NJ Wind Anemometer Loan Program

New Jersey Board of Public Utilities

Center for Advanced Energy Systems, Rutgers University Final Report

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After receiving shipment of the three NRG TallTower 20m anemometer towers, work commenced immediately. Initially, our goal was to install the anemometer on a test site to determine the specifics of tower installation. Shortly following approval from New Jersey to install anchors at our test location, the first anemometer tower was erected late in summer 2005. Our first attempt at installation was unsuccessful as the screw-in type anchors kept binding on rocks under the surface of the soil. Most of New Jersey, at least the northern portion, shares the same type of rocky soil that we encountered, so a new type of anchor was needed. We purchased two sets of arrowhead anchors from NRG Systems. Arrowhead anchors are driven into the ground via drive rod and are designed to maneuver around or break through rocks. Our second attempt at installation of the tower was much more successful with the new anchors. The anemometer remained on the test site for a few months while we monitored the condition of the tower and the provided wind measurement equipment. Although our test site would not suffice as a viable wind energy site, it was able to provide us with valuable information regarding installation and operation of the tower.

During the test anemometer's tenure, we were able to contact several wind power vendors with clients that were proposing the installation of a small scale wind turbine. Most of these vendors were found on the NJCEP website. We provided such vendors with our contact information and requested that it be passed on to such clients that seemed good prospects for the use of wind power. We have received several solicitations for the use of our wind measuring equipment as a result of this. Prices of small and

medium sized wind turbines were also researched in order to give a general idea of how much installation of a small scale wind turbine would cost. This information will allow us to offer better advice in response to any questions that prospective loan clients may have.

The first organization to secure the use of an anemometer was the General Square Stanley Theater located in Jersey City. The taller buildings surrounding the theater create a wind tunnel, funneling large amounts of wind over the rooftop of the theater. No tower was required for the installation, as we were able to attach the anemometer to a scaffolding construct that was erected for such a purpose. Data for the first month has been collected and will continue to be collected for each following month.

The second site for the use of our anemometer towers is a farm in Long Valley. The farm itself is 80 acres, much of the area being open space and fields. Their farm is located at the top of a mountain at an elevation of 1,100 feet. They intend to convert a barn into an education center to teach children about renewable energy. Installation of the tower is scheduled for May 11.

The third anemometer has been erected at Iona Hill Farms near Hackettstown, NJ. Because of the farms location near a lake, this wind speed data will help provide insight into the increase of wind speed due to proximity to bodies of water. It is generally understood that coastal winds are stronger due to minimal obstruction, but little research has been done on smaller lakes and ponds. Data is currently being collected for the 12-month period and will be analyzed as soon as all data is collected.

There are also some prospective clients that we may not be able to serve in the immediate future due to our limited resources. However, we are keeping a list of organizations that are interested in the loan anemometer program as possible future

clients. Also, should one of our clients fall through or decide they do not need the anemometer for the full twelve month term; we can redistribute the anemometer to another interested party with minimal loss of time.

Results: Stanley Theatre

The Stanley Theatre anemometer was more of an academic pursuit than a specific feasibility study. Because of its urban location, wind patterns are both complex and unpredictable. The Stanley Theatre is located downwind of two large buildings. Our theory was that wind might be funneled through the larger buildings, as shown in Figure 1, concentrating the wind power that's available above Stanley Theatre.

Figure 1: Google Maps Satellite Image of Stanley Theatre, showing possible wind funneling.

As shown in figure 2, wind speeds were lower than expected.

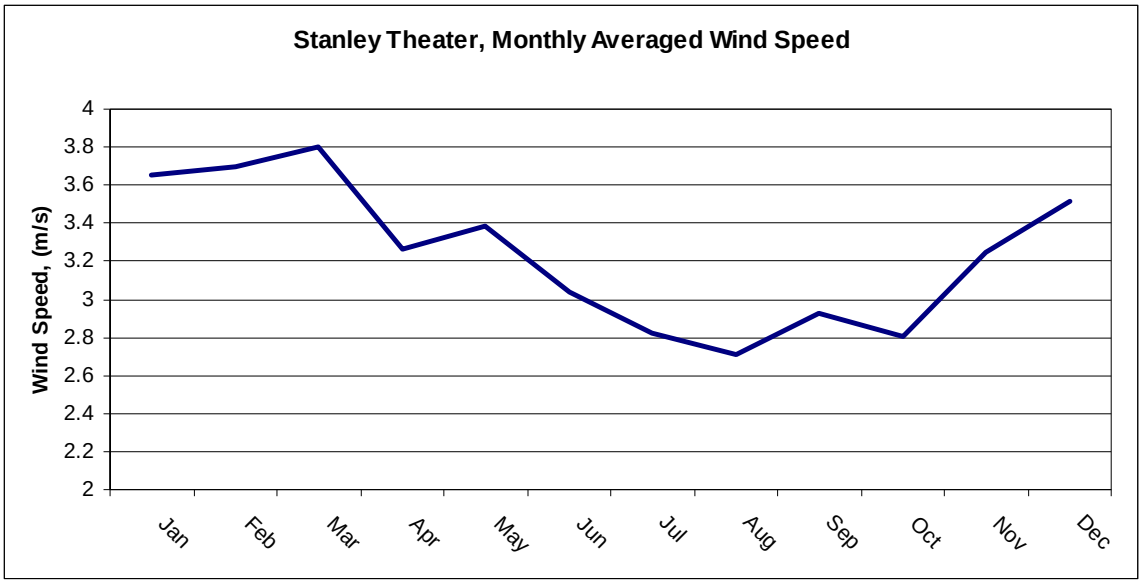

Figure 2

In order to fully analyze the wind potential of the location, one must look at the power density of the wind. Since power density scales with the cube of velocity, bins are used to maintain accuracy in the resultant, as shown in Figure 3.

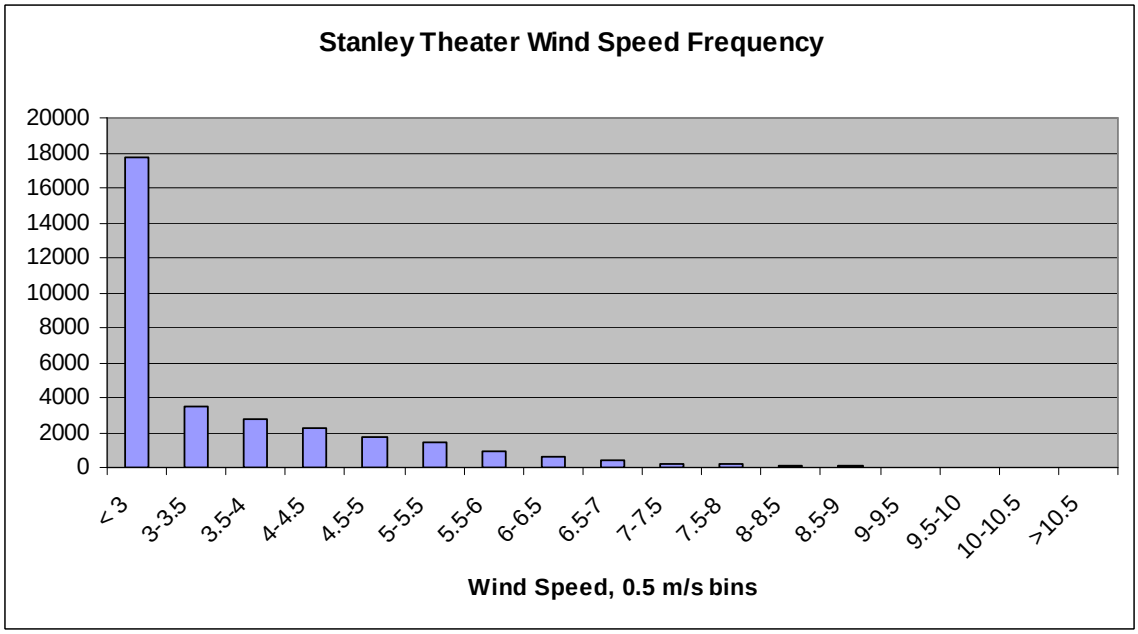

Figure 3

The wind rose shown below in figure 4 shows the prevailing wind directions as a percentage of time.

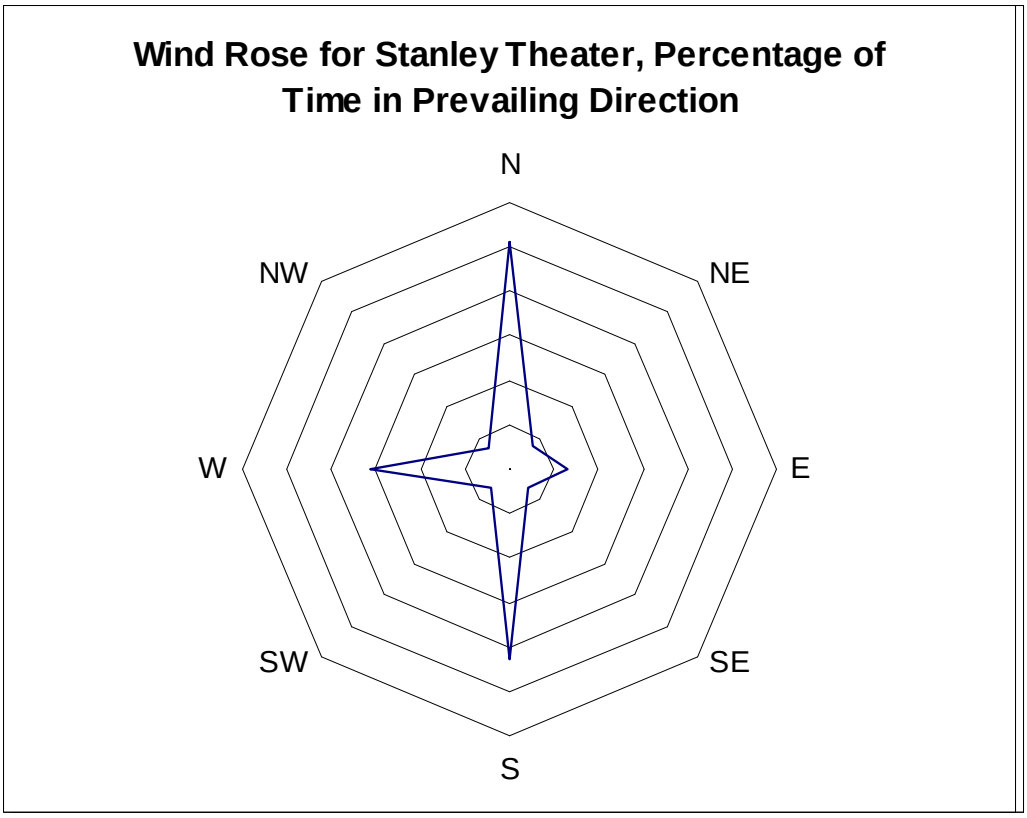

Figure 4

These data lead to final values of power density and turbulence intensity. Power density averaged to 29.7 W/m^2, and turbulence intensity averaged to about 30%. In conclusion, this location is not a good spot for a traditional horizontal axis turbine. Perhaps with the commercialization of vertical axis turbines, this location may seem more attractive.

Results: Totten Family Farms

A tower was erected at Totten Family Farms in Long Valley, NJ. The farm itself is 80 acres, much of the area being open space and fields. Their farm is located at the top of a mountain at an elevation of 1,100 feet. They intend to convert a barn into an education center to teach children about renewable energy.

Wind Speeds

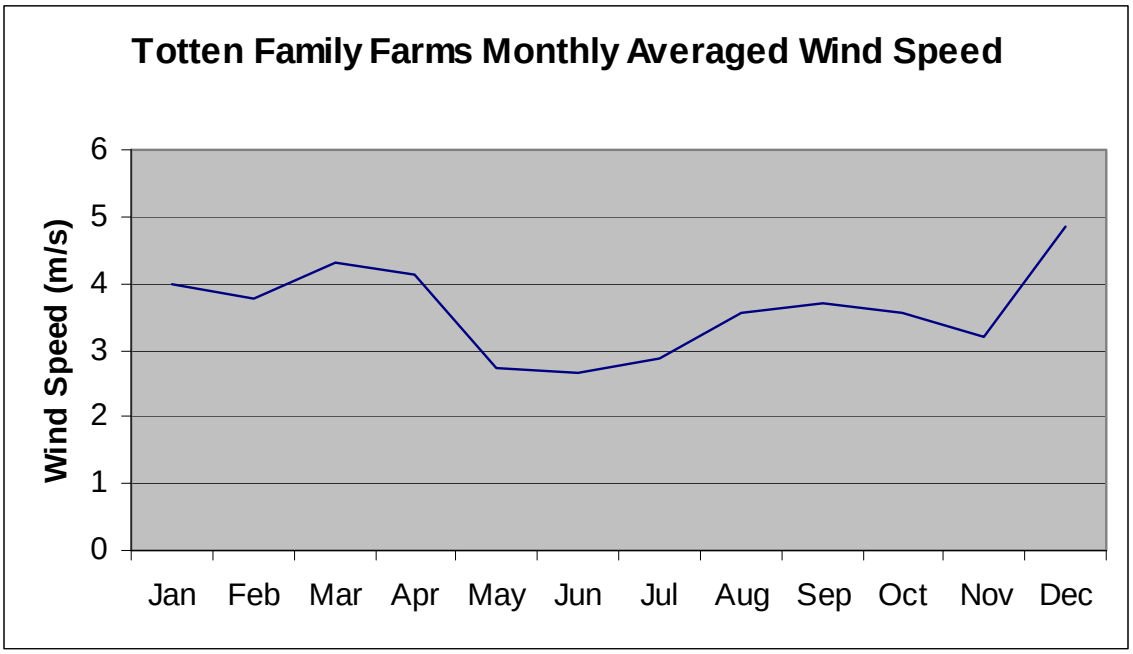

Figure 5

Wind Speed Bin Distribution

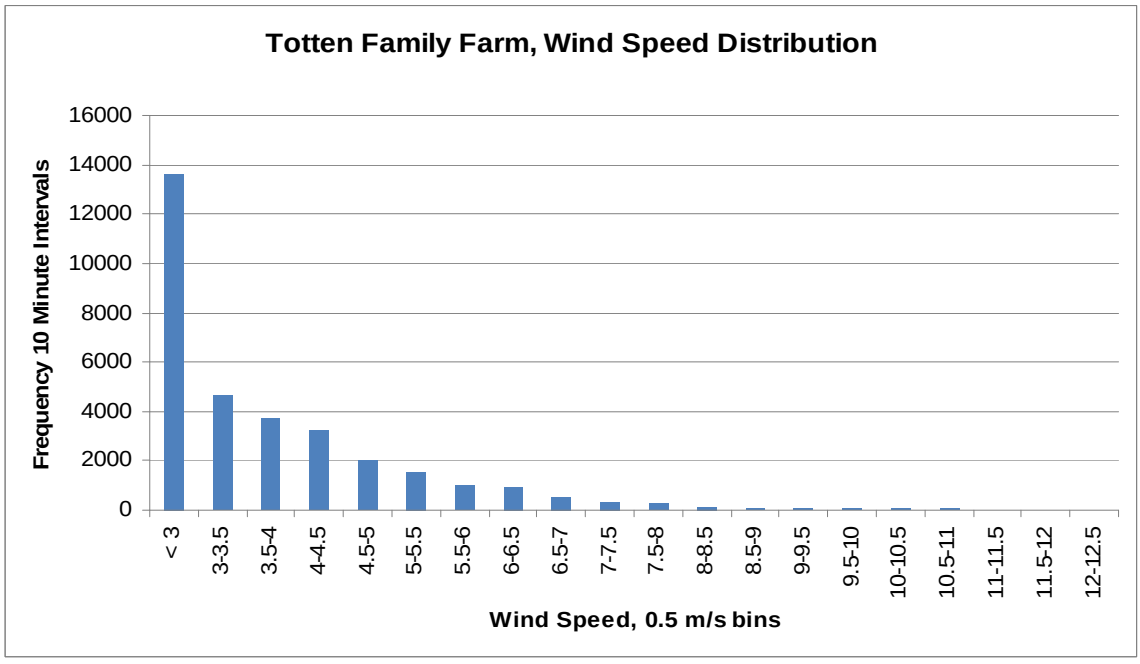

Figure 6

Because of malfunctioning equipment, directional data was not obtained from the Totten Family Farms anemometer. The average power density came out to 49 W/m^2, which is

better than was available at Stanley Theatre. The average wind speed was 3.7 m/s, and turbulence intensity was calculated to be 34%. While more feasible than the Stanley Theatre location, the power density is lower and the turbulence intensity was higher than we had hoped. It has been suggested that the treeline in northern New Jersey is higher than average, and that the turbulence intensity is a product of the tower being as high or lower than the treeline. A taller tower may provide more favorable results.