Potential Wind Energy in the vicinity of Ball State

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ABSTRACT

The primary focus of this study is to determine the power production potential of BSU's Cooper farm site located north-west of Muncie, IN. The annual potential electrical energy that can be harnessed from the wind in the vicinity of Ball State is here calculated and compared to BSU's total electrical consumption for one year.

Background

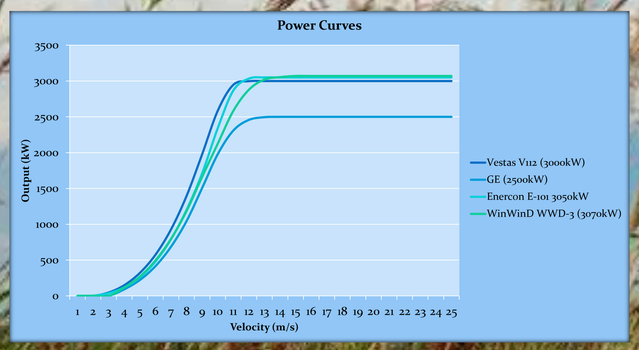
The American College and University Presidents Climate Commitment which was signed by President Jo Ann M. Gora in 2006, specifies that the campus must eliminate its net greenhouse gases in a reasonable amount of time. By investing in wind energy on campus, we could reduce the amount of electricity consumed by the University and further our goal of eliminating greenhouse emissions.

Time constraints on Cooper Farm data

In order to calculate the power production of the site, wind data needed to be complied over the course of one or more years before it could be analyzed. Currently, the only data for the site is now just under one year. Because of this, a comparable site was picked with similar terrain conditions and a larger data set. The Delaware County Johnson Air Field has 30+ years of weather data. This data was used to gage the potential of the Cooper farm site.

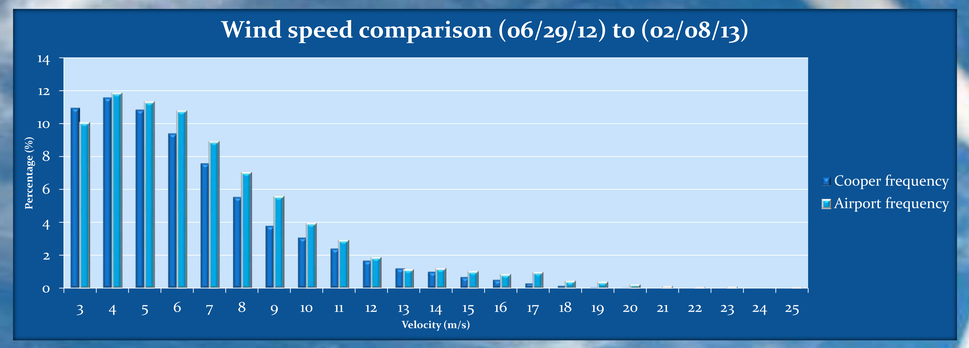
Wind turbine power curves

To accurately predict the electrical power that can be produced from a site, a suitable wind turbine must be selected . On comparison of various turbines, the Vestas V112 turbine rose to the top for best option to produce electrical power at the site. Below are the power curves for a few larger and more popular wind turbines.



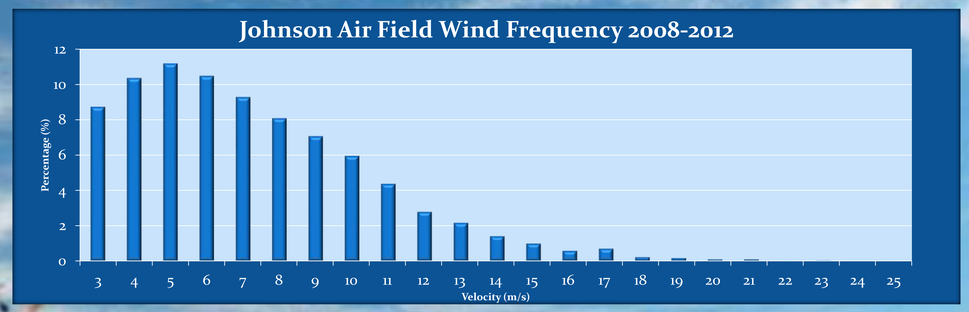
Johnson Air Field compared to Cooper Farm

Two frequency distributions were created, one for the collected wind speed data from Cooper Farm and one for the Johnson Air Field wind speed data during the same time period. The frequency distributions were compared to determine if the two sites collected similar wind speeds during the same time period



Johnson Air Field wind speed frequency from 2008-2012

Possibly due to some onsite obstructions of the measuring equipment the Johnson Air Field frequency is slightly higher at faster wind speeds than Cooper Farm during the sampling time period. If the data is interpreted to mean the limit of Cooper Farm's power production is less than or equal to Johnson Air Field, then an analysis of the Johnson Air Field data will produce the maximum potential for wind energy at the Cooper Farm site.



Equations

Hours per year at each wind speed = $(\%\ at\ each\ velocity/100) \times 8760$ hours

Power produced per wind speed = Power curve×Hours per year at each wind speed

Total kWh of electric power annually = Sum of power produced per wind speed

Percentage of Ball State's total consumption = (power produced/power consumed)× 100

Annual savings = Power produced × \$0.05/kWh

Total yearly output power

The total annual output power can be calculated by first determining the annual power produced at each wind speed. Next the individual power produced at each wind speed is summed to find the total annual output power for the site.

Annual Power Reduction and Savings

Ball State consumes around 111,000,000 kWh of electricity per year and pays around \$0.05 per kWh. If the power produced by the site is compared to Ball State's annual consumption, then it is possible to find a percentage of the total consumed power that could be offset by investing in a wind turbine. It is also possible to calculate an annual savings due to this offset in consumed power.

Other Benefits and Savings

Investing in clean renewable wind energy could save money by reducing the amount of energy purchased from the power grid. It is also possible that the initial investment in the project could be government subsidized with grants or that it could produce a profit by selling green energy credits. Ball State might also have the opportunity to offer new classes on campus based on renewable wind energy. Lastly there is the continued recognition of Ball State's leadership in investing in green energy and its commitment to reduce carbon emissions.

Results

Due to the numerous factors involved in purchasing and constructing a wind turbine, the total expenditure of such a project is not defined at this time. Upon contact and consultation with a manufacturing company an quote could be acquired. However, a reasonable estimate is a payback time of approximately 15 years.

Annual Power Output (kWh)	8,944,860
Annual Power Reduction	8.06%
Annual Savings	\$447,250.00