Thesis Project Portfolio

Sustainable Utilization of Whey By-Product For the Production of Biobutanol

(Technical Report)

Evaluating the Present and Future Efficacy of Sweden's Shift to Renewable Energy from a Utilitarian Perspective

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

My technical and STS research projects were both grounded in producing clean energy and assessing its viability and impacts. Over the duration of my technical project, my team and I have been designing and simulating a process to convert acid whey waste from a large yogurt plant into sustainable biofuels, principally butanol. To study the social and ethical impacts of renewable energy on the lives of people, I researched how Sweden has been affected by their early shift to sustainable lifestyles and renewable energy production. Since a major source of Sweden's energy is biofuels, analyzing human impacts in Sweden can help predict what a future may look like where biofuels play a major role in the infrastructure of the United States and across the globe. Since my technical project focuses on the production of sustainable energy while my STS research project addresses the impacts of creating biofuels and other renewables, I feel that they collectively demonstrate the upstream and downstream challenges and successes of implementing renewable energy on a global scale.

In my technical project, "Sustainable Utilization of Whey By-Product For the Production of Biobutanol," our team utilized a sequence of ultrafiltration, reverse osmosis, fermentation, and distillation to produce and then separate butanol from an initial whey feedstock. Pre-treatment processes were calculated by hand to determine yields and process parameters. Further, fermentation was modeled using MATLAB and our distillation sequence was designed and tested using Aspen Plus. Because biofuels are not currently profitable without heavy subsidies, whey protein was also isolated as a side product and sold to ensure profitability of the plant. The aim of this project was to brainstorm creative alternative energy production methods to fossil fuels, and it was concluded that more efficient biofuel production processes are needed for feasibility of this goal.

My STS research paper, “Evaluating the Present and Future Efficacy of Sweden’s Shift to Renewable Energy from a Utilitarian Perspective”, looks at how Sweden’s backbone of renewable energy has changed the lives of its residents. I first examined how green living has helped increase quality of life across Sweden, and how a healthier environment promotes happiness. I next looked at how sustainable lifestyles have helped Swedes simultaneously lower their energy usage and increase satisfaction with their habits and hobbies. Finally, I studied from a broader perspective to identify how environmentally-focused political and economic changes have altered the lives of Swedes from all angles. The paper argues that Swedes have overall increased their happiness from a utilitarian perspective through their amplified environmental focus.

Completing the technical and STS projects side by side gave me a deeper understanding of the responsibilities of engineers in the workforce. While designing a biofuel-producing plant and calculating the numbers required to make the plant profitable was a fun experience, examining the social and political impacts of building such a plant was extremely valuable. In a world that may be plunged into a large-scale transition to renewable energy, proving that it is possible to produce biofuels at scale and showing the positive impacts on humans in such a society makes me hopeful for a cleaner future.