THE NORTHBOROUGH WIND TURBINE COMMITTEE

BASIC WIND ENERGY Qs AND As

Information Sheet

September 11, 2010

Introduction

In 2008 several leading Northborough citizens felt, we as a Town should actively support the "Green Movement" toward clean environmentally friendly energy sources. Coincidental with that goal the Commonwealth of Massachusetts legislature approved a concept called net metering, which allows small renewable energy power sources (solar, wind and hydro) to offset municipal energy consumption.

In 2009, the Northborough Selectmen created the Northborough Wind Turbine Committee. This is composed of seven members, two alternates and eight advisory members. This team of skilled professionals was tasked with evaluating if a wind turbine installed within the Town of Northborough had sufficient wind energy available to result in an economically viable project. Under the net metering concept, Town municipal electric loads (high school, middle school, elementary schools, fire, police and public works departments, water pumping station, town hall and similar facilities) would be offset by a wind turbine output.

An initial "desktop" study was made at University of Massachusetts, Amherst where readily available wind data was reviewed, and the Wind Energy Center in May 2009 determined sufficient wind energy maybe present to support a project. Subsequent work by the committee resulted in an $85,000 grant to install a meteorological tower to measure actual wind conditions on Ball Hill over an 8 to 12 month period. The actual measurements will be collated with NOAA data, a turbine size determined (if the available wind energy supports the project), a construction cost estimate prepared, financing investigated including state and federal grants, and ultimately placed before the town voters for acceptance or rejection.

How it will operate

The attached sketch shows in a schematic and pictorial format how the electrical connections will be made. The turbine will be tied to National Grid's electrical distribution system and a revenue meter (similar to the meter on the side of a home) will measure the electrical power distributed directly to the grid. National Grid will then credit the Town of Northborough with the power provided. At this time the turbine size is undetermined, however a range of 900 kilo-watts (kW) to 1.2 Mega-watts (MW) is under consideration.

There are similar installations at UMass Maritime Academy in Bourne, MA; Holy Name High School in Worcester, MA, Princeton MA, Hull MA, with other communities like Auburn and Charlton applying for studies and construction grants.

Tentative Schedule

If the meteorological tower measurements provide promising data, the feasibility study will be completed in the summer of 2011. After the generation potential is determined, projects costs are determined, potential grants & financing identified and a business plan prepared, the project may be presented to the Town voters in 2012. If the project is determined to be viable with a reasonable return on investment and payback, and is accepted by the Town, construction could begin in 2013.

Technical Questions

What is Wind Energy?

Wind energy is the energy contained in the movement of air. The sun heats the earth at different rates and at different times. The difference in temperature throughout the earth generates pressure differences that in turn drive the movement of air. Air has a mass and when a mass is put in motion, it contains what is called kinetic energy, much like a baseball thrown by a pitcher. Wind energy has been used for centuries to drive pumps and mills by taking the kinetic energy and converting it to mechanical energy through the use of windmills. This same concept is used to convert kinetic energy into electrical energy through the use of wind turbines (like the alternator on your car).

What is a wind turbine and how does it produce electricity?

A wind turbine is a machine that harnesses the kinetic energy in the wind and converts it to electrical energy. Mechanical energy created by its rotating blades, turns a generator that creates electricity. A typical wind turbine consists of the following components:

Rotor blades -rotate in response to the wind and are attached to the rotor hub.

Rotor Hub- connected to a gearbox and generator inside the Nacelle (the housing at the top of mast/tower).

Nacelle – houses the mechanical and electrical components of the turbine.

Generator- converts mechanical energy into electricity

Tower – Used to elevate the nacelle, hub and blades so as to reach greater wind velocity.

What is a Kilowatt (kW) and what is a kilowatt hour (kWh)

A kW (kilo-watt) is a rate of energy production or consumption, and a kWh (kilo-watt-hour) is a unit of energy. Compare it too driving a car. A mile or a kilometer per hour is a rate at which you cover distance with a car and a mile or kilometer is a unit of distance. For example, if you drive for 1 hour at 60 MPH you have traveled a total of 60 miles. Similarly, if you produce 60 kW of power for 1 hour, you have produced a total of 60 kWh.

How much electricity can a wind turbine generate?

The amount of electricity produced by one turbine depends on its size and the quality of wind resource being applied. For example, a 1MW (Megawatt or 1,000,000 watts) turbine if placed in an appropriate wind resource, can generate approximately 2.5 to 3.5 million kWh annually. That's enough electricity to supply a large portion of Town of Northborough's municipal needs (schools, police, fire, town hall and dept of public works). The Town of Northborough annual municipal electric energy use is approximately 6.25 million kWHs.

Wind Turbine Specific Topics

Will the Turbine be Noisy?

Sounds emitted from wind turbines can be from two sources. Mechanical Sounds can originate from internal hardware including gearboxes and yaw drives. Recent design improvements in sound proofing have helped reduce these noise sources. Aerodynamic sound, commonly described as "whooshing" has also been reduced using state of the art design tools. The average sound emitted by a new turbine is around 45dBA at a distance of 350 meters or an equivalent of distant traffic noise. Note: ("A" scale best models human hearing at lower frequencies overall range is 20Hz to 20,000Hz)

Another type of sound that has been associated with wind turbines is "Infrasound" or levels below normal human hearing of 20Hz. This issue was raised by Dr. Nina Pierpont in her self-published book. Lacking training in neuro acoustics, Dr. Pierpont undertook a study where a few individual with complaints were interviewed. There was no control group including members of the general population and perhaps more disturbing her work was not published in any scientific journal, where a peer review could be conducted. There have however been Canadian investigations into Infrasound and independent reviews that have concluded, there is NO reliable evidence that Infrasound has an effect on the human body.

What about the Turbine Reliability?

Early in 2009 the world-wide installed wind turbine capacity was approximately 120,000 MW with 26,400 MW in the US with China and Europe making up the majority of the remainder. Estimates of the operating machine population today are in the 200,000 range. While the

Internet has pictures of various wind turbine failures dating back to the 1970s; some of these failures were due to early mechanical blade problems and others related to electrical faults. However all power generating equipment is at risk for failure, transformer faults occur and steam or combustion turbines occasionally fail due to bearing or other mechanical issues. Fortunately based upon improved designs and new composite materials, the reliability of today's wind turbines is very high. This is supported by the large number on new turbine projects financed by banks and financial institutions with demanding operational and return-on-investment requirements. The average life of a new wind turbine with routine maintenance is 25 years.

How will Property Values be Effected?

The Department of Energy, Berkeley National Laboratory completed a study where 7,500 sales within 10 miles of 24 wind facilities in nine states were studied, using eight different pricing models. The results "none of the models uncovers conclusive evidence of the existence of any widespread property value impacts". The Renewable Energy Research Laboratory, Univ of Massachusetts Amherst in their Fact Sheet #3 also concluded after examination of some 25,000 property transactions there was no evidence of wind power reducing property values. The proposed Northborough wind turbine is also a single machine not a large scale wind farm operation.

What about Impacts on the Birds?

Risks to birds experienced in other parts of the country have not largely been a problem at operating wind turbine facilities in New England. As part of the feasibility study an avian risk assessment is conducted. In the case of the proposed Northborough turbine there are several other factors to consider. As described earlier, the installation is a single turbine with a single limited sweep; not a large wind farm with hundreds of machines concentrated in a specific area. The wind turbine tower will be a tubular design to eliminate areas for raptors to perch like on a transmission line lattice or cell towers. The turbine will not be located in a steel valley or canyon, which may by geography limit the available "air space". Finally the turbine blade speed will be relatively low at 12 to 18rpm.

Will Television Interference be a Problem?

In earlier designs metal bladed wind turbines may have created a "ghosting" on TV screens. The fiberglass composite material of modern blades is unlikely to result in any interference with broadcast signals. Cable television connections as a closed, shielded circuit will also not be affected.

What about Visual Impacts?

The primary impact of a wind turbine is visual. Because a turbine must be exposed to the wind, they are in prominent locations in the case of Northborough possibly on the Tougas or Davidian farms. Aesthetic considerations are impossible to quantify and difficult to discuss. Some people enjoy watching and seeing wind turbines, others do not. The questions of whether a community

is willing to accept a visual impact in turn for clean power is an issue for public policy, planning and voting.

Summary

The Wind Turbine Committee will continue with the wind data gathering, feasibility study and other analysis aspects of the project well into 2011. Our hope is that a wind turbine will be ultimately justified on its economic merits to help significantly reduce the annual town electric bill of $850,000.

Other Applefest Hand-outs

1. WTC Project Brochure
2. Wind Turbine Interconnection Sketch
3. Comparison with the Cape Wind Project