Section 05:

Wind Energy Feasibility Breadth

5.01: Historic Background:

Western New York has a rich history and vibrant present in renewable energy. Perhaps the greatest example of such technology was the emergence of hydroelectric power at Niagara Falls, over a century ago. Even today, it is still a significant contributor to the region's electric supply. The city of Buffalo also has a distinct advantage in the ability to harvest wind power, due to its close proximity to the Great Lakes.

It has been observed over time that as winds move over large bodies of water, their speeds increase drastically as compared to winds over forested and urbanized land. Buffalo, New York has a strong reputation of taking the brunt force of these winds year around, and blows in the harsh lake-effect snowstorms that have grown to be associated with the region. Some of the best wind sites are along the eastern shorelines of the lakes, where prevailing westerly winds have traveled considerable distances across bodies of water. These factors ultimately make wind power a significantly larger renewable energy source than the total hydroelectric potential of the Great Lakes. Appendix E-1 contains wind maps detailing the average yearly wind speeds in the region.

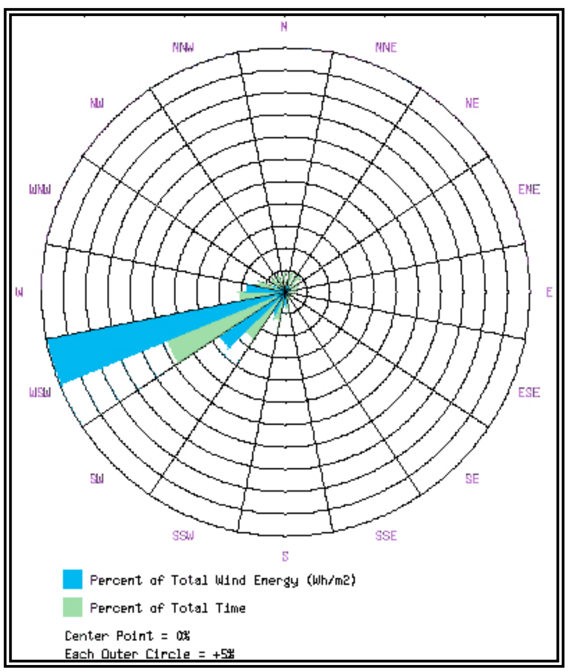


Figure XXXV: Wind Rose for Buffalo, NY

As shown on the wind map in Figure XXXV, prevailing winds tend to flow across Lake Erie from the west-southwest direction to the east-northeast direction, paralleling the major orientation of the lake.

Figure XXXV1: Wind Farm in Ontario, NY

The winds for the Great Lakes region are constantly monitored by more than a dozen stations by the National Oceanic and Atmospheric Administration (NOAA). According to the NOAA, the average yearly wind speed for Buffalo, NY is 5.5 m/s. With this average wind speed, I suspect that wind power could be a viable supplement to the electric power supply at the Hauptman Woodward Institute.

5.02: Economic Background:

The New York State Energy Research and Development Authority (NYSERDA) is a public benefit corporation that was founded in 1975, and provides cash incentives for wind turbines to be used in community, planning, economic development and educational buildings. Under the terms of the program, buildings such as the Hauptman Woodward Medical Research Institute are eligible for 70% of the total funding provided the project can increase community knowledge of wind power and spur knowledge of renewable energy in the region. New York State has a very progressive renewable energy program, in that currently 18% of all electricity generation within the state is done by means of renewable sources. NYSERDA is currently supporting extensive wind resource efforts and encouraging the development of upwards of 500MW across the state. Although the generation at HWI would only be a small fraction of this amount, other sites across the state are cooperating in the efforts to provide New York State with upwards of 25% of the total electricity generation by renewable resources over the next 10 years.

In addition to the NYSERDA first-cost incentives, the New York State legislature recently passed a bill requiring New York’s utility co turbine owners for excess electricity provided to the grid. This policy of “net-metering” will allow wind generation to offset normal electricity usage and run the electric meter backwards when the turbine produces more electricity than the building uses. This allows owners to receive actual retail price for the electric power their wind turbine produces.

Figure XX: Wind Farm in Ontario, NY

5.03: Wind Turbine Analysis:

One of the greatest concerns facing this retrofit was the location of the actual wind turbines. Upon consultation with the engineers at Cannon Design, it was found that the structural members of the building had been oversized to allow extra rigidity as well as for possible expansion to the rooftop penthouse. Of greater concern in this redesign is the architectural impact on the site. Due to the high-design of the building, it was necessary to incorporate the turbines in such a way that they would be aesthetically pleasing

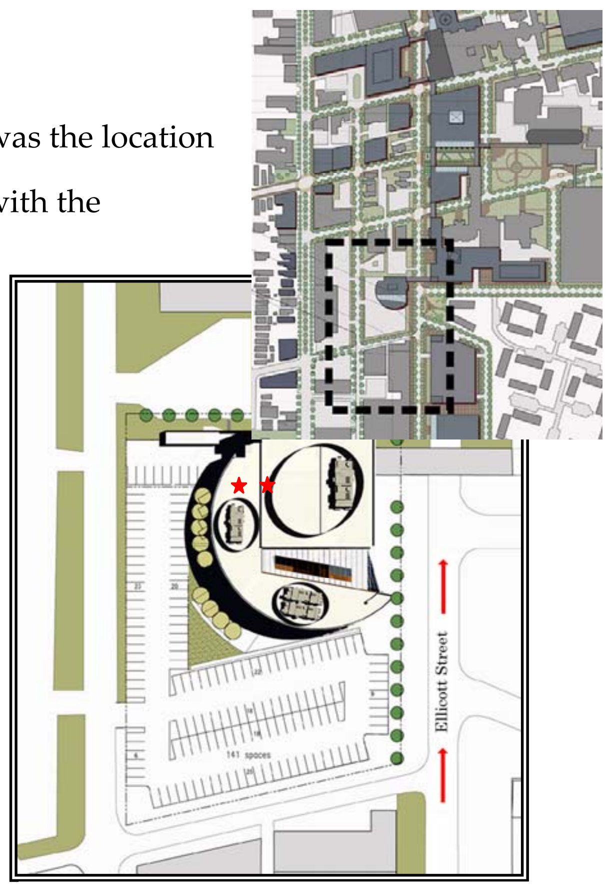
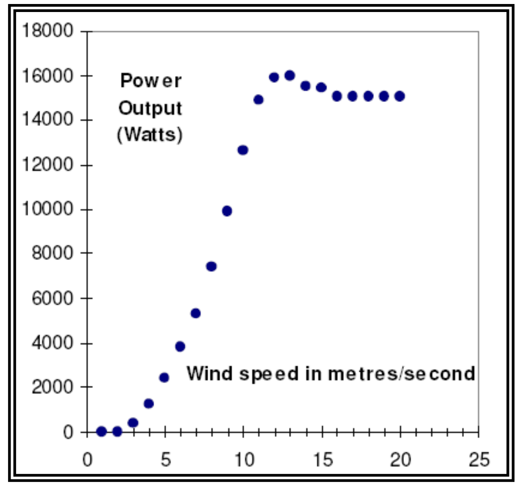


Figure XXXVII: Site and Location of Turbines

Figure XXXVIII: Proven 6kW Turbine Power



to those approaching the building. In this respect, I have decided to locate the wind turbines along the north-facing wall, while the blades will face in the south-westerly direction. (Figure XXXVII) In this respect, attention will not be taken away from the aluminum-clad façade. Due to the northern one-way flow of vehicular traffic on Ellicott Street, the north façade of the building will be the least obtrusive location for the turbines to be placed. After researching a number of small to medium size wind turbines, I have decided to incorporate two 6kW wind turbines by Proven Energy, Ltd. into the design at the Hauptman Woodward Medical Research Institute. Figure XXXVII shows the power curve for the turbine as published by the manufacturer. The highest output is between 15-20 m/s, however the

Manufacturer	Proven Energy, Ltd.
Rated Output @ 12.5 m/s	6 kW
Rated Output @ 5.5 m/s (Buffalo, NY)	1 kW
Rotor Diameter	5.5m
Total Weight	860 kg

Table XIL: Rooftop Wind Turbine Specifications

average wind speed in Buffalo, NY is approximately 5.5 m/s. Although this value is considerably less than the maximum output, Proven Energy, LTD actually anticipates an average wind speed of 5 m/s in its calculations. As shown in Table XIL, the anticipated rated output at the Hauptman Woodward Institute would be approximately 1kW per turbine. Although I had originally anticipated using one 15kW turbine, the initial cost was actually cheaper to install two 6kW turbines which provided the same power output at wind speeds found on site. In addition, the roof will not be as cluttered and the architecture of the building and surrounding area will not be as affected. Cut sheets from the manufacturer can be found in Appendix E-2.

5.04: Turbine Payback and Conclusions:

A summary of the installation costs are found below in Table XLI. As noted, a majority of the project cost would be subsidized by the New York State Energy Research and Development Authority. With a peak electric rate of 9.5c per kWh in Buffalo, NY, the payback period was found using the method below.

Figure XL: Proven 6kW Wind Turbine

Table XLI: Rooftop Wind Turbine Costs

Proven 6kW Wind Turbine w/Grid Connect	$18,160
Isolation and Rectification Controller	$1,090
Tilt-up self-supporting mast (9m)	$6,860
Total Cost per Turbine	$26,110
Total Installed Cost	$52,220
Total Cost with 70% NYSERDA discount	**$15,666**

$$\text{Payback Period (years)} = \frac{\text{Initial Investment}}{\text{Annual Savings}}$$

Assume Annual Savings at Peak Electric Rate:

Annual Savings = 12,000 kWh * $0.0095/kWh = $1,140

$$\text{Payback Period} = \frac{\$15,700}{\$1,140} = \textbf{14 years}$$

Table XLII: Wind System Payback

No. Units	2
Total Weight	1720 kg
Initial Investment	$15,700
Total Power Output	2 kW
Annual Electric Savings	12,000 kWh
Payback	**14 years**

According to the payback calculation described above, the Hauptman Woodward Medical Research Institute would require a 14 year payback on the wind turbine and related equipment before seeing a profit. Although this length of time is somewhat high, these units have a typical life span of 20-25 years provided they are maintained properly. In that case, this system would prove profitable for perhaps a decade or more. It is important to note that this is only the case when NYSERDA subsidizes the cost of the units. Had the owner been forced to pay the full installation costs, the payback period would be 46 years – well beyond the life span of the units. A summary of the findings can be found in Table XLII.