Thesis Portfolio

Large Scale Fuel Grade Cellulosic Ethanol Production from Mixed Waste Paper

(Technical Report)

Causes and Origins of COVID-19 Vaccine Hesitancy in the United States

(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 scientific community is currently searching for cleaner, sustainable alternatives to fossil fuels to meet the world's energy needs. A suitable alternative is needed since fossil fuels are in limited supply and release carbon dioxide to the atmosphere, contributing to climate change. Many environmentalists support the adoption of electric vehicles coupled with a transition to renewable energy sources for generation of electricity as the way to reduce use of fossil fuels. However, issues associated with charging electric vehicles and the expense of their batteries are major barriers to widespread adoption. A better solution may be the use of biofuels as a replacement to gasoline in vehicles powered by internal combustion engines. One popular biofuel candidate is ethanol.

Life cycle emissions for ethanol are lower than those of gasoline because the ethanol's carbon source comes from plants that recently obtained their carbon from the atmosphere, whereas the carbon source for gasoline is crude oil made from carbon that has been sequestered for millennia. Since the source material for ethanol-based biofuels is grown within a lifetime, it's considered a sustainable, renewable energy source, unlike fossil fuels.

Currently, corn ethanol is used extensively as a blended add-in for gasoline, allowing for more complete combustion and lower emissions. Corn ethanol is cheap and easily fermented since corn kernels contain simple, fermentable sugars. However, production of corn ethanol competes with food production, effectively raising both the price of food and the price of ethanol. Another common solution is using inedible, cellulosic sugar sources like corn stover, however corn stover also has additional uses as fertilizer and animal feed. Moreover, the cost of

the enzymes needed to break down cellulose and the price of feedstock make cellulosic ethanol more expensive to produce than gasoline. This project is an attempt to lower the cost of ethanol production by using a cheap and sustainable feedstock in the form of documents destroyed by government entities, businesses, and individuals.

As a general rule of thumb, ethanol fuel is not cost effective to produce if it must be transported more than 50 miles. As such, the location of the ethanol production plant determines what members of society are able to use ethanol fuel. Additionally, the feasibility of ethanol fuel production, at least using current technology, is entirely reliant on government tax credits to compete financially with fossil fuels. The political forces for and against these tax credits have major influence over the adoption of this technology. While these implications are certainly important to consider, the subject of my STS prospectus is unrelated to the technical topic assigned to me by the department of Chemical Engineering.

For my STS thesis, I will be studying the origins and causes of vaccine hesitancy in the United States as it applies to the COVID-19 vaccine. While the advent of any technology begets a wide array of reaction, including skepticism, vaccine efficacy is dependent on complete or nearly complete adoption, motivating research to determine the roots of hesitancy. While research has been conducted on vaccine hesitancy in general, this focuses almost exclusively on parental attitudes towards the vaccination of their children, as most vaccinations are administered in childhood. However, with a novel virus such as COVID, individuals will be tasked with making this decision for themselves, and different factors will be at play.

My research will center on the organizations involved in the discovery and communication of novel vaccine technology, including medical researchers, healthcare professionals, governmental bodies, and media organizations, and the degree to which an

individual’s trust toward and involvement in them influences their attitudes toward vaccine technology.