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State of wind turbine developments in northeastern USA – 2013

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Abstract

Noise has been a much discussed and studied issue for the range of proposed and installed wind turbine projects in the northeastern United States. Developers, community groups, government agencies, suppliers, and consultants have all invested substantial time and effort in addressing wind turbine noise and seeking to achieve their various goals. This paper provides an update on the state of wind turbine developments in this region of the U.S. In particular, it describes the efforts of state agencies to define a noise assessment protocol, understand the health effects of wind projects, and quantify wind turbine noise characteristics; compares several projects that have not experienced significant complaints along with ones that have; and comments on the potential future of on-shore and off-shore wind projects for this region.

1. Introduction

The northeastern United States has experienced significant growth in wind projects over the past five years. This area of the country fortunately contains numerous hilly areas and coastal zones, both of which can provide a significant wind resource. With the aim of creating renewable energy projects and high-quality jobs, Massachusetts established a state agency that would support solar and wind power developments through direct grants of funds and services. This agency and other state agencies have also funded specific research projects as part of their effort to help guide project applicants, officials, and the public to understand better the potential noise impact of wind projects. This paper focuses on wind projects in the northeastern United States, New England, and Massachusetts, discusses several current projects, and comments on the expected growth of on-shore and off-shore projects.

2. Wind development in the northeast

At the end of 2012, wind energy facilities in the northeastern U.S. accounted for nearly 4,000 MW of power generation and approximately 6% of the national output. Figure 1 shows the installed wind power capacity for 11 states in the northeastern U.S., with New York and Pennsylvania at the top of the group, having the respective 12th and 15th highest capacity nationally.

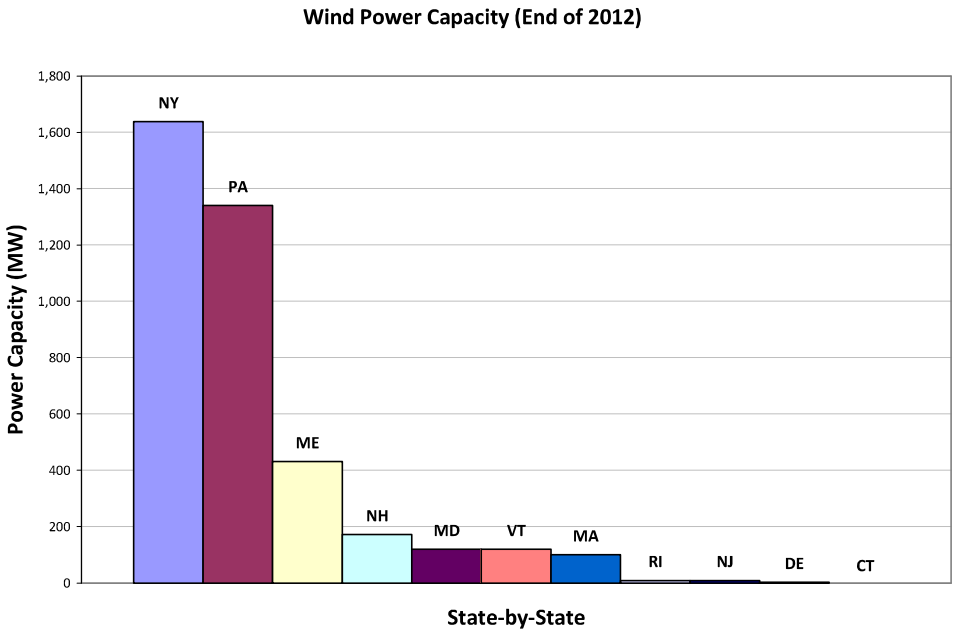

Figure 1. End of year 2012 installed wind power capacity

The industry continues to grow at an extraordinary pace, with approximately 12,000 MW of planned increases under construction or in the planning process. In the past few years, both Maryland and Delaware have installed their first wind projects while Massachusetts embarks on the first offshore project named Cape Wind, planned to generate 468 MW of electrical power.

Figure 2 displays the geographical distribution of the large scale wind projects that are operating across New York State and Figure 3 shows the various large scale wind projects that are operating or under development in Pennsylvania.

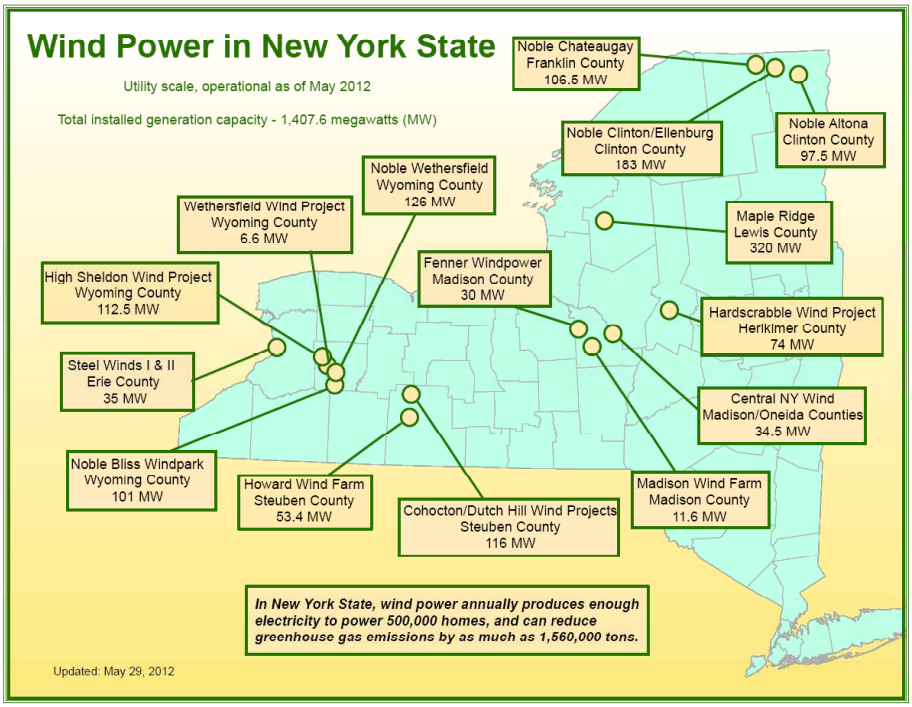

Figure 2. Large scale wind projects in New York

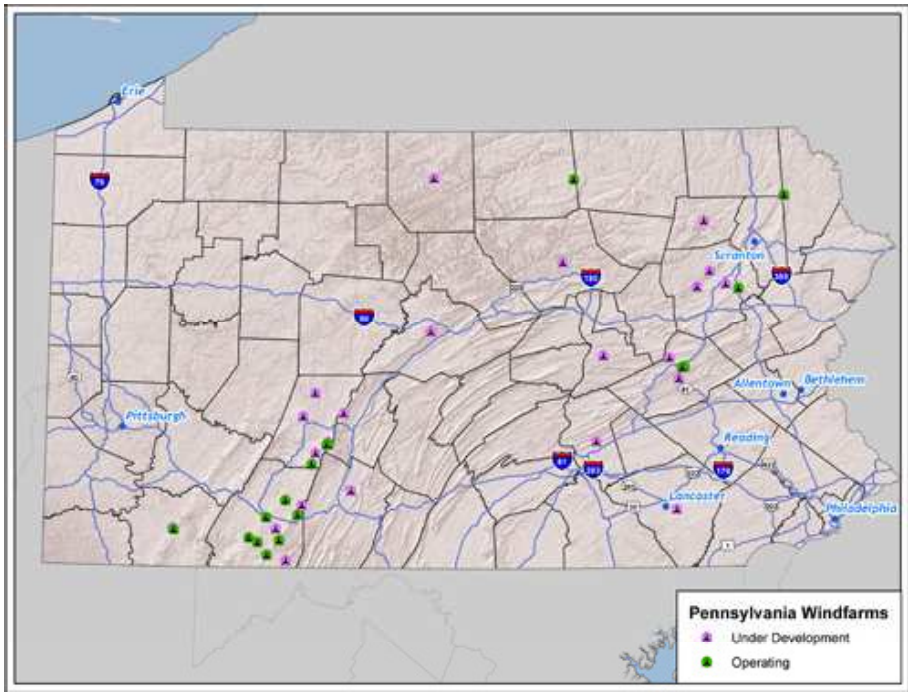

Figure 3. Large scale wind projects in Pennsylvania

The above figures show the geographical spread of the large wind projects across these two states; and not unexpectedly, the projects are typically located in the more mountainous rural areas of the region.

The regulations pertaining to noise are generally similar in many of the states, often drawing from each other's experience. In some states, such as New York, New Jersey, and Massachusetts, the process generally involves environmental approval prescribed by state-wide policy, whereas in others, such as Pennsylvania, New Hampshire, Maryland, and Vermont, projects are subject to various local ordinances.

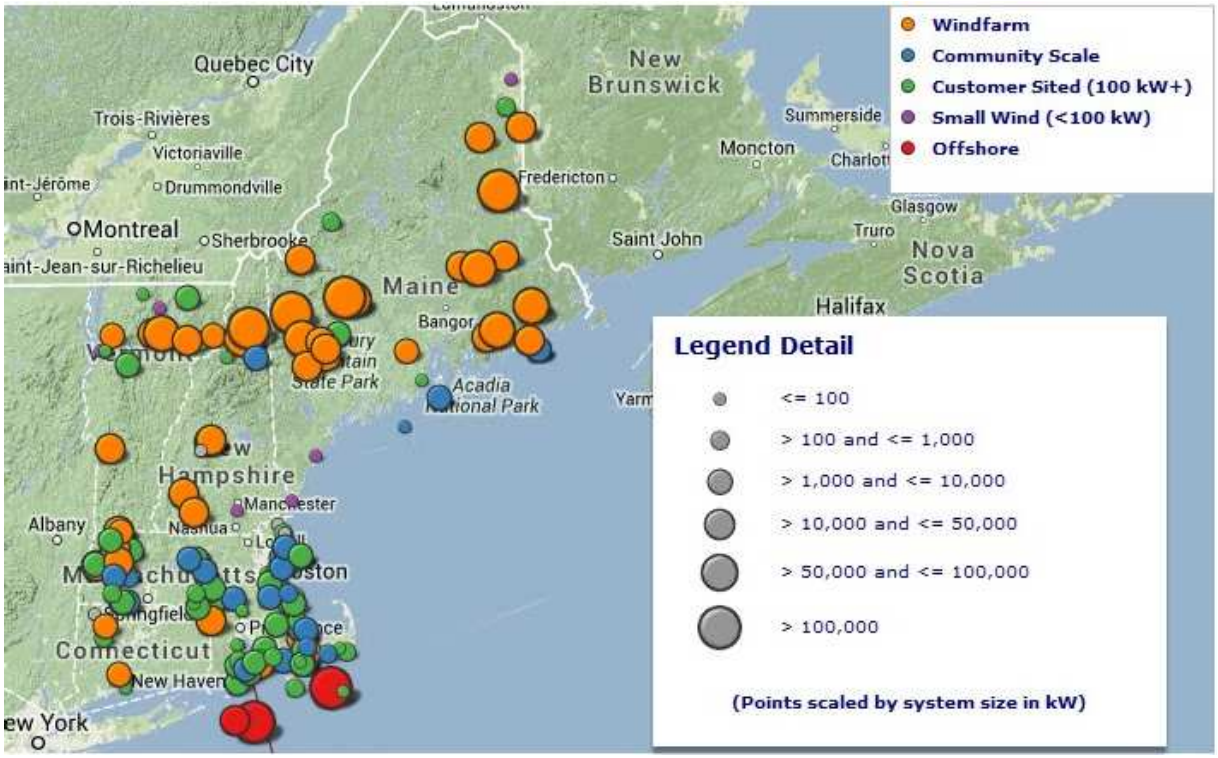

Figure 4. All wind projects in New England

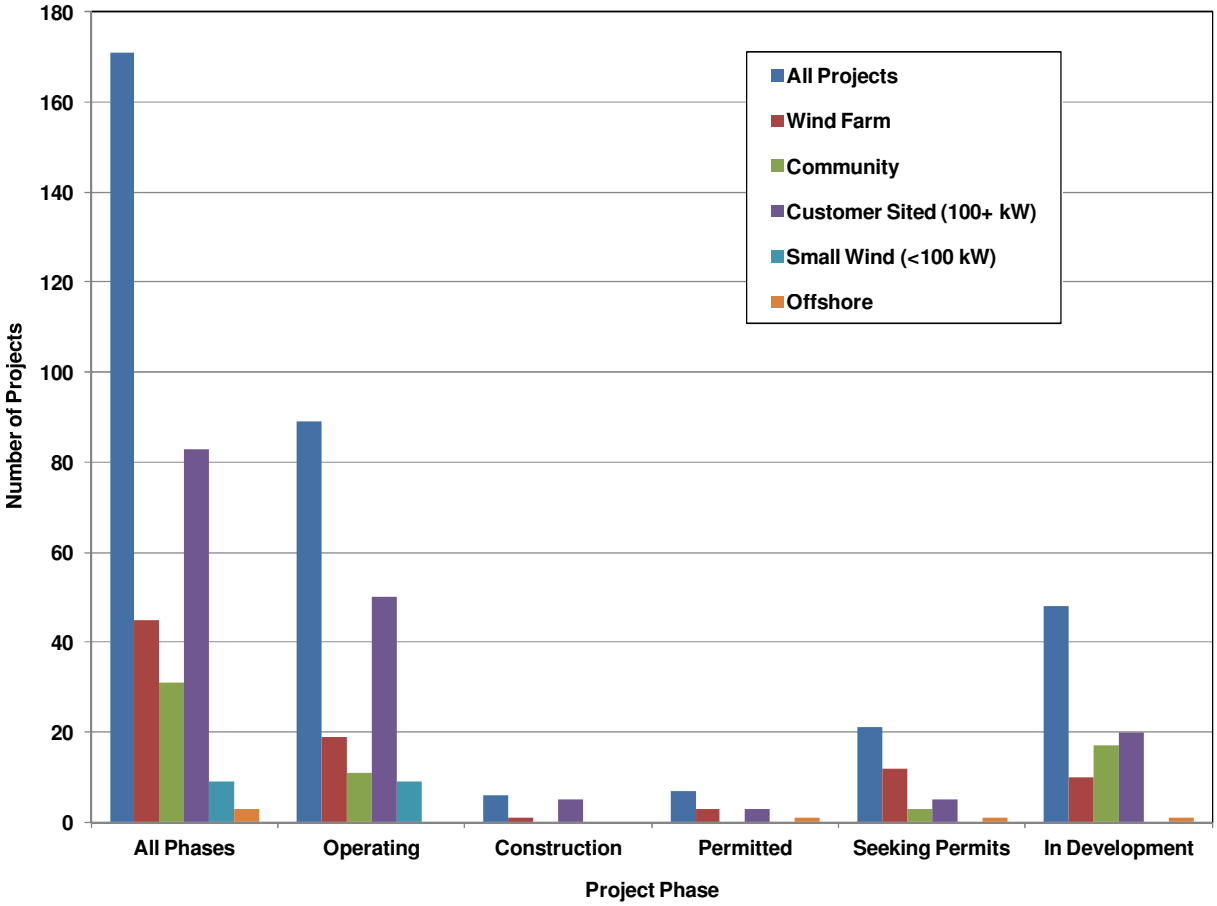

Figure 5. Number of wind projects by type and phase in New England

Figures 4 and 5 reveal several major characteristics: 1) typical on-shore wind farm projects are in the rural and more mountainous areas of the region; 2) many community scale projects are located in the more populous southeastern coastal areas; and 3) the planned new off-shore projects are few in number but large in scale.

3. Development support by Massachusetts state agencies

The Massachusetts Clean Energy Center (MassCEC) was formed in 2009 to accelerate the success of clean energy technologies, companies and projects in the Commonwealth—while creating high-quality jobs and long-term economic growth for the people of Massachusetts. MassCEC is the first of its kind in the United States and helps support the development of hundreds of megawatts of wind and solar systems across the Commonwealth by providing guidance and seed funding. MassCEC receives funding from the Renewable Energy Trust Fund, which was created by the Massachusetts Legislature in 1998 as part of the deregulation of the electric utility market. The trust is funded by a systems benefit charge paid by electric ratepayers of investor-owned utilities in Massachusetts, as well as municipal electric departments that have opted to participate in the program. The average residential ratepayer pays $0.30 a month into the trust.

MassCEC has developed the Commonwealth Wind Incentive Program ("Commonwealth Wind") to: 1) guide and support wind project proponents through the detailed analysis and community engagement necessary to evaluate proposed projects; and 2) support the development and construction of projects that, through the results of this process, demonstrate appropriate siting. Funding is available for residential, commercial, industrial, and public facilities and is based on the size and other characteristics of the wind project. It supports Small Wind (less than 100kW), Community Wind (100kW and greater) and Commercial (typically have three or more large turbines) wind projects. MassCEC published the "Commonwealth Wind Program Manual

for Community and Commercial Wind Projects (27 November 2012)" to help guide applicants through the wind development process. The Commonwealth Wind Program includes the following offerings:

Small Wind projects

- Construction rebates

Community and Commercial Wind projects

- Site assessment grants of services
- Feasibility study grants
- Design and construction grants
- Development grants and loans

A feasibility study grant would normally require an applicant to perform a detailed acoustic study in this project phase. The pertinent requirement is:

> "If the distance between the proposed project and the nearest existing or planned residence or other sensitive receptor is less than a distance of five (5) times the blade tip height (defined as the height of the tip of the blade at the highest point in the blade sweep) of the turbine, MassCEC requires that a pre-construction acoustic study be completed by the Grantee during the feasibility study phase. Projects with setbacks beyond this limit may also apply for acoustic study funding. All acoustic studies funded by MassCEC must be completed according to MassCEC's Wind Turbine Acoustic Methodology. Applicants must identify their acoustic consultant at the time of application."

The results of the sound study should indicate as a minimum that:

> "…. acoustic levels are expected to comply with the Massachusetts Department of Environmental Protection (MassDEP) noise regulations based on rigorous analysis with conservative assumptions and a margin of error."

To help guide the design of feasibility studies and to address MassDEP's noise criteria, which state that a noise source may not increase the ambient sound level by more than 10 dBA and not create a pure tone condition, MassCEC developed the document "Acoustic Study Methodology for Wind Turbine Projects (9 December 2011)." This document establishes a standardized methodology for conducting acoustic studies for projects that receive or request technical or financial support from MassCEC. Specifically, the document outlines the design and conduct of the ambient survey, the development of a turbine sound model, and the assessment of expected community sound impacts.

The Massachusetts Department of Public Health (MassDPH) and MassDEP commissioned an in-depth analysis of current literature on wind turbines and acoustics in an effort to understand the expected community impact of wind turbine sound. This study is described in "Wind Turbine Health Impact Study: Report of Independent Expert Panel (January 2012)." The study team found that:

> "….while there is limited epidemiological evidence suggesting an association between wind turbine noise and annoyance/sleep disruption, none of the epidemiological studies reviewed suggested a direct association between wind turbine noise and specific physical or psychological effects."

And presently, MassCEC and MassDEP are conducting a "Research Study on Wind Turbine Acoustics" in an effort to improve the understanding and prediction of wind turbine sound. This study involves detailed acoustic, wind, and turbine operational monitoring of a variety of existing Massachusetts wind projects and associated analyses of the monitored data to:

> "….gain a better understanding of the characteristics of wind turbine sound and the parameters that contribute to it."

The study's results should help to inform the various stakeholders in potential wind projects. This research study is expected to be complete by January 2014.

4. Community acceptance of wind projects

The examples in this section display the range of community reaction to sound from wind turbines operating in Massachusetts and Maine. Community reactions to actual turbine projects vary from widespread acceptance and requests for additional turbines to strong complaints and calls to modify or shut down the units.

4.1 Hull, Massachusetts Hull is a seaside town south of Boston with a municipal light department. The town purchased and installed a 0.66 MW turbine (Hull Wind) in 2001, which by all accounts, has successfully operated since then to reduce the town's electric bills without community noise complaints. In response to the positive results and public reactions with the first turbine, the town installed a 1.8 MW turbine (Hull Wind 2) at a second site in 2006. Approximately 10% of the town's entire consumption of electric energy is now being supplied by the pair of turbines. And as a result, the turbines have been deemed a success and considered a source of pride by the community.

4.2 Scituate, Massachusetts This town of roughly 18,000 people and 83 square km (32 square miles) has a single wind turbine capable of producing 1.5 MW of power. The goal of the privately-owned Scituate Wind project is to provide the town with 50% of its necessary capacity. A sister project has begun to provide the remaining 50% capacity from a solar farm located nearby. Scituate wind estimates that the turbines should produce roughly 4,300 MWh of electricity in a year, allowing for a reduced electric rate and making it possible for the town to save a bit of money. The project has been operational since March 2012, and in the year following, reported electricity production of roughly 3,700 MWh, falling just short of the estimated production since going operational. The first two months in the second year are reportedly up from the first and the project seems on track to meet production estimates.

There is an organized group of neighbors near the wind turbine that has expressed health concerns since the turbine became operational. It has been reported that 32 people have been affected by the turbine and have experienced symptoms such as headaches, dizziness, and lack of sleep due to the noise and shadow flicker. According to the turbine operation, the town's board of health has received health complaint forms from 13 households, with multiple complaints from three of those, and a group of 16 households have petitioned the town's board of health to shut down the turbine. In response to the petition the turbine operator prepared a presentation and the town's board of health is commissioning a study, funded by the turbine operator, to determine compliance with local and state noise laws. The group of neighbors is also funding and commissioning their own noise study that will measure beyond the legal noise requirements. Additionally, the town itself may fund a study of shadow flicker since there are no requirements for the turbine operators to meet.

Information presented by the turbine operator indicates that 34% of total power is produced during nighttime hours. Such a decrease in production would increase the electric rate from $0.089 to $0.148, an increase of 66%, which would mean a shift from the town seeing savings to the town incurring costs. It was also noted that a forced curtailment would be a violation of rights granted to the operator and would result in a shortfall of their creditor's requirement for guaranteed electric output.

In response, the group of neighbors has expressed their support of green energy and stated that the turbine was improperly sited in a residential area. They have brought the issue to the attention of the board of health at no less than three public hearings and strongly urged the

board to address their health concerns. The board's response to the petition is that a decision will be made based on "reason, facts, evidence, and science" and those facts will be forthcoming with the pending commissioned noise studies. Quite recently, the group submitted a citizens' petition at the April 2013 Town Meeting that asks the town to rescind the special permit granted to the turbine operator; this non-binding resolution was narrowly defeated.

4.3 Falmouth, Massachusetts This town has two 1.65 MW turbines and a similar story. The turbines have been in operation for the last three years and abutters have been levying health concerns since the start of their operation. A thorough study was launched by Falmouth to assess the problem and potential options. This study reports that 47 people have indicated negative health effects including sleep deprivation, stress, mental health problems, hearing problems, and cognitive difficulties. The study also makes it clear that it is impossible to explain completely the relationship between health complaints and operation of the turbines, so it accepts the concerns as reality and seeks solutions to address them. Over the course of the assessment, the town hired expertise from two acoustical consulting firms for measurements and modelling and had MassDEP conduct their own measurements; unfortunately, the results of each proved to be inadequate for full consideration in the options assessment. Numerous options and operating conditions were given in the study's report, including full operation, full curtailment, and other less serious changes such as break-even curtailment, purchasing the homes of those affected, and legal action against technical experts in siting the turbines. With the report submitted and in the public record the Board of Selectman chairman has indicated that the turbines "simply need to come down." Even though it would mean operating at a loss, the town first tried curtailment, reduced nighttime operation, and considered buying out homeowners. But, with continuing complaints, the Board of Selectman was forced to let the town vote in May 2013 to either purchase abutters' homes or remove the turbines. Falmouth is believed to be the first community in the country to vote on whether to remove existing turbines because of noise complaints. By a 2-1 margin, the turbines will not be removed and the complaints are expected to continue until the town addresses how to move forward.

4.4 Vinalhaven, Maine The island of Vinalhaven, ME has three 1.5 MW turbines. The town has a history of high electric rates since the electricity has to cross the Penobscot Bay before reaching residents. The electric utility is an Electric Cooperative and as such the decision to use wind turbines was put to a vote, which passed 383-5. This project is the largest community wind power facility on the East Coast and resulted in a reduction of the high-priced electric rates on the island. Unfortunately, a small number of residents began reporting some health problems after the turbines became operational in 2009. The abutters formed a group called the Fox Island Wind Neighbors to get visibility in the community; they then secured legal representation, an acoustical consultant, and formed a website. It has been reported that the group has caused significant controversy on the island. Despite all of this, the project continues to have the support of most of the island residents. The video "Islands in the Wind," which was developed about the project is available for viewing online at: http://www.youtube.com/watch?v=5I6F1-1sJa0.

5. Potential future of wind projects

Communities and public officials continue to embrace renewable energy projects at the same time that turbine sound is receiving greater examination. Acceptance of a wind project is expected to vary within a particular community and to depend on numerous factors, including the residents, applicant, setting, and the project design, all of which affects the potential sound impacts and non-acoustic impacts. We believe that developers will continue to identify and build wind projects in New England as long as government policies, state and local officials, the general public, and the economic climate support these efforts. Although U.S. offshore wind efforts have lagged the rest of the world, we believe that the large wind resource just off the east coast will be harvested as long as green energy and green jobs remain of vital interest to the public.

6. Conclusions

Public and private developers have invested substantial time and capital to grow the wind industry in the northeastern United States. Government agencies, including the first-in-the-nation MassCEC, have supported these efforts with direct grants of funds and services to project applicants. Community acceptance of these projects has depended on numerous factors, and turbine sound has been identified as a potential major issue. Recent experience in New England has illustrated the range of community reactions to individual wind projects, which in some cases has encouraged greater review and analysis by state and local officials.

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