# SLATT UNDERGRADUATE RESEARCH FELLOWSHIP
# FINAL REPORT

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| **SCHOLAR NAME:** | Yan Saltar |
| **FACULTY ADVISOR:** | Alexander Dowling |
| **PROJECT PERIOD:** | May 23- July 22 |
| **PROJECT TITLE:** | Using Superstructure Optimization Models to Analyze Case Studies for Shale Gas and Sugarcane Processing in the U.S. and Brazil |
| **CONNECTION TO ONE OR MORE ENERGY-RELATED RESEARCH AREAS (CHECK ALL THAT APPLY):** | **( ) Energy Conversion and Efficiency** **( ) Sustainable and Secure Nuclear**<br>**( ) Smart Storage and Distribution** **( ) Transformation Solar**<br>**(x) Sustainable Bio/Fossil Fuels** **( ) Transformative Wind** |

## MAJOR GOALS AND ACCOMPLISHMENTS

Summarize your research goals and provide a brief statement of your accomplishments (no more than 1-2 sentences). Indicate whether you were able to accomplish your goals by estimating the percentage completed for each one. Use the next page for your written report.

| RESEARCH GOALS | ACTUAL PERFORMANCE AND ACCOMPLISHMENTS | % OF GOAL COMPLETED |
|---|---|---|
| **Search literature for shale gas superstructure models** | Compare collected models to the one I did last summer. | 100% |
| **Analyze technology options for bio aviation fuel production** | Collected location of facilities, economic and environmental data. Illustrated this data compared to conventional. | 100% |
| **Search literature for case studies of co-production with bio-aviation fuels** | Collected data from different papers on co-processing. | 100% |
| **Assisted grad mentor on superstructure model for ethanol to jet fuel.** | Worked on refining already established model | 85% |
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## RESEARCH OUTPUT

Please provide any output that may have resulted from your research project. You may leave any and all categories blank or check with your faculty advisor if you are unsure how to respond.

| CATEGORY | INFORMATION |
|---|---|
| **EXTERNAL PROPOSALS SUBMITTED** | (Sponsor, Project Title, PIs, Submission Date, Proposal Amount) |
| **EXTERNAL AWARDS RECEIVED** | (Sponsor, Project Title, PIs, Award Date, Award Amount) |
| **JOURNAL ARTICLES IN PROCESS OR PUBLISHED** | (Journal Name, Title, Authors, Submission Date, Publication Date, Volume #, Page #s) |
| **BOOKS AND CHAPTERS RELATED TO YOUR RESEARCH** | (Book Title, Chapter Title, Authors, Submission Date, Publication Date, Volume #, Page #s) |
| **PUBLIC PRESENTATIONS YOU MADE ABOUT YOUR RESEARCH** | (Event, Presentation Title, Presentation Date, Location) |
| **AWARDS OR RECOGNITIONS YOU RECEIVED FOR YOUR RESEARCH PROJECT** | (Purpose, Title, Date Received) |
| **INTERNAL COLLABORATIONS FOSTERED** | (Name, Organization, Purpose of Affiliation, and Frequency of Interactions ) |
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| **WEBSITE(S) FEATURING RESEARCH PROJECT** | (URL) |
| **OTHER PRODUCTS AND SERVICES** (e.g., media reports, databases, software, models, curricula, instruments, education programs, outreach for ND Energy and other groups) | (Please describe each item in detail) |

## RESEARCH EXPERIENCE

| Please let us know what you thought of your research experience: Did this experience meet your expectations? Were lab personnel helpful and responsive to your needs? What else could have been done to improve your experience or achieve additional results? |
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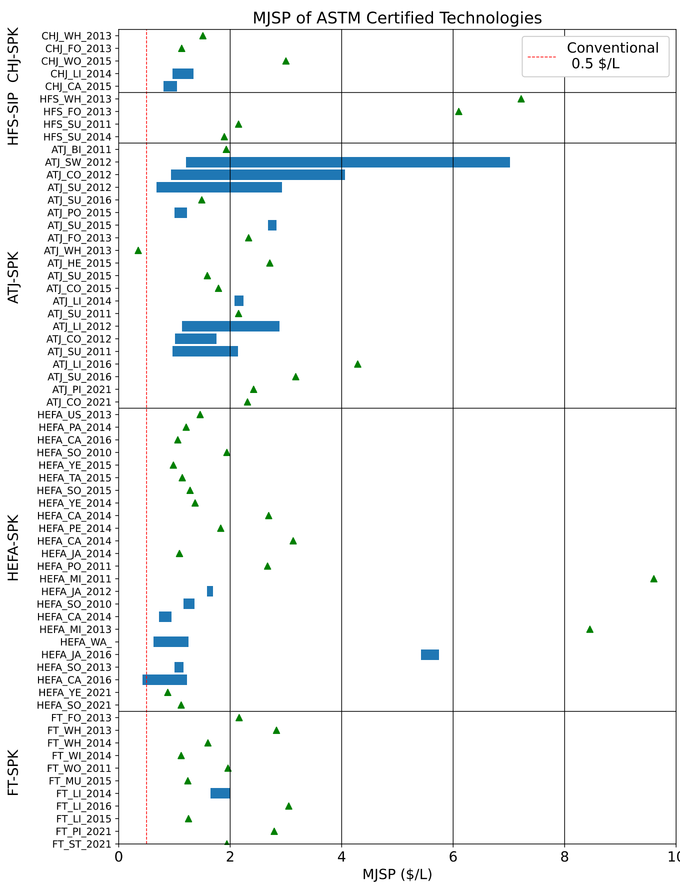
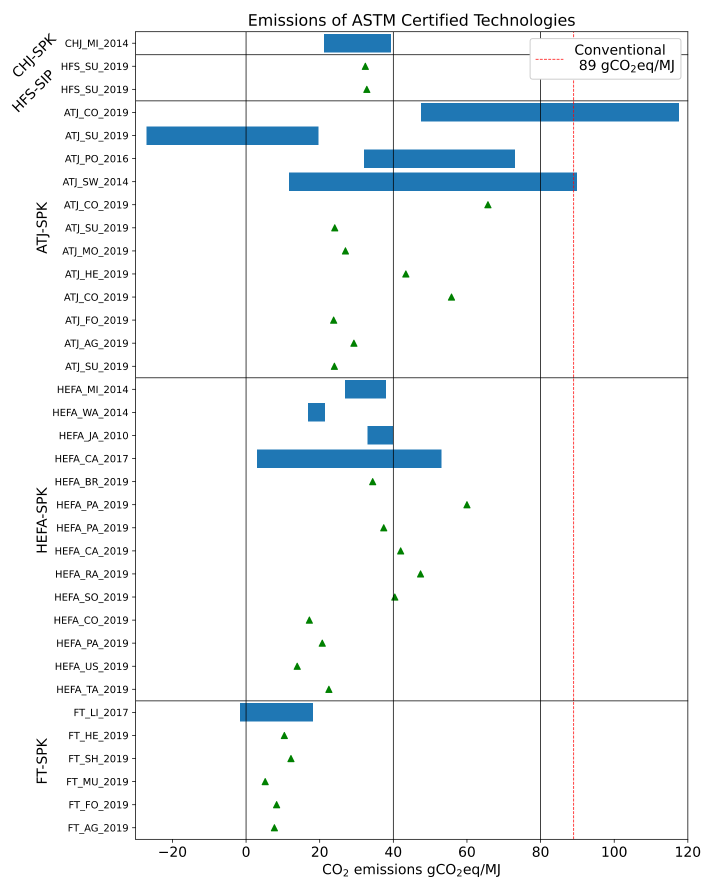
| **This program really met my expectations, the professional development activities were instructional and helpful. Everyone in my lab, especially mentor, was nice and I got along with them really well.** |

# FINAL WRITTEN REPORT

(Please use the space below to describe your research project and objectives, any findings and results you can share, and graphs, charts, and other visuals to help us understand what you achieved as a result of this research experience.)

The aviation industry accounts for 2.8% of the global greenhouse gas (GHG) emissions in 2020 and these emissions are expected to dramatically grow as the passenger numbers doubles from 2016 to 2035. To mitigate the expected increase, the International Air Transport Association (IATA) set a cap on the amount of CO2 emissions in 2020, and a 50% reduction by 2050 compared to 2005. There are various options in the aviation sector to reduce GHG such as alternative fuels, renewable fuels, and aircraft electrification. Renewable aviation fuels (RAFs) offer a way to turn different feedstocks like agriculture residues, municipal waste, and other organic substances into biofuels for aviation. Even though in recent years the demand for new fuels has been slow, reaching 150 million liters in 2020, it is expected to reach 65 billion liters by 2050. We reviewed the seven different technology pathways approved by the American Society for Testing and Materials (ASTM) to produce RAF: Fischer Tropsch Synthetic Paraffin Kerosene (FT-SPK), Fischer Tropsch with added aromatics (FT-SPK/A), Alcohol-to-Jet (ATJ-SPK), Hydroprocessed Esters and Fatty Acids (HEFA-SPK), Hydro processing of Fermented Sugars (HFS-SIP), Catalytic Hydrothermolysis Synthetic (CHJ-SPK) , and Hydrocarbon-Hydroprocessed Esters and Fatty Acids (HC-HEFA-SPK). Today, there are only 25 refineries in operation that implement only 4 of these technologies. We compared two metrics – the minimum jet fuel selling price (MJSP) and CO2 emissions – across these technologies to understand the slow adoption.




As can be seen from the plots the reviewed technology options have a MJSP on average 336% higher than conventional with the highest MJSP reaching 960%. They also have an average potential to reduce emissions by 60.38% with the possibility to reach below 0 emissions.