ASCENT 1 Scenario Analyses using the Freight and Fuel Transportation Optimization Tool (FTOT) and Biomass Scenario Model (BSM)

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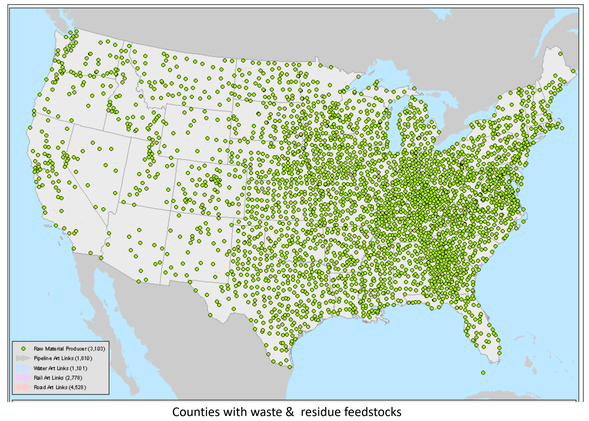
Motivation and Objectives

- The Federal Aviation Administration (FAA) needs to understand future alternative jet fuel (AJF) deployment scenarios to facilitate goal-setting and planning.
- This analysis is focused on answering two questions:
  - How much AJF can be produced and how soon?
  - What is the likely geospatial distribution of feedstock and fuel production and AJF delivery?
- ASCENT 1 researchers are providing the technoeconomic, efficiency, product-slate and feedstock production data that can inform future scenario analyses.
- The National Renewable Energy Laboratory (NREL) Biomass Scenario Model (BSM) and the Volpe National Transportation Systems Center (Volpe) Freight and Fuel Transportation Optimization Tool (FTOT) provide complementary approaches to assessing the future production potential and spatial flow and delivery patterns for alternative jet fuel, respectively.

Scenario Definitions

Included ASTM-approved pathways: Hydroprocessed Esters and Fatty Acids (HEFA), Fischer Tropsch (FT), and Alcohol to Jet (ATJ)

- Experience with AJF production has shown that there is a significant lag prior to commercialization after approval
- TEA data and product slates from A01 Research
- Feedstocks evaluated (aligned to 2030 projected availability)
  - Waste fats, oils and greases (tallow) – HEFA (WSU projection)
  - Municipal solid waste (MSW) – FT (WSU projection)
  - Woody residues – FT (LURA modeling from NARA team)
  - Agricultural residues – ATJ (Univ. of TN POLYSYS Modeling)



Counties with waste & residue feedstocks

Models Used

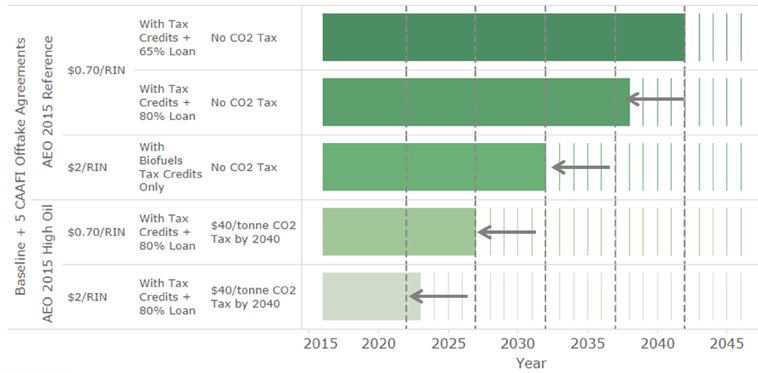
- NREL Biomass Scenario Model (BSM)
- Volpe Freight and Fuel Transportation Optimization Tool (FTOT)

Conclusions and Next Steps

- Reaching a billion gallons of AJF using only FT, HEFA, and ATJ by 2030 will require concerted policy support and incentives
- While wastes and residues are widely distributed around the United States, aggregation, delivery, and conversion are likely to be concentrated regionally. Likely locations for new facility development are the Midwest, the Southeast, the Pacific Northwest and Southern California.
- Analyses will continue to focus on greater alignment between the two models and further exploration of differences between technology deployment.

BSM Initial Results

Results of initial BSM runs projecting future AJF production under different policies and incentives



- Assuming current conditions continue, 1 billion gallons of renewable jet fuel are reached by 2042.
- By increasing loan guarantee rates, including a carbon dioxide tax, elevating oil prices, or including a higher RIN price, one billion gallons could be met sooner (as early as 2023 with all of these in place).
- The majority of the fuel in the early market is supplied by HEFA and is supplemented later by cellulose to hydrocarbon pathways.
- The lowest-cost feedstocks (fats, oils, and greases for HEFA and forest residues for cellulose to hydrocarbons) are used first.

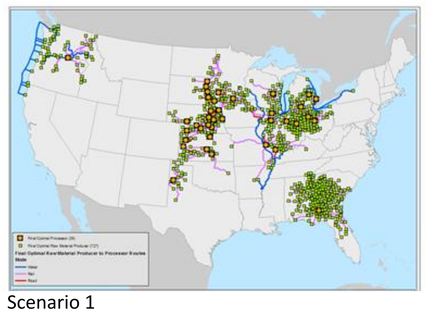
FTOT Initial Results

FTOT results for low, nominal and high feedstock availability and two incentives

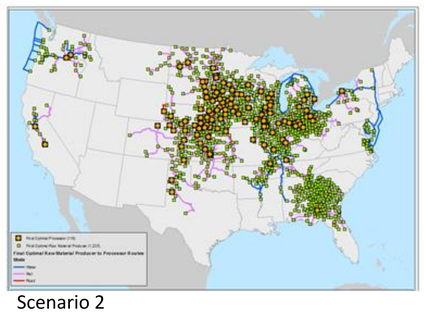
Scenario	Feedstock Level	Incentive	Feedstocks Used	Processes Used	Jet Fuel Delivered / Technical Potential	Airports Receiving Delivery
1	Low	$0.50/gal	Residues	ATJ	0.86 / 1.58	31
2	Nominal	$0.50/gal	Residues	ATJ	4.1/5.5	111
3	High	$0.50/gal	Residues	ATJ	4.5 / 6.5	113
4	Low	$2.50/gal	Residues, MSW	ATJ, FT	1.03/1.58	40

- Based on FTOT analysis, it would be cost effective to move close to a billion gallons even in the low feedstock availability scenario.
- Lignocellulosics are more prevalent than lipid-based fuels due to small feedstock collection radius and low tallow availability.
- FTOT produces more ATJ than the BSM simulations because FTOT assumes ATJ facilities are built at existing ethanol refineries whereas the BSM assumes greenfield facilities.
- Feedstock routing maps (below) show that the first feedstocks to be used are concentrated in the Midwest and Southeast, with some forest residue usage in the Pacific Northwest.
- Note that FTOT routing identifies candidate processing locations and provides an "optimal" route rather than actual, so the costs provided by the model may underestimate actual costs and emissions.
- Most feedstock was moved by rail in the current analyses due to proximity of county population centroids to rail network.

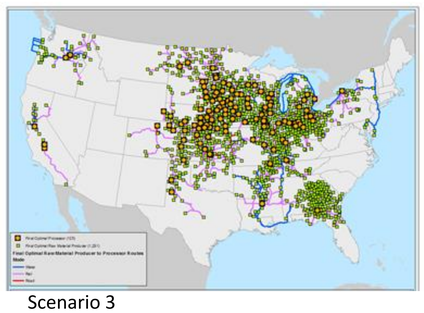
FTOT Routing of Feedstocks from County of Origin to Processing Locations



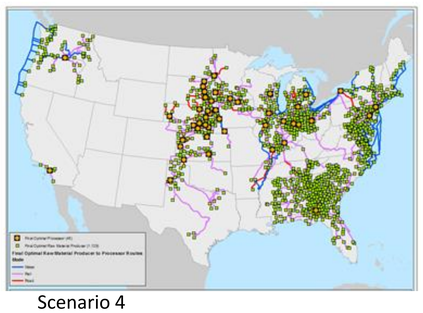
Scenario 1



Scenario 2



Scenario 3

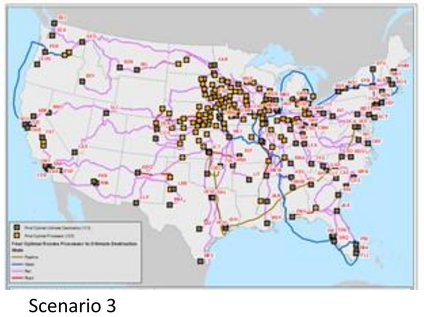


Scenario 4

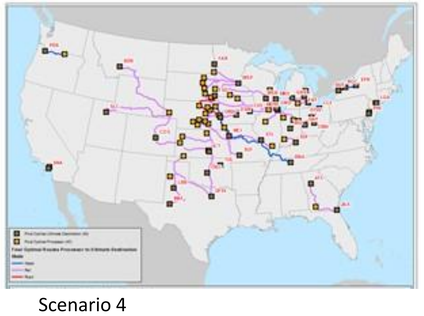
FTOT Routing of Jet Fuel from Processing Locations to Airports

Scenario 1

Scenario 2



Scenario 3



Scenario 4