USDA: Feedstocks and the AJF Supply Chain The Broad Picture

Harry Baumes, Ph.D., Director
Office of Energy Policy and New Uses
Office of the Chief Economist
United States Department of Agriculture

Alternative Aviation Fuel Workshop
Macon, Georgia
September 14, 2016
**Efforts across Alternative Jet Fuel Supply Chain**
*Public-Private Partnerships*

**Feedstock Production**
- USDA: BCAP & CIP, Feedstock Development Center Grants, AFRI/NIFA Caps

**Feedstock Logistics**
- DOE & DOD: R&D grants

**Fuel Conversion**
- USDA & DOE: R&D grants

**Conversion Process Scale-up/Integration**
- FAA & DOD: C/Q Fuel testing

**Fuel Testing/Approval**
- FAA, DOD, & NASA: Enviro Analysis

**Environment Assmt**
- USDA, USN, & DOE: Defense Production Act and Biorefinery Program

**Enable Production**
- DOD/DLA & Airlines: fuel purchase

**End User/Buyer**
- FAA: Guidance for Airports

---

**“Farm to Fly 2.0”**

**CAAFI State Initiatives**

*Jim Heilman, FAA*
Agenda

• Research
  • Biomass Research Centers
  • Coordinated Agricultural Project

• Policy
  • Title IX

• Partnerships
  • Interagency Working Groups
  • Defense Production Act
  • Farm to Fly 2.0
Supply Chain Approach for the Bioeconomy

Feedstock Development & Production Research and Education

Feedstock pathways – Integration - Scale Up Commercial Production

End – Use Markets
Alternative Fuels
Heat & Power
Renewable Chemicals
Biobased Manufacturing & Products
Use Region-based Strategies to Develop Sustained Feedstock Supplies

- Crop residues
- Perennial grasses
- Energy cane
- Non-food biomass sorghum
- Oil Seeds including Algae
- Woody Biomass

No one feedstock will meet all national biofuel needs
Facilitate the development of sustainable regional production systems for biofuels, biopower, industrial chemicals, and biobased products, through partnerships and collaboration, for increased rural economic vitality, ecosystems services, and national energy security.
Background: Coordinated Agricultural Projects

Regionally-appropriate Biomass Feedstock Systems

- Focus on non-food feedstocks for alternative jet fuel:
  - Woody biomass (NARA, AHB, BANR, IBSS)
  - Energy cane (SUBI)
  - Perennial grasses (IBSS)
  - Sorghum (SUBI)

Transdisciplinary and systems approach

- Focus on feedstock development, production, and delivery
- Must partner with feedstock users & well-align with appropriate conversion technologies and industry for bioproduct production
Objective 1—Develop technologies that enable the commercial production of marketable lipid-based advanced biofuels from lignocellulosic biomass hydrolyzates. (SY: Slininger, Dien, Liu)

Goal 1—Develop oleaginous yeast and associated processes for converting hydrolyzates of lignocellulosic biomass to lipids for biodiesel, jet fuel and valuable co-products for other uses.

(Hydrolyzate emphasis – herbaceous biomass, especially switchgrass)
Pending yields, oleaginous yeast may have the capability of producing ~50-190 gal bio-oil per crop acre.

As a reference, ~50 gallons of oil/acre are produced from processing soybeans.
Agricultural Act of 2014 (Title IX - Energy)

- Biorefinery, Renewable Chemical, and Biobased Product Manufacturing Program (9003)
- Biomass Crop Assistance Program (9010)
9003 Biorefinery Assistance Program Overview

- Provides loan guarantees of up to $250 million for the construction and retrofitting of commercial scale biorefineries that produce advanced biofuels.

- Investments in “First of its kind” commercial production

- Purpose -- Assist in the development of new and emerging technologies for the development of:
  - Advanced Biofuels
  - Renewable Chemicals
  - Biobased product manufacturing
Biomass Crop Assistance Program

BCAP provides incentives to create a supply of feedstock for the cellulosic biofuels industry. Two categories of financial assistance:

1. Establishment and annual payments for perennial crops, for non-woody and woody perennial biomass crops

2. Collection, harvest, storage, and transportation (CHST) of eligible materials (low value biomass forests and fields) for use in a biomass conversion facility.
• **Incentivizing** nearly 1,000 growers and landowners farming nearly 49,000 acres to establish and produce dedicated, nonfood energy crops for delivery to energy conversion facilities.

• In 2016, **$1 million** was allocated toward the sign up of up to 1,000 acres in project area 5 for miscanthus in Ohio and Pennsylvania and project area 10 for shrub willow in New York.

• In 2014 and 2015, USDA approved 209 contracts for matching payments of $15.8 million toward the collection/harvest of approximately 300,000 dry tons of forest residues from National Forest and BLM public lands - forest residues removed for the reduction or containment of disease or insect infestation and reduction of fire threat.

• In 2016, USDA allocated $1.5 million toward the sign up for matching payments with sign up running from June 15th to August 4th.
USDA Partnerships

Defense Production Act (USDA, DOE, NAVY)

- Fulcrum Brighton Biofuels
- Emerald Biofuels
- Red Rock Biofuels

Farm to Fleet Program

U.S. Departments of Agriculture (USDA) and Navy's joint "Farm-to-Fleet" venture makes biofuel blends part of regular, operational fuel purchase and use by the military. The announcement incorporates the acquisition of biofuel blends into regular Department of Defense (DOD) domestic solicitations for jet engine and marine diesel fuels. The Navy will seek to purchase JP-5 and F-76 advanced drop-in biofuels blended from 10 to 50 percent with conventional fuels.
USDA Partnerships

Environmental Protection Agency

- Feedstock Pathway Reviews
- RFS Volumes

Farm to Fly 2.0
Partnership to accelerate sustainable production and use of alternative jet fuel

- USDA
- DOE
- DOT
- Commercial Airline Industry
The Feedstock Readiness Level (FSRL) Tool, developed in collaboration the FAA, Volpe, US Department of Agriculture (ARS, OEPNU). Designed to track development and availability of the raw materials (or feedstocks) required to make alternative jet fuels;
<table>
<thead>
<tr>
<th>Activity</th>
<th>Scale</th>
<th>Description</th>
<th>Prod Rating</th>
<th>(2) Market Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preliminary Feedstock Evaluation</td>
<td>1</td>
<td>Basic Principles</td>
<td>Identify potential feedstock for a specific conversion technology</td>
<td>Identify current feedstock producers, feedstocks and coproduct users, and wastes</td>
</tr>
<tr>
<td></td>
<td>2.1</td>
<td>Concept Formulated</td>
<td>Estimate likely range of production environments and competing land uses</td>
<td>Assess feedstock market alternatives</td>
</tr>
<tr>
<td></td>
<td>2.2</td>
<td></td>
<td>Identify production system components</td>
<td>Identify potential coproducts and other benefits (e.g., carbon sequestration)</td>
</tr>
<tr>
<td></td>
<td>2.3</td>
<td></td>
<td>Develop enterprise budget for potential feedstock</td>
<td>Identify waste disposal requirements</td>
</tr>
<tr>
<td></td>
<td>2.4</td>
<td></td>
<td>Identify possible consequences of expanded production, articulate responses to trade-off’s</td>
<td>Identify harvest techniques, post-harvest collection, transportation, and storage logistic options</td>
</tr>
<tr>
<td></td>
<td>3.1</td>
<td>Proof of Concept</td>
<td>Screen candidate genetic resources for feedstock yield</td>
<td>Estimate feedstock production costs</td>
</tr>
<tr>
<td></td>
<td>3.2</td>
<td></td>
<td>Screen candidate genetic resources for biofuel conversion potential</td>
<td>Evaluate current and alternative future scenarios for establishing a feedstock sector - feasibility study</td>
</tr>
<tr>
<td></td>
<td>4.1</td>
<td>Preliminary Technical Evaluation</td>
<td>Perform coordinated regional feedstock trials to determine potential for yield improvement and</td>
<td>Identify biorefiners for targeted feedstock market development and link feedstock producers to</td>
</tr>
<tr>
<td></td>
<td>4.2</td>
<td></td>
<td>Compare performance of candidate feedstock with alternative feedstock choices</td>
<td>Identify specific alternatives for reducing production and supply uncertainties (i.e., contracts and loan</td>
</tr>
<tr>
<td></td>
<td>4.3</td>
<td></td>
<td>Implement agricultural extension and education programs to promote feedstock production</td>
<td>Implement education programs to establish interest in production and demand for feedstock</td>
</tr>
</tbody>
</table>

**Feedstock Experimental Testing**

**Preliminary Feedstock Evaluation**

**Concept Formulated**

**Proof of Concept**

**Preliminary Technical Evaluation**

**Implementation**
<table>
<thead>
<tr>
<th>Activity</th>
<th>Scale</th>
<th>Description</th>
<th>(1) Production</th>
<th>Pro Rating</th>
<th>(2) Market</th>
<th>Market Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-commercial Feedstock Assessment</td>
<td>5.1</td>
<td>Production System Validation</td>
<td>Define range of adaptation for feedstock and identify production uncertainties</td>
<td></td>
<td>Develop and refine post-harvest logistics and storage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.2</td>
<td></td>
<td>Conduct on-farm, field-scale production cost trials and assess production impacts on resource concerns</td>
<td></td>
<td>Assess maximum market potential for feedstock and coproducts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.3</td>
<td></td>
<td>Establish partial budget costs and returns</td>
<td></td>
<td>Evaluate waste disposal and other costs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.4</td>
<td></td>
<td>Establish price points for feedstock market competitiveness with competing land uses</td>
<td></td>
<td>Develop feedstock offtake options and pathways to realizing market potential</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.1</td>
<td>Full-Scale Production Initiation</td>
<td>Establish source material nurseries and begin feedstock production scale-up process</td>
<td></td>
<td>Ancillary service providers apply knowledge gained to advise producers and other supply chain participants</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.2</td>
<td></td>
<td>Produce feedstock planting materials to meet demand</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercialization</td>
<td>7</td>
<td>Feedstock Availability</td>
<td>Commercial-scale production and feedstock delivery to conversion facility - payments made for feedstock</td>
<td></td>
<td>Utilize risk management tools to reduce uncertainty of feedstock production</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Commercialization</td>
<td>On-going monitoring and research to improve production system performance while managing</td>
<td></td>
<td>Market established - make necessary adjustments to the supply chain as the feedstock market evolves</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>Sustainable Feedstock Production Capacity Established</td>
<td>Full array of private services support feedstock production sector - understanding of feedstock sector evolves</td>
<td></td>
<td>Market functions to support sustainable feedstock production</td>
<td></td>
</tr>
</tbody>
</table>
Now that I have been involved with bioenergy/bioeconomy for almost a decade I have come to believe that feedstock supply is going to make or break the bioeconomy.
THANK YOU