wind industry has led to occasional bottlenecks in turbine supply. In 2008, most turbine manufacturers had waiting lists up to a year and a half long.[31] As a result, wind turbines are often chosen based on availability rather than site-specific needs and conditions. To avoid this situation, it is important to check with an expert early on to see if availability is a concern. If so, make turbine selection a priority and place an order as soon as financing is secured.

Price

As a general rule of thumb, wind turbines under 100 kW cost roughly $3,000-$5,000 per kilowatt of capacity. A 10 kW wind turbine typically costs somewhere in the range of $30,000-$50,000.[32] However, the price of the turbine alone is just one component of the overall cost of the project. Total costs will vary based on a host of site-specific factors, such as the cost of the wind resource assessment, freight, construction, permitting, interconnection studies, maintenance, and financing among others.

Additionally, most turbine manufacturers require a 10-25% down payment and a letter of credit before they will accept an order. Before negotiations take place, the manufacturer may also want to know some basic information about the project, such as the size and location of the project, the quality of the wind resource, the site layout and the interconnection plan.

→For more information on project costs and economics, see the **Economic Analysis** section earlier in this Guidebook.

Size

A wind energy project's size is largely influenced by the amount of available land; the wind resource; the financing available for the project; the ability of the grid to handle additional energy from the project without significant upgrades; and local, state or federal policies that affect the project's return on investment.

Ultimately, the key determinant for the size of a project is economics. Turbine size should be factored around obtaining the best possible return on investment given the various constraints associated with the project

In Maine, several state policies can influence the size of community wind projects. For instance, if the intention of the

[31] Citizens Energy Wind Development. Available: http://www.citizensenergy.com/english/pages/25/wind-development

[32] Windustry. 2008. Community Wind Toolbox. Available: http://www.windustry.org/CommunityWindToolbox

project is to utilize the net energy billing policy, the turbine can be no larger than 660 kW. Additionally, Maine's permitting requirements vary based on size—projects under 100 kW are not subject to state or local permitting requirements, while projects over 100 kW are subject to more stringent permitting requirements.

Wind Resource

Wind turbines are designed for specific wind speeds and conditions. For example, turbines designed for low wind areas may have two generators (one which operates at lower wind speeds), or use longer blades to maximize their swept area and energy production. Turbines designed for high wind areas, on the other hand, often have larger nameplate generator ratings and smaller rotors.

For especially turbulent or gusty conditions, a wind turbine may need additional features. For example, turbines with controlled pitch blades perform well in gusty areas since the blades can respond quickly to changes in wind speed and reduce the overall burden on the generator. Turbines located in especially turbulent areas may require generators that allow for "slip" (variation in rotor speed) to compensate for rapidly changing wind speeds.[33]

Climate

Manufacturers also make versions of their turbines designed for specific climates and weather conditions. For instance, some turbine models are made to handle colder, winter climates where icing is more frequent, and some have special features that allow them to be more compatible with marine environments. Both features may be applicable for many locations in Maine.

Reliability

A turbine that is underperforming or frequently breaking down will quickly cut into the project's bottom line. It is therefore essential to choose a turbine that has a good track record in the field and a manufacturer with a reputation for quality equipment and service. The easiest way to do this is to seek advice from wind experts, and other wind developers in the region to learn about their experiences with various turbine models and manufacturers.

Another factor to consider when selecting a wind turbine is the proximity of the service team qualified to work on the turbine. If the manufacturer has a trained service team in close proximity, the operations and maintenance costs for the project will be significantly reduced.

Warranty

The majority of turbine manufacturers offer a standard two-year parts and labor warranty. These warranties address major design and manufacturing defects, and provide replacement parts and labor. Some warranties may even include some form of energy production warranty that ensures

[33] Northwest Sustainable Energy for Economic Development. Community Wind: An Oregon Guidebook. Available: http://www.nwseed.org/Educational%20Resources/publications/Guidebook/oregon_wind_guidebook.pdf

the turbine will perform as advertised given the conditions at the site—these warranties may be difficult to arrange for smaller projects. Most manufacturers will extend their warranties to five-years for an additional cost, and occasionally the lending institution may require a warranty extension before agreeing to finance the project.

Since a warranty will only cover the first two to five years of the project, it is advisable to create a contingency fund for repairs at the onset of the project. When the warranty expires, the contingency fund will ensure there are adequate resources to pay for scheduled, or unscheduled, repairs.

→For a list of turbine manufacturers serving the New England region, please see **Section 4** of this guidebook.

Construction

Once all the essential project elements are in place, the construction of the wind turbine(s) can begin. Installing any size turbine is a major operation and will require the expertise of a qualified construction company. in Maine, a number of construction companies have experience managing wind turbine installations and are more than capable of completing the job—*please see* ***Section 4*** *of this guidebook for a list of qualified construction companies*. Ideally, it will be possible to hire one of these firms.

Choosing a Construction Company

The construction company is a critical component of the project, responsible for overseeing the installation of the turbine and operating within the budget and schedule constraints of the project.

Before selecting a construction company, it helps to do background research. Investigate potential companies online to get a better sense of their experience with such projects. If possible, talk with other wind developers in Maine to find out which companies they use, and which companies they feel are most competent. The turbine manufacturer may also be a valuable source of information; some manufacturers even provide turn-key installation services themselves.

Once this is done, solicit estimates, evaluate the options, and choose the company that best fits the needs of the project. Work with the company to develop a detailed construction plan and execute a construction contract. To reduce the risks associated with construction delays, develop a contract that includes completion dates and penalties.

Tasks Associated with Construction

The following tasks are commonly associated with the construction of wind energy projects:

- ✓ Initial site preparation
- ✓ Grading and road improvements/construction
- ✓ Trenching, cable-laying, and transformer installation
- ✓ Foundation and crane pad construction
- ✓ Fencing and erosion-control projects
- ✓ Turbine and tower transportation
- ✓ Turbine and tower installation
- ✓ Interconnection
- ✓ Testing and Commissioning
- ✓ Site restoration
- ✓ Inspections completion

Once all safety tests have been performed, the project is ready to go online.

Notify the Public

Before construction begins, it is appropriate to notify the community and surrounding landowners that construction will be taking place. Good preparation by local officials and advance information to residents about what to expect can go a long way towards generating good will for the project.

Operations and Maintenance

Once the wind project is operational, it must be properly maintained to maximize its output. If the turbine(s) is under-performing, or breaks down frequently, it will significantly reduce the project's lifespan and overall return on investment.

Warranty

Periodic maintenance begins as soon as the project is operational. Most turbine vendors offer two to five year warranties and provide operations and maintenance (O&M) services while the project is under warranty. During this time, the vendor's service team will follow a specific maintenance schedule to meet the requirements of the warranty.

Post-Warranty

Once the warranty has expired, it is usually necessary to enter into a long-term contract with a third party firm that specializes in turbine maintenance. Some vendor's may extend the warranty period for a fee, or provide their own long-term contract; however, this is not standard practice across the wind industry.

Before entering into a long-term contract, consider where the service provider is located. Ideally, the provider is nearby, as this will reduce the cost of travel and allow technicians to be available for unscheduled maintenance. If there are other wind projects in close proximity, find out which provider they use and determine if it is possible to hire the same service team.

Other Operating Costs

In addition to maintenance, operating costs also include warranties, administrative fees, insurance, a contingency fund for decommissioning costs or any unforeseen problems, and property taxes. Most literature on the subject suggests that taken together, the tasks associated with O&M of a wind project account for approximately 4 to 5% of total project costs.

Decommissioning or Repowering

Permits sometimes require assurances that funds be available for decommissioning. Assurances can take the form of a bond, corporate guarantee, letter of credit, or reserve fund. Once the turbine infrastructure has been removed, the site must be restored back to its original state. An alternative to decommissioning is repowering (this happened in Hull, Massachusetts when the community rallied to replace their circa-1980's 40 kW turbine with a 660 kW turbine in 2001).

Repowering a project is not a simple task however. It involves the replacement of the old turbine and foundation, removal of outdated equipment, permit revision, new financing, negotiation of a new power purchase agreement, and a number of other tasks.

Section 3:

Community Wind Projects in Maine and Massachusetts

Examples of Community Wind Projects in Maine

Location: Pittsfield Recycling Facility, Pittsfield, Maine
Owner: Town of Pittsfield
Size: 10 kW Bergey wind turbine
Funding: $50,000 grant from the Voluntary Renewable Resource Fund at Efficiency Maine
Status: Operating

The electricity generated by the wind turbine is used directly on-site at the recycling/transfer station and also provides excess power back into the grid (net energy billing). This saves money for the town in the form of reduced (town and school building) electricity bills.

*Photo and information courtesy of the Town of Pittsfield

Location: University of Maine at Presque Isle (UMPI) Campus, Presque isle, Maine
Owner: The University of Maine system
Size: 600 kW Vestaas RRB PS-600
Funding: $50,000 grant from the Voluntary Renewable Resource Fund at Efficiency Maine; Rebuild America grant from Efficiency Maine (no longer available; campus reserves
Status: Operating

The 700,000 kWh per year generated is used to power the UMPI campus. The UMPI turbine is the largest project in Maine to use net energy billing. It saves more than $100,000 per year in electricity costs. The University has incorporated aspects of the wind project into its curriculums and Northern Maine Community College (NMCC) uses the wind turbine as an instructional tool for its wind technology program.

*Photo and information courtesy of the University of Maine at Presque Isle

Location: Vinalhaven, Fox Islands, Maine
Owner: Fox Islands Wind, LLC (created by Fox Island Electric Coop, FIEC)
Size: 4.5 MW (three General Electric 1.5 mw wind turbines)
Funding: Private third party investment; the Island Institute, and other foundation funding; own reserves
Status: Operating

The roughly 11,605 MWh per year generated is enough to meet the needs of the residents of the Fox Islands (the islands of Vinalhaven and North Haven), who are served by the FIEC. In the first year of operations, the project reduced the FIEC's electric rates by 27%.

*Photo and information courtesy of Fox Islands Wind

Location: Historic Pittston Farm, Pittston Academy Grant Township, Maine
Owner: Historic Pittston Farm
Size: 20 kW (two 10 kw Bergey turbines); photovoltaic system
Funding: $325,000 loan from Machias Savings Bank in Bangor, Maine, backed by the Small Business Administration
Status: Operating

Located in a remote, “off-the-grid” area of Northern Maine, Historic Pittston Farm had always relied on a diesel generator to power its operations –at a rate of 48 gallons per day. With the price of diesel fuel increasingly on the rise, energy costs were threatening the overall profitability of the Farm. To avoid these costs, the Farm’s owners decided to invest in a combined wind- and solar-energy system. Two, 10-kw turbines and a photovoltaic system with 80 batteries and 60 solar panels now generate approximately 75% of the energy needed to run the four-season Pittston Farm lodge and restaurant. The combined system is estimated to pay for itself within five to seven years.

*Photo and information courtesy of Historic Pittston Farm

Location: Millstream Heights Apartments, Winter Harbor, Maine
Owner: Millstream Heights Apartments
Size: 10 kW Bergey Turbine
Funding: $64,536 (total cost) funded by a Federal Residential Energy Assistance Challenge (REACH) grant; joint project between MaineHousng, Efficiency Maine, Washington-Hancock Community Agency (WHCA), and the town of Winter Harbor
Status: Operating

In 2007, a 100 foot, 10 kW wind turbine was installed to provide power for the community building at Millstream Heights, a subsidized elderly housing complex in Winter Harbor. The building houses both the laundry –which typically uses significant energy—and the community room. The turbine will reduce energy costs for the tenants, for whom 90% are on a fixed income.

*Photo and information courtesy of Wind Powering America

Location: Camden Hills Regional High School (CHRHS), Camden, Maine
Owner: Camden Hills Regional High School
Size: 100 kW (Northwind 100)
Funding: $500,000 raised by Camden High Students
Status: Planned

This project is the culmination of eight-years of work by a student-led group called the “Windplanners.” The student group gathered site data, researched wind feasibility, coordinated with town officials to change local ordinances, attended and testified at PUC hearings, and raised the $500,000 needed to purchase and install the turbine. A groundbreaking ceremony was held in January, 2012, and the turbine is expected to begin generating electricity by March 31, 2012.

*Photo courtesy of Bangor Daily News
**Information courtesy of the Windplanners at CHRHS

Examples of Community Wind Projects in Massachusetts

Location: Hull Municipal Light Plant, Hull, Massachusetts
Size: 660 kW Vestas, and 1.8 MW Vestas
Owner: Hull Municipal Light Plant
Funding: Production Tax Credit (PTC), Renewable Energy Production Incentive: (REPI), Renewable Energy Credits (RECs)
Status: Operating

Located on a peninsula just 10 miles from Boston, Hull installed its first wind turbine in the mid-1980s, an 80-foot, 40 kW turbine that reduced the Hull High School's electric bill by close to 30 percent. When the turbine was no longer performing at its best, the town installed a 660 kW turbine in 2001 (referred to as Hull Wind 1). The turbine was so successful the town decided to install a second, and larger 1.8 MW turbine in 2006 (Hull Wind 2) on an old landfill site. It is estimated the two turbines save the town $680,000 in energy costs per year, and offset the town's power needs by roughly 10-13 percent (enough to power about 1,100 homes and the town's traffic and street lights).

Based on the success of the first two wind turbines, the town is now considering installing a set of four turbines offshore, with total rated power to be roughly 15 MW.

*Photos courtesy of: www.hullwind.org and Google Maps
**Information courtesy of www.hullwind.org, and Spark Magazine

Location: John J. McGlynn Elementary and Middle School, Medford, Massachusetts
Size: 100 kW Northern Power turbine
Owner: City of Medford
Funding: Massachusetts Technology Collaborative ($250k grant), 2008 Massachusetts Energy Bill ($200k appropriation), Massachusetts Energy Consumers Alliance ($100k grant), ongoing matching grant funds through Massachusetts Technology Collaborative Clean Energy Choice Program.
Status: Operating

In 2009, the City of Medford commissioned a 100 kW wind turbine at the John J. McGlynn Elementary and Middle School. The turbine offsets approximately 10 percent of the school's energy requirements, and saves the town about $25,000 a year. The turbine will also be used as an educational tool for the entire Medford school system. A renewable energy curriculum—which will include real-time data on wind speed and energy output from the school's turbine—is being developed. Total cost for the project was $644,000.

*Photo courtesy of Martin LaMonica
**Information courtesy of Massachusetts Office of Energy and C/Net

Location: Princeton Municipal Light Department PMLD, Princeton, Massachusetts
Size: 3 MW (two 1.5 MW Fuhrlander turbines)
Owner: Princeton Municipal Light Department
Funding: Renewable Energy Credits (REC), Renewable Energy Portfolio Incentive (REPI, *no longer available*)
Status: Operating

The Princeton Municipal Light Department commissioned two 1.5 MW turbines in January 2010. The turbines were expected to produce close to 40% of the town's annual energy requirements, but actual generation is better than predicted; the turbines produce 9,000 MWh of electricity, which covers 43-49% of Princeton's annual energy requirements. Total cost for the project was $7.3 million.

*Photo courtesy of www.windwatch.org
**Information courtesy of Portland Municipal Light Department

Community Wind Projects in Massachusetts				
Owner/Advocate	**City/Town**	**Capacity (kW)**	**# of Turbines**	**Installed**
Town of Ipswich	Ipswich	1600	1	2011
Berkshire Wind Power	Hancock	15000	10	2011
Mount Wachusett Community College	Gardner	3300	2	2011
Berkshire East Ski Resort	Charlemont	900	1	2011
Barnstable Wastewater Treatment Plant	Barnstable	200	1	2010
Nantucket High School	Nantucket	100	1	2010
Narragansett Regional Middle-High School	Templeton	1650	1	2010
Notus Clean Energy, LLC	Falmouth	1650	1	2010
Mount Saint Mary's	Wrentham	100	1	2009
Falmouth Wastewater	Falmouth	1650	1	2009
Princeton MLP	Princeton	3000	2	2009
Air Force Center for Engineering and the Environment	Bourne	1500	1	2009
MWRA-Deer Island	Boston	1200	2	2009
Woods Hole Research Center	Woods Hole	100	1	2009
Bartlett's Ocean View Farm	Nantucket	250	1	2009
Mark Richey Woodworking	Newburyport	600	1	2009
City of Medford	Medford	100	1	2009
Nature's Classroom	Charlton	100	1	2009
Williams Stone	Otis	600	1	2009
Forbes Park	Chelsea	600	1	2008
Holy Name Central Catholic School	Worcester	600	1	2008
Hyannis Country Garden	Hyannis	100	1	2008
Jiminy Peak Mountain Resort	Hancock	1500	1	2007
Massachusetts Maritime Academy	Bourne	660	1	2006
Town of Hull 2	Hull	1800	1	2006
IBEW 103	Boston	100	1	2005
Town of Hull 1	Hull	660	1	2001
Totals		39620	40	

Section 4:

New England Based Community Wind Resources

New England Based Community Wind Resources

Wind Manufacturers / Installers / Servicers / Developers										
Company	**Manufacturer**	**Site/Wind Assessment**	**Permitting/Engineering**	**Financial Services**	**Installation/Construction**	**Transportation/Logistics**	**Servicing/Repair**	**Developer**	**Turbine Sizes Offered**	**Location(s) / Website**
Aeronautica Windpower	X	X	X	X	X		X		225kw, 750kw	Plymouth, Massachusetts www.AeronauticaWind.com
Bergey Windpower	X								1kw to 10kw	Oklahoma www.bergey.com
Broadwind Energy							X			Naperville, Illinois www.bwen.com
CCB, Inc.					X					Westbrook, Maine www.ccb-inc.com
Cianbro Corporation					X	X				Pittsfield, Maine www.cianbro.com
Citizens Energy Corp.		X	X	X	X			X		Boston, Massachusetts www.citizensenergy.com
The Cote Corporation					X					Auburn, Maine www.cotecrane.com
DeWind	X								600kw, 1.25mw, 2mw	Germany / Numerous U.S. offices www.dwindco.com
EAPC Wind Energy		X	X	X	X					Norwich, Vermont www.eapc.net/wind
Endless Energy Corp.								X		Jamestown, Rhode Island www.endlessenergy.com
Endurance Wind Power	X								5kw, 35kw, 50kw	England / Assembled in Canada www.endurancewindpower.com
First Wind								X		Boston, Massachusetts www.firstwind.com
Fox Islands Electric Cooperative								X		Vinalhaven, Maine www.foxislands.net
Fuhrlaender	X								250kw, 600kw, 1.25mw, 1.5mw, 2.5mw	Germany / New York (Lorax Energy) www.lorax-energy.com
Gamesa Eolica	X								850kw, 2mw	Spain / Pennsylvania www.gamesacorp.com/en
GE Wind Energy	X								1.5mw, 2.3mw, 2.5mw, 3.6mw	Georgia www.ge-energy.com/wind
Independence Wind, LLC								X		Brunswick, Maine www.independencewindpower.com
Juwi Wind, LLC		X		X			X			Boulder, Colorado www.juwi-usa.com
KEAN Project Engineering, Inc.					X		X			Turner, Maine www.keanengineering.com
Maine Drilling and Blasting					X					Gardiner, Maine www.mdandb.com
Mittsubishi	X								240kw to 2.4mw	Japan / Florida, California www.mpshq.com
Next Generation Power Systems	X								44kw	Pipestone, Minnesota www.ngpowersystems.com
Nordic Windpower	X								1mw	Berkeley, California www.nordicwindpower.com

Wind Manufacturers / Installers / Servicers / Developers										
Company	Manufacturer	Site/Wind Assessment	Permitting/Engineering	Financial Services	Installation/Construction	Transportation/Logistics	Servicing/Repair	Developer	Turbine Sizes Offered	Location(s) / Website
Northern Power Systems	X						X		100kw	Barre, Vermont www.northernpower.com
Patriot Renewables, LLC								X		Quincy, Massachusetts, www.patriotrenewables.com
Progressive Rail Specialized Logistics						X				Lakeville, Minnesota www.prorailspecialized.com
Reed and Reed, Inc.					X	X				Woolwich, Maine www.reed-reed.com/5/5i.asp
ReDriven Power, Inc.	X				?		X		6kw, 12kw, 25kw, 55kw	Ontario, Canada www.redriven.ca
Sargent Corporation					X					Stillwater / Bangor, Maine www.sargent-corp.com
Seaforth Energy	X	X	X	X	X		X	X	50kw	Nova Scotia, Canada http://seaforthenergy.com
SGC Engineering						X				Westbrook, Maine www.sgceng.com
Siemens	X								250kw, 400kw, 1.3mw, 2.3mw, 3.6mw	Denmark / Numerous U.S. offices www.energy.siemens.com
Sprague Energy Corp.						X				Portsmouth, New Hampshire www.spragueenergy.com
Southwest Windpower	X								400w, 900w, 1kw, 1.8kw	Arizona www.windenergy.com
Sustainable Energy Developments (SED)		X	X	X	X		X	X	750kw, 2mw, 2.5mw, 3mw	Ontario, NY http://sed-net.com
Talco Electronics	X				X				Wholesale Distributor	San Diego, California www.talco.com
Terrence J. DeWan and Associates		X								Yarmouth, Maine www.tjda.net
Tetra Tech		X	X		X					Portland, Maine www.tetratech.com
Thomas Dicenzo, Inc.					X	X				Calais / Herman, Maine www.tdicenzo.com
TransCanada								X		Alberta, Canada www.transcanada.com
Unison Co., Ltd.	X								10kw	Korea / Golden, Colorado http://www.unison.co.kr
Ventera Energy	X								275kw, 1mw	Duluth, Minnesota www.venteraenergy.com
Vergnet	X								850kw, 1.65mw, 1.8mw, 2mw, 2.75mw, 3mw, 4.5mw	Cambridge, MA / France www.vergnet.com
Vestas	X								2.5kw, 80kw, 250kw	Denmark / California www.vestas.com
VFG Energy Systems	X								7.5kw	Kittery, Maine www.vfgenergysystems.com
Wind Energy Solutions (WES)	X								10kw, 12.5kw, 15kw, 17.5kw, 20kw	Ontario, Canada www.windenergysolutions.ca
Windsine, Inc.					X		X			Westhampton, New York www.windsine.org
Wind Turbine Industries, Corp.	X								2.5kw, 10kw	Minnesota www.windturbine.net
Xzeres Wind	X	X	X	X	X		X		2.5kw, 10kw	Wilsonville, Oregon www.xzeres.com

Wind Related Businesses / Organizations Serving New England										
Company	**Env. Consulting**	**Eng. Services**	**Project Mgmt.**	**Financial Services**	**Insurance**	**Legal**	**Consulting**	**Grantwriting**	**Location(s)**	**Phone / Website**
Allen Insurance and Financial				X	X				Camden, Rockland, SW Harbor, Maine	1-800-439-4311 www.alleninsuranceandfinancial.com
Amec	X	X	X						Portland, Maine	207-879-4222 www.amec.com
Baker, Newman, Noyes				X			X		Portland, Maine	207-879-2100 www.bnncpa.com
Barton & Gingold Comm. Mgmt.							X		Portland, Maine	207-774-2458 www.bartongingold.com
Bernstein Shur						X			Portland, Maine	207-228-7312 www.bernsteinshur.com
Bill Bayreuther								X	Readfield, Maine	207-242-6029 www.billbayreuther.com
Boreas Renewables, LLC			X	X			X		Somerville, Massachusetts	www.boreasrenewables.com
CES, Inc.	X	X							Brewer, Machias, Bar Harbor, Presque Isle, Topsham	207-989-4824 (Brewer) www.ces-maine.com
CLD Consulting Engineers, Inc.	X	X							York, Maine	207-363-0669 www.cldengineers.com
Coastal Enterprises Inc. (CEI)				X			X	X	Portland / Wiscassett, Maine	207-882-7552 www.ceimaine.org
Community Energy Partners			X	X			X	X	Freeport, Maine	207-221-5639 www.communityenergypartners.com
Cushman and Wakefield of MA, Inc.							X		Boston, Massachusetts	617-330-6966 www.cushwake.com
Eaton Peabody				X		X	X		Augusta, Maine	207-622-9820 www.eatonpeabody.com
Ed Holt and Associates, Inc.							X		Harpswell, Maine	207-798-4588
Eliot Field Law Office						X			Wiscasset, Maine	207-882-9446 www.fieldlaw.us
Enercon Technologies		X							Gray, Maine	207-657-7000 www.enercontechnologies.com
Energy Options, LLC							X	X	Wayne, Maine	207-685-3173 www.ecg-llc.com
GEI Consultants, Inc.	X	X							Portland, Maine	207-797-8901 www.geiconsultants.com
Greater Portland Council of Gov'ts							X	X	Portland, Maine	207-774-9891 www.gpcog.org
HDR/DTA	X	X							Portland, Maine	207-775-4495 www.devinetarbell.com
Heliotropic Technologies							X	X	Boothbay Harbor, Maine	207-633- 1061 www.heliotropictech.com
HMMH Consulting	X								Burlington, Massachusetts	781-229-0707 www.hmmh.com

Wind Related Businesses / Organizations Serving New England										
Company	Env. Consulting	Eng. Services	Project Mgmt.	Financial Services	Insurance	Legal	Consulting	Grantwriting	Location(s)	Phone / Website
Hughes Engineering and Controls		X							Freeport, Maine	207-865-0522
The Island Institute				X			X	X	Rockland, Maine	207-594-9209 www.islandinstitute.org
James W. Sewall Company	X	X							Old Town, Maine	207-827-4456 www.sewall.com
Juwi Wind, LLC			X	X					Boulder, Colorado	216-538-5420 www.juwi-usa.com
KEMA, Inc.	X	X	X	X		X	X		Burlington, Massachusetts	1-781-273-5700 www.kema.com
Kleinschmidt	X	X							Pittsfield, Maine	207-487-3328 www.kleinschmidtusa.com
Larkin Enterprises, Inc.		X	X						Lincoln, Maine	207-794-8700 www.larkinent.com
Main(e) International Consulting, LLC							X		Bremen, Maine	207 529 2291 www.maine-intl-consulting.com
NBT Solutions, LLC	X								Portland, Maine	1-866-446-5039 www.nbtsolutions.com
Normandeau Associates, Inc.	X								Falmouth, Maine	207-797-7717 www.normandeau.com
Norton Insurance and Financial Services				X	X				Cumberland Foreside, Maine	207-829-3450 www.nortoninsurance.com
Partners Creating Wealth							X		South Portland, Maine	207-409-7576 www.partnerscreatingwealth.com
Pierce Atwood				X		X	X		Portland, Maine	207-791-1100 www.pierceatwood.com
RLC Engineering		X							Hallowell, Maine	207-621-1077 www.rlc-eng.com
Roaring Brook Consultants, Inc.		X							South Berwick, Maine	1-877-722-2643 www.roaringbrook.com
Sebago Technics, Inc	X	X							Lewiston / Westbrook Maine	Lew. 207-783-5655 / West. 207-856-0277 www.sebagotechnics.com
SGC Engineering, LLC	X	X	X						Westbrook, Maine	207-866-6561 www.sgceng.com
Stantec	X	X							Topsham / Scarborough, Maine	Tops. 207-729-1199 / Scar. 207-883-3284 www.stantec.com
S.W. Cole Engineering, Inc.	X	X							Maine / New Hampshire	207-848-5714 http://www.swcole.com
Terracon Consultants	X	X							Scarborough, Maine	207-396-5374 www.terracon.com
Tetra Tech	X	X	X						Portland, Maine	207-879-9496 www.tetratech.com
TRC	X	X	X						South Portland, Maine	207-620-6626 www.trcsolutions.com
United Insurance Bradish-Young Agency					X				Falmouth, Maine	207-781-3519 www.unitedinsurance.net
Verrill Dana				X	X	X			Portland, Maine	207-774-4000 www.verrilldana.com/energy

National / State Web Resources and Trade Associations	
Organization	**Website**
Alliance for Renewable Energy	www.allianceforrenewableenergy.org
American Wind Energy Association (AWEA)	www.awea.org
The Database of State Incentives for Renewable Energy (DSIRE)	www.dsireusa.org
Distributed Wind Energy Association (DWEA)	www.distributedwind.org
Efficiency Maine	www.efficiencymaine.com
Energy Information Administration (EIA)	www.eia.gov
Environmental and Energy Technology Council of Maine (E2 Tech)	www.e2tech.org
Environmental Law and Policy Center	www.elpc.org
Green Energy Maine	www.greenenergymaine.com
The Green Power Network (Department of Energy)	http://apps3.eere.energy.gov/greenpower
ISO New England	www.iso-ne.com
Maine Department of Economic and Community Development	www.maine.gov/decd
Maine Insights	www.maineinsights.com
Maine Office of Energy Independence and Security (MOEIS)	www.maine.gov/oeis
Maine Public Utilities Commission (MPUC)	www.maine.gov/mpuc
Maine Renewable Energy Association (MREA)	www.renewablemaine.org
Maine Technology Institute (MTI)	www.mainetechnology.org
Maine Windependence	www.mainewindependence.org
Maine Wind Industry Initiative (MWII)	www.mainewindindustry.com
Massachusetts Clean Energy Center (MCEC)	www.masscec.com
Massachusetts Office of Energy and Environmental Affairs	www.massgov/eea
National Renewable Energy Laboratory (NREL)	www.nrel.gov
National Resource Council of Maine (NRCM)	www.nrcm.org
New England Power Generators Association (NEPGA)	www.nepga.org
Northwest SEED	www.nwseed.org
New York State Energy Research and Development Authority (NYSERDA)	www.nyserda.ny.gov
Northern Maine Development Commission	www.nmdc.org
Renew New England	www.renewnewengland.com

National / State Web Resources and Trade Associations	
Organization	**Website**
Renewable Energy Policy Project (REPP)	www.repp.org
UMASS Renewable Energy Laboratory	www.umass.edu/windenergy
Union of Concerned Scientists (UCS)	www.ucsusa.org
USDA Natural Resource Conservation Service / Maine	www.me.nrcs.usda.gov
USDA Rural Development	www.rurdev.usda.gov
Wind Power for ME	www.windforme.org
Wind Powering America / New England Wind Forum (Department of Energy)	www.windpoweringamerica.com
Windustry	www.windustry.org

Wind Resource Assessment Companies			
Company	**Location**	**Phone**	**Website**
3 TIER Renewable Energy Risk Analysis	Seattle, Washington	206-325-1573	www.3tier.com
AWS True Power	Albany, New York	518-213-0044	www.awstruepower.com
Inspeed - Pole Mount Anemometer *Anemometer/Equip. Supply*	Sudbury, Massachusetts	978-397-6813	www.inspeed.com
NRG Systems, Inc. *Anemometer/Equip. Supply*	Hinesburg, Vermont	802-482-2255	www.nrgsystems.com
Second Wind, Inc. *Anemometer/Equip. Supply*	Somerville, Massachusetts	617-776-8520	www.secondwind.com
Wind Analytics	Brooklyn, New York	1-800-808-9463	www.windanalytics.com
Wind Logics, Inc.	St. Paul, Minnesota	641-556-4200	www.windlogics.com