

**Thesis Project Portfolio**

**Supercritical Production of Biodiesel from Waste Cooking Oil**

(Technical Report)

**Biodiesel Process Technology Transition: Brazil's Indigenous Population**

(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**

My technical project and STS research both centered around biofuel technology. Biofuels are a fuel source derived from biomass. Depending on the processing technology utilized, either fresh or second-generation feedstocks are required. Fresh feedstocks include agricultural products such as corn and soy, while second generation feedstocks are waste streams, such as used fryer oil. While both of my works concerned biofuel manufacturing, my STS research focused on the societal impact of using fresh raw materials, and my technical project detailed a plant that employs a technology to reduce the dependence on fresh feedstocks.

For our technical project, my capstone team and I designed a biodiesel manufacturing plant that uses waste cooking oil (WCO) as the biomass feedstock. A reactor that operates at methanol's supercritical conditions converts WCO to biodiesel and glycerol. Supercritical operation allows for the use of WCO with high water and free fatty acid concentrations; therefore, unlike conventional catalyzed biodiesel processes, no pretreatment is required. The final purified products of the plant are ASTM D6751-24 biodiesel and USP grade glycerol. Furthermore, my team and I assessed the plant's economic viability over a twenty-year lifespan to determine the potential for investment.

My STS research focused on the problems caused by using first generation feedstocks in biofuel production. Specifically, my research aimed to analyze why Brazil is beginning to transition to biofuel manufacturing methods that use second generation feedstocks, despite the initial unwillingness of the government and biofuel manufacturers. Actor Network Theory (ANT) was employed to better understand how changing relationships between social groups can threaten the stability of an established technological network. For my case, I explored how the continued land expansions to support agriculturally based biofuel technologies marginalized Brazil's indigenous population. This led them to stray from their established relationships with those in power, form new relationships with the international community, and, finally, leverage their new relationships to cause a change in Brazilian biofuel manufacturing.

Each project informed the development of enhanced my understanding of the other. The choice to use a waste stream as a feedstock for my technical project was based on the societal problems of using fresh feedstocks that I uncovered during my preliminary STS research. Moreover, the thorough understanding I obtained from my STS research on shifting power dynamics and how they can influence technological change, not only impacted my decision on investment potential through the inclusion of social impact but also provided me with insight into how the experimental technology I proposed in my technical project could break into an established market. Therefore, working on both projects simultaneously increased the depth of analysis and, thus, increased the overall value of both projects.