Renewable Energy Research Laboratory, University of Massachusetts at Amherst

Wind Power

On the Community Scale

Community Wind Case Study: Hull

Community Wind Power Case Study

RERL—MTC Community Wind Fact Sheet Series

In collaboration with the Massachusetts Technology Collaborative's Renewable Energy Trust Fund, the Renewable Energy Research Lab (RERL) brings you this series of fact sheets about Wind Power on the community scale:

1. Technology
2. Performance
3. Impacts & Issues
4. Siting
5. Resource Assessment
6. Wind Data
7. Permitting

Case Studies

Inside this Edition:
Hull Case Study

Hull Wind One

In 2001 Massachusetts' first modern wind turbine was installed in at Windmill Point, at the tip of the town of Hull. The turbine is owned and operated by the Hull Municipal Light Plant (HMLP), and the project was developed by HMLP with assistance of the University of Massachusetts' Renewable Energy Research Laboratory and the Massachusetts Division of Energy Resources.

The 660 kW turbine is close to the high school, within 100 ft of the site of a 40 kW turbine (since removed) which was installed approximately 20 years before. The town is in a highly populated coastal area, within 8 miles of Boston (city hall) and 5 miles of the runways at Boston's Logan International Airport, so it might at first seem that it would be a difficult location at which to site a wind turbine. In fact, there are many factors that affect the siting of a wind turbine. Some of these tend to make siting more difficult at towns such as Hull; others make it easier.

What made Hull Wind One such a success?

- Municipal electric utility that was an active participant in the process
- Local champions
- Good wind resource
- Public involvement
- Previous experience in wind
- Town realized public benefit
- Available site
- Technical support

Hull Wind One represents three historic "firsts":

- The first commercial-scale wind turbine to go online anywhere on the eastern U.S. coastline
- The first suburban-sited turbine on the North American continent, and
- The first such publicly owned wind turbine to be sited in the United States within a short walking distance of a stop on a mass transit system (a ferry).

This case study briefly discusses the history of "Hull Wind One," as the turbine is now called. It is condensed from a longer paper (Manwell et al., 2003) that more closely examines the factors that led to successful realization of the project and the manner in which they affected Hull's decision to proceed with its new turbine.

Profile of Hull

A town with a history in wind

The town of Hull, Massachusetts is located on a peninsula in Boston Harbor. Its population is about 10,500, which increases to over 16,000 during the summer vacation season. Electricity is supplied to the residents by the Hull Municipal Light Plant (HMLP), a municipally owned utility. Annual average power consumption is approximately 6 MW (corresponding to an energy use of approximately 53,000 MWh/yr). HMLP purchases most of its electricity at wholesale from the Massachusetts Municipal Wholesale Electric Company (MMWEC).

Hull has a long history of land-based wind energy use, beginning at least 200 years ago, when wind was used to produce salt. The site of Hull Wind One was referred to as "Windmill Point" as early as the 1820's. In the 1980's, the town's first electricity-producing wind machine was installed, a 40 kW Enertech machine. Today the town continues to look for ways to make the best out of their windy location, with proposals for more wind power.

Photo credit: Doug Welch, Island Alliance.

Project History

Siting study: The Massachusetts Division of Energy Resources (DOER) discussed potential wind power projects with the Hull Municipal Light Plant (HMLP) in the 1980's and 1990's. Work on Hull Wind One began in earnest in 1998, when the UMass RERL, under sponsorship from the DOER, carried out a detailed technical evaluation of possibilities for the replacement of the old wind turbine installed at the High School. The study (Ellis, Rogers, and Manwell, 1999) reviewed the issues related to the installation of a wind turbine at the High School site and identified the potential merits and impacts of a number of different wind turbines. For this proposal, it was assumed that HMLP would assume responsibility for the operation of the machine. The work (which involved extensive interaction with numerous Hull community groups) consisted of the following six major parts:

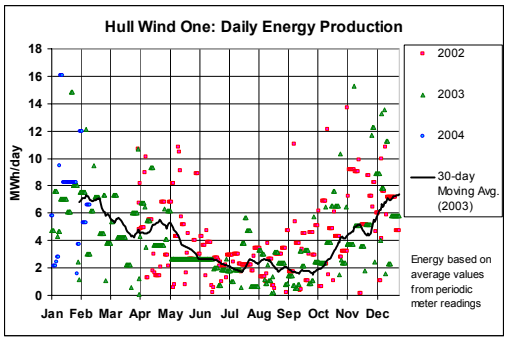
Hull Wind One, seen from Peddocks Island, across Hull Gut

- Detailed description of the proposed site
- Description of the available wind resource
- Description of candidate turbines
- Review of environmental, regulatory, and public acceptance hurdles
- A preliminary economic evaluation
- Discussion and recommendations

Selection of New Wind Turbine: Following the positive results and recommendations of the study, and after a number of news reports on the subject (Boston Globe, the Patriot Ledger, the Tiny Town Gazette, and the Hull Times), HMLP notified the town's citizens of a public meeting on June 16, 2000 at the High School. The meeting included presentations by the town manager, the town historian, and representatives from the Hull Light Board, Massachusetts Municipal Wholesale Electric Company (MMWEC), RERL, and the local group Citizens For Alternative Renewable Energy (CARE). This group fielded questions from the public and responded to fellow panelists. Following the strongly positive results of this meeting, it was announced that HMLP would solicit a Request for Proposals (RFP) for the supply and installation of a wind turbine. At the same time, HMLP announced its intention to apply for the various permits that would be required. Over the following months, a detailed RFP was prepared. The RFP was formally released in January 2001, and by March three bids were received. In April the town accepted Vestas' bid which included their popular V47 turbine. The "turnkey" contract price was $698,699, including a standard set of spare parts. This contract included purchase and installation of the transformer, providing a buried cable, and connection with the HMLP distribution system. Note that this figure did not include work done directly by HMLP, valued at $54,000. The total installed cost was approximately $753,000 (not including development services supplied by DOER and RERL). Vendor selection was followed by contract negotiations, and by a signed contract in August, 2001.

Construction: Excavation for the foundation began in November, 2001, and by the end of November the foundation concrete was cured. On December 16th the tower was in place and the rotor was installed. At 2:45 PM on December 27th the turbine was put online.

Current status: Hull Wind One, represents the high point of almost 20 years of wind energy activity at Hull's Windmill Point. In its first two years of operation (Dec. 27, 2001 - Dec. 26, 2003) it produced about 3,100 MWh, for a capacity factor of 27%.



Many groups of visitors have made special trips to the site and media coverage of the installation, and its successes and awards, have been extensive. Awards to HMLP include:

- Certificate of Special Congressional Recognition from US Congressman Delahunt, June 2002. The Award cites benefits both to the environment and to the community.
- EPA Environmental Merit Award, 2002
- US Department of Energy Award 2002
- Utility Leadership Award from American Wind Energy Association, 2003
- Massachusetts Municipal Association's Innovation Award, 2003
- Climate Award for communities from Clean Air - Cool Planet, 2003

Hull's Wind Machine

Manufacturer:	Vestas
Model:	V47
Rotor Diameter:	47m = 154'
Hub height:	50m = 164'
Power rating:	660 kW
Rotational speed:	28.5 RPM

Assembly of Hull Wind One's rotor

Obstacles & Champions

Issues to be addressed

The following is a list of potential issues that are typically considered in *any* wind project of this type, along with the town's perception of them for Hull's particular case.

Beneficiaries vs. those impacted The proposed owner and operator of the project was always to be the Hull Municipal Light Plant. The beneficiaries were thus the residents of Hull. Similarly, those affected were also residents, with those closest to the turbine being the most affected.

Visual impact To some extent the concern for the visual impact in Hull was less than it might otherwise have been because there had been a turbine at the site for many years.

Noise Noise is commonly brought up in relation to wind turbine proposal. The proximity of Hull to the Logan Airport flight paths, as well as the experience with a previous turbine near the site diminished concern with this issue. Nonetheless, detailed consideration was given to this issue in the development process. Experience with the turbine since the installation has confirmed that noise is not a significant problem.

Avian impact The possible effect of a wind turbine on birds has become a concern in nearly every siting exercise ever since the problem first arose in California. The issue did arise in Hull as well, but in fact generated little debate.

Value of energy produced In most non-municipal cases, this is the selling price of energy. In Hull's case, the monetary value of the energy is relatively high, since it displaces purchases of the transmitted power that the municipal light plant buys from its supplier.

Guaranteed market for the energy The construction of any power plant depends on a long-term market for the power. Often this is sought in the form of a power purchase agreement (PPA). Since Hull has a municipal light plant, it is its own market, and needed no additional PPA.

Responsibility of operation, maintenance and dismantling The low availability of the old 40 kW wind turbine was blamed in part on the fact that it was maintained by the high school. Since HMLP was the assumed to be the new project's operator and maintainer from the outset, this issue was not a major concern.

Skepticism in technology Skepticism in new technology is common and not without foundation. Hull had some experience with modern wind energy technology, so it was not completely new to them. The previous turbine did not function as well as hoped. Nonetheless, it did function to some degree, and it may be that the experience with that turbine, together with an understanding of how the wind turbines had changed over the last twenty years, prevented residents from expressing much concern over the technology.

Confidence in proponents Townsfolk may understandably be skeptical about advice from any source, whether from local proponents, developers, salesmen, or officials from out of town. The process Hull used was conducive to building up trust, by being slow, deliberate, and securing the assistance of entities that were familiar with the technology and the issues, but did not stand to profit from the outcome.

Permitting and zoning Permitting and zoning are often issues in any proposed wind energy project. In Massachusetts, municipal light plants are exempt from zoning requirements, so that was not a concern in Hull. In any case, the land where the turbine was sited was owned by the town. Difficulties with other permitting issues were minimized on account of the deliberate process of involving the town in the decision making.

Factors Affecting Hull's Decision to Install a Wind Turbine

The factors affecting Hull's decision to install a new wind turbine are closely related to the issues that needed to be addressed to realize such a project (as outlined above). The most important factors are summarized below.

Municipal electric light plant The presence of a municipal utility in a town simplifies the process of acquiring distributed generation (such as a wind turbine), since there is clear mechanism for doing so. This was certainly true in the case of Hull, where the municipal light plant was a participant in all stages in the process.

Local champions Undertaking projects of the type described in this paper can be a long, slow process. Experience has shown that having a few local people ("champions") who can push the project along can greatly facilitate the process. Hull was fortunate to have dedicated champions, including a determined resident, the Operations Manager of the Light Plant, and various local and state public officials.

Local Champion John MacLeod, operations manager of Hull Municipal Light Plant.

Good wind resource It was already apparent to the casual observer that Hull has a promising wind resource. Hull is on a peninsula far out in the Boston Harbor, with as good an exposure to the winds as anywhere on the coast of Massachusetts. Historical experience from the days of sail, as well as the performance of the previous wind turbine, were consistent with that observation. During the course of the project, the wind resource was quantified to some extent by reference to monitoring stations at nearby Logan Airport and Thompson Island.

Public involvement Public involvement is one of the keys to addressing concerns of the residents. The decision making process involved the public at every step. This process was facilitated by the participation of the municipal light plant in the project.

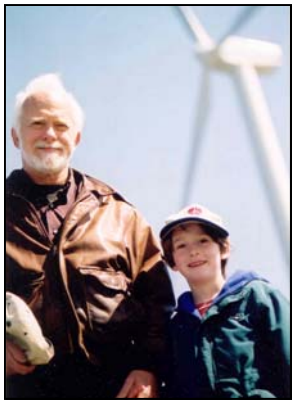
Previous experience As mentioned above, and as will be described in more detail below, Hull had previously had a wind turbine installed very close to where the current turbine is now located. Experience with that turbine was not altogether positive, but it did help to focus attention on important issues and minimize concern with issues that are less important.

Public benefit As discussed above, the energy produced by the turbine was recognized to benefit the town directly, through reduction in purchased energy. This was made particularly concrete by the Light Plant's decision to use part of the "profit" from the wind turbine to cancel the bills to the town for the street lights.

Available site No project can succeed without a suitable site. Hull was fortunate in that it owned a site (Windmill Point) with good exposure to the winds, where the turbine could be sited without serious conflicts with other uses.

Technical support Innovative projects such as the one in Hull often require significant technical support in order to be brought to successful fruition. Hull was fortunate in that it could take advantage of the Commonwealth's Division of Energy Resources long-standing partnership with the University of Massachusetts Renewable Energy Research Laboratory to assist in this project.

Local Champions Malcolm Brown and Andrew Stern display one of Hull's many leadership awards.



Wind Champion Jim Manwell and his son Nate in front of Hull Wind One.

Credit for Brown & Stern photo: hullwind.org, Malcolm Brown. For Manwell photo: Frank Ward

Renewable Energy Research Laboratory

University of Massachusetts at Amherst

160 Governors Drive
Amherst, MA 01003
Phone: 413-545-4359
E-mail: rerl@ecs.umass.edu
www.ceere.org/rerl/

MASSACHUSETTS TECHNOLOGY COLLABORATIVE
RENEWABLE ENERGY TRUST

Mass. Technology Collaborative
Mass. Renewable Energy Trust
75 North Drive
Westborough, MA 01581
phone: 508-870-0312
www.mtpc.org/RenewableEnergy/

Economics

As a town with a good wind resource and a municipal electric company, Hull is especially well placed to benefit economically from wind power. Here is a brief overview of the economics of the project:

Annual energy production:	1,590,000 kWh
Revenue	
Value of energy purchases avoided*:	$0.08/kWh
Value of REC's**:	$0.03/kWh
Value of REPI:	$0.018/kWh
Total Current Value of Energy :	$0.128/kWh
Costs	
Capital cost, incl. installation***:	$753,000
Operations, Maintenance & Insurance:	~$30,000/yr
Economic indicators	
Cost of producing energy:	~6 ¢ /kWh
Simple payback:	4-5 years
Net present value of savings:	$2-3 million, depending on inflation rates.

Notes:
See the full paper by Manwell et al. for a discussion of how these values are calculated .
* This value is quite high because Hull has a municipal electric company, which means that the value of the power produced is the avoided cost. A similar project by a town without a municipal power company and without a large electric load would sell the power onto the grid, and the value of the power would be a good deal lower.
** See Fact Sheet 2, "Performance & Economics" for a discussion of REC's and the REPI
*** Not including in-kind development assistance from RERL, DOER, etc.

Public Power

Hull is one of 40 towns in Massachusetts that have municipally owned electric utilities. All of these utilities were set up in the early days of electrification (before 1927). They serve about 13% of the customers in the state. Municipal utilities can generate their own electricity, although most of them do not do so. In general, they purchase electricity from wholesalers, such as the Massachusetts Municipal Wholesale Electric Company, and then distribute that power to customers in the town. Municipal utilities own and service the distribution system in their town, and so are experienced in issues associated with electricity supply. Municipal utilities are operated under the management of a Light Board, which is elected by residents of the town. Day-to-day operation is carried out under the direction of the Superintendent or Operations Manager.

For More Information

Hull wind's website: www.hullwind.org
Case studies of community wind: www.greenpowergovs.org/wind/Case%20Studies.html
Danish Wind Industry Association: thorough and very accessible technical information: www.windpower.org
American Wind Energy Association: www.awea.org
Wind Turbine Siting In An Urban Environment: the Hull, MA 660 kW Turbine, J. F. Manwell, J. G. McGowan, A. Rogers, A. Ellis, S. Wright, M. Brown, J. MacLeod, Conference Proceedings, American Wind Energy Association, 2003. Available at RERL website, /www.ceere.org/rerl/publications/whitepapers/AWEA_Hull_2003.pdf
Bolgen, N., *"Power Supply Proposal to New England Power Company for the Development of the Hull Wind Turbine Powerplant,"* Massachusetts DOER Proposal, March 27, 1992.
Bolgen, N., *"Hull Wind Turbine: Eleven Years of Operation."* Massachusetts DOER Draft Report, June 3, 1996
Ellis, A. F., Rogers, A. L., and Manwell, J. F., *"Wind Turbine Replacement Options Study,"* Massachusetts DOER Report, June 18, 1999.
Public power:
Massachusetts Municipal Wholesale Electric Company: www.mmwec.org/
Northeast Public Power Association www.neppa.org/
American Public Power Association: www.appanet.org/
RERL's website: www.ceere.org/rerl/
For the complete series of RERL Community Wind Fact Sheets, see www.ceere.org/rerl/about_wind/