Feedstock Supply and Logistics Program Overview

• The Team
• Goals and Focus Areas
• Strategic Approach
• Funding History
• Key Accomplishments
• Upcoming Activities
Feedstock Supply and Logistics Team

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**Feedstock Supply and Logistics**

**Strategic Goal:** Develop technologies to provide a sustainable, secure, reliable, and affordable biomass feedstock supply for the U.S. bioenergy industry, in partnership with USDA and other key stakeholders.

**Approaches:**
- Develop high-capacity, high-efficiency feedstock supply systems to increase the volume of available high-quality and cost-effective feedstock
- Actively manage feedstock variability and supply uncertainty to meet cost, quality, and conversion-ready targets
- Develop advanced harvesting, handling, storage, and transport technologies
- Solve locally and regionally, but provide technology innovation nationally.

**Reliable, affordable, and sustainable supplies of biomass feedstock sources**
Feedstock Supply and Logistics

Focus

- Fully integrate feedstocks into supply chain (multiple interfaces)
- Reform raw biomass into high-quality feedstocks
- Ensure sustainable supply and cost reduction through innovative technologies
- Reduce risks to enable industry expansion

Approaches

- Use basic and applied science to understand, model, and manage feedstocks
- Provide biomass nationally, but solve local problems of supply and demand
- Meet environmental performance targets and goals while assuring sustainability
- Work with stakeholders and partners
BETO Strategic Plan: Feedstock Goals and Focus Areas

• Develop and provide a framework for multiple distributed processing scenarios for utilization of high-impact biomass feedstocks leading to commoditization, standardization, and risk mitigation.

• Develop and provide a framework for biomass quality grading systems for at least one woody and one herbaceous biomass supply-shed associated with an existing or planned demonstration-scale (or larger) biorefinery.

By 2022, develop and validate feedstock supply and logistics systems that can economically and sustainably supply 285 million dry tons per year at a delivered cost of $84/dry ton to support a biorefining industry (i.e., multiple biorefineries) utilizing a diversity of biomass resources.
Future research:
1) Supply push
   a) Crop improvement
   b) Advanced logistics
   c) Precision agriculture

2) Market pull
   a) Conversion processes
   b) Co-optimization
   c) Co-products
   d) Aviation biofuels
   e) International markets
   f) Policy impacts

3) Interactions
   a) Scenario analyses
   b) Industry evolution
5 – Future Work

Market pull

Supply push

2015 | 2017 | 2020 | 2022 | 2025 | 2030 | 2035 | 2040

$30
$40
$50
$60
$70
$80
$90
$100

Energy Efficiency & Renewable Energy
Feedstock Focus Areas: Logistics R&D Accomplishments

- Reduced logistics costs up to 25%
- Commercialization of purpose-designed ag and forestry equipment
  - AGCO
  - Case New Holland
  - Kelderman Mfg.
  - TigerCat
- Dozens of stakeholder partners in many states
Approach: Work Breakdown Structure

Feedstock Supply and Logistics

- Analysis and Sustainability
- Logistics Core R&D
- Conversion Interface
- Scale-Up and Integration

Conduct:
- Integrated techno-economic analyses
- Resource assessments
- Production and characterization assessments
- Supply chain modeling
- Annual State of Technology (SOT) reports
- GREET
Approach: Work Breakdown Structure

Feedstock Supply and Logistics

Analysis and Sustainability
Logistics Core R&D
Conversion Interface
Scale-Up and Integration

Growth → Harvest → Conversion

Focus specifically on:
- Yield mapping
- Lowering cost associated with
  - Storage
  - Preprocessing
  - Handling
  - Transportation
Approach: Work Breakdown Structure

Feedstock Conversion Interface Consortium
- Size reduction and managing particle size distribution
- How to ensure a steady flow of biomass into the conversion system
- Introduction of biomass into conversion processes against a pressure gradient
- How process yield varies as a function of physical and chemical characteristics of feedstock materials
Focusing on feedstock logistics:
• Cost, quality, quantity of feedstocks
• Advanced vs conventional supply systems
• Demonstrate the depot concept at pilot scale using the Biomass Feedstock National User Facility
Feedstock Supply and Logistics Funding History

Feedstock Supply and Logistics R&D Funding, in millions

<table>
<thead>
<tr>
<th>Year</th>
<th>Funding (in millions)</th>
</tr>
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<tbody>
<tr>
<td>FY13</td>
<td>~17</td>
</tr>
<tr>
<td>FY14</td>
<td>~23</td>
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<td>FY15</td>
<td>~7</td>
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<td>FY16</td>
<td>~15</td>
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<tr>
<td>FY17 Request</td>
<td>~20</td>
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The Projects were selected to stimulate the design and demonstration of a comprehensive system to handle the harvesting, collection, preprocessing, transport, and storage of sufficient volumes of sustainably produced feedstocks.

Advanced Biomass Feedstock Logistics Systems I ($21 Million)

Projects focused on development and demonstrating strategies, equipment, and rapid analytical methods to manage feedstock quality within economic constrains through the feedstock supply chain.

Advanced Biomass Feedstock Logistics Systems II (Up to $13 Million)

Landscape Design (Up to $14 million)

Integrated production and logistics R&D at a meaningful scale.
Feedstock Supply and Logistics – Accomplishments

Supply Systems to Handle and Deliver High-Tonnage Biomass Feedstocks

**Goal:** Design and demonstrate a high productivity system to harvest, process, and transport woody biomass from southern pine plantations

**Impacts:**
- Money saved by reducing:
  - Machine time
  - Labor costs
  - Costs for fuel to operate the machinery and associated reductions in GHG emissions
- Harvesting in fewer operations means:
  - Potential for less contamination of harvested biomass by soil
  - Less machine travel on the field, which limits soil compaction and helps to maintain soil health, minimize soil erosion, and improve water quality
Supply Systems to Harvest and Deliver Biomass Feedstocks

- Reduced delivered feedstock cost up to 25%
- Commercialization of purpose-designed ag and forestry equipment
- Dozens of stakeholder partners in many states

$ Saved:
- Machine time
- Labor costs
- Fuel costs
- Maintenance costs

The Sun Grant Initiative

This partnership aimed to solve America’s energy needs and revitalize rural communities with land-grant university research, education, and extension programs on renewable and biobased non-food industries.
Feedstock Supply and Logistics – Accomplishments

2016 Billion-Ton Report, volumes 1 & 2

• Covers all aspects of the biomass supply chain.

• First foray into environmental sustainability analysis for biomass production scenarios, with transportation costs to the biorefinery.

• Resource assessments can help evaluate impacts of supply push and market pull and inform strategies to increase biomass utilization.

To be presented during tomorrow’s plenary!
Feedstock Supply and Logistics – Future Activities

Objective: Transform raw biomass into consistent high-density, stable, commodity feedstocks

Priorities for next 5-10 years

• Identify and validate markets in which logistics systems can establish a competitive position vs. the current supply and demand

• Enhance the performance of logistics equipment to efficiently handle different types of regional biomass

• Ensure Feedstock Conversion Interface Consortium is fully functional in FY18 (portfolio of projects reviewed on Thursday)

Advanced logistics work for FY17

• Actively manage feedstock variability and supply uncertainty: downselect to working blends meeting cost, quality, and convertibility targets

• Scale-up: Advanced logistics projects; PDU; Conversion verification
Introductions – Peer Reviewers

- Steve Searcy (Lead), Texas A&M University
- Emily Heaton, Iowa State University
- Gerson Santos León, Abengoa
- Giovanna Aita, Louisiana State University
- Sudhagar Mani, University of Georgia
- Kathrine Behrman, University of Texas
Appendix
Feedstock Supply and Logistics – Program Goals

• **Strategic Goal:** Develop technologies to enable a sustainable, secure, reliable, and affordable biomass feedstock supply for the U.S. bioenergy industry, in partnership with USDA and other key stakeholders.

• **Performance Goals:**
  – By **2017**, validate efficient, low-cost, and sustainable feedstock supply and logistics systems that can deliver feedstock to the conversion reactor throat at required conversion process infeed specifications, at or below $80/dry ton (2014$).
  – By **2022**, develop and validate feedstock supply and logistics systems that can economically and sustainably supply **285 million dry tons** per year at a delivered cost of $80/dry ton to support a biorefining industry (i.e., multiple biorefineries) utilizing a diversity of biomass resources.
Conversion Interface

GOAL: Range of Feedstock Conversion technology options and pathways

FSL Focus
- High quality biomass
- Advanced Preprocessing technologies

Conversion Focus
- Robust catalysts and enzymes
- "Accommodating" Pre-treatment technologies

High quality biomass
Advanced Preprocessing technologies
Robust catalysts and enzymes
"Accommodating" Pre-treatment technologies
Biomass supply chain

Production
- Site preparation, planting, cultivation, maintenance, profit to landowner
- In the field or forest, dispersed

Harvest
- Cut and bale, rake and bale; fell, forward, and chip into van
- Baled or chipped into van roadside

Delivery and Preprocessing
- Load, transport, unload
- Comminuted to ≤¼ inches (conventional) or pellet (advanced)

Grower payment, stumpage price, procurement price
Farmgate price, roadside price
Delivered Cost

Chapters: (3) At the Roadside, Forestland Resources; (4) At the Farmgate, Agricultural Residues and Biomass Crops; (5) Waste Resources; and (7) Microalgae
Chapters (2) Currently Used; (8) Summary, Interpretation, and Looking Forward
Chapter (6) To the Biorefinery, Delivered Supplies and Prices