Thesis Project Portfolio

Active Control of Wind Turbine Blades to Increase Efficiency

(Technical Report)

The Tortoise and the Hare: American and Chinese National and Technological Cultural Values Influence on Sustainability Transition Mechanisms

(STS Research Paper)

An Undergraduate Thesis

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

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In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

Efficiency of Technical, Governmental, Cultural, Organizational, and Systemic Transformations in Sustainability Revolutions

1.2 trillion tons of ice are lost from the polar ice caps each year. Mitigating global warming, climate change, and other consequences of modern, human-caused, environmental issues is one of the greatest challenges we face in the 21st century. My projects focus on realizing innovations and systemic changes that enable us to tackle these challenges. For my technical project, my team and I focused on exploring additions to the trailing edge of wind turbine blades to increase the efficiency they gather energy from incoming wind. My STS project focused on defining the salient features of American and Chinese technological cultures, connecting them with underlying cultural values, and drawing inferences about systemic and societal changes necessary in sustainability transitions.

In the technical portion of my thesis, my group and I focused on increasing the efficiency wind turbines gathered energy from oncoming wind, increasing electric energy output and decreasing the cost of energy, furthering the economic viability of wind turbines as a renewable energy source. The first stage of our project was to 3D model and print a wind turbine with a modular trailing edge. For the second stage of our project, we created a testing matrix with materials of different lengths and stiffnesses to attach to the trailing edge, increasing the lift coefficient. We validated our model using flow analysis via ANSYS. As a result, we determined the optimal ratio of edge modification length to blade width for wind speeds ranging from 20-55 mph.

My STS research modeled the framework of an analysis by Weibe Bijker, comparing contemporaneous national action and policy plans released by the United States and China. My analysis of these documents draws out features if each nations technological cultures as they relate to sustainability transitions. Further, I connect the features of each technological culture to underlying national cultural values. The core of my analysis is juxtaposing Chinese and American technological cultures to reveal their relative strengths and weaknesses in unique sustainability transitions. It also sheds light on organizations, systems, and actors that enable and drive change, and the organizations that rein in transition mechanisms. My analysis concludes that both are necessary, but need to be balanced and recognized as such.

By synthesizing my technical and STS research projects together, I gained an understanding of the multidimensionality of innovation. It goes far beyond creating something in a lab. The innovation must be implemented into society, involving legislation, regulation, intellectual property, consumers, and cultural attitudes. Specifically, the synthesis of my research highlights much of the innovation needed for a sustainable future lies with the transformation of societal systems and organizations that surround renewable energy technology rather than the technology itself.