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A COMMUNITY WIND ENERGY PROJECT N RURAL ALBANY COUNTY, NEW YORK STATE

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1. ABSTRACT

[1]A community-owned wind farm is under consideration at a site near Knox, NY. The establishment of a wind farm using mega-watt class wind turbines requires meteorological monitoring at the site of interest for a period of at least one year, and preferably longer. Sustainable Energy Developments, Inc. and Integrated Environmental Data, LLC have undertaken to monitor the wind speed and direction, the wind shear and the temperature for this period. A 50 m tilt-up meteorological mast was erected and commissioned by Sustainable Energy Developments, Inc. near the beginning of October, 2006. Data were emailed daily to Integrated Environmental Data, LLC, archived and analyzed. This report summarizes the meteorological data and energy yield analysis based on the one-year period of record (POR) from October 10, 2006 through October 9, 2007.

2. INTRODUCTION

Increasingly the "new energy economy" features distributed generation of many types. There is a growing interest in local, or "community" ownership of energy plants, including electric generation facilities. Community-based energy projects can take many shapes. In particular "community wind" projects can range from a single wind turbine placed behind the meter to offset a particular load, to farmer-owned projects selling power to the wholesale market, to municipally-owned projects. Two things that community wind projects have in common are their generally smaller size in terms of total capacity and the involvement of local community members as developers and/or owners of the project. This paper will focus on the Helderberg Community Energy wind project in rural Albany County, NYS. The project began as a NYSERDA-funded research project with the overall goal of creating a business model for community-based wind energy projects. The purpose of the model is to broaden public participation in the wind energy development process.

3. METHODS

3.1 Site Prospecting

The project team examined nine potential sites within rural Albany County that may be capable of hosting an economically viable project of 10MW or less. A report was generated and is included as Appendix A. Four meetings were held at different locations throughout the hilltowns region to describe the findings of the analysis and solicit feedback from community members as to the social acceptability of potentially hosting a project in their community.

Three criteria were used to determine the site with the greatest level of support for a potential project: willingness of landowner to host a wind measurement tower, willingness of other landowners to potentially host MW class wind turbines on their land, and willingness of town to host wind measurement tower and potentially host a small wind farm. Based on these criteria, it was determined that the site with the highest level of public acceptability was located in Knox, near the Beebe and Middle Road intersection.

The site selected for this study was in the Town of Knox and is referred to as the Octagon Barn Site. The Octagon Barn Site (OBS) is located at approximately N 42.6848 latitude, W 74.1525 longitude on Middle Road in the Town of Knox. The area consists largely of farm fields (hay production and grazing) with hedgerows (fencerows) separating the fields. There are delineated wetlands to the northwest approximately 1300 m from the site and to the southeast approximately 1550 m. Interspersed throughout the agricultural landscape are varying sized patches of forested areas.

3.2 Wind Resource Assessment

A 50 m tilt-up meteorological tower (Figure 1) has been operating since October 10, 2006, for the purpose of assessing the wind resource and

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potential energy yield from a wind turbine placed at the tower's location in Knox, NY within the Helderberg Community Wind Project. The configuration of instrumentation on the tower is shown in Table 1. This report summarizes the results of a one-year period of record from October 10, 2006 through October 9, 2007 for the tower, referred to here as tower 0118.

An ART, LLC model VT-1 sodar was used in a six-week campaign in the fall of 2006 to provide shear parameters above the 50-m tower top, to hub height. Additional sodar measurement campaigns were also conducted in cooperation with AWS Truewind, LLC as the need arose for testing sodars belonging to them. The sodar was used primarily to provide a power law shear parameter for extrapolation from the 49.5 m tower top to an 80-m hub height.

Climatological adjustment of the tower data was done via the Measure-Correlate-Predict (MCP) method using the KALB surface data, located at the Albany Airport. Better correlation was obtained with the KSCH station in Schenectady NY during the first few months of the study, but this station stopped reporting about six months into the study period.

4. RESULTS AND DISCUSSION

Table2 summarizes the annual statistics derived from the qualified data on tower 0118. The mean wind speed at 50 m was 5.40 m/s. The energy in the wind is mainly in the WNW sector, with much smaller contributions in winds from the NW and the W. (Figure 2).

The diurnal trend in wind speed at 30 m and at 50 m is shown in Figure 3. The shear in wind speed was greatest at night.

Correlation of the daily mean tower speeds with those at the Albany airport (Figure 4) was moderately good using robust regression techniques. Better results (not shown) were subsequently obtained with orthogonal regression. The long-term 80-m speed obtained in the MCP process was 6.5 m/s, yielding a gross capacity factor of 28%.

Figures 5 and 6 depict the monthly and daily average speeds for the Albany airport site for the tower period of record and for the entire period since 1995. Interannual variability in the wind speed shown in these figures illustrates the need for the MCP process and highlights the critical requirement on the part of the wind industry for reliable long-term surface met. data.

Sodar wind profiles (Figure 7) consistently upheld the use of a shear parameter of 0.28 for extrapolation from 50 m to 80 m.

The distribution of the tower-top speed in comparison with an example wind turbine power curve is shown in Figure 8.

5. CONCLUSIONS

A resource assessment was conducted in support of a small-scale community-developed wind project. The resulting capacity factor was 28%, which is generally considered low for commercial-scale wind energy development. Nonetheless economically attractive options exist for development of a small locally-owned wind farm (4.5 MW total capacity). Such options depend on the cost of financing and the wholesale price of electricity bundled with available RECs (Renewable Energy Credits).

The process of climatological adjustment of 1 or more years of on-site met. tower data ("MCP") depends heavily on long-term data sets from surface stations. Such stations were not designed for this purpose. There is a critical need for a network of standardized met. stations which meet the requirements for the wind energy industry.

Further project development activities are being conducted by a group of community members who formed Helderberg Community Energy, LLC as an outcome of this project.

6. REFERENCE

Moore, K. E. and B. H. Bailey, 2005. Maximizing the accuracy of sodar for wind energy resource assessment. Proceedings of the American Wind Energy Association, Denver, CO. May 2005.

7. ACKNOWLEDGEMENTS

This project was funded in part by the New York State Energy Research and Development Authority as project # 9003. AWS Truewind, LLC allowed the use of extra sodar data collected in conjunction with their testing of sodars, conducted with the cooperation of Integrated Environmental Data, LLC at the site.

8. FIGURES AND TABLES

Figure 1 - Site of tower 0118, looking SW toward tower.

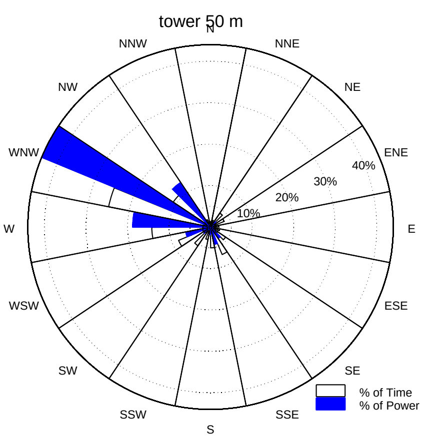

Figure 2. Wind rose for the 50 m met. tower at the Octagon Barn site.

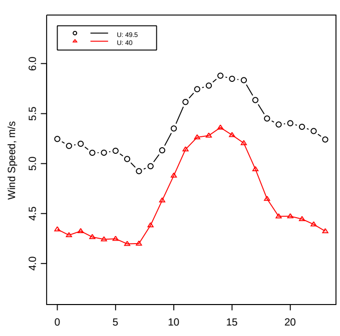

Figure 3 Mean wind speeds by hour of day at two heights, for tower 0118.

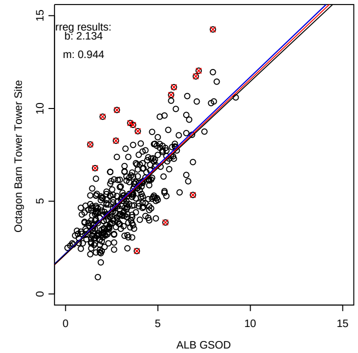

Figure 4 Daily mean wind speeds at the Knox tower 0118 site compared to the wind speeds at the Albany airport (KALB). Observations deemed to be outliers (having weights less than 0.5 in a robust regression) are shown with a red "X", and were removed from the overall regression equation.

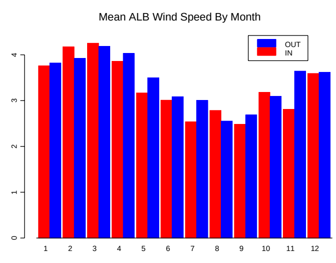

Figure 5. Monthly mean wind speeds at KALB for the tower period of record ("IN") and for the period before the tower period of record ("OUT").

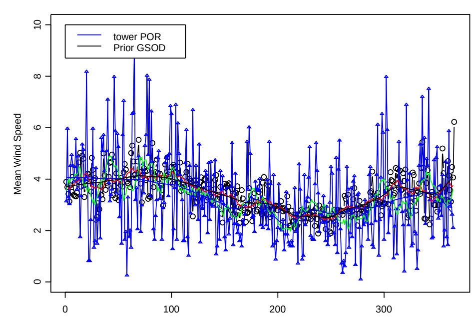

Figure 6. Mean wind speeds at KALB by day of year for the tower period of record, and for the period before the tower period of record (1995 through September, 2006). The smoothed lines are 15-day running means.

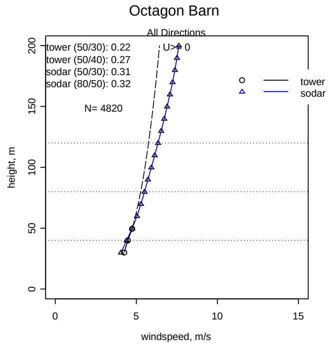

Figure 7. Average wind profile for sodar and tower, for all wind speeds and directions. Dashed line in the extrapolated tower wind profile using the tower 49.5/30 shear parameter.

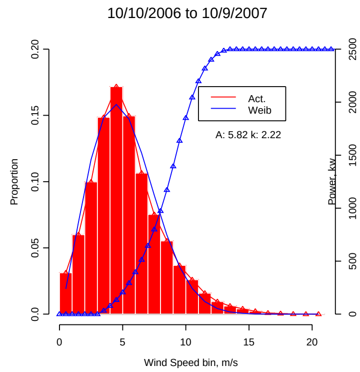

Figure 8. Histogram of wind speeds at 49.5 m (1 m/s bins) for the one-year tower POR. Plain blue line is best-fit Weibull distribution using non-linear least squares regression. Blue line with triangles is the power curve for the Clipper Liberty C89 turbine.

Table 1. Configuration of the instrumentation on met. tower 0118, as given by SED, Inc. Boom orientations are in degrees relative to magnetic north.

Instrument	Height, m	Boom Orientation
NRG Max. 40 Anemometer	49.5.	264
NRG Max. 40 Anemometer	49.5	354
NRG Max. 40 Anemometer	40	4
NRG Max. 40 Anemometer	30	258
NRG Max. 40 Anemometer	30	351
NRG 200P Vane	47.5	16
NRG 110S Temperature	48	n/a
NRG 110S Temperature	3	n/a

Table 2. Summary of wind characteristics for the one-year period from October 10, 2006 through October 9, 2007 at site 0118.

Site	0118
Mean Wind Speed @ 49.5 m (m/s)	5.4
Mean Wind Speed @ 40 m (m/s)	5.1
Mean Wind Speed @ 30 m (m/s)	4.6
Wind Shear (49.5/30 m)	0.281
Wind Shear (49.5/40 m)	0.268
Mean Wind Speed at 80 m (m/s)[1]	6.1
Mean Wind Speed at 100 m (m/s)[2]	6.5
Prevailing Wind Directions	WNW
Mean Turbulence Intensity	0.152
Mean Temperature (^{o}C)	10.67
Weibull A/k (Long-term 80 m speed)	7.03/2.29
Availability (%)	97.5%
Long-term 80 m speed (m/s)[3]	6.5