Thesis Project Portfolio

Renewable Wind Energy via the Triboelectric Effect

(Technical Report)

We Don’t Want It: Resistance to Solar in the Region of Charlottesville, Virginia

(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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Table of Contents

Sociotechnical Synthesis

Renewable Wind Energy via the Triboelectric Effect

We Don’t Want It: Resistance to Solar in the Region of Charlottesville, Virginia

Prospectus

Sociotechnical Synthesis

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My technical work and Science Technology and Society (STS) research are both within the realm of renewable energy studies. While my technical work focuses on a specific solution for small-scale wind renewable energy production, my STS research project looks at reasons for local resistance to many utility-scale solar energy projects in Virginia, with the aim of informing implementation of not only utility-scale renewable energy projects, but any implementation of the outcome of the technical project.

Currently, there are limited options for wind energy in urban environments due to the low wind speeds on roofs where turbines are inefficient and inability to construct large wind turbines within the confines of a city. Through developing a structure inspired by the natural movement of grass and leaves, we generate electricity from low wind speeds while keeping a low-profile in the structure design such that it would not look out of place on a roof. The structure utilizes the triboelectric effect, which is more often called static electricity, to generate electricity from repeated contact-separation of two triboelectrically dissimilar materials. Dissimilar triboelectric materials are common (e.g. hair and balloon, sock and carpet, etc.) and easy to source compared to materials required for other forms of electric generation. This project will enable small-scale, self-sufficient power generation for wind energy and address the growing need for sustainable energy solutions in urban environments. Cities and residents will be able to partially fulfill their energy needs while reducing their environmental impact and dependence on fossil fuels.

My STS research paper seeks to understand the reasons for resistance to utility-scale renewable energy projects focusing on rural regions in Virginia. Through local government

meeting notes and news articles, four contested solar energy projects were examined. Place identity, the emotional and evaluative membership to a place, is used as a framework for the analysis of these sites. Resistance to solar at these sites was examined for common themes: solar developers not following local ordinances and comprehensive plans, and residents concerned about the local environmental impacts and impacts to the agricultural character of their communities. Based on my research, I recommend solar developers develop strategies to educate the local community on design choices made to preserve the agricultural character of communities and how they follow environmental best practices. In addition, solar developers should always follow all local regulations and ordinances and show that the development is in line with the comprehensive plan for the community.

By working on these projects simultaneously, I was able to see the development and implementation of different renewable energy technologies. By experiencing different scales and stages of development of a technology group that has enormous effects on our society, I was able to experience firsthand some of the challenges and benefits of the sector. In my technical project, I experienced the struggle of developing and designing a new technology from an idea to a working product. It taught me the value of persisting when there were long periods of ideas that did not end up working, until we came up with a working system at the end. It gave me a firsthand view of the process of developing an early-stage technology, and more appreciation for the long timelines for developing those technologies that are given for some technologies in the renewable space. The research project gave me a broader perspective for the energy industry as a whole and the renewable energy sector in particular. It gave me knowledge of the environment in which our solution would enter and some of the challenges it would face in the implementation of the

technology. In particular, why there is resistance to certain technologies, particularly when they represent change and are seen as attacking a group or idea.