Title:

Humidity Levels And Wind Turbine Performance

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Authors:

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Statement:

How does humidity affect wind turbine output? Humidity can weigh down wind turbines performance.

Badges:

We are student researchers the reason being is that we researched and analyzed multiple different projects and obtained information to help us with our project.

We are collaborators due to the fact that we had an ad undnce of people give us feedback including the following: Peers, Mr.Kubiak, Mr. Richardson, Mrs. Ward, Sara, Mr. Best, and Dr. C. Therefore, we are confident that we are collaborators.

We are problem solvers due to our problem solving mechanisms throughout our research project on humidity and wind turbine performance. Our team faced many challenges due to unpredictable weather conditions and wind turbine issues. Our team had to operate and manage around these problems and find solutions.

We are data scientists because throughout our project we have took multiple sets of data such as wind temperature, wind speed, windturbine performance, and the humidity level. We collected

all the data and complied it together to prove our hypothesis right

We make an impact by giving information and spreading our knowledge and experiences through our project. We hope to help others in the future with our data and hope to inform others into careers within solar research. We hope to make it easier for further researchers to learn and gather information and is a high priority for us.

We are engineers because to determine the solutions of our hypothesis we had to do many test and find multiple different ways to of doing so. So we had to plan and execute our decisions in order to receive the best results and data, therefore, we are engineers in multiple different avenues.

We are storytellers due to the fact we can explain our experiences in detail revolving around the logical and ethical processes of our work and can help create engaging ways to demonstrate our work ethics in solar and wind.

Abstract:

Humidity also impacts the overall efficiency of our wind turbines. Higher the humidity levels increase the water content in the air, which can lead to erosion and wear on the turbine blades. This deterioration can result in decreased aerodynamic efficiency and lower overall efficiency of the wind turbine system.

Intro:

Renewable energy sources, such as wind power, are becoming increasingly important in the global push for a sustainable and low-carbon future. According to Weipeng Yue et al., contributors to International Journal of Rotating Machinery state, "High humidity combined with rain, foggy weather, and icing can cause turbine performance degradation, especially in offshore wind farm development" (p.15). This quote relates to our project by examining the different factors in wind turbine performance. Among the various factors that influence wind turbine performance from past research and has been proven humidity has emerged as a significant environmental parameter that can impact air density, aerodynamics, and overall turbine efficiency. According to Salih et al. (2012), results are graphed with the previously mentioned parameters, "The wind turbine is affected by many parameters whether internal (electrical connection, rotor size, copper and iron losses, efficiency of wind generator and blade shape) or external (wind speed, weather parameters, location and height of wind tower). Understanding the relationship between humidity and wind turbine performance is crucial for optimizing energy output, improving design strategies, and implementing effective maintenance practices. This study aims to investigate the effects of humidity on wind turbine performance, with the goal of contributing to the efficient utilization of wind resources and further advancing the development

of renewable energy technologies.

Hypothesis:

The hypothesis is higher humidity levels will cause wind turbine to have lower output results due to humidity's weight and damage it can cause.

Objective:

The purpose of this analysis is to find how humidity levels will affect the output and overall performance of a wind turbine.

Methods:

Our methods include the following:

(Wind Turbine, Anemometer Psychrometer, Data Sheet, and Webquest)

Set up Wind Turbine in the designated test area-away from buildings and trees

One person will take the Anemometer and the Psychrometer and collect the data via Data

Sheet-convert turbine output to amps/volts into watts

Collect the data of the Wind Turbine from the Webquest

Repeat for the next time you collect the data
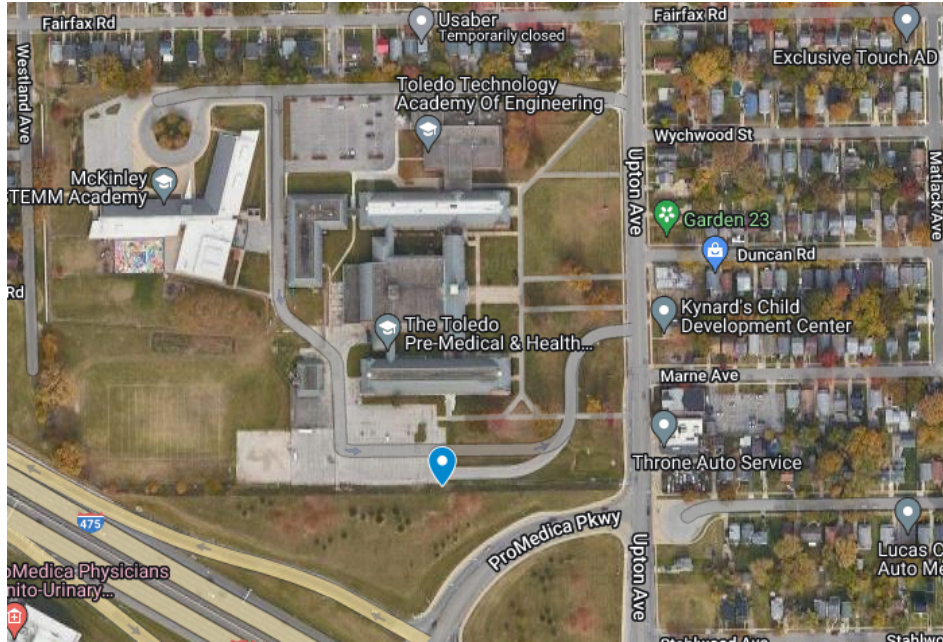
Finally enter the data into the GLOBE WEBSITE

We used Stats blue website to enter variables to look for correlations, Stats blue uses the equation

$(Y=C+a*X1+b*X2)$ to determine the correlation

Correlation

watts= 0.0331 + 0.0358 * voltage-0.006 * humidity + 0.002 * speed

Results:

here have been several studies conducted to examine the effect of humidity on wind turbine

performance. According to Weipeng et al., "It is found that, at high temperature, the high

humidity effect on air density cannot be ignored for annual energy production calculation" (p. 15). His quote shows high humidity can have a significant impact on energy production, and must be taken into account in calculations. Yue also states, "Blade contamination and icing due to water condensation may have significant effects on turbine performance degradation" (p. 15) His quote highlights the importance of understanding the indirect effects of high humidity on turbine performance. Our data suggests higher humidity levels have also been found to reduce the power output of wind turbines. This is because humid air is denser than dry air, leading to increased air resistance and higher aerodynamic losses. As a result, our wind turbine performed worse on days with higher humidity levels.

Energy Output & Humidity
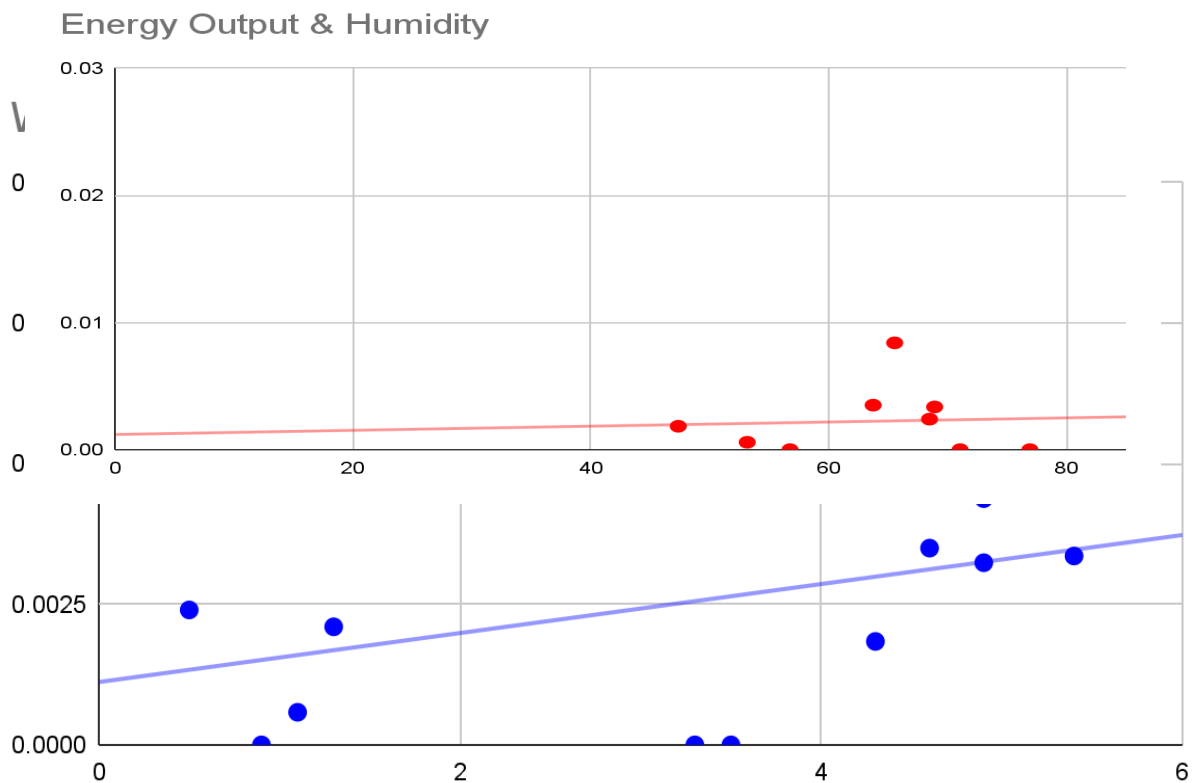
Conclusion:

In conclusion, high humidity levels can negatively impact the performance of wind turbines. It

can increase air density, causing more drag on the turbine blades and reducing their efficiency. Our charts show the correlation on how humidity and wind speed affect wind turbine performance. Through research we have found water droplets on the blades can also add weight and further decrease performance. Additionally, humidity can contribute to corrosion and icing issues, leading to structural damage and safety concerns. Our hypothesis indeed did reach overall expectations.

Acknowledgements:

References:

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    using artificial neural network. *Neural Computing & Applications*, *27*(5), 1231–1244.

Badges