

Thesis Project Portfolio

**Wind Turbine Blades:
Modifications to Reduce Aerodynamic Noise**
(Technical Report)

**Evaluating the Social Factors
that Impact the Implementation of Wind Turbines in the U.S.**
(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

Megan Anderson

Spring, 2021

Department of Mechanical and Aerospace Engineering

Table of Contents

Sociotechnical Synthesis

Wind Turbine Blades: Modifications to Reduce Aerodynamic Noise

Evaluating the Social Factors that Impact the Implementation of Wind Turbines in the U.S.

Prospectus

Sociotechnical Synthesis

Both the technical project and STS research explore the sociotechnical factors that impact the growth of wind power within the modern energy sector. The technical project addresses a key issue in the adoption of wind turbines: aerodynamic noise. With recent studies that link the noise to adverse health effects, the project examines wind turbine design to remedy this undesired side effect. The STS analysis of the current role of wind turbines in American industry offers further insight into the social limitations to future advancement.

More specifically, the technical project focuses on the aerodynamics of the rotor blades, studying three separate designs that each target one specific source of noise. The leading edge, wing tip, and trailing edge are all primary contributors to the characteristic swishing sound associated with most of the complaints about nearby turbines. Local outcry has been supported by reports of sleep disturbance, headaches, and nausea coined “wind turbine syndrome.” Although government and industry have disputed these claims in the past, more recent evidence supporting the contrary makes it a controversial issue. Moreover, the technical work aims to lay the foundation for research into sound mitigation modifications that ultimately eradicate any negative health impacts.

While the technical project tackles a mechanical obstacle to wind turbine development, the STS research goes further to consider the political, economic, and social limitations to its growth. Using the Social Construction of Technology framework, it considers the historical context of wind power in the United States to derive its impact on public perception. This background supports the following analysis of legislation and corporate adoption to determine its impact on the functionality of wind turbines within the modern utility structure. Furthermore, the

STS research offers a more complete understanding of the limitations faced by wind turbines, rooting the technical work in its application to the broader sociotechnical issue.