Quantifying the Trends in Wind Speed and Wind Power Potential in Arizona

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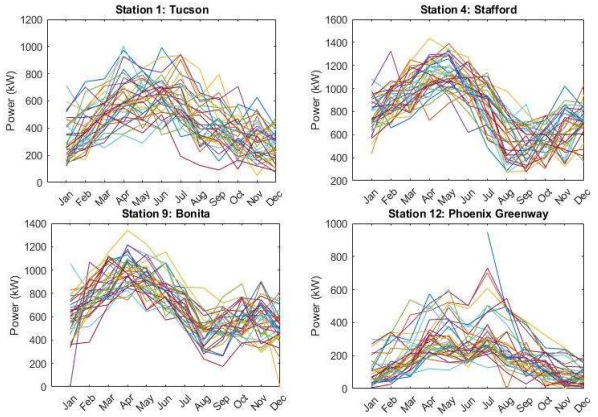
Figure 1. *Wind power trends of two urban and two rural stations*



Research Findings

MATLAB was used to collect, store, and analyze data from the AZMET website. As seen in Figure 1, the trends vary across urban (Stations 1 and 12) and rural (Stations 4 and 9) environments with change in elevation. In the first semester all stations were analyzed using monthly data to determine that there was a trend of windspeed decline over the years. This falls in trend with the "Global Stilling" which has been recently observed happening over the world. In the spring semester daily data was used to find the wind power potential across Arizona. This was done by taking the daily wind speed data from the AZMET website and then extrapolating the wind speed from the station's height to a wind turbine hub's height using the log wind profile and then wind profile power law. Once the wind speed was extrapolated to 100m, the wind speed was converted to power using an equation modeled from a GE Energy 1.6-82.5 wind turbine power curve. The modeled equation came from using the data points take from the power curve of the turbine and MATLAB's polyfit and polyval functions. May was chosen to represent the peak month of power and November was chosen to show the low months of power that way the trend could be better shown as seen on the right.

Figure 3. *Wind power trends for the month of May*

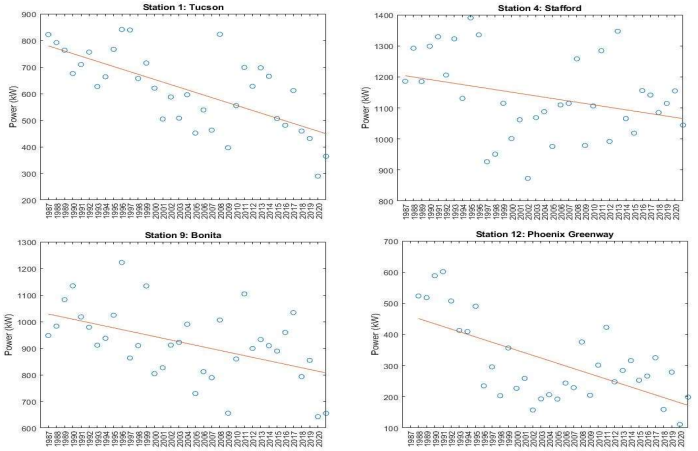
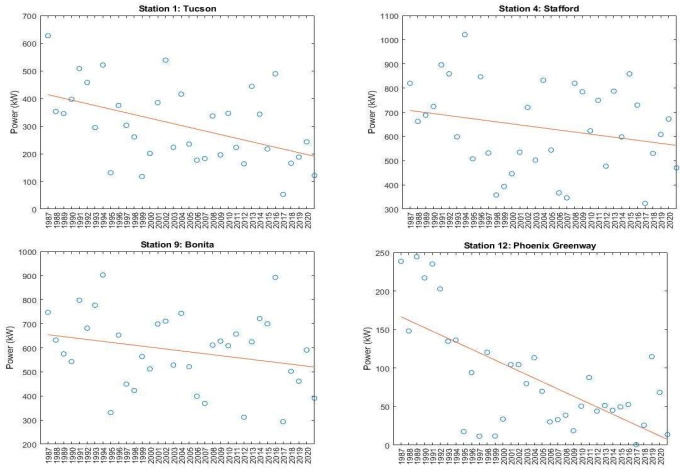


Figure 4. *Below: Wind power trends for the month of November*



Research Goals

The initial task of this research was to find and establish the general long-term wind speed trends across Arizona using monthly data from the AZMET meteorological network. The AZMET meteorological network was chosen since their stations have available recorded wind speed data over long periods of time in various environments. The 12 selected AZMET stations were picked to represent urban and rural environments as well as longest ran stations in order to gain the best understanding of the long-term wind speed trends across Arizona. The long-term goal is to determine the exact long-term wind speed trends across Arizona as well as calculate the equivalent wind power potential change that is created by these trends.

Figure 2. *Photo of a typical station. Source: cals.arizona.edu/azmet*

Future Research

Contour plots over Arizona can be made to show the wind speed trends as well as the wind power potential. This information would be useful to renewable energy companies as they will be able to see the best locations for wind turbines. The culmination of this data will allow for a complete picture of how Arizona's long-term wind trends have an impact on renewable energy.

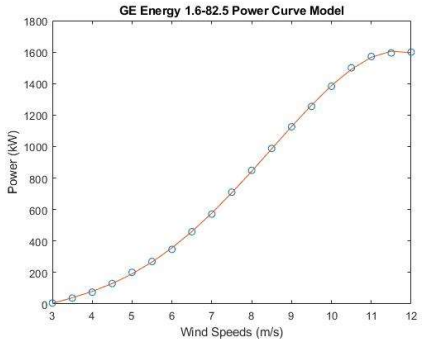


Figure 5. *Modeled Power Curve of the GE-Energy 1.6-82.5 Wind Turbine Cut-in: 3 m/s, Max Power (1600 kW): 12-25 m/s, Cut-out: 25 m/s*

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