From Seed … to Sky: Eastern Shore/Delmarva Energy Beet-to-Jetfuel Project Feasibility Study Exective Summary

- *Project lead by University of Maryland Eastern Shore*
- *Study by Advanced Biofuels USA, September 2017 with a USDA Rural Business Development Grant*

Introduction

The ***US Navy*** has identified a need for renewable jetfuel at the port in Norfolk, Virginia. Renewable jetfuel may also help ***decarbonize air travel*** consistent with objectives of international policies, especially the European Union's ETS (emissions trading system). With Norfolk and Mid-Atlantic international airports in the area, ***could Maryland's Eastern Shore, part of the Delmarva (Delaware, Maryland, Virginia) Peninsula develop an economically viable sustainable alternative jetfuel*** (SAJF) supply and production chain to serve these markets?

This question was assessed by Advanced Biofuels USA, a nonprofit educational organization, with a US Department of Agriculture Rural Business Development Grant using available product yield and production cost information from Phase 1 of an energy beet project conducted in 2016 by the University of Maryland Eastern Shore.

This project used ***newly developed energy beets*** as the feedstock, ***enzymatic conversion*** of the biomass to obtain fermentable sugars, and proposed processing of those sugars into oils or ethanol as precursors or biointermediates for jetfuel production. The advantage of energy beets over feedstock such as switchgrass, agricultural/forest residues or woody biomass rests in its ***lack of lignin***, a substance in plant cell walls that is difficult to convert to sugars (biomass recalcitrance).

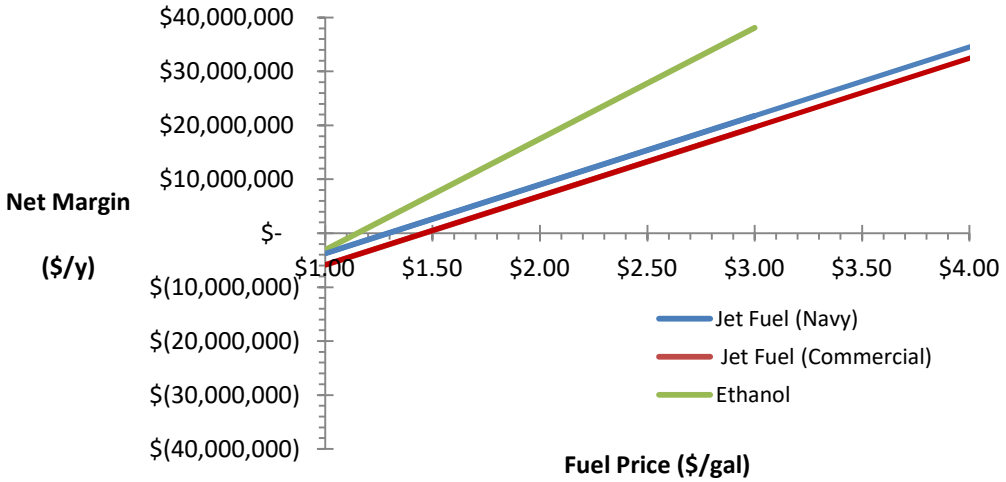
The proposed ***markets*** were the ***Defense Logistics Agency*** solicitations for the U.S. Navy at Norfolk, and ***future commercial aviation*** markets. Alternatively, the ethanol could be used as in the Mid-Atlantic markets or in renewable chemical production.

Three aspects of ***sustainability*** (economic, environmental and social) have been incorporated into every element of the analysis tailored to the unique characteristics of the region. Specific considerations include:

- ***Prioritizing potential environmental benefits*** for the health of the Chesapeake Bay;
- ***Minimizing stresses*** on local transportation infrastructure;
- ***Minimizing*** processing ***energy and water*** use;
- Recognizing the future impact from sea level rise in the area; and
- ***Maximizing the potential for wealth and job development*** in an economically depressed part of the Mid-Atlantic Coast.

This study finds that it could be feasible to produce low greenhouse gas emissions advanced ethanol or jetfuel on the Eastern Shore and Delmarva in an economically and environmentally sustainable way for the U.S. Navy solicitation using energy beet feedstock as illustrated in the Energy Beet Biofuel Net Margin Sensitivity Analysis Fuel Price graph.

Energy Beet Biofuel Plant Net Margin Sensitivity Analyses. Fuel Price.



In addition, this could bring economic, environmental and social benefits to the region.

Producing environmental benefits from phosphorus uptake and contributing feed to the existing poultry industry, alongside producing cost-competitive biofuels has the potential to support not only a positive return on investment for a biorefinery, but also for growers and for entrepreneurs servicing this new industry.

Results

The study concludes that:

- The Plant Sensory System energy beets grow well on the Eastern Shore with ***minimal fertilizer*** and ***take up phosphorus at levels sufficient for potential inclusion in nutrient management*** plans and cap-and-trade remediation credits credits with 50% increase of P uptake by energy beets compared to corn grown in adjacent fields..

- ***August to December harvest*** minimizes land use and costs for storage and maximizes beet growth.

- ***High protein residues*** from biomass conversion and beet tops could have value as poultry or animal feed. This may allow a 1:1 replacement of Delmarva corn crops with energy beets meaning that no crop displacement would occur with the implementation of this system.

- The Atlantic Biomass enzymatic system successfully ***converts the beet pulp to sugars*** that can be fermented into ethanol or oils using processes under study at Purdue University and the USDA Agricultural Research Service National Center for Agricultural Utilization Research in Peoria, Illinois.

- These oils might be converted to jetfuel using existing approved processes.

- ***Twice as much ethanol can be produced from an acre of energy beets as from an acre of corn.***

- Alcohol-to-jet conversion processes under review by ASTM could use energy beet ethanol as a feedstock ***for jetfuel and renewable chemical*** co-products.

- The jetfuel market for the U.S. Navy at Norfolk, based on Defense Logistics Agency solicitations, provides a ***clear demand at a set price*** for an amount of jetfuel that could be produced and delivered from energy beet feedstock grown and processed on the Delmarva.

- A ***market for ethanol for ground transportation*** in the region exists, is growing and could provide customers for energy beet ethanol as the alcohol-to-jetfuel conversion processes mature and ASTM or U.S. Navy approvals are obtained.

- Using ***barge-based production and transportation*** could minimize stress on traffic and maximize efficient use of resources.

Additional Research Needed

Overall, the study finds that development of an energy beet-to-SAJF supply and production chain is in its early stages, but could be economically feasible as described above depending on the results of significant research which is needed on a number of fronts. These include:

- ***Pathways*** must be submitted and approved for energy beet-based fuels to be able to participate in federal renewable fuel incentives such as the Renewable Fuels Standard, and agricultural programs such as crop insurance and access to Commodities Credit Corporation funds as part of the Farm to Fleet program.

- Continuing to develop ***energy beet seed stock*** bred for Delmarva conditions and determining best practices and ***equipment for planting, harvesting, pest management***.

- ***Clarifying the nutrient management benefits*** of growing energy beets.

- Establishing use of high protein energy beet ***residues for poultry feed***.

- Building a ***pilot scale*** facility to improve sucrose extraction and the enzymatic conversion system and to research enzyme recycling and other ways to reduce the cost of the system.

- Fleshing out, with industry expertise, ideas for ***barge-based conversion facilities and barge transportation.***

- ***Optimizing the fermentation processes*** for conversion of energy beet sugars to ethanol (Purdue University) and oils (USDA National Center for Agricultural Utilization Research).

- ***Recycling enzymes*** to reduce production costs.

- ***Optimizing the conversion*** of ethanol to jetfuel and renewable chemicals (Vertimass).

- Exploring the availability and suitability of ***local facilities*** for jetfuel production, with priority given to reviving stranded industrial assets or adding capabilities to existing refineries.

This project, in its initial stages, has engaged a number of renewable fuel industry and academic personnel, with outreach during UMES and USDA events in the region to the agricultural community and occasional interactions with state and federal government agencies and nonprofit organizations. As the project is pursued, involvement should expand to include a wider range of stakeholders who have interest, concerns, suggestions or questions about aspects of the proposed project and who would like to become involved in next steps.

Policy Support Needed

Although they have not been assessed in depth, this report lists some government programs and initiatives that can benefit or shape the development of this project such as programs under the US Departments of Agriculture, Energy and Defense and the Environmental Protection Agency and the state of Maryland such as the nutrient management and trading programs. Evaluation is based on current government policies, regulations and opportunities which are subject to change.

Economic and Environmental Benefits

This report provides a description of how a new crop can ***complement, not disrupt***, Delmarva economic activities, revive underutilized or stranded agricultural and industrial assets in the Mid-Atlantic and bring to the region new wealth and jobs based on bio-based industries of the future, starting with high protein feed, sustainable renewable transportation fuels and renewable chemicals.

It should be used by farmers, land owners, government officials, economic development staff, community leaders, potential investors, researchers, students contemplating career paths and the general public for information about what it will take to develop a successful sustainable feed and fuel industry on the Delmarva to serve Mid-Atlantic markets.

The study has determined that on the Delmarva it is economically possible for energy beets to be grown and processed into advanced ethanol as a stand-alone product for motor transportation or as a feedstock for renewable jetfuel to meet the needs of the US Navy at Norfolk complementing, not disrupting existing agricultural industries. Alternative markets for commercial aviation biofuel or for ethanol as feedstock for chemical production should give investors and growers confidence as they consider developing a new industry in this area.

Economic Feasibility Study of the Eastern Shore Energy Beet to Bio-Jetfuel Project

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Full report available at https://advancedbiofuelsusa.info/energy-beet-feasibility-study-finds-navy-best-potential-near-term-customer-for-alcohol-to-jetfuel-product/

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