

**Thesis Portfolio**

**Active Control of Wind Turbine Blades to Increase Efficiency**  
(Technical Report)

**Analysis of Renewable Energy's Impact on the Fossil Fuel Industry and Life in the United States**  
(STS Research Paper)

An Undergraduate Thesis

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## **Sociotechnical Synthesis**

### **Introduction**

The topic of my STS research paper shared a strong connection to the research conducted in my technical project. The field of renewable energy is becoming increasingly important for the United States as the country battles the effects of climate change. My group's technical research sought to increase the efficiency of wind turbine blades as the industry continues to grow at a rapid pace and is crucial to renewable energy's success. In my STS paper, I examined how renewable energy has gained so much traction over recent years and the impact it has had on American culture and the fossil fuel industry, ultimately leading to the point that renewables need to be accepted by society for a complete and successful energy transformation to occur. It was extremely important for me to connect my STS research paper to my technical work as I was able to understand the relevance of STS in a real-world engineering setting, which I believe has helped me grow as an engineer.

### **Project Summaries**

The technical aspect of my research looked to produce a wind turbine that is more effective, which is important to an industry that is starting to plateau in terms of efficiency. My group wanted to manipulate the area of a blade using active control, so that during lower speeds a turbine could be more efficient and at higher speeds there isn't too much power created. Most wind turbines have a cut out speed because there is a realistic problem with turbines creating too much power during intense winds that would overpower local electrical grid systems. Thus, we focused strictly on improving efficiencies at lower velocities. Using a 3D printed turbine of a generic NACA airfoil for the blade shape, we developed a mechanism that would control

whether a flap of flexible plastic would extend from the blade's trailing edge based off the wind speed experienced by the turbine. The flap itself is pushed out by a series of springs and brought back in by a string that is connected to a stepper motor controlled by an Arduino controller at the varying wind speeds. With an increased budget and a larger wind tunnel available, the project would continue to ensure that such modifications to a blade could be made at scale and used on turbines worldwide, further improving on a technology that is already leading the field of renewable energy.

My STS research paper connected my technical research on the topic of renewable energy's role in society. Examining the rapid rise of renewable energy in United States, I also researched one of the harmful byproducts of the industry's success- the decline of the fossil fuel industry. To finalize how renewable energy will become the main source of energy in the US, I had to understand what factors may cause turbulence in societal acceptance of a new form of energy usage, as well as the work being used by American governments to ensure a smooth transition. My research was conclusive that renewable energy is going to have a lasting impact on both the US economy and the global environment and requires valuable cooperation from governments to ordinary citizens to even the fossil fuel corporations to ensure that the planet still has a future.

## **Conclusion**

While completing my STS research paper, I came to understand the importance of ethics as an engineer. While my technical research focused on creating an innovative technological advancement for the future of wind energy, the work would not be meanwhile if the social repercussions weren't assessed in the meantime. As engineers continue to expand on the role that

technology has in society, they must also keep in mind the different impacts that their work may have on the world. Wind turbines and other forms of renewable energy mechanisms are crucial to fighting against the effects of climate change, but such a transition must be done with acknowledgment to those that could suffer from the change. As with any invention, the government and renewable energy companies must keep in mind that if society is not accepting of the innovation, then an important technology's implementation could go unsuccessful. In the end, completing my technical research and conducting an STS research paper alongside the work has provided me with an invaluable experience as a rising engineer. I now see the important responsibilities that engineers have as they continue to innovate and the importance of analyzing the possible impact their work could have on those affected by their newly developed technology.