Thesis Project Portfolio

Power Plant Design using Allam Cycle CCS

(Technical Report)

Lack of Compromise and Understanding Due to Network Pressure in the Congressional Controversy Around Michael Mann's Climate Change Research

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

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Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

Carbon Capture and Sequestration's Technical and Legislative Connections

Carbon capture and sequestration (CCS) is a form of climate action that has the potential to drastically lower greenhouse gas emissions and reduce global warming. The two most significant hurdles for successful CCS implementation are the development of effective and economically feasible technologies and the lack of legislative action supporting CCS infrastructure. My thesis project works to add on to the basis of research which addresses these two hurdles. By connecting engineering practice, specifically a novel chemical plant design, with sociotechnical thinking, an increased understanding of how actor-network pressure influences legislative action, I developed a better understanding of the far-reaching societal impacts of my work as a chemical engineer.

In the technical portion of my thesis project, my team and I designed a 600 MWe natural gas power plant which employs the Allam cycle to achieve net zero carbon emissions. The Allam cycle is a CCS method that uses supercritical CO_2 as a working fluid to create a modified version of the Brayton cycle, which produces CO_2 and H_2O as byproducts. The CO_2 is separated and sold to enhanced oil recovery, so that no carbon is released into the atmosphere. The major and ancillary process equipment design as well as the operational costs were researched and designed, ultimately finding that the financial estimates for the power plant show the plant will lose over $4 million annually. However, further changes such as additional equipment design and changing economic conditions could make the plant profitable.

My STS research examines a case study of a series of 2006 congressional hearings in which U.S. Senator Joe Barton criticized climate scientist Michael Mann's millennium temperature reconstruction research. To analyze why neither the climate scientists nor the

government officials fully attempted to understand the other's reasonings for their arguments over Mann's research, the lenses presented in Venturini's "Diving into Magma" were used to explore the actor-network relationships. The weight of Barton's network overshadowed all of his literature-actor relationships, propelling Barton to ignore effective communication methods which could have resulted in the advancement of climate change ideals and actions. This concludes that by adjusting network pressure in climate-based controversies, compromises can be reached more effectively which will spur vital climate action.

The STS research directly supports the implementation of the technical project. The conclusions drawn from my STS research could facilitate congressional discussions on climate action and encourage legislative and financial support. Financial support would bring the economic analysis for the plant into the range of profitability and thus make this Allam cycle power plant a competitive alternative to traditional natural gas power plants that is environmentally friendly. For future undergraduate students, I recommend working on technical and STS research topics that enrich each other, so that you may also develop a similar improved understanding of the far-reaching effects of engineering work and sociotechnical practice.

I would like to acknowledge my technical project teammates for their year-round commitment and dedication to furthering the design of a process with significant environmental implications and promoting me to grow my understanding of engineering practice and ethics.