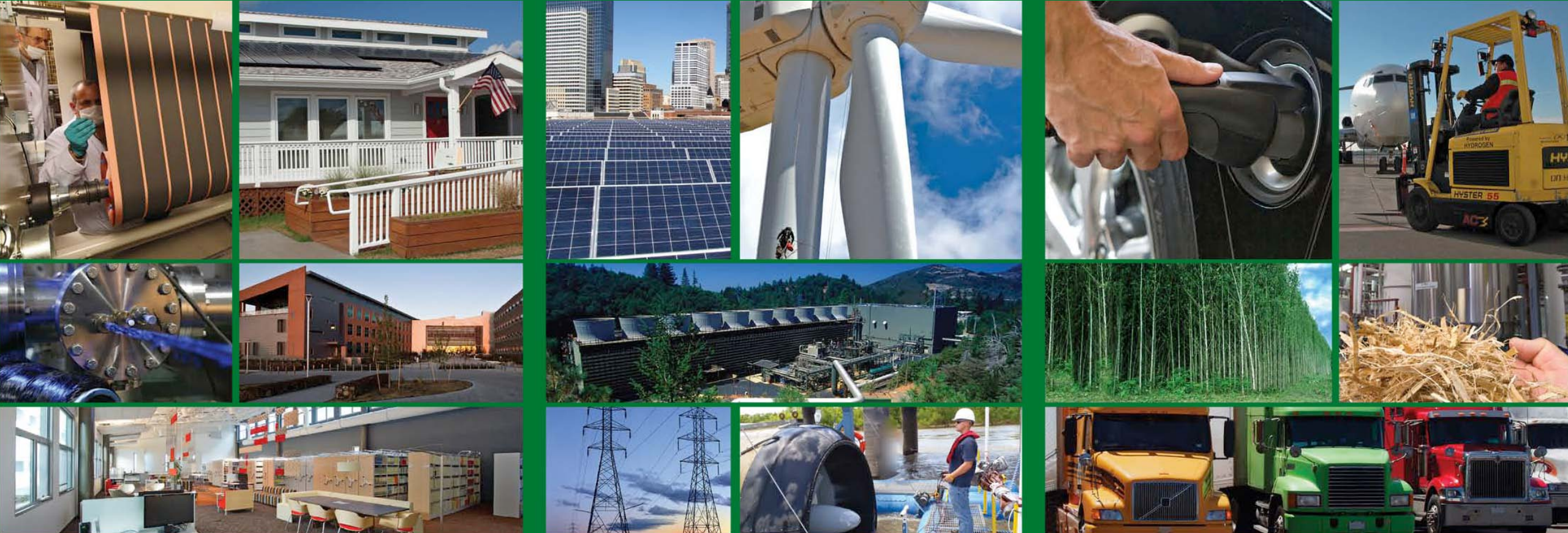


2017 PROJECT PEER REVIEW

U.S. DEPARTMENT OF ENERGY
BIOENERGY TECHNOLOGIES OFFICE

Feedstock Supply & Logistics R&D

Bioenergy Technologies Office



U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy

Alison Goss Eng
Program Manager
March 6, 2017

Feedstock Supply and Logistics Program Overview

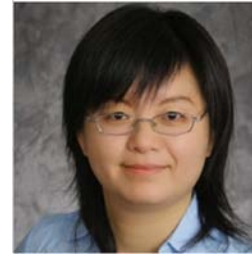
- The Team
- Goals and Focus Areas
- Strategic Approach
- Funding History
- Key Accomplishments
- Upcoming Activities



Feedstock Supply and Logistics Team



Alison Goss Eng
Program Manager



Chenlin Li
M&O Contractor, Idaho
National Lab

Steve Thomas
Technology Manager



Art Wiselogel
Allegheny Science &
Technology

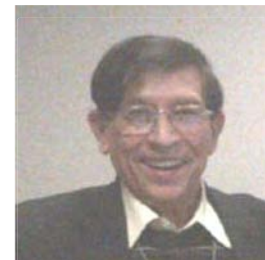


Mark Elless
Technology Manager



Bryce Stokes
Allegheny Science &
Technology

Sam Tagore
Technology Manager



Megan Lucas
BCS, Inc.



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.

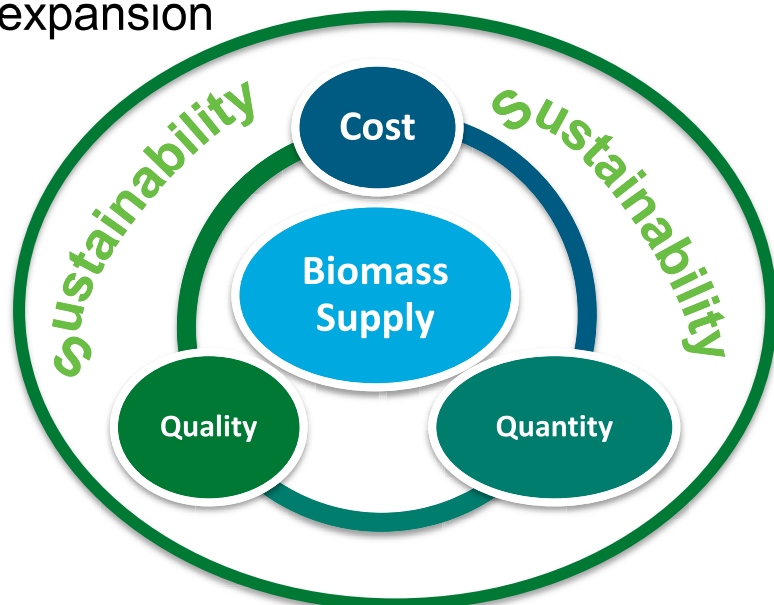


Reliable, affordable, and sustainable supplies of biomass feedstock sources

Feedstock Supply and Logistics

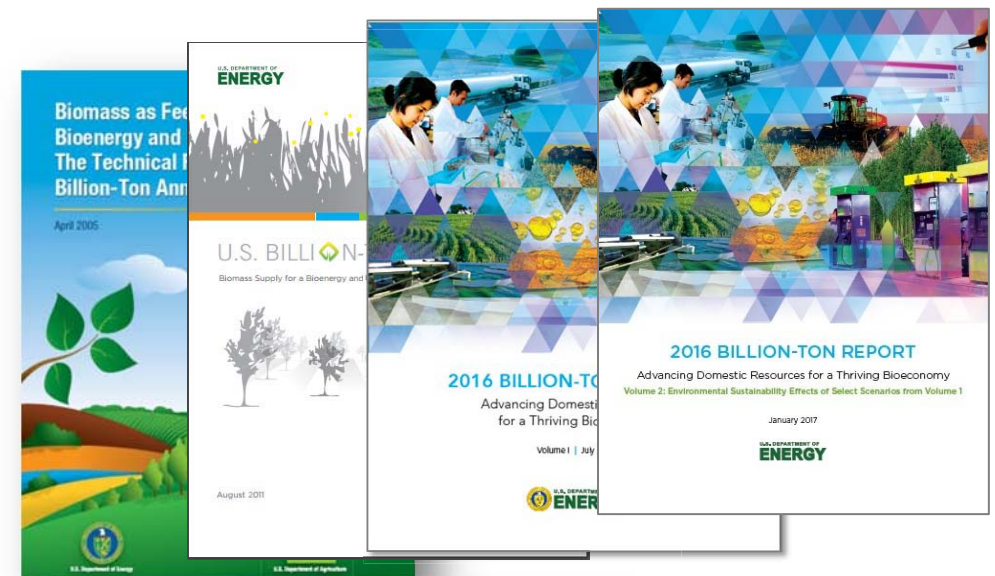
Focus

- 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



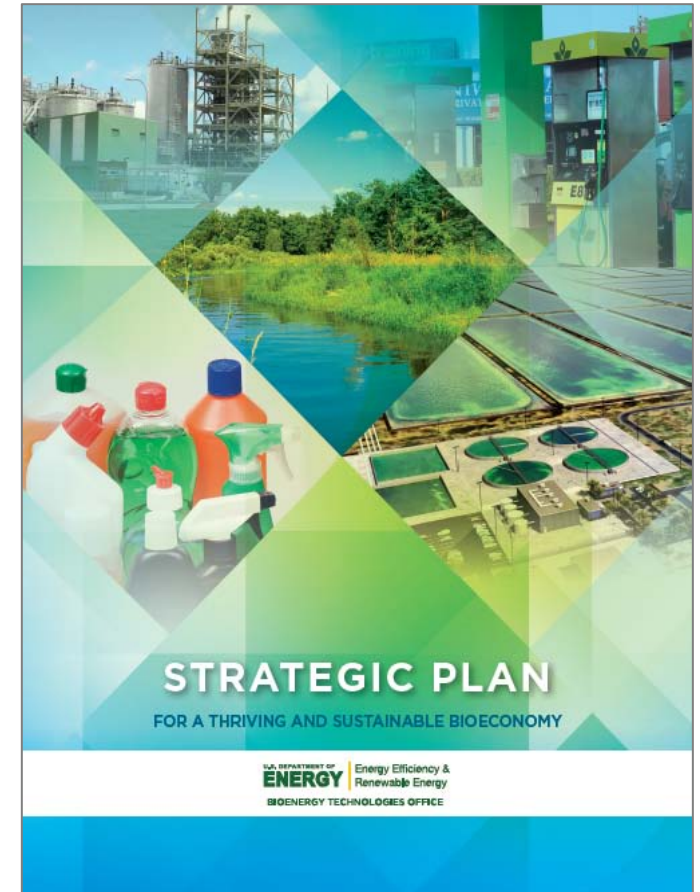
Approaches

- 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.*

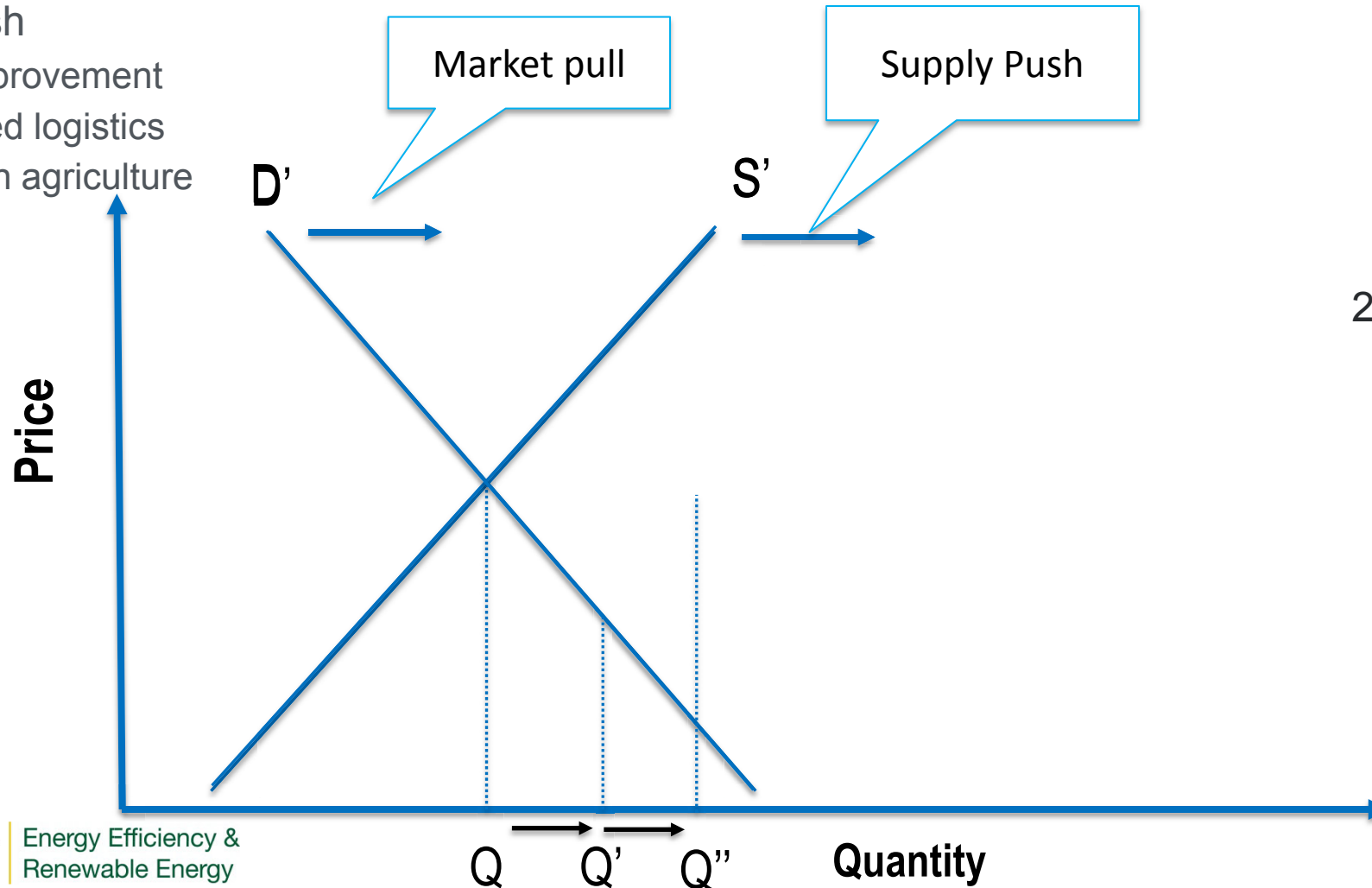


By **2022**, develop and validate feedstock supply and logistics systems that can **economically** and **sustainably** supply **285 million dry tons** per year at a delivered cost of **\$84/dry ton** to support a biorefining industry (i.e., multiple biorefineries) utilizing a diversity of biomass resources.

Feedstock Focus Areas: Resource Assessment

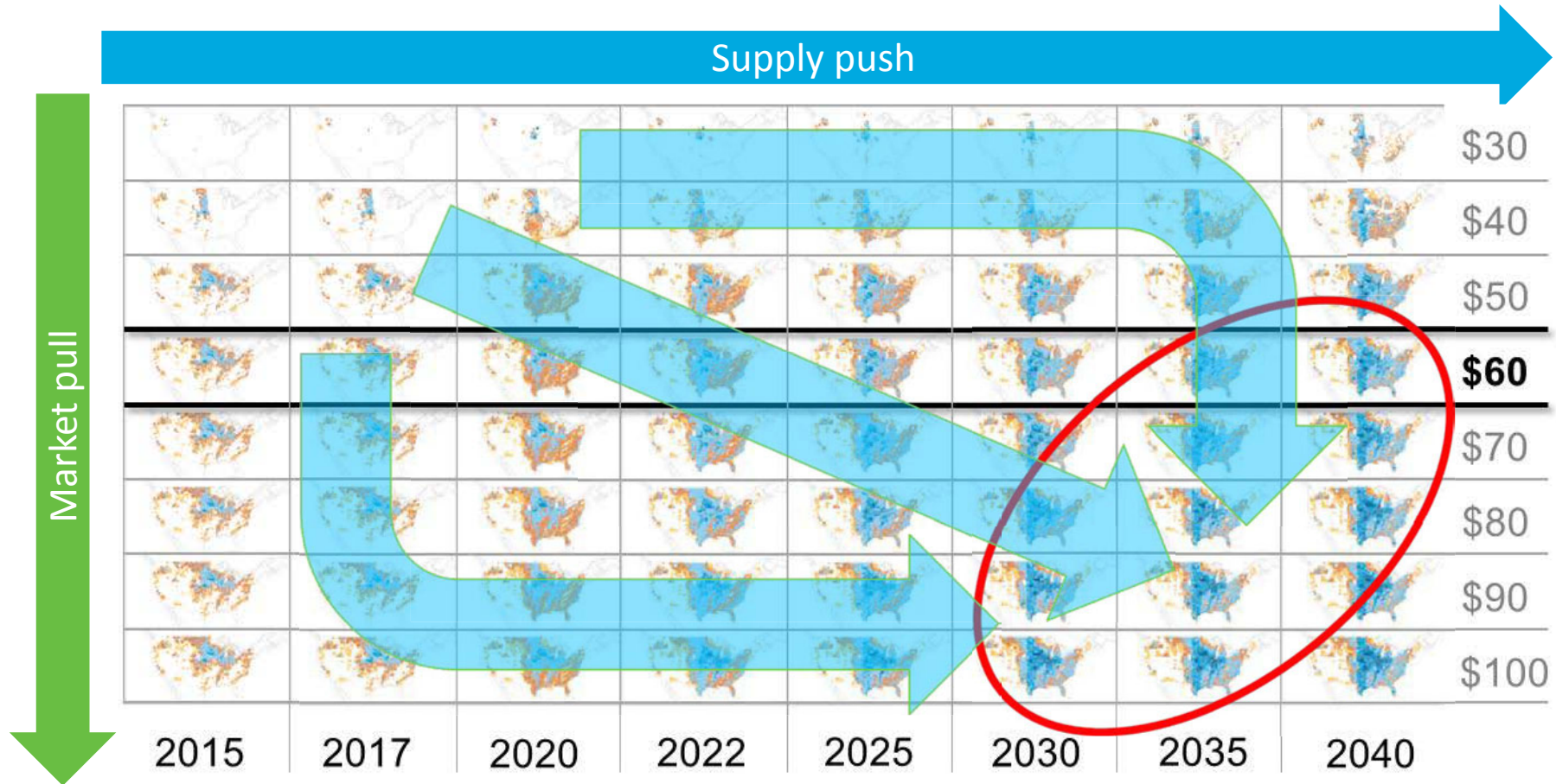
Future research:

- 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

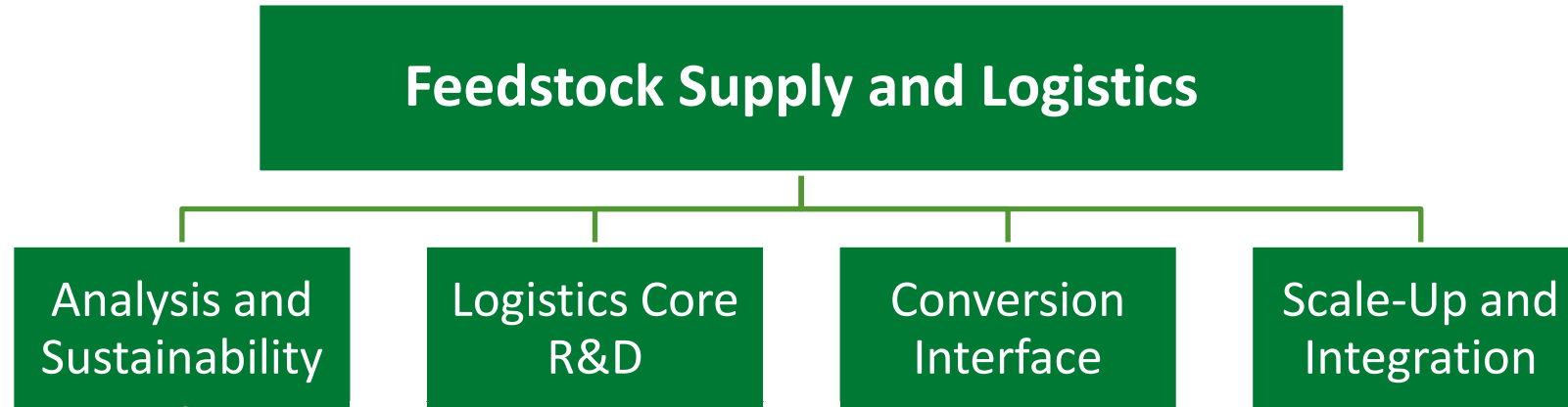


Feedstock Focus Areas: Logistics R&D Accomplishments

- 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

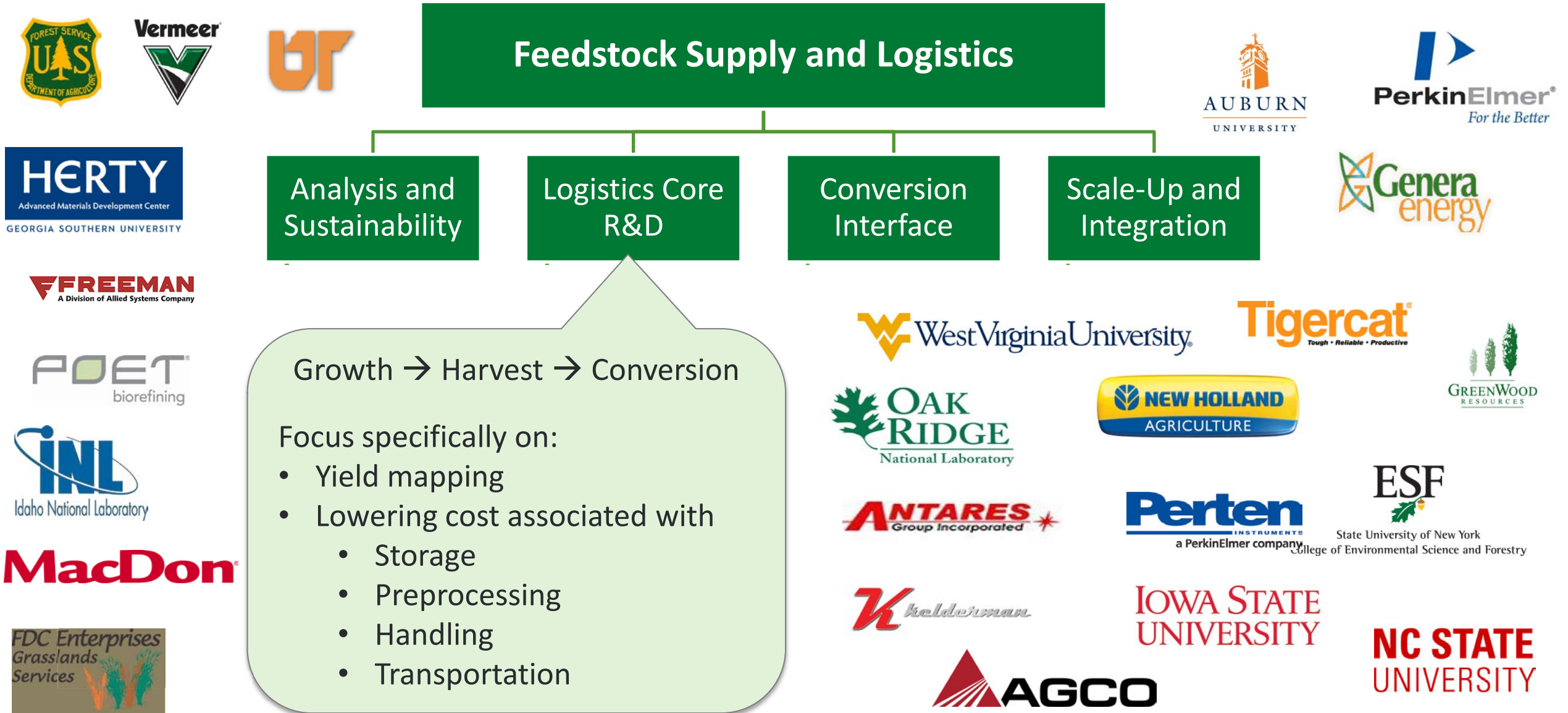


Conduct:

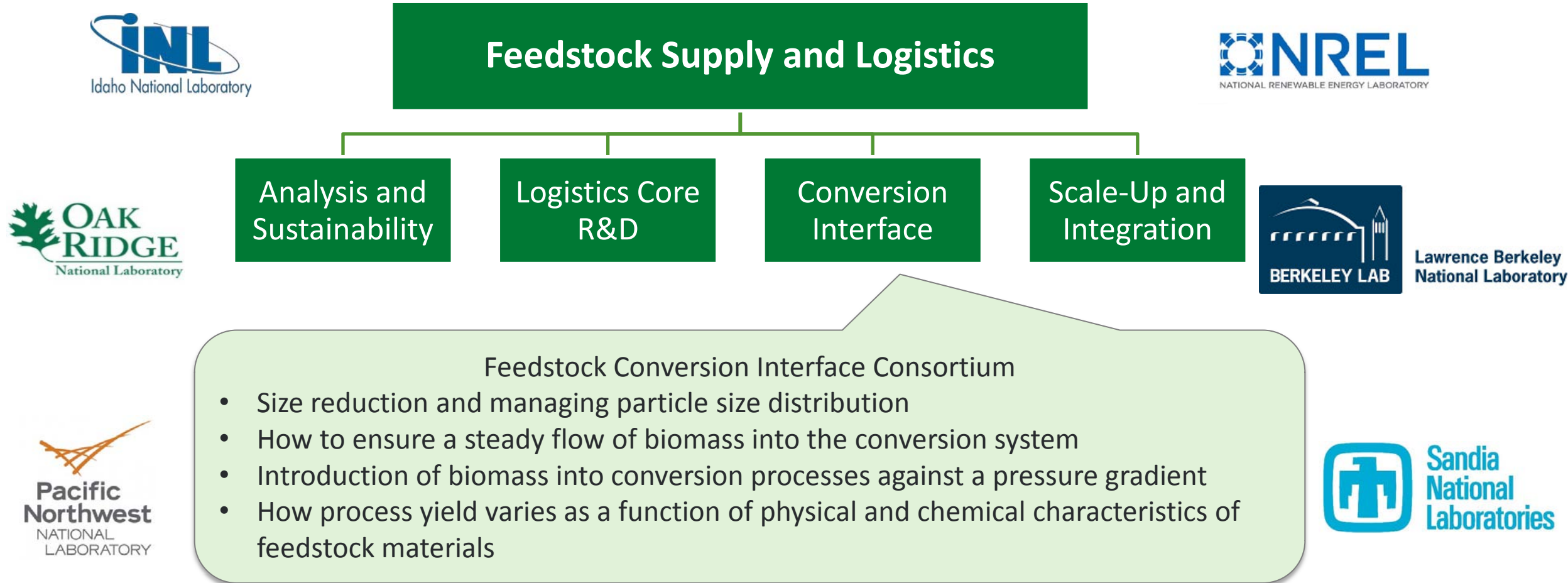
- Integrated techno-economic analyses
- Resource assessments
- Production and characterization assessments
- Supply chain modeling
- Annual State of Technology (SOT) reports
- GREET



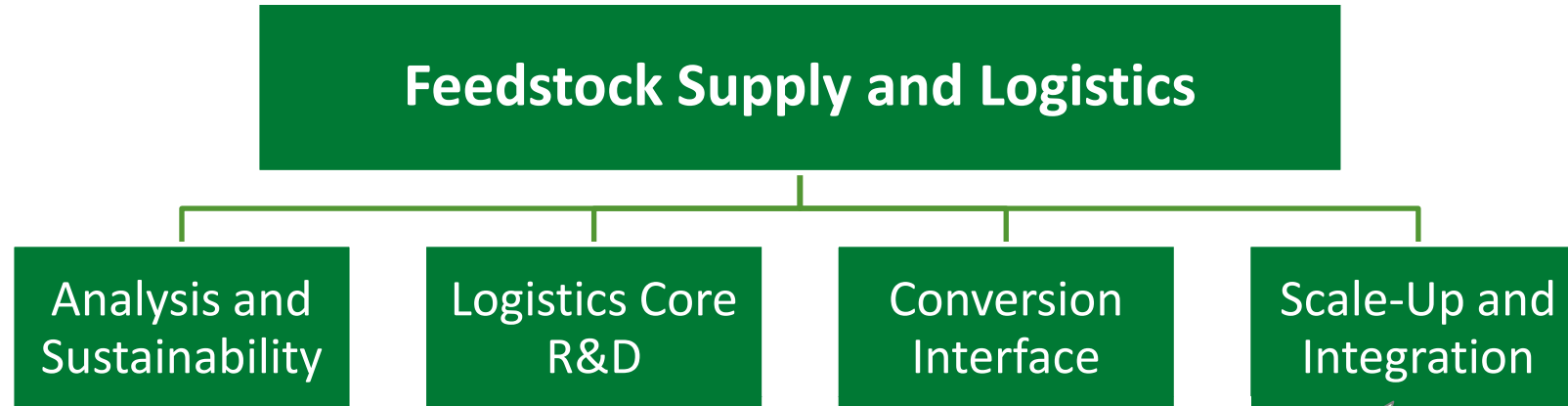
Approach: Work Breakdown Structure



Approach: Work Breakdown Structure

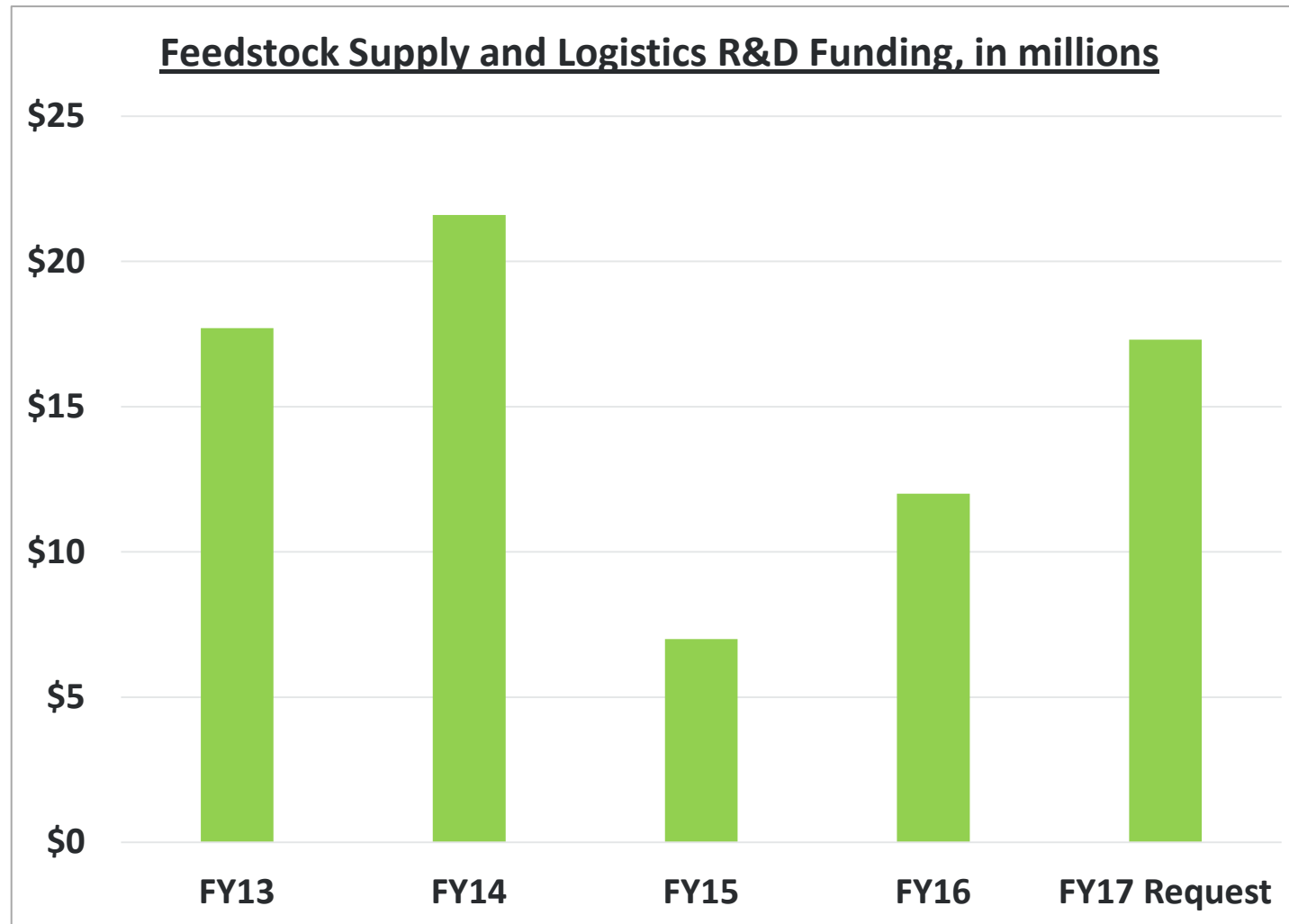


Approach: Work Breakdown Structure



- 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 Program FOA History

2009

2012

2013

2014

2015

2016

2018

Advanced Biomass Feedstock Logistics Systems I (\$21 Million)

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 II (Up to \$13 Million)

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

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



INNOVATION
IMPROVED EFFICIENCY

Tracked Feller Buncher with High-Speed Harvester Head

The extendable harvesting arm, high-speed shear head, and tracked mode of movement of Auburn University's feller buncher allow it to harvest several trees by simply swinging the cutter head from one position to the next without driving up to each one individually.

CONVENTIONAL

FEEDSTOCK: LOBLOLLY PINE TREES

The image is a vertical comparison of two harvesting methods. The top half, labeled "INNOVATION" and "IMPROVED EFFICIENCY", shows a yellow tracked feller buncher with a long, extendable arm and a high-speed shear head, harvesting a cluster of trees. The bottom half, labeled "CONVENTIONAL", shows a yellow tracked harvester with a shorter arm, harvesting a single tree. An upward-pointing arrow is between the two scenes. On the right side, there is a tree silhouette and a red banner that says "FEEDSTOCK: LOBLOLLY PINE TREES".

Feedstock Supply & Logistics : Accomplishments



AGCO



Tennera



Auburn University

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



State University of New York



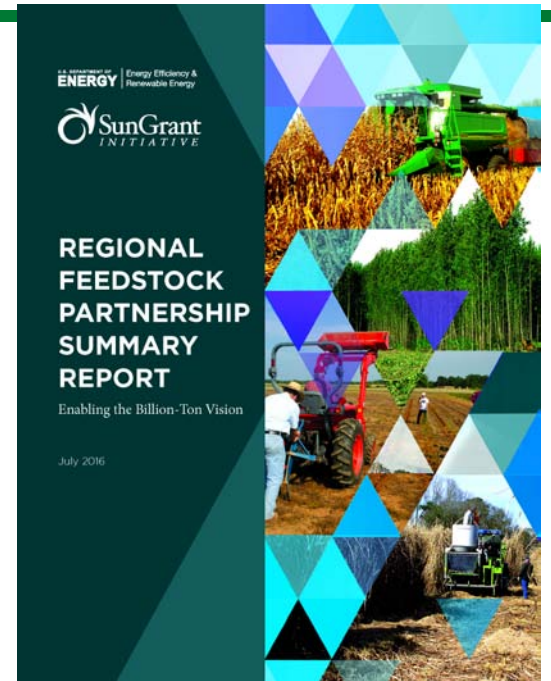
FDC Enterprises



University of Tennessee

\$ Saved:

- Machine time
- Labor costs
- Fuel costs
- Maintenance costs



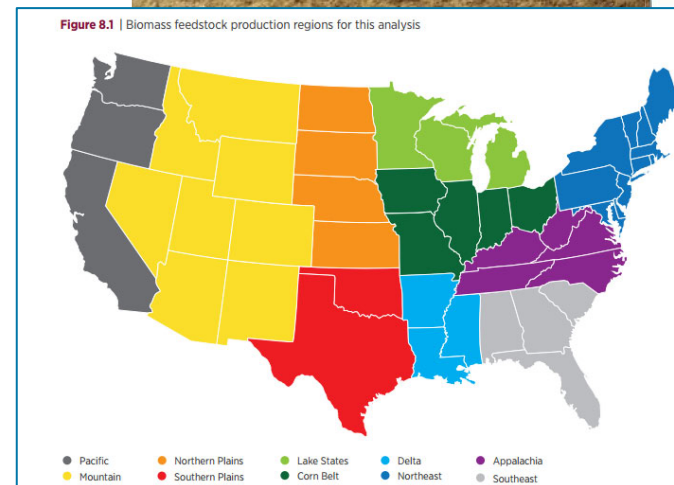
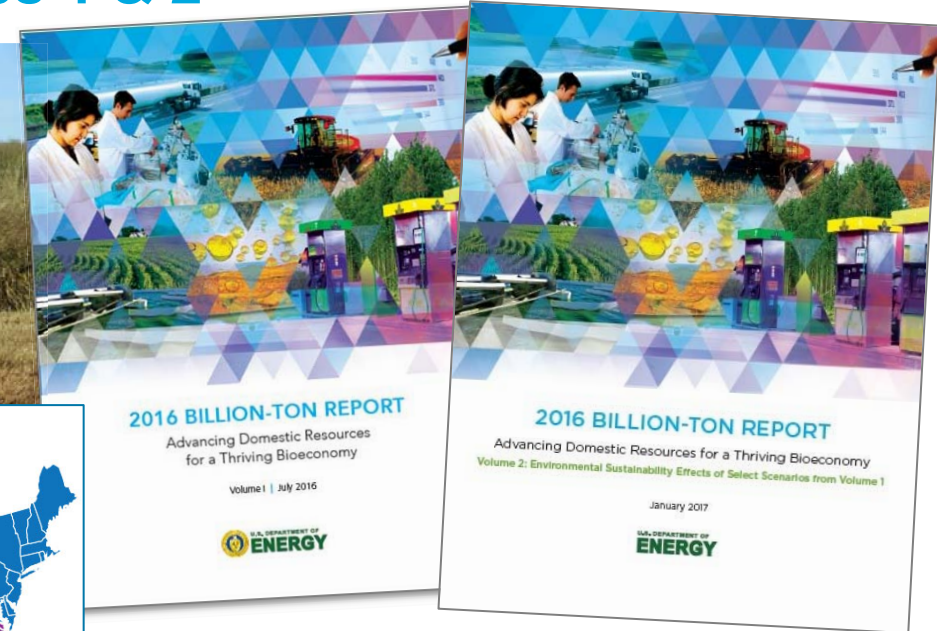
The Sun Grant Initiative

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!*

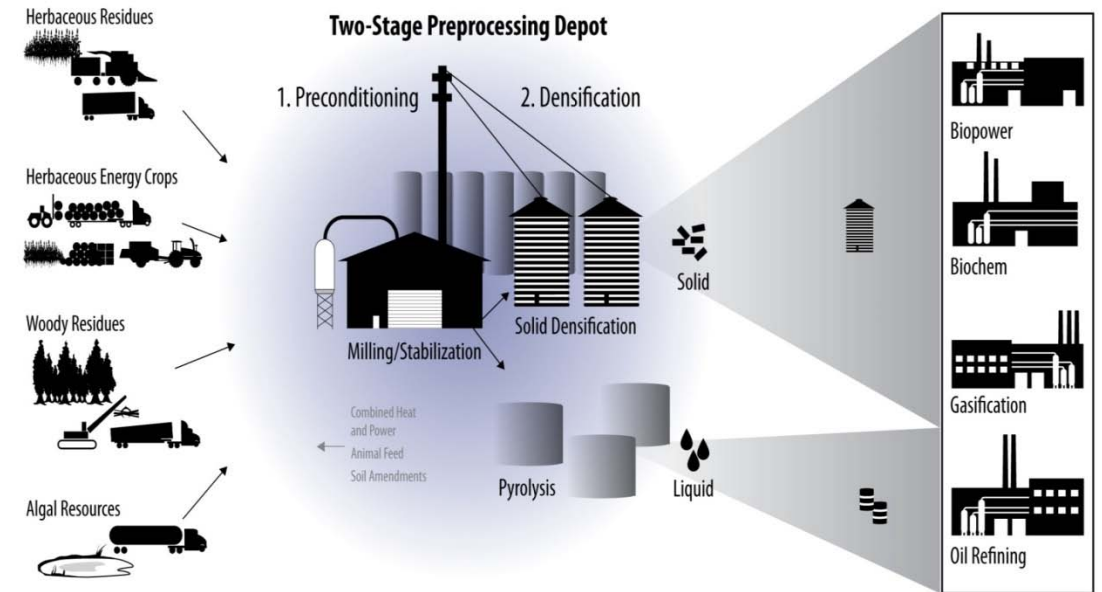


Feedstock Supply and Logistics – Future Activities

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**

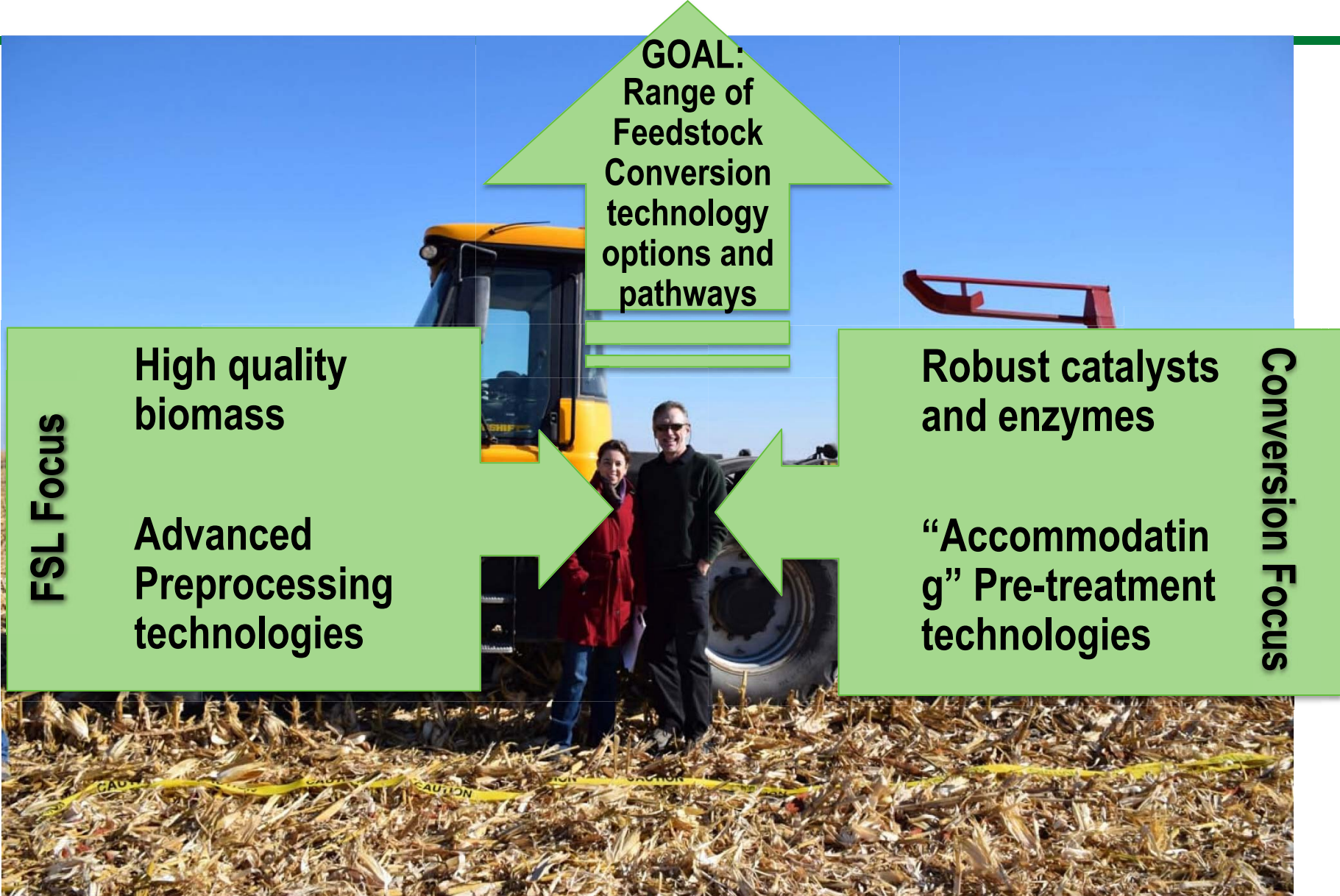
Appendix

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



Biomass supply chain

