# Alternative Jet Fuels Tools & Analysis

#### Presented to: REDAC

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## Outline

- ASCENT 1 Team & Overview
- ASCENT 1 Supply Chain and Deployment
  - Washington State Univ. siting in the PNW
  - Univ. Tennessee Polysys feedstock modeling
  - Volpe Alt. Fuels Transportation Optimization Tool (AFTOT)
  - DOE NREL Biomass Scenario Model (BSM)
  - Farm to Fly
- ASCENT 1 ICAO Alternative Fuel Task Force (AFTF) support
  - Fuel production assessment
  - Ongoing Life Cycle Analysis (LCA) work



# ASCENT

#### FAA CENTER OF EXCELLENCE FOR ALTERNATIVE JET FUELS & ENVIRONMENT

#### Lead Universities:

- Washington State University (WSU)\*
- Massachusetts Institute of Technology (MIT)

#### **Core Universities:**

- Boston University (BU)
- Georgia Institute of Technology (Ga Tech)
- Missouri University of Science and Technology (MS&T)
- Oregon State University (OSU)\*
- Pennsylvania State University (PSU)\*
- Purdue University (PU)\*
- Stanford University (SU)
- University of Dayton (UD)
- University of Hawaii (UH)\*
- University of Illinois at Urbana-Champaign (UIUC)\*
- University of North Carolina at Chapel Hill (UNC)
- University of Pennsylvania (UPenn)
- University of Tennessee (UT)\*
- University of Washington (UW)\*





\* Denotes USDA NIFA AFRI-CAP Leads and Participants & Sun Grant Schools

ASCENT Website: http://ascent.aero



# **ASCENT 01 Supply Chain Analysis**

#### Database Development and Archive

#### Scenario and Sustainability Analysis





Project

**Outputs** 

### **WSU Siting Benefits and Strategies**



#### GREENFIELD

CAPEX – Hi Equipment Costs Hi Infrastructure Costs OPEX – No Labor Savings No Services Low Energy/Feedstock

#### CO-LOCATE

- CAPEX Med Equipment Costs
  - Med Infrastructure Costs
- OPEX Hi Labor Savings
  - **Full Services**
  - Low Energy/ Feedstock

Valuable and attractive locations



REPURPOSE / RETROFIT CAPEX – Low Equipment Costs Low Infrastructure Costs OPEX – No Labor Savings Full Services ? - Energy/ Feedstock

Federal Aviation Administration

#### WSU layers - Facilities, Electricity, Gas, Demand, Infrastructure





#### **WSU Depot Facility Score Example**



**Preliminary Results – Do Not Cite** 



### **UTenn Polysys - Feedstock Supply Curves**





# Alternative Fuels Transportation Optimization Tool (AFTOT)



Flexible scenario testing tool optimizes feedstock flows, aggregation, conversion processing and fuel transport for local, regional and national scenarios.

Leverages data from ASCENT P1 on feedstock supply, biorefinery size and cost, conversion processes and product slate.

Volpe has constructed unique multimodal network of roadway, railway, waterway, and pipeline with associated transport and transloading costs.

Outputs of optimized scenarios include:

- Material/commodity flows
- Potential biorefinery locations
- CO2 emissions
- Fuel burn
- Number of vehicle trips
- Distance, vehicle miles traveled
- Costs









#### NREL Biomass Scenario Analysis Model (BSM) Necessary Assumptions for One Billion Gallons

Policies affecting fuel price have a considerable impact on when aviation will get to 1 billion gallons of AJF production



This figure shows possible scenarios that would accelerate reaching 1 billion gallons of



# Farm to Fly 2.0 (F2F2) Agreement

#### Goal:

- Enable commercially viable, sustainable bio-Jet Fuel supply chains in the U.S.
- Support the goal of one billion gallons of bio-Jet Fuel production capacity and use for the Aviation Enterprise by 2018
- ASCENT 1 & AFTOT future analysis supports efforts in Chesapeake, SE, PNW, Hawaii, Midwest
- USDA NIFA CAPs program targets jet fuel – linkages:

Airlines for America

- ASCENT, CAAFI, F2F2





GAM

# International Civil Aviation Organization (ICAO) Alternative Fuels Task Force (AFTF)

- 2050 Global AJF Fuel Production Assessment (FPA)
  - Effort is complete used for CAEP/10 Trends Assessment
  - MIT conducted fuel production analysis
  - MIT/ANL compiled life cycle GHG emissions factors
- LCA Methodology for the Global MBM
  - CAEP/10 meeting accepted methodology to compute values -MIT/Purdue/ANL/Volpe all instrumental to method development
  - MIT will use methodology to develop core LCA default values
  - Purdue will calculate induced land use change emissions
  - Team is providing input on development of sustainability criteria



## **AFTF FPA Approach**

• *Scenario approach:* Exploration of a wide range of parameters for environmental stringencies, socioeconomic development and policy-emphasis on bioenergy in general and alternative aviation fuels in particular





### **AFTF FPA Results**

- Large variability in results: 0-100% replacement of conventional jet fuels with alternative jet fuels depending on scenario by 2050
- Maximum GHG emissions of ~50% if all of conventional jet fuel is replaced with alternative jet fuels in 2050
- Range of emission reduction in mid-scenarios on the order of 10-20% in 2050, all of this could come from residues, waste and microalgae
- Higher replacement rates are feasible if alternative aviation biofuel production is prioritized over other usages



### **AFTF Core LCA Work**

MIT leading effort to develop default core LCA values using agreedupon methodology for AJF production pathways of interest.

#### Process:

- 1. Develop guidance and memo to solicit data on fuels of interest to the aviation community
- 2. Acceptance of existing LCA data/analyses that adhere to identified guidance;
- 3. Augmentation of existing LCA data/analyses such that they adhere to the identified guidance;
- Aggregation of fuel production pathways on the basis of technology, feedstock, or production region, where shown to be appropriate; or
- 5. Calculation of new LCA data/analyses that adhere to the identified guidance.



### **AFTF Induced Land-Use Change Sample Problem**

Purdue calculating ILUC values that will be added to the core LCA value to get the LCA factor that will be used within the GMBM. Currently working on sample value calculation.

| Region  | Conventional Biofuel    | Advanced Biofuel for<br>Ground Uses | Aviation Biofuel           |
|---------|-------------------------|-------------------------------------|----------------------------|
| U.S.    | Corn Ethanol            |                                     |                            |
|         | Soy biodiesel (FAME)    | Renewable diesel                    | Soy jet (2016)             |
|         |                         | Cellulosic ethanol                  | Cellulosic jet fuel (2016) |
| EU      | Canola biodiesel        |                                     | Canola jet (2016)          |
|         | Wheat/sugarcane ethanol |                                     |                            |
| Brazil  | Sugarcane ethanol       |                                     |                            |
|         | Soy biodiesel           |                                     | Soy jet (2016)             |
| SE Asia | Palm oil biodiesel      | Renewable diesel                    | Palm oil jet (2016)        |



## Summary

- ASCENT P1 universities have teamed with DOT Volpe Center, DOE Argonne National Labs (ANL) and DOE National Renewable Energy Lab (NREL) to conduct integrated alternative jet fuel analyses
- Creating domestic alternative jet fuel production scenarios to understand challenges in reaching 1 billion gallons of fuel production
- Providing robust technical support to the CAEP AFTF in evaluating future alt jet fuel production for trends assessment and to incorporate alt jet fuels within the global market based measure for international CO2 emissions

