CARBON CAPTURE, UTILIZATION, AND STORAGE

IMPACTS OF SOCIAL, ECONOMIC, AND REGULATORY INEQUALITIES ON GLOBAL CLIMATE CHANGE ADAPTATION

An Undergraduate Thesis Portfolio
Presented to the Faculty of the
School of Engineering and Applied Science
In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science in Chemical Engineering

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April 28, 2020

SOCIOTECHNICAL SYNTHESIS

As the atmospheric concentration of carbon dioxide continuously increases, it is crucial to develop innovative strategies to rapidly reduce greenhouse gas emissions. The technical research report aims to solve this issue by implementing carbon capture, utilization, and storage, a technology that involves using a chemical solvent to remove carbon dioxide from emissions at industrial sites such as power plants or oil refineries. The motivation behind this project is to expand upon previous research by converting the carbon dioxide into diesel fuel, thus both reducing emissions and producing a useful energy source. The tightly coupled STS research paper explores the characteristics of a successful environmental policy, as well as how to implement global climate change adaptation despite vast differences in the cultural, economic, and structural settings of developed versus developing countries. The goal of both the technical report and the STS paper is to determine a lasting solution to the climate crisis through adaptable environmental policies and green technologies that are suitable to all regions of the globe.

Since fossil fuels are expected to remain the dominant energy source for several decades, it is crucial to develop innovations that can reduce carbon dioxide emissions in the immediate future. The technical project aims to achieve this by modeling a carbon capture, utilization, and storage system at the Pastoria Energy Facility, a natural gas power plant in California that emits a large quantity of carbon dioxide each year. Unlike many previous applications of this technology, in which the carbon dioxide is liquified and stored underground, the goal of the technical project is to convert the purified gas into diesel fuel that can power various automobiles. This system was created using Aspen Plus modeling software, which enabled team members to design and optimize each piece of equipment required to separate and convert the carbon dioxide through a series of chemical reactions.

While the modeled process was successful from a technical standpoint, it was concluded that based on the current price of utilities and diesel, the fuel production aspect of the project is not economically feasible. Thus, it is recommended that companies choose to purify and store the carbon dioxide underground in order to reduce the cost of the overall process. However, if the Pastoria Energy Facility's customers are willing to pay an increased fee for electricity in the future, this would enable the company to invest more heavily in a carbon capture project and add the diesel production equipment to the existing system.

Although green technologies such as carbon capture, utilization, and storage can easily be implemented in developed areas of the world that have the government policies and economic support to make these ventures possible, developing countries are not provided with the same opportunities. This problem prompts the research question that guides the STS analysis: What does an effective climate change policy look like, and how can this approach be implemented on a global scale? Green technology comes in many forms, and while large-scale technical innovations are suitable to developed areas of the world with adequate funding and pre-existing infrastructure, in developing nations, it is appropriate to employ adaptation education methods that teach citizens how to reduce their reliance on natural resources.

Through an Actor Network Theory analysis of Denmark's environmental policy, it was proven that by thoroughly considering citizens' values and goals, it is possible to reduce emissions while aligning with the lifestyles of the people in a given area of the world. For example, the construction of the Amager Resource Center, a waste-to-energy facility including an artificial ski slope and an outdoor rock-climbing wall, reduced the city of Copenhagen's carbon footprint while providing citizens with an opportunity to stay active and healthy. Unfortunately, this contrasts the current state of climate change adaptation in developing

countries, which was modeled using the System in Context framework. Citizens of developing nations are viewed as passive victims of climate change and the disasters it causes, while, in reality, they are capable agents of change. Thus, it was determined that in order for a climate change policy to thrive, government leaders and innovators must seamlessly ingrain emissions reduction strategies in the cultural setting of a given area of the world, including all citizens of the globe in the effort to resolve the climate crisis.

In order to prevent the impacts of climate change from irreversibly damaging the planet, green technologies must be applied in all areas of the world, regardless of inequalities in government, economic, and structural support. In developed areas, technologies such as carbon capture, utilization, and storage can drastically reduce emissions and produce renewable fuel. Contrastingly, in developing areas, innovations such as adaptation education frameworks can be used to create an inclusive effort to reduce the severity of climate change, creating a more sustainable environment for future generations.

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