

Thesis Portfolio

Production of Cellulosic Ethanol from Mixed Paper
(Technical Report)

The Environmental and Economic Sustainability of Cellulosic Ethanol
(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree
Bachelor of Science, School of Engineering

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Spring, 2021

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Sociotechnical Synthesis

The Technical report discusses the design and economics of a cellulosic ethanol plant. The plant was designed to convert waste paper sourced from businesses and government facilities in need of a secure method for the disposal of documents. Additionally, the design also explores the use of acid hydrolysis to convert cellulosic fibers into fermentable glucose as a possible alternative pathway to enzyme hydrolysis. Converting cellulose into glucose is an additional step that must be performed when making ethanol from a cellulosic biomass rather than corn starch or cane sugar. This process is expensive due to the dependency on expensive enzymes that must be constantly replaced in order to continue production. By exploring a possible alternative, the team hopes to find a cheaper solution to manufacturing of cellulosic ethanol. The project team used a combination of equations and simulation software to design a manufacturing plant capable of creating over 8.5 million gallons per year of cellulosic ethanol through the proposed pathway. Additionally, a profitability analysis was performed on the design to determine if creating cellulosic ethanol through this pathway should be further pursued or abandoned in favor of alternative pathways.

The STS research paper focuses on predicting the long term economic and environmental impacts of large-scale production of cellulosic ethanol. As the supply of oil is nearing depletion countries like the United States are investing in a variety of possible replacements such as biodiesel, electricity, hydrogen, and ethanol. These alternatives each have the possibility of being chosen as a primary replacement to fossil fuels, however before a decision is made it is imperative that the long-term effects of each choice is understood. Due to rising concerns of the impact climate change is having on the planet the search for an environmentally sustainable fuel is

paramount to making this decision. The research paper focuses on the environmental and economic impacts of cellulosic ethanol production and seeks to determine its suitability as a replacement for petroleum-based fuel in the United States.

The technical and STS research papers are closely related due to this focus on cellulosic ethanol. The research paper focuses solely on the design and economics of one individual manufacturing plant. In contrast the STS research paper analysis the full process of cellulosic ethanol production from the growth and procurement of biomass to the release of greenhouse gasses when the fuel is combusted. Additionally, the Research paper tries to predict the possible impacts of large-scale production in the United States over an extended period of time. Together this research offers a more complete understanding of the production of cellulosic ethanol.