Thesis Project Portfolio

Autonomous & Water-Free Solar Panel Cleaner

(Technical Report)

The Feasibility of Domestic Solar Panel Use in the United States

(STS Research Paper)

An Undergraduate Thesis

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Bachelor of Science, School of Engineering

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Executive Summary

The conversation around renewable and green energy has grown in recent years. One of the many potential renewable sources growing in popularity is solar energy. Using the power of the sun could solve America and the world's energy issues. To further explore the possibilities of solar, my thesis portfolio is focused on solar energy. For my capstone, my group and I were tasked with solving solar panel soiling. Soiling is when debris such as dirt, dust, leaves, bird droppings and other foreign objects block the solar panel surface from being able to produce energy. Solar panel soiling greatly decreases solar panel efficiency and currently requires cleaning services, wasting billions of gallons of water worldwide. In addition to this, my thesis focuses on American homeowner solar system adoption. As solar panel technology improves, the technology needs to find ways to integrate with everyday life. One of those ways is in at home solar systems. Yet, the adoption of these systems appears to be slow. The thesis goes in depth into the surrounding socio-technical systems and the hindrances to domestic solar panel adoption in America.

The capstone project is focused on creating a water free, fully autonomous solar panel cleaning system. Many considerations were given to us, highlighted by durability, ease of use, safety, and price. Throughout the year, many concepts and designs were considered. Eventually, a two-part system was chosen, consisting of an electrically charged plate (developed by MIT) and a brush. The electrically charged plate is designed to remove small, dust-like particles while the brush will remove larger objects, such as leaves and twigs. The cleaning system was created using wood, 3-D printed parts, limit switches, two lead screws, two DC motors, and two linear motion shafts. The system was built into a proof-of-concept model and tested for feasibility, reliability, and effectiveness. As of now, the proof of concept demonstrates that our model could

work under low stress situations and low angles of tilt. Further research is needed to assess ease of manufacturing and scalability.

The thesis portion of this portfolio provides an in-depth analysis of domestic solar panel adoption in the United States. As solar technology has improved, it can be seen being used in both large scale solar projects and small, at home systems. However, despite the benefits of solar energy, we have yet to see every roof in America be covered in solar panels. There are multiple reasons for this, including but not limited to, costs, space, American renting culture, government funding, aesthetics, and hope for better technology. The main contributors, pricing and space, severely limit the current feasibility of at home solar. However, every aspect highlighted above comes together in one way or another to make applying solar technology to American homes very difficult. Despite all the headway solar has made in becoming a very viable option for the future of energy creation, it has yet to become valuable enough to overcome all the obstacles surrounding it. Until solar technology can seamlessly integrate with American homes in a cheap, easily added, visually pleasing way, it will continue to stay out of the American home.

The thesis portfolio highlights the continuing issues and potential solutions of solar energy production. The capstone project coming all the way to proof of concept in one year shows the ability to solve solar issues when a group of dedicated engineers combine efforts to solve new issues. The thesis concludes that solar energy is not quite feasible for domestic usage. However, if the capstone project can be used as a small-scale demonstration of problem solving, it demonstrates that, in time, the hinderances to at home solar will be overcame. When the issues of cost, efficiency, space, and aesthetics are resolved, domestic solar will become normal. While this portfolio's work is not fully finished, it demonstrates a hopeful future and the steps that can be taken to change solar energy.