Life cycle GHG emissions modeling for international policy

Project 01

Presenter: Mark D. Staples
Lead investigator: Steven R.H. Barrett
Project managers: Nathan Brown, Daniel Williams & James Hlieman, FAA

December 5, 2018
Washington, DC

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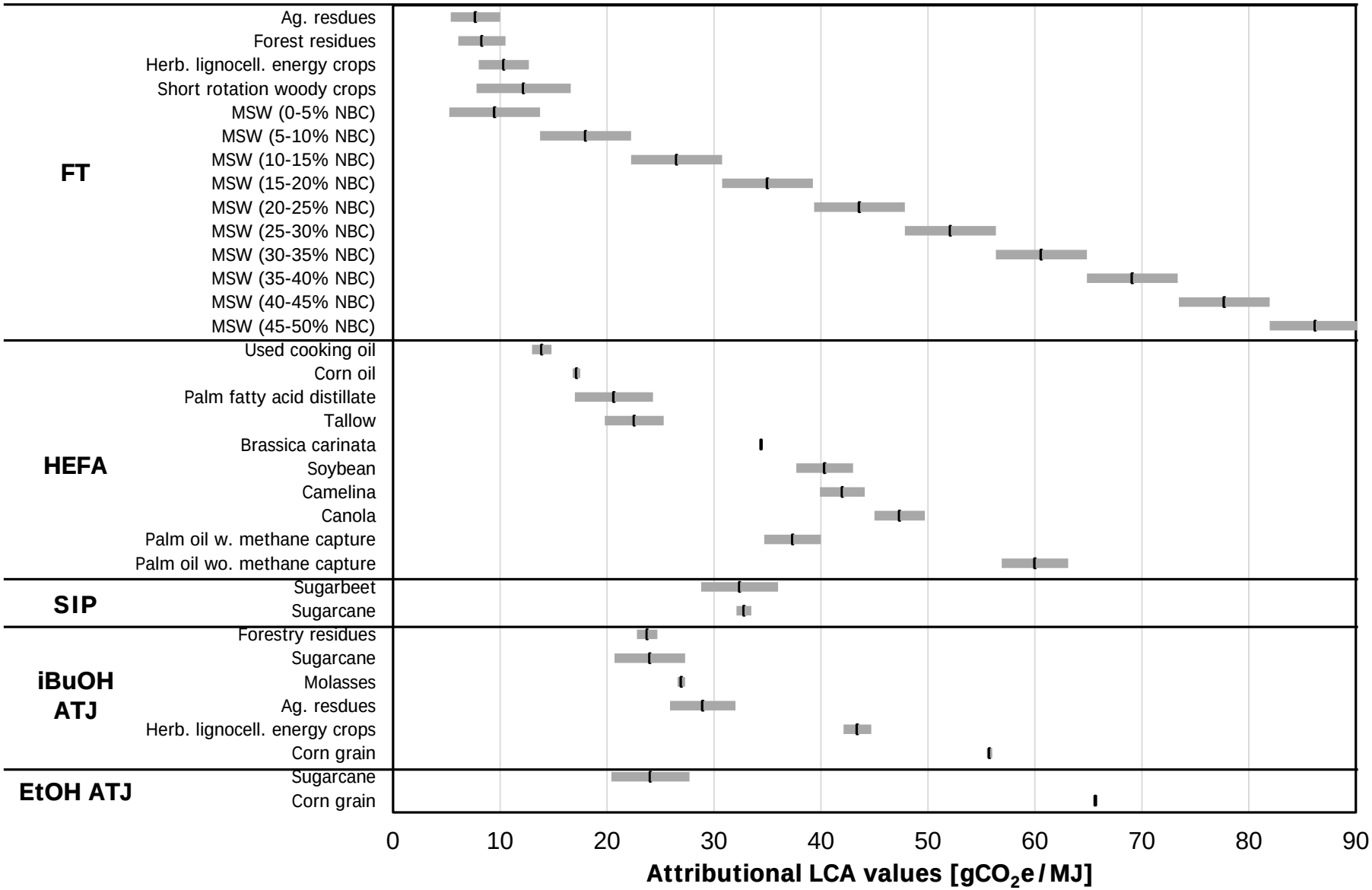
Emissions accounting for alternative aviation fuels

- **Problem**
  - Under ICAO's CORSIA, airlines must limit their CO_2 emissions from 2021
  - Airlines can meet their obligations through the use of alternative fuels
  - Dozens of different pathways for alternative fuel production

How should CO_2 emissions reductions from the use of alternative fuels be accounted for under CORSIA?

- **Approach**
  - Consistent, globally robust, application of life cycle analysis (LCA)
  - Multi-model, independent validation/verification of default LCA values
  - Mechanism to account for processes that differ from default assumptions

Default LCA values under CORSIA



Preliminary results – Please do not cite or quote.

Using LCA values under CORSIA

- **Stakeholders**
  - Airlines using alternative fuels to meet CORSIA obligations can use default LCA values presented here
  - Consequential emissions impacts may need to be included as well (land use change emissions, avoided landfilling emissions)
- **Engagement & access**
  - Technical report detailing all LCA calculations and input data to be published on the ICAO CAEP website (anticipated 2019)
  - All LCA calculations carried out by MIT (and ANL) in open-source GREET model
  - Airlines and producers can compare their data to default assumptions, and calculate producer-specific values, if desired
- **Next steps**
  - On-going calculation of new default values as promising pathways are ID'd
  - Development of ICAO-specific version of GREET model

Induced Land Use Change Emissions Estimation

Project 13-C-AJFE-PU

Project managers: Dan Williams, Jim Hileman, Nate Brown, FAA
Lead investigator: Wallace E. Tyner, Purdue University

December 5, 2018
Washington, DC

This research was funded by the U.S. Federal Aviation Administration Office of Environment and Energy through ASCENT, the FAA Center of Excellence for Alternative Jet Fuels and the Environment, project 107208 through FAA Award Number 13-C-AJFE-PU under the supervision of Dan Williams, Nate Brown, and Jim Hileman. Any opinions, findings, conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the FAA.

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Problem / Solution

- **Problem**
  - Induced land use change (ILUC) emissions must be estimated for SAF pathways for inclusion in the CORSIA for ICAO.
  - When there is a sizeable increase in demand for a commodity due to biofuel production (e.g., maize for ethanol, rapeseed for biodiesel, etc.), that demand increase causes an increase in the price of the commodity unless the commodity supply is perfectly elastic.
  - The price increase causes some combination of five main market mediated responses.
- **Solution: GTAP model background**
  - There are about 16,150 members of the GTAP network around the world representing 174 countries.
  - There are 23,500 Google Scholar citations for ‘GTAP’
  - There are 948,537 bilateral trade flows in the GTAP data base.
  - 52 GTAP courses have been offered all over the world training 1,150 professionals and students.
  - Many MS and Ph.D. students have used GTAP in their research.

Major Drivers of Induced Land Use Change

1. Higher commodity price, consumption normally falls.
2. With higher price for this commodity, there can be switching among crops: more of this crop is produced and less of other crops.
3. With higher commodity demand, more cropland can be needed to meet increased demand, and this cropland can come from pasture or forest converted to cropland (extensive margin).
4. With higher commodity demand, existing cropland might be farmed more intensively (intensive margin e.g. double cropping, using idled land, etc.). This leads to less demand for land conversion.
5. Impacts on international trade of the commodity and of substitute commodities could also induce land use changes across the world.

How to use this resource

- **Which stakeholders can use tool / resource**
- Any stakeholder with a GTAP license can access and use the model
- **How can those stakeholders engage / access tool or resource**
  https://www.gtap.agecon.purdue.edu/databases/v9/default.asp
  https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=5172
- **Schedule / timeline / next steps**
- Work continues adding new SAF pathways and on model and data improvements and updates.

Alternative Jet Fuel Supply Chain Analysis

Conversion Pathways to Alternative Fuels

Project 01

Lead investigator: M. Wolcott, M. Garcia-Perez, X. Zhang, A. Tanzil, K. Brandt

Project manager: J. Hileman, FAA; N. Brown, FAA

Biennial Meeting

December 5, 2018
Washington, DC

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Problem / Solution

Technical Problem Addressed

Up to now all the jet fuel supply chain analyses published have been limited to **standalone jet fuel technologies without bio-products**. The potential techno-economic and environmental benefits of **using existing industrial infrastructure** and **the production of co-products** on jet fuel production scenarios could facilitate the deployment of alternative jet fuel supply chains.

Long term contribution:

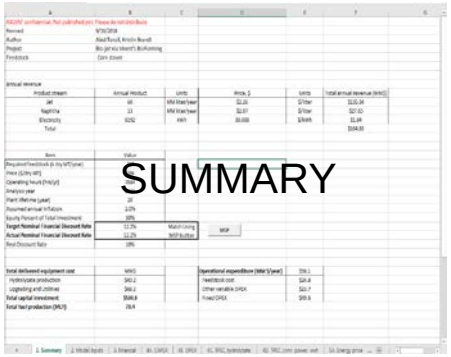
Design cases of:
(1) standalone AJF production technologies,
(2) bio-refineries that take advantage of existing industrial infrastructure and
(3) bio-refineries generating co-products from AJF intermediates.
The use of these design cases in the analysis of regional supply chains.

AJF technologies - 1) Virent, 2) Alcohol to Jet, 3) Direct sugar to hydrocarbon, 4) Fast pyrolysis, 5) Gasification & Fischer Tropsch, 6) HEFA, 7) CH, 8) HTL

Existing infrastructure - 1) dry grind corn mill, 2) Sugarcane mill, 3) Petroleum, 4) Pulp and paper mill

Sample Results

Standardized format of our TEA's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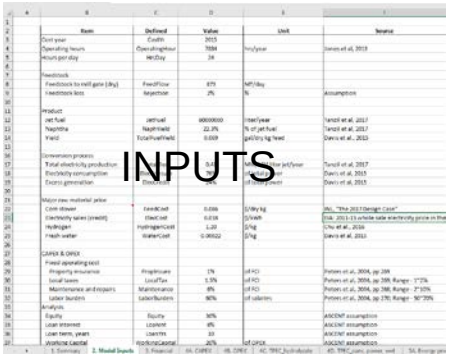
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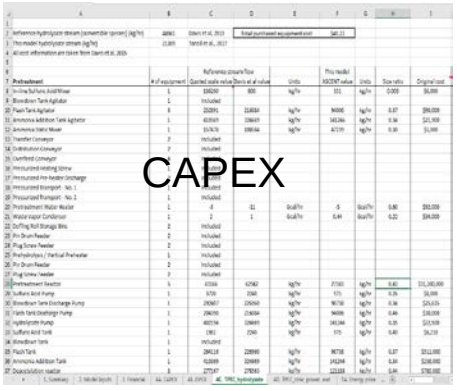
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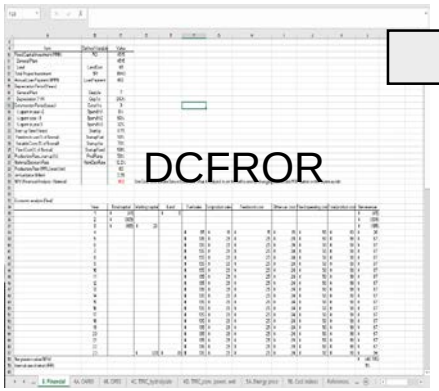
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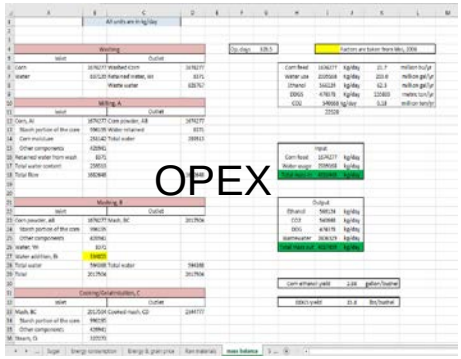
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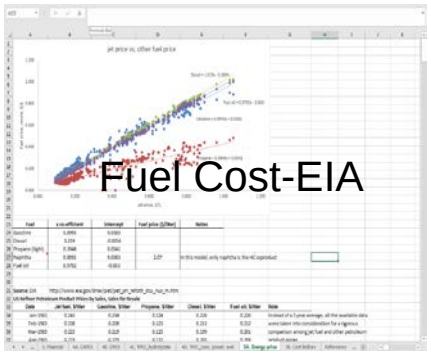
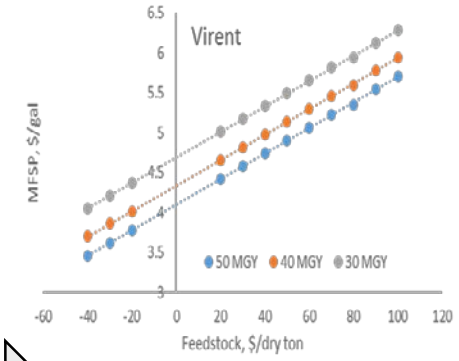
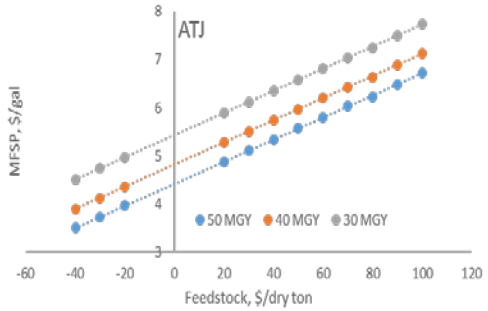
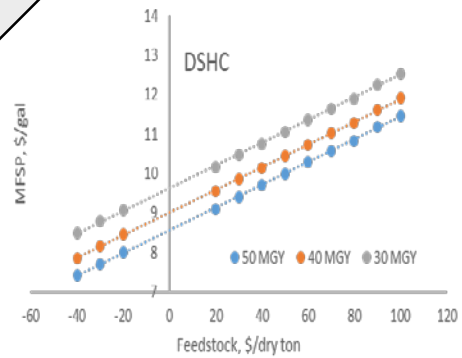
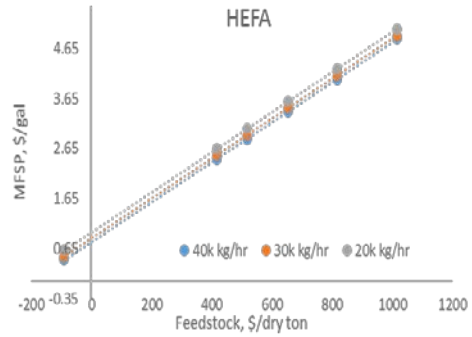

Fuel Cost-EIA

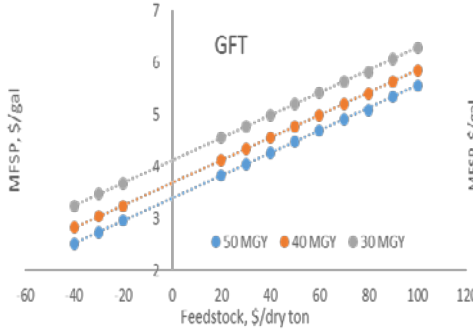
Jet Fuel Minimum Selling Price

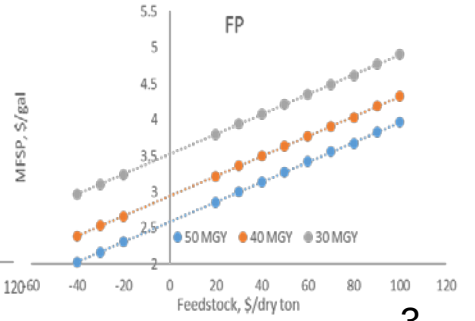




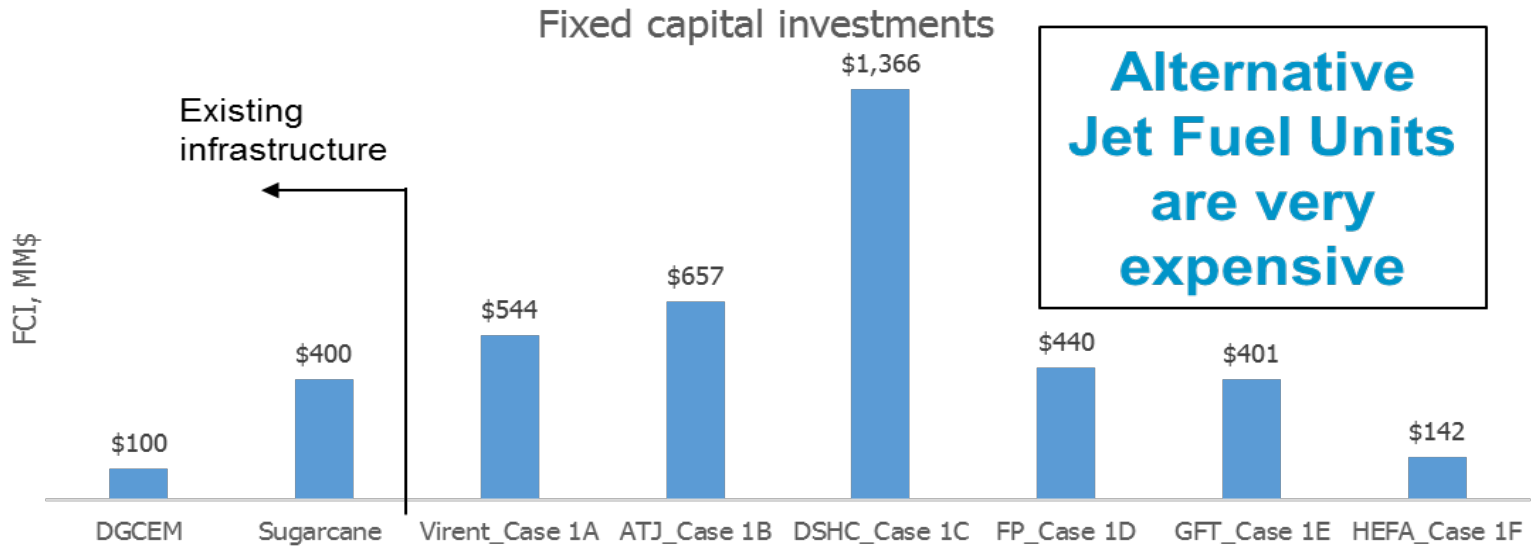








Sample Results



How to use this resource

- **Which stakeholders can use tool / resource**
  - For AO1 team through Box, which is managed by ASCENT Penn State.
  - **How can those stakeholders engage / access tool or resource**
  - Will be made available to the public through ASCENT website in two years
- **Schedule / timeline / next steps**
  - The design cases are being finalized and accessible through Box now.
  - Petroleum and Pulp and Paper design cases are being modified

FAA CENTER OF EXCELLENCE FOR ALTERNATIVE JET FUELS & ENVIRONMENT

Risk Analysis Tool: Alternative Jet Fuel Supply Chain Analysis of the Mid-Atlantic

Lead investigator: Saurabh Bansal
Project manager: Jim Hileman, Dan Williams, Nate Brown

Date
Washington, DC

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Problem / Solution

- **Problem**
  - AJF supply chains have multiple partners (e.g., farmers, pre-processors, refineries, airlines) who may not understand the business challenges faced by others.
  - Perception that other supply chain partners may benefit at their expense is an obstacle in AJF supply chains taking off.

- **Solution**

An interactive pro-forma cash flows of all supply chain partners can:

  - Provide an understanding for all supply chain partners of the constraints and risks in the supply chain.
  - A faster pace of establishment of AJF supply chains.

- **Tool**
  - Transparent Excel based tool with multiple risk-sharing mechanisms
  - They can be switched off and on, and levels can be chosen for “on” options.

Sample Illustration and Results

Grower (Per Acre)		Y/N	Year -3 Year -2 Year -1	Year 1	Year 2	Year 3	Year 4	Year 5
Receives Input Cost Support Per Acre	No			$125	$100	$20	$20	$20
Receives Minimum Price Gurantee?	No			$0	$70	$60	$60	$60
Crusher								
Has Minimum Volume Guarantee?	No			100	100	100	100	100
Has Minimum Price Guarantee?	No			$290	$290	$290	$290	$290
Refinery								
Assets and Operations Help	Yes			$125,000	$110,000	$110,000	$110,000	$110,000
Receives Minimum Purchase Quantity Gurantee from Airline	No			10000	10000	4000	4000	4000
Has Minimum Quantity of Raw Material Guarantee?	No			3000	3000	3000	3000	3000
Asset Cost (No Help)				$120,000	$120,000	$120,000	$120,000	$120,000
Operations Cost (No Help)				$5,000	$5,000	$5,000	$5,000	$5,000
Airline								
Receives Percentage Price Gap Guarantee?	No			0%	90%	50%	40%	30%
Promises to buy Minimum Quantity ?	No			10000	10000	4000	4000	4000
Government								

- **Is the tool effective? Preliminary Evidence**
  - MBA class used a two-tier version of the tool
  - Negotiations were quicker, and led to a higher satisfaction from individual positions.

How to use this resource

- **Which stakeholders can use tool / resource**
  - Tool best used in group settings with representatives from all partners.
  - Useful for individual partners to prepare for negotiations.
- **How can those stakeholders engage / access tool or resource**
  - Tool will be hosted for download on Smeal College of Business website.
  - Will be accompanied with a video to explain the use.
- **Schedule / timeline**
  - Preliminary version available to download (by Dec 1).
  - The video will be uploaded in a few weeks (by Dec 20).

FAA CENTER OF EXCELLENCE FOR ALTERNATIVE JET FUELS & ENVIRONMENT

The Legal & Regulatory Landscape of the Biofuels Industry

Project 01

Lead investigator: Lara Fowler & Gaby Gilbeau, Penn State University
Project manager: Nate Brown, FAA

December 5, 2018
Washington, DC

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Problem / Solution

- **Question: What is the current biofuel law and policy landscape and drivers nationwide and in three sub-regions (Hawaii, the Pacific Northwest, and the Southeast)?**
  - Approach: Research and draft white papers for each region of interest, as well as a national overview

- **Solution:** Research the law and policy on the following questions:
  - What is the general landscape of the energy portfolio and biomass industry in the region?
  - What laws or regulations in each region impact the biofuels industry?
  - What biofuels and ecosystem services incentive programs currently exist in the region, if any?
  - Has the state or region defined ecosystem services, and if so, how?
  - Are there opportunities to incentivize markets for ecosystem services?
  - What is are the best practices in each region and what are the stumbling blocks?

Sample Results

- **Hawaiian Biofuel Law & Policy Drivers:**
  - **Renewable Portfolio Standard (RPS)**
    - Requires each electricity utility company to establish a RPS of 100% of its electric generation and sales from renewable energy sources by 2045
- **Pacific Northwest Biofuel Law & Policy Drivers:**
  - **Western Climate Initiative**
    - Agreement between several western states to reduce regional greenhouse gas emissions by 15% below 2005 levels by 2020
    - Indirectly promotes the consumption of renewable fuels by exempting carbon emissions from renewable fuels from cap-and-trade program
  - **California's Low Carbon Fuel Standard**
    - Sept. 2018: 20% reduction in transportation fuel carbon intensity by 2030, including aviation fuels (allows renewable aviation fuels to generate LCFS credits)
- **Southeastern Biofuel Law & Policy Drivers**
  - **Biofuel Green Island Corridor Network**
    - Creates a network of E85 ethanol or B20 biofuel pumps at existing retail fuel stations at least every 100 miles along the entire 1,786-mile length of Interstate-75 (from Florida to Michigan).

How to use this resource

- **Which stakeholders can use tool / resource & how can those stakeholders engage / access tool or resource**
  - The synthesized research will be made available online for review by interested persons
- **Schedule / timeline / next steps**
  - Future work includes:
    - Further investigation of innovative funding opportunities to address both ecosystem services and industry needs
    - Work with regional partners to identify opportunities and needs for stakeholder engagement in each region

FAA CENTER OF EXCELLENCE FOR ALTERNATIVE JET FUELS & ENVIRONMENT

Community Capitals
Strategic Application of the CAAM
Project 01

Lead investigator: Michael Wolcott
Project manager: Nathan Brown

Date: 12/5/2018
Washington, DC

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Problem / Solution

- **Problem**
  - Need for a mechanism to simplify identification of suitable locations for project siting, and to suggest appropriate engagement strategies post-selection that will enhance likelihood of project success.
- **Solution: Community Assets and Attribute Model (CAAM) Strategic application**
  - **Community Asset scores to determine how well any county performs on key community capitals: social, human, political, cultural**
  - **Strategic engagement approaches based on these scores and supplemental data**

Step 1:
- Initial CAAM/Capital Scores to identify potential communities
- Based on CAAM what can we determine about county?

Step 2:
- Supplement CAAM with other available or collected data

Step 3
- Based on CAAM and supplemental data:
- What strategies can be utilized to enhance likelihood of project success?

Sample Results

Step 1: CAAM

Tacoma Community Capitals		
Community Capital	Pierce County Score (Z)	PNW Average
Social	-1.01 (-1.02)	.20
Human	.88 (-.04)	.92
Cultural	.66 (.16)	.41
Political	1.10 (-.96)	2.07

CAAM suggests:

Higher than average cultural capital, human capital near regional average: suggesting adequate workforce for project, creativity and adaptability to adopt innovation

AND:

Lower social capital: potentially low levels of sustained community collaboration, low community trust, limited community mobilization

Low Political Capital: potentially limited access to political power, limited engagement politically, limited trust of political actors

Step 2: Supplemental data

Tacoma Diversity	
Diversity Measure	Pierce County
Diversity Index	.43
Segregation	43

Moderately diverse, but segregated:

Distrustful of outsiders, other community members, lack of strong internal bonds, posing a strong challenge for project implementation. **Requires multiple engagement strategies.**

Step 3: Strategize

Tacoma, WA

1. Need to Build Trust:

- Connect with trusted community individuals – “proxies”
- Address diverse networks: several actual “communities”
- Be highly transparent throughout project
- Be highly communicative throughout project

2. May need extra engagement strategies

- Extra effort needed to sustain community collaboration and engagement
- May have to overcome distrust of political actors in community

3. Framing the project: Still need to investigate community support for specific project before proceeding

- Elections data suggest that the county is more Democratic and might be more supportive of alternative jet fuel projects

Final Conclusions: May be difficult to implement project, expect extra time/effort to implement and sustain engagement.

How to use this resource

- **Tool designed for project leads needing to site complex technical projects in the U.S.**
  - **CAAM measures available by Census Region for most U.S. Counties (some exceptions in Alaska and Hawaii)**
- **Tool can also be used at the county-level to strategically advance community and economic development**
  - **Identify strengths and weaknesses, strategic interventions to aid community-level project success.**
- **Data and Codebook available through FAA ASCENT**
  - **Tool currently available for application at U.S. Census Region level**
  - **For tool specific to different regional parameters contact: Christina Sanders (cmsanders@wsu.edu); or Season Hoard (hoardsa@wsu.edu).**
- **Validation in Inland Northwest and BANR Regions**
  - **Winter 2018 and Spring 2019**
- **Creation of Online Strategic Application tool**
  - **Spring 2019**

Assessing Future AJF Scenarios with The Freight and Fuel Transportation Optimization Tool

Lead investigator: Kristin Lewis (Volpe Center)
Project manager: Nate Brown (FAA)

Date Dec. 5, 2018
Washington, DC

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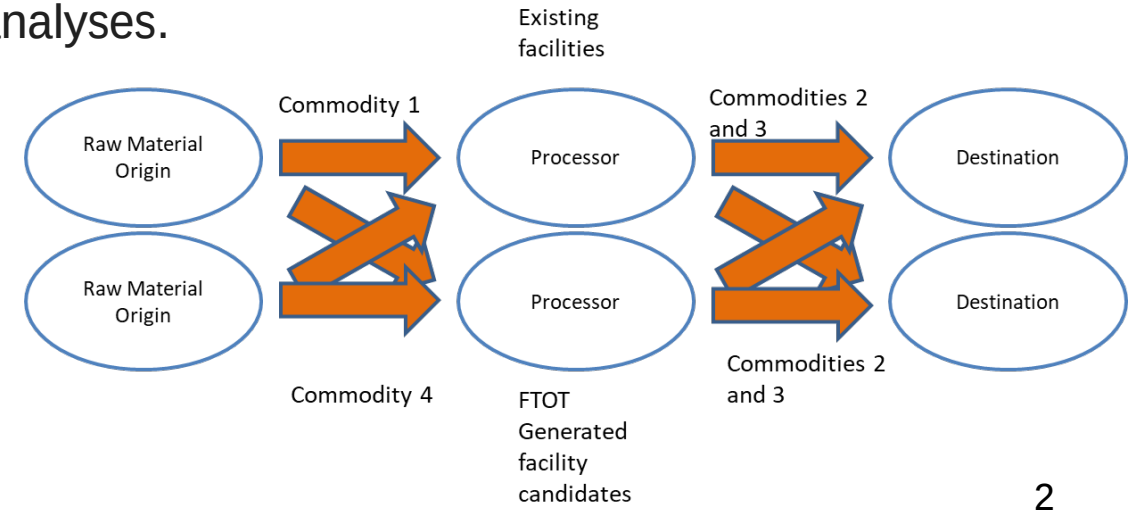
Problem / Solution

- **Problem: FAA and AJF stakeholders needed a way to explore future transportation needs and impacts of AJF scenarios**
  - Transportation costs, infrastructure requirements, and emissions depend on mode choice and routing.
  - A supply-chain-level optimization approach to mode choice and routing of feedstocks and products can help assess viable options and identify likely geographic patterns of AJF supply.

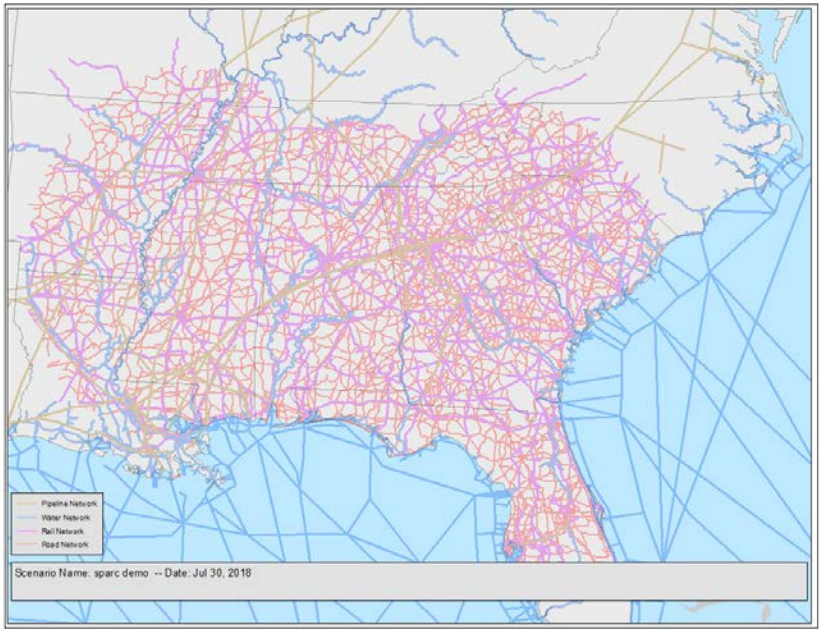
- **Solution: Freight and Fuel Transportation Optimization Tool (FTOT)**
  - Optimizes routings and flow of materials over multimodal GIS network for national or regional analyses.

Supply chain number of steps, commodities, processor type, and time (e.g., facility availability, route availability) can be expanded.



Regional Supply Chains: Southeast Partnership for Advanced Renewables from Carinata (SPARC) collaboration

- **Goal:** Explore Southeast regional AJF supply chain flow patterns and transport costs and emissions.
- **Scenario focus:**
  - Oilseeds to crushing facilities to biorefineries to airports (and other co-product end uses)
  - What are "best case" costs and patterns associated with supply chain?
- Beta tests Summer 2018 –familiarized SPARC team with FTOT, identified data needs and scenario approach.
- SPARC team currently defining scenarios.
- Will work with SPARC team to regionalize cost parameters, network specifics.



- SPARC includes: U. of FL, U. of South FL, Applied Research Associates, Agrisoma, RCB Altman Associates, and CAAFI.

How to use this resource

- **Currently FTOT is used in-house at USDOT's Volpe Center.**
- **Public version is in development.**
  - A beta-test release is scheduled for late spring 2019.
  - A full "experts' release" is planned for mid-late 2019.
- **Feedback from Experts' Release will assist with future refinements.**
- **If you would like to receive notification of the experts' release, please contact Kristin Lewis (kristin.lewis@dot.gov).**