Sociotechnical Synthesis

A Sociotechnical Synthesis submitted to the Department of Engineering and Society

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In Partial Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Oliver Avier Nicholson Jr.

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Advisor

Caitlin D. Wylie, Department of Engineering and Society

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The overarching problem that connects my technical and STS research problems is the degradation of societal wellbeing due to unsustainable actions. These unsustainable actions defile the health of our environment and our bodies. For my technical problem, this manifests from overexploitation of fossil fuels which changes the world's climate, exacerbates extreme weather, and poisons the air. For my STS problem, this manifests from the lackluster response to COVID-19 which allows for excess death and disability. These problems need to be addressed because unsustainable practices threaten the well-being of every person in the world. Whether it's the death and displacement caused by climate change or the death and disability caused by COVID-19, these problems have serious consequences which require a significant response.

My technical project addresses the problem of large-scale wind turbines being unable to generate electricity in areas with wind speeds under 15 mph. This problem matters because most areas in Virginia have average wind speeds under 15 mph. Not being able to utilize wind energy to generate electricity limits Virginia's ability to transition from fossil fuel to renewable energy. This transition is necessary to stop climate change and decrease toxins in the air. In order to fill this gap in wind generation, my team sought to create a new triboelectric energy generator. It would create power by having a component of the generator hit two materials together repeatedly in quick succession. Upon contact, these materials would become oppositely charged and generate a voltage. With enough of these components connected to a houses electrical grid, it could produce a voltage with a steady current and thus power. My team tested triboelectric material by tapping them together and measuring the voltage generated to find the best paring. Next, we 3D printed designs which would bend in low wind speeds and vibrate allowing for repeated hits and separations. We also created a pinwheel that could spin in the wind with one material on its tips hitting another stationary material to generate triboelectricity. We found that

Polyurethane foam and Silicone rubber produced the highest voltages of all the materials tested at 55-65 V. We also found that the best design for bending in the wind has a large, leaf-like plate connected to a base with a small, thin, rectangular beam.

My STS project addresses the problem of millions of Americans being killed and disabled by COVID-19. These casualties matter today because COVID-19 is still infecting people and will kill and/or disable more people. On top of this, those disabled by COVID-19 could be disabled indefinitely, changing their life forever. I researched the flaws in the federal response to the COVID-19 pandemic by analyzing the actions taken under the Trump and Biden administration. From this I found 3 major issues with the federal response: There was a lack of clear communication about the harm done by the virus. No clear and accurate explanation of how the virus spreads was give. Also, the spreading of distrust in the COVID-19 vaccine inhibited an effective response. To correct these mistakes, I proposed the federal government followed the Crisis and Emergency Risk Communication framework, explains the harm done by Long COVID, and reassure their constituents on the need and reliability of COVID-19 vaccines.

The research I have completed provides a solid foundation for future solutions trying to dismantle unsustainable practices. For the triboelectric energy generator, more research needs to be done to maximize the oscillations of the leaf design to maximize the voltage and current generated. To create a better COVID-19 response, future researchers can look into what was done state-by-state. It would also be useful to analyze different nations' responses to the virus to potentially provide an example the United States could follow.

I would like to thank the many people at UVA who helped with my capstone. My STS advisor, Professor Caitlin Wylie, provided valuable assistance in determining how I should go about researching and writing my STS project. My technical advisors, Professors Sarah Sun and

Thomas Ward, supported my team in the setup and analysis of experiments. Finally, I want to thank my technical teammates for working with me in creating better designs to advance towards a more sustainable future.