City of Worcester, Massachusetts

SUSTAINABILITY PROFILE

The Winds of Change – Holy Name's Large Wind Turbine

In 2008, Holy Name Central Catholic Junior/Senior High School (aka Holy Name), located at 140 Granite Street, installed the first wind turbine in the City of Worcester. The turbine stands at 262 feet high on the campus hilltop and has been producing an average of 74% of the school's yearly energy needs since its installation. It was a sound economic decision for the school but also emblematic of its values. The turbine is a point of pride for the school of ~570 students and the City as a whole. Its visibility on one of Worcester's windswept hills from many points in and near the City is a visual confirmation that renewable energy is possible and welcomed in Worcester.

The turbine is located at the rear of the school building, not far from the main entrance. Credit: John Riedell, Jawniffer Photography

Aerial view of Holy Name with wind turbine location circled.

Motivation

Before this project, Holy Name, built around 1967 and electrically heated, was paying approximately $180,000 in utility bills every year. These costs were unsustainable and prompted the school to investigate solutions to this problem in order to avoid tuition increases and/or cuts to extracurricular programs. The school looked into a possibility of replacing its electric heating system with a more affordable and efficient natural gas system, but found it to be not economically feasible.

The school conducted a number of energy efficiency projects over the years, such as the installation of a computerized energy management system, ongoing updates to the efficiency of the existing electrical heating system, and weatherization work. However, these measures did not reduce the overall energy use of the school and its associated costs to sufficiently address the run-away electrical costs.

School community members and officials wanted to explore the feasibility of tapping into the strong wind energy existing on the school's hilltop campus. In 2004, the school reached out to Worcester Polytechnic Institute (WPI), and worked with a group of five undergraduate students to conduct a wind turbine feasibility project in order to fulfill their project-based degree requirement. Wind turbines harness the power of the wind and use it to generate electricity. Based on wind availability, projected electrical prices, and payback estimates, the WPI students determined that a 600 KW wind turbine appeared to be appropriate for the school's needs[1].

[1] "Holy Name High School Wind Feasibility Study." Worcester Polytechnic Institute Student Project. 2006. Prepared by Young, Adam S.; Jensen, Hans E.; Forbes, Tyler Dunlap; Foley, Brian M.; Emanuel, Alexander E. - Faculty advisor

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With the help of a $50,000 donation from the Sisters of Saint Anne, in the beginning of 2007 Holy Name hired Sustainable Energy Developments, Inc. (SED), a company specializing in the construction and maintenance of wind turbines and photovoltaic systems, to conduct a more in-depth assessment. SED's findings confirmed the feasibility of the project and also recommended a 600 kW nameplate capacity.

Wind Turbine Specifications and Other Interesting Facts:

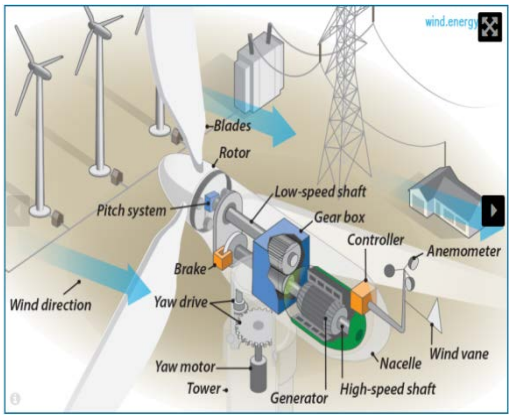
- ✓ **Model:** Vestas RRB V47
- ✓ **Maximum rated output:** 600 kW
- ✓ **Description**: Large-scale, horizontal-axis, three-bladed
- ✓ **Height (to top of blade):** 262.4 ft. (265 ft. max allowed by regulations)
- ✓ **Tower height:** 180 ft.
- ✓ **Rotor diameter:** 154 feet
- ✓ **Total weight:** 145,860 lb.
- ✓ **Distance from nearest non-participating landowner's occupied building:** 798 ft. (650 feet min allowed by regulations)

City's Policies and Land Use Permitting

While at the time local regulations did not allow wind energy installations in the City, because of the school's proposal and the high level of interest from the community, the City administration allocated staff resources to review and revise its regulations.

In June of 2007, the City adopted a Large Wind (Energy Conversion Facilities) Ordinance which allowed for wind energy turbines (minimum rotor diameter 20-ft, maximum height 265 ft.) to be located in the City by Special Permit with certain provisions for height, buffers from abutting uses, and noise regulations.

Holy Name applied for a Special Permit under this new ordinance in December 2007, which was granted by the Planning Board in February 2008.



The Inside of a Wind Turbine
http://energy.gov/eere/wind/inside-wind-turbine-0; last accessed April 6, 2015

Project Costs

The total cost of the turbine reached nearly $2 million. With a significant grant from the Massachusetts Technology Collaborative, several large donations from charitable foundations and trusts, and the collective contributions of alumni and community sources, the up-front cost was reduced to ~$900,000, which was taken out as a 15-year loan from the Diocese of Worcester. This resulted in a total of $50,000 in annual savings during the term of the loan with approximately $150,000 to be saved annually once the loan is paid off and until the end of the useful life of the turbine (additional 5-10 years) (see Figure 3)[2].

Harvesting the Wind

Holy Name hired Sustainable Energy Developments, Inc. to install and maintain the turbine. The installation took place during the fall of 2008 and the turbine began generating electricity in October 2008 (see Figure 1). The turbine produces an average of 74% of the school's annual electricity needs (see Figure 2). After paying the remaining 26% of electrical costs and making payments on the loan from the Diocese, the school is still saving approximately $50,000 per year in energy-related expenses compared to what it previously spent on utility bills alone (see Figure 3). When the 15-year loan is paid in full (~ 2023), the school is expected to have five to ten more years of electricity generation from the

Holy Name's wind turbine

[2] Based on the following assumptions:
a) An average annual electrical production by the turbine since it went on-line (637,220 kWh)
b) $0.20/kWh cost of electricity
c) 25 year turbine life span
d) Assumed 2.5% a year increase in electricity costs once the loan is paid off

turbine (based on an expected 20-25 year turbine lifetime), resulting in significant savings. The annual maintenance costs are covered by the sale of generated renewable energy credits.

Figure 1: Monthly Electricity Production of Holy Name's Wind Turbine, 2008-2015[3]

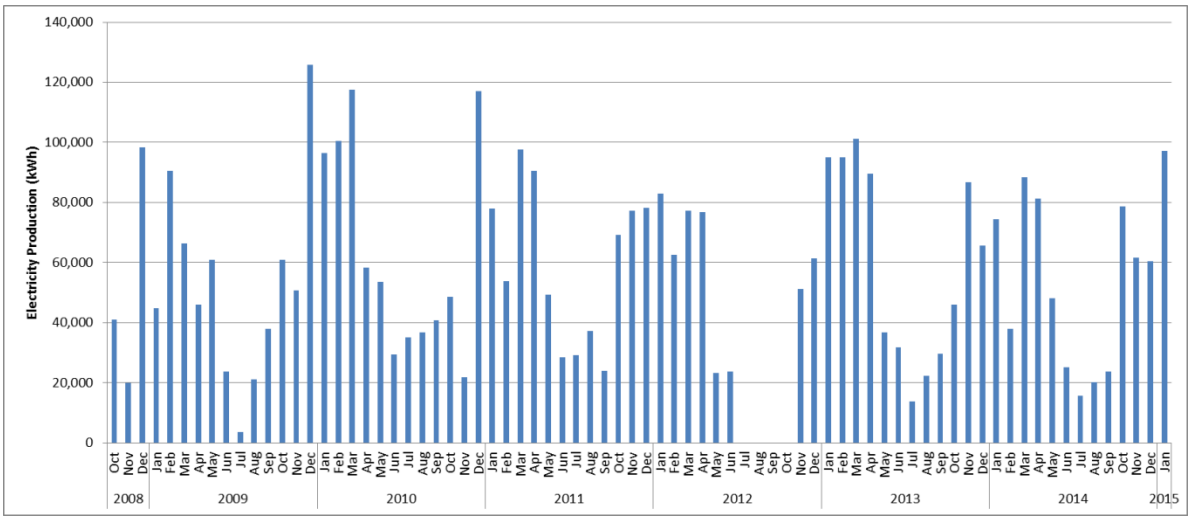
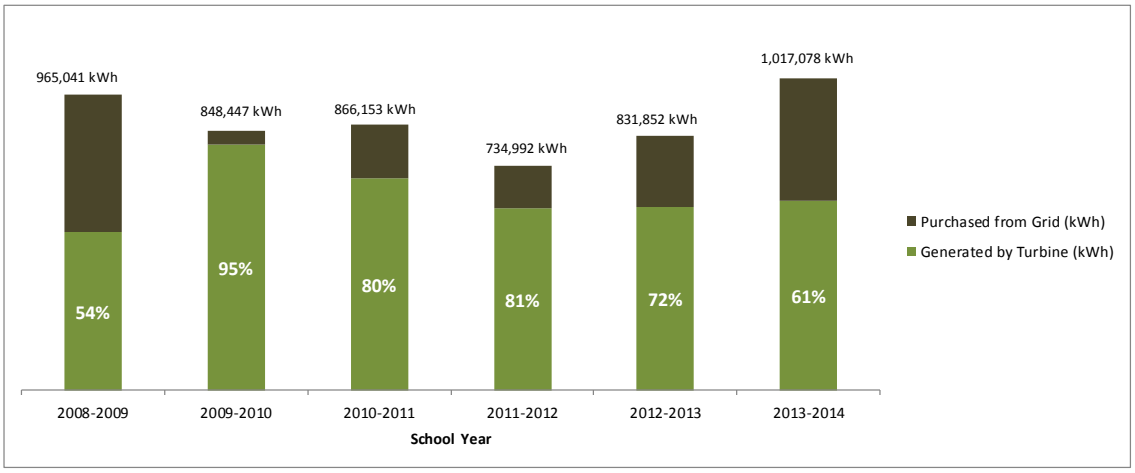
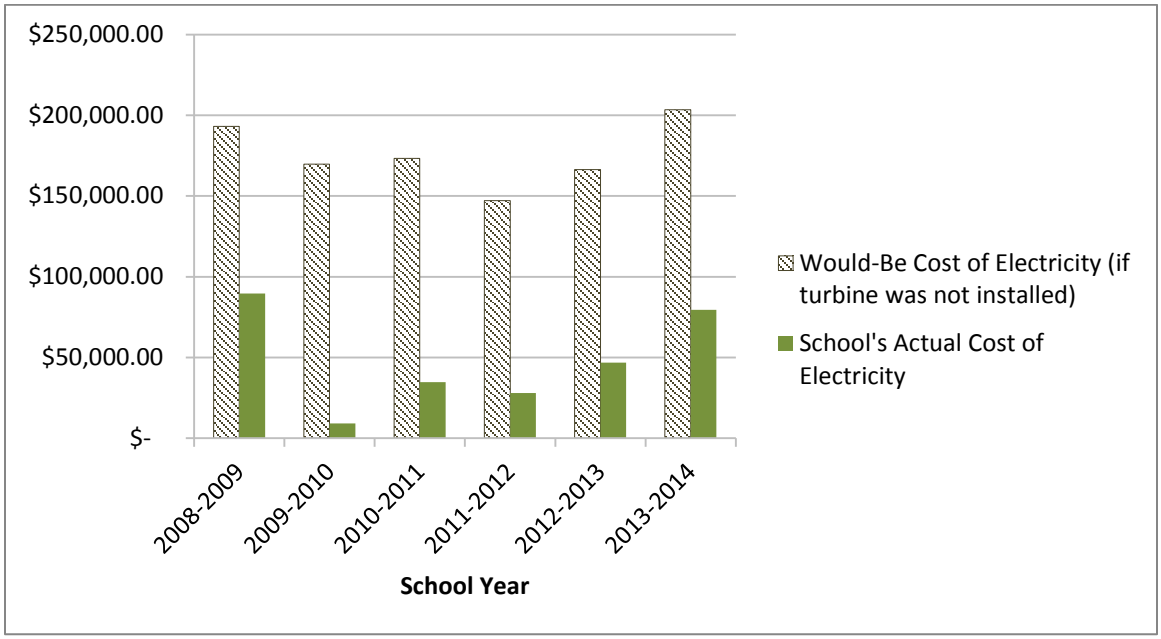


Figure 2: Holy Name's Electricity Consumption and Breakdown of Electricity Sources, 2008-2014[4]



[3] Headmaster Edward Reynolds' records.
[4] Ibid.

Figure 3: Comparison of Holy Name's Electrical Expenses With and Without the Wind Turbine, 2008-2014 (using $0.20/kWh cost estimate)



Operations

Following six turbine stoppages in its first three years of operations and a four-month outage in 2012, the School hired Gamesa, a maintenance firm that has been resolving any issues expeditiously so that wind power is harvested to the maximum.

A number of school staff, including the Headmaster and maintenance staff, are trained on general maintenance of the turbine (such as restarting it in the mornings if high winds activate a brake on the blades) and diagnosing a problem and calling the maintenance company for help when needed.

Community's Feedback

Throughout the design, permitting, construction and operation phases, Holy Name has received only positive feedback from the community. Concerns related to shadow flicker, sound, or visual impact that some abutters to a large wind turbine development project may have, have been addressed via compliance with the City's zoning ordinance regulations and the location of the wind turbine on the top of the hill far removed from any nearby residence. The turbine is located about 20% further than the required minimum setback from neighbors. Shadow flicker (the moving shadows from the rotating blades) always falls on the school's campus, and the turbine is as quiet as predicted in the acoustical study completed as part of the zoning ordinance requirements.

Beyond Financial Benefits

Beyond the monetary benefits, Holy Name's wind turbine has made a positive impact on the environment, students, and the greater Worcester community. By producing almost 4 million kWh of electricity in the six years that the turbine has been online, the renewable energy credits the school has been able to sell are the equivalent to offsetting greenhouse gas emissions of burning almost 3 million pounds of coal![5]

Headmaster Edward Reynolds stands in front of student artwork in his office.

Holy Name's eighth grade science classes and AP Physics classes conduct projects related to the turbine every year, and the school offers wind turbine tours and assemblies for schools across Central Massachusetts, from the elementary level through college.

Edward Reynolds, the headmaster of Holy Name, is deeply passionate about the turbine's tangible benefits as well as the role it serves in the communities in which the school belongs. His message is that the school is "fulfilling its duties as a Catholic community" by being "stewards of God's Earth" and that the turbine is a point of pride for the school, for nearby residences and businesses, and for the City.

This case study was written by Worcester Energy staff based on the research, as well as a site visit and interview with the School's Headmaster Edward Reynolds on March 18, 2015.

[5] EPA carbon calculator http://www.epa.gov/cleanenergy/energy-resources/calculator.html