Independence, VA

Project Summary
As part of Virginia's State-Based Anemometer Loan Program, an anemometer was placed in Independence, Virginia to assess the area's wind energy potential. Wind speed and direction were recorded from November 8, 2004 through November 7, 2005. Annual average wind speed during the monitoring period (66 ft. [20m] above ground level) was recorded to be 10.55 mph (4.72 m/s). Wind power density is calculated to be 131.49 W/m^2.

Project Location
The monitoring equipment was installed on private land in Independence, Virginia at an elevation of 3400 feet. The site is located at N 36° 40.02', W 81° 12.36'.

Monitoring Equipment
The 20-meter NRG-NOW Systems – Wind Explorer kit includes one tower, one Wind Explorer data logger with shelter box, one #40 Maximum anemometer, one #200P wind direction vane, sensor cabling, one lightning rod with copper ground, and two data plugs.

Results

Average annual wind speed	10.55 mph (4.72 m/s)
Average annual wind power density	131.49 W/m^2
Month with greatest wind resource	March
Average wind speed during month with greatest resource	13.1 mph
Month with least wind resource	September
Average wind speed during month with least resource	7.9 mph

Monthly Variation

Figure 1 below shows the average monthly wind speed for each month throughout the recorded year. Above average months occur during winter and early spring, while below average months occur during summer.

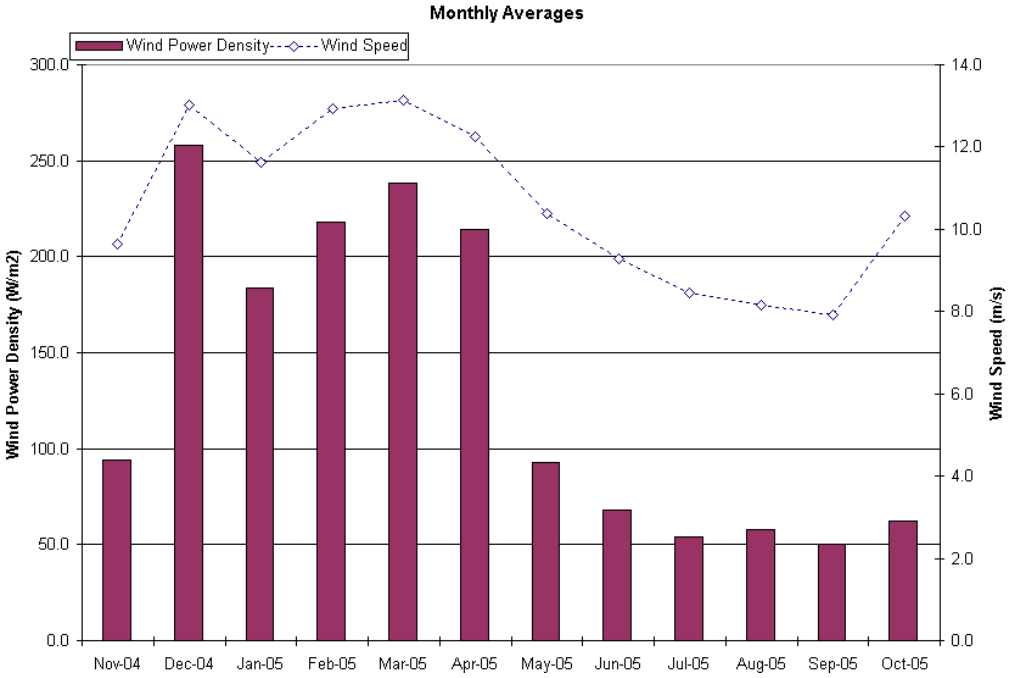

Figure 1. Monthly average wind speeds and power densities throughout the year.

Diurnal Variation

Figure 2 shows how wind speeds vary on an hourly basis. Stronger winds are more prevalent during afternoon and late evening, early morning hours. Slower winds more often exist during sunrise and early evening hours.

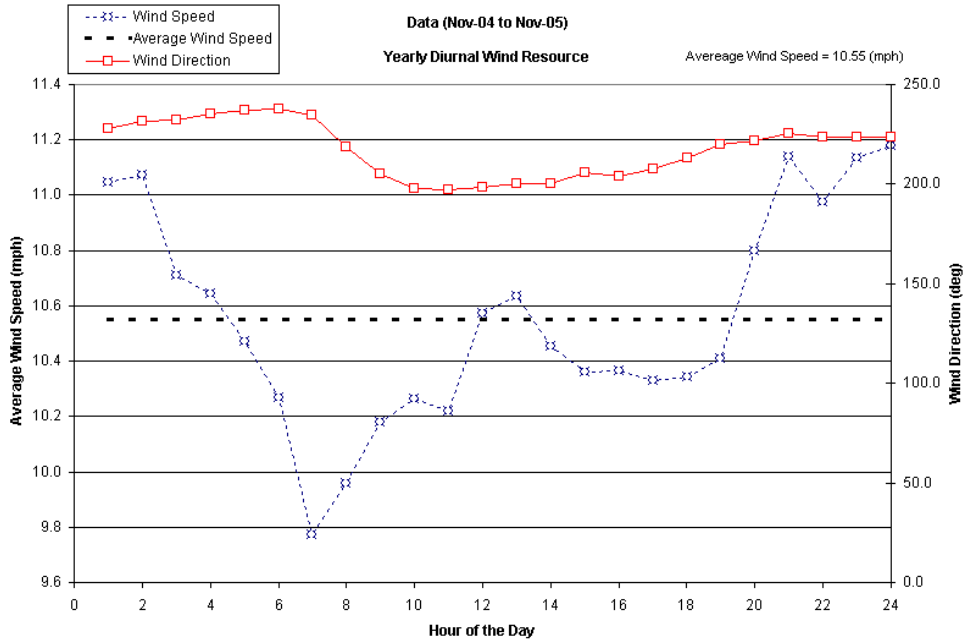

Figure 2. Average hourly wind speeds and directions throughout the year.

Monthly Diurnal Variations

Figure 3 shows the diurnal (hourly) variations of the wind speed over each month. The trends of each month closely follow one another.

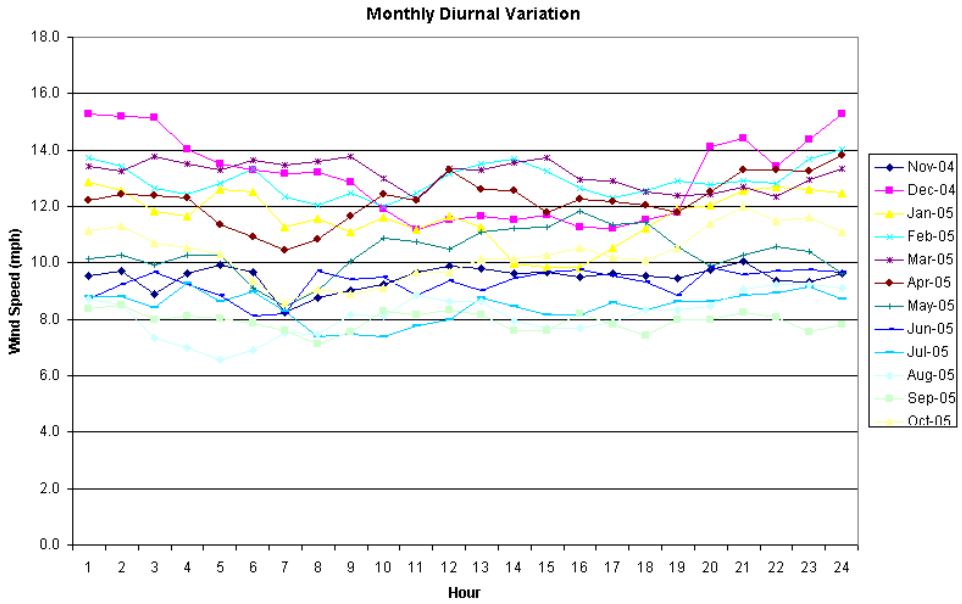

Figure 3. Average hourly wind speeds for each month.

Wind Speed Histogram

Figure 4 shows the occurrence in number of hours that each wind speed occurs. Typically this falls under what is called the Weibull distribution, with a high peak early, and a tailing off at higher wind speeds.

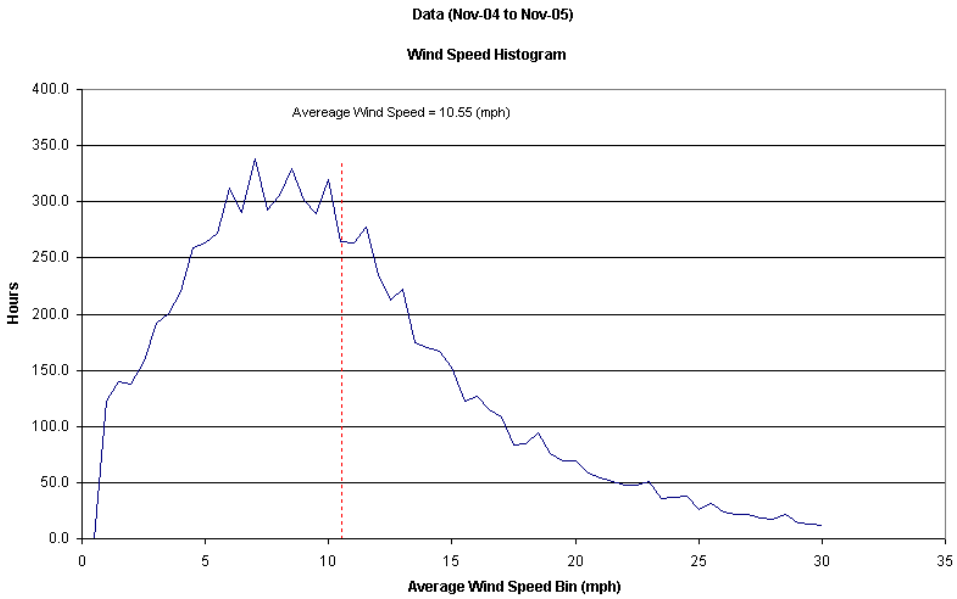

Figure 4. Wind speed frequency over the year by # of hours.

Wind Speed and Direction Trace

Figure 5 shows the wind speed and wind direction reading for every ten-minute average over the course of the data. The wind speed data is the blue line, and the directional data are the red lines.

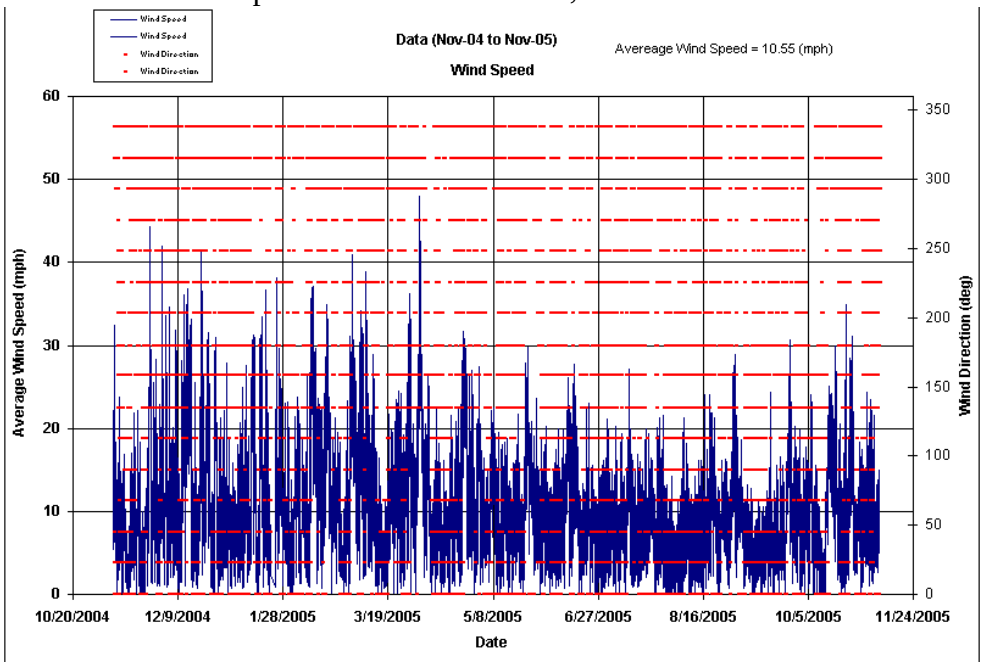

Figure 5. Wind speed and direction readings throughout the year.

Wind Daily Averages

Figure 6 shows the average wind speed and direction by day of the month. Notice there is no particular trend here.

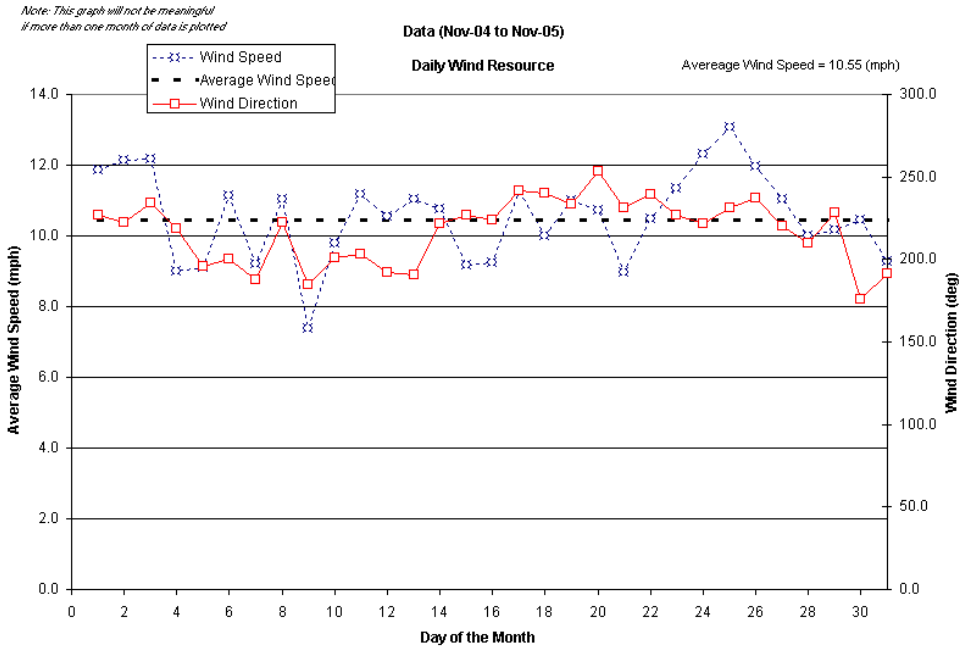

Figure 6. Wind speed and direction averages by day of the month.

Wind Speed Occurrence by Direction

Figure 7 displays the average wind speed for each direction the wind comes from. It also shows the percent of time in that direction bin. For this site the higher wind speeds came from the northwest and south-southeast.

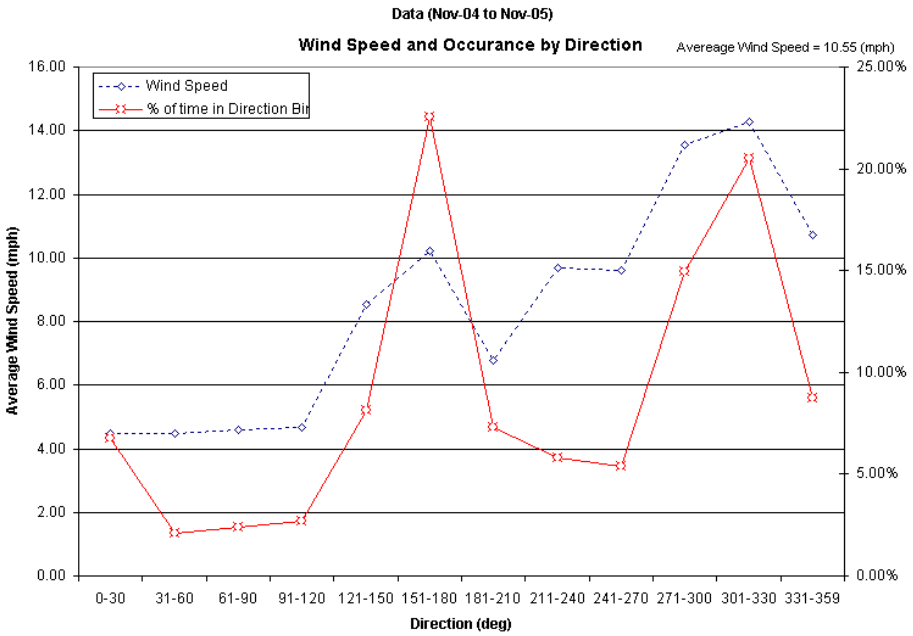

Figure 7. Average wind speed for each direction bin and % time in that bin.

Frequency Wind Rose

Figure 8 displays a frequency wind rose. It can be seen that the majority of the wind comes from the northwest and south-southeast directions.

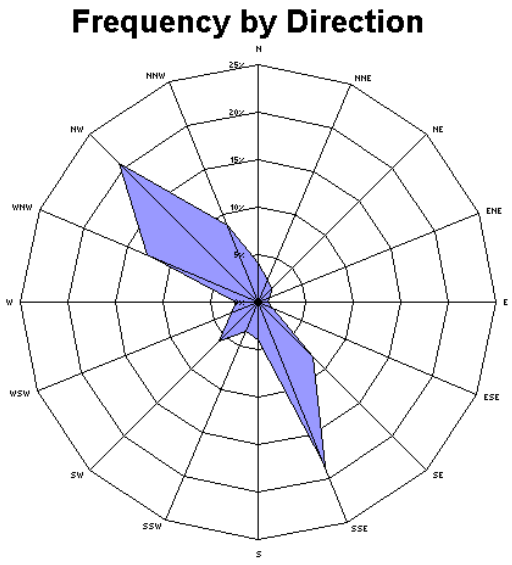

Figure 8. Wind rose displaying wind direction frequency.

Energy Rose

Figure 9 is an energy wind rose, showing the number of kWh/m^2 available from 16 compass-point directions. The majority of energy comes from the northwest and west-northwest. This is due to the high frequency of occurrence of these winds along with relatively high wind speeds.

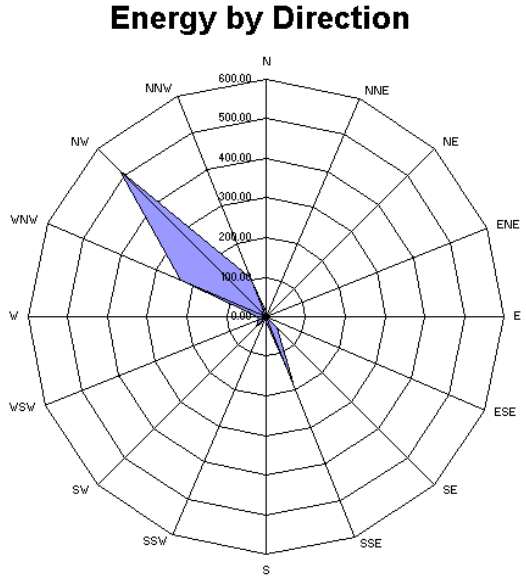

Figure 9. Energy wind rose with units in kWh/m^2.