Thesis Project Portfolio

Active Control of Wind Turbine Blades to Increase Efficiency

(Technical Report)

Economic and Cultural Impacts of Wind Farm Developments on Native American Lands

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

The engineering profession finds its basis in inventing and implementing unique technical solutions to help solve the world's many complex problems. As the world constantly changes, engineers must use analytical thinking to help society develop and adapt. Many solutions merely swap one problem for a future one. Thus, it is important for engineers to be cognizant of their work and remember their common goal to build a sustainable world.

My capstone investigates barriers to the broadening of wind energy use. Both my technical project and STS research paper are related as subsets of this general issue. The expansion of renewable energies, including wind power, is essential for warding off the cataclysms of impending climate change. By testing technical improvements to wind turbine design and investigating the social impact of wind development on Native American lands, my capstone aims to help ease some of the impediments to expanding wind power.

For my technical project, I work in a team of six to improve the efficiency of wind turbines by using active control systems to increase power production at lower wind speeds between cut-in and peak power production. After lots of brainstorming, design, and testing, we learned that wind turbine design has stalled in the sense of incremental improvement. Over the past few decades, wind turbine design has continually improved efficiency by simply increasing the height and diameter of wind turbines. However, we concluded that this pattern of incremental design improvement is not sustainable and wind turbine design requires more creative thinking to push forward. Floating offshore wind turbines currently offer the most promising chance for advancement in wind turbine design.

My STS research paper explores the economic benefits and cultural detriments of wind farm developments on or near Native American tribal lands and hopes to improve the ability of wind developers to find success in appropriately expanding wind energy use. For optimal siting,

developers look for sparsely populated areas to set up wind farms because they are aesthetically displeasing, make noise, and cause unwanted shadows. Native American lands in the midwest often meet these criteria and are some of the most wind resource-rich areas of the United States. Through majority ownership and other precautions, Native American tribes can potentially stand to benefit from potential wind developments, although not all tribes may be interested. However, to avoid all areas of social conflict, I've learned that floating offshore wind seems to be the most favorable sector for future wind energy expansion.