# Sociotechnical Synthesis

A Sociotechnical Synthesis submitted to the Department of Engineering and Society

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University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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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.

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Industrialization is a valuable aspect of human livelihood and well-being. The issue is that the pollution from human industrialization spews emissions that trap heat, poison the environment, and cause an increase in the frequency and magnitude of natural disasters. This issue is important because the supersized hurricanes and raging wildfires caused by climate change devastate entire cities and nations in addition to the environment. My technical research focused on designing a solar-powered aircraft. This research aimed to provide a green solution for the aviation industry, which is a growing industry that continues to use inefficient combustible fuel that contributes to greenhouse gas emissions and climate change. My STS paper focused on researching short-term solutions to climate change through the use of geoengineering. This research aimed to analyze and argue for geoengineering as a short-term solution through the lens of Utilitarianism and other ethical theories.

In my technical project, I was the project manager of SPARC, the Solar-Powered Autonomous Reconnaissance Craft team. SPARC is a UVA Aerospace Engineering capstone that focuses on designing a high-altitude and high-endurance solar-powered aircraft for military or civilian needs of surveillance, such as reconnaissance or disaster relief. The main issue this project hopes to help bring solutions to is that the aviation industry is a rapidly growing industry that still uses combustible fuel, which has inefficiencies that produce waste emissions. The SPARC team hopes to bring a solution for long-duration aircraft, which not only cuts the emissions produced directly into the upper atmosphere, but also saves money on fuel required for multi-day flights. The evidence we analyzed was whether or not our aircraft was capable of flight. This was done by finding the power required for propulsion using solar panel and motor efficiency tests, and by finding aerodynamic efficiency through wind tunnel tests for forces and particle image velocimetry tests for drag-inducing vortices. Some important findings from these

tests and simulations included a fudged Oswald Efficiency Factor. This number is used in the equation to reconcile the slope of the lift coefficient vs angle of attack curve for an infinite wing to a finite wing. This value is based on the aspect ratio and wing shape, and was interesting to analyze because of our low aspect ratio test sections. Another important finding was the overall weight of the aircraft, which was significantly heavier than expected. The solar panels and batteries alone contributed to a significant percentage of the total weight.

For my STS research, I investigated and analyzed geoengineering solutions to climate change while using and critiquing a Utilitarian framework. The issue is that as governments and environmental groups continue to push for greener regulations, the devastating effects of global warming aren't going away. This means that short-term solutions must be invested in to counter the devastating effects of superstorms and droughts. The evidence I analyzed was how effective the two main geoengineering methods of Carbon Dioxide Reduction and Solar Radiation Management are using the Utilitarian and some other ethical frames of analysis. Some important findings include the effectiveness of geoengineering and how impactful they can be to producing quick impacts that reverse the effects of climate change. Another finding was the limitation of the Utilitarian analysis perspective and how it doesn't consider other non-human actors.

Both the design of the solar aircraft and research of geoengineering contributed valuable solutions to combat the effects of climate change. Some research and design the SPARC team can take in the future in upcoming capstone projects include refining some experiments that we designed, getting more accurate variables and data with the refined experiments, and building a small scale model to test the flight capabilities of this aircraft. Some future research that would could be done for geoengineering include testing the effectiveness of some of the methods, such as solar radiation reflection via mirrors or cloud seeding for solar radiation management. Other

research that could be done include looking into the longer term effects of these solutions and critically evaluating them for possible negative impacts.

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