

The Reduction in Turbine Noise Through Blade Design

(Technical Paper)

Removing the Resistance to Wind Energy

(STS Paper)

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

"One of the fastest ways to build the clean energy economy is to allow more people to benefit from it," (Woody, 2013, p.2). Energy production in this modern world comes in many different forms and there is an increasing global social drive to find cleaner and cheaper ways to produce energy. One growing form of renewable energy is wind turbines. Wind turbines have many advantages over traditional power, such as lower cost and renewable energy, but some challenges come along with it such as transportation and producing noise ("Energy Efficiency & Renewable Energy", p.1). Since wind energy is cheap and doesn't have any major roadblocks besides social rejection, the ultimate goal is to make it more acceptable to people and their communities. If offshore wind energy can become more common, the prices will be driven down even more and people will benefit more from this cheap energy (O'Boyle, 2018, p.2).

Wind energy is not a new idea, but it is rapidly growing and becoming more common. There is currently only one offshore wind energy farm in the United States (Woods, 2019, p.1). Since a lot of expensive infrastructure has to first be built up in order to mass produce offshore wind energy. According to the Social Construction of Technology theory, the most helpful thing for the implementation and production of wind energy is getting American citizens to see the benefits. As society embraces wind energy, people will vote for it and push for initial funding and allow wind turbines to be built in more places (Creative, 2019, p.1). Along with energy production, the goal for my Capstone team is for wind energy to have a minimum negative impact on society and the environment. We are striving to produce advancements in wind turbines that will decrease the negative impacts wind turbines have on humanity. In our technical project, we are endeavoring to help clear the way to make wind energy better for humanity by engineering quieter turbines.

Reduction in Turbine Noise

My team's technical research addresses decreasing the noise pollution produced by wind turbines. Noise pollution is one of the major concerns with wind turbine placement near urban areas (Lange, 2018, p.1). Our goal is to reduce sound to allow better integration of clean wind energy into our environment. The current designs of wind turbines and wind turbine blades place little emphasis on reducing the noise produced by wind turbines. Our research team's goal is to find the best turbine blade design that will decrease the noise generated without a significant negative decrease of energy production. Our capstone team is developing three different ideas for turbines blades.

The first blade design is based on owl wings. The trailing edge of owl wings have a tattered edge that reduces the eddies and decreases the noise generated by their wings going through the air (Meyers, 2018, p.1). The second design is based on existing quiet propellers with a curved tip that curves in the direction of the wind. This curved tip goes between the high and low pressure sides at the end of the blade and results in a more laminar flow to reduce the sound. Since the end of the blade is where the majority of sound comes from, this should greatly reduce the sound. The third design has nodes at the leading edge of the blade to break up the flow, allowing it to ease the filling in of low pressure gaps to produce less blade noise. We will produce four sets of blades; three sets with our designs and one as a control to compare sound levels and efficiency.

After our team manufactures the blades using 3D printing we will attach the blades to a hub and motor and spin the blades to measure their sound output. Our team is opting for motor driven testing due to the size restrictions of a 12 inch wind tunnel and the noise output the wind tunnel makes. After we measure the noise levels of each design we will place the manufactured turbines behind the wind tunnel by using the exhaust of the tunnel as a consistent wind source.

We will use the motor as a generator to measure the efficiency levels of each blade design to determine how much our design affected the efficiency of the blade (Woodford, 2019, p.2). Our project timeline projects completion of testing to be done on November 11th with analyzing results and possible redesign and testing to follow. Our team is being advised in this project by Michael Momot in the Mechanical Engineering department. With a clear path to follow, we hope to produce significant results.

Removing the Resistance to Wind Energy

There are many issues and controversies surrounding the area of producing clean energy. Offshore wind turbines fit as the best possible solution to fill the need of clean renewable energy. Many scientists say that being able to produce renewable energy will reduce global warming. Much of society would agree that “renewable energy is a warranty for human survival” (Zafar, 2020, p.1). As there is much controversy over the feasibility and soundness of such an idea, and because we already implemented power sources such as nuclear power, we have to consider the economic and implementation cost of such a strategy (Fialka, 2020, p.1).

Society needs to first accept and then drive the production of offshore wind before offshore wind can become more commonplace. According to the social construction of technology, human action shapes technology. People supporting and wanting offshore wind energy will push offshore wind turbine technologies to be both cheaper and more common. People resist onshore wind due to the noise and turbines being visible against the skyline, but putting wind farms offshore removes those obstacles. Before offshore wind farms can be developed the government, which is directed by society, has to allow wind farms to be built in the middle of the ocean. For the first few wind farms, the government may need to incentivise offshore wind farms to help companies get over the initial infrastructure cost that goes into constructing them. There have also been people protesting against new wind farms and has

resulted in having more restrictions and made them more expensive, or not being built at all. This has been a problem in the United States and in other countries with wind energy production (Deutsche, p.1). In all cases, the bottom line is for people to realize wind turbines are overall a great way to produce energy. The social implications of wind farms need to first be considered in order for wind energy production to rapidly develop.

In the research we plan to cover the economic cost of offshore wind energy and dig into the reasons people may be against such an idea. In our research I hope to determine the reasons why people are against wind energy. I hope to show that moving wind energy offshore into the ocean not only has great benefits for wind power, but removes the barriers preventing massive wind energy to be installed.

Research Question

The research question that is going to be answered in the STS research project is if offshore wind farms are the solution to getting over the barrier of public resistance to wind farms. I plan on researching previous cases especially in other countries to see how offshore wind has affected the production and public view of wind energy. I will also analyze existing research data and compile information from other sources to produce a well-answered question on whether moving wind energy production into the ocean will remove the barrier for people who resist it. I may also employ a survey or interview someone who is against wind energy. However, my primary source of information will be from case studies about building wind turbines in other countries and analyzing previous data and studies. This is because of the massive amount of data already out there on the internet; It would be expensive and time consuming to produce new less accurate data in order to research this question.

Conclusion

The deliverable for the technical project will be a new turbine blade design to reduce the noise that wind turbines generate. This should reduce a barrier some people have in not wanting wind farms in their area. Our capstone team anticipates the blade designed after the owl wing will be the best combination of sound reduction and blade efficiency. This sound reduction should help the core issue of the STS research topic. In the STS deliverable I plan to research if moving wind farms far offshore will be a viable solution to overcoming the issues that people have with wind farms. I expect the research will show that this is the best solution to overcome resistance to wind farms becoming the way of the future.

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