U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

The Future of Bioenergy Feedstock Production

Cornell University

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John Ferrell

Feedstock Technology Lead

Bioenergy Technologies Office

US Department of Energy

Overview

- Bioenergy Technologies Office background
- Feedstock assessment, production and logistics
- Biomass yield improvements
- Sustainable feedstock production
- Future directions

Bioenergy Technologies Office

EERE Goals:	Reduce Dependence on Oil, Reduce Greenhouse Gas Emissions, and Create Jobs				
Program Strategies	**Develop sustainable, commercially viable, advanced cellulosic biofuel, bioproduct, and biopower technologies**		**Demonstrate, and deploy advanced cellulosic biofuel, bioproduct, and biopower production capability**		**Ensure environmentally sustainable biofuels, bioproducts, and biopower**
Program Approaches	Reduce costs and develop commodity-scale feedstock logistics systems	Reduce costs by increasing conversion yields and reducing conversion costs	Demonstrate and deploy technology at first-of-a-kind facilities	Establish production incentives for cellulosic biofuels	Develop approaches to support sustainability and best practices

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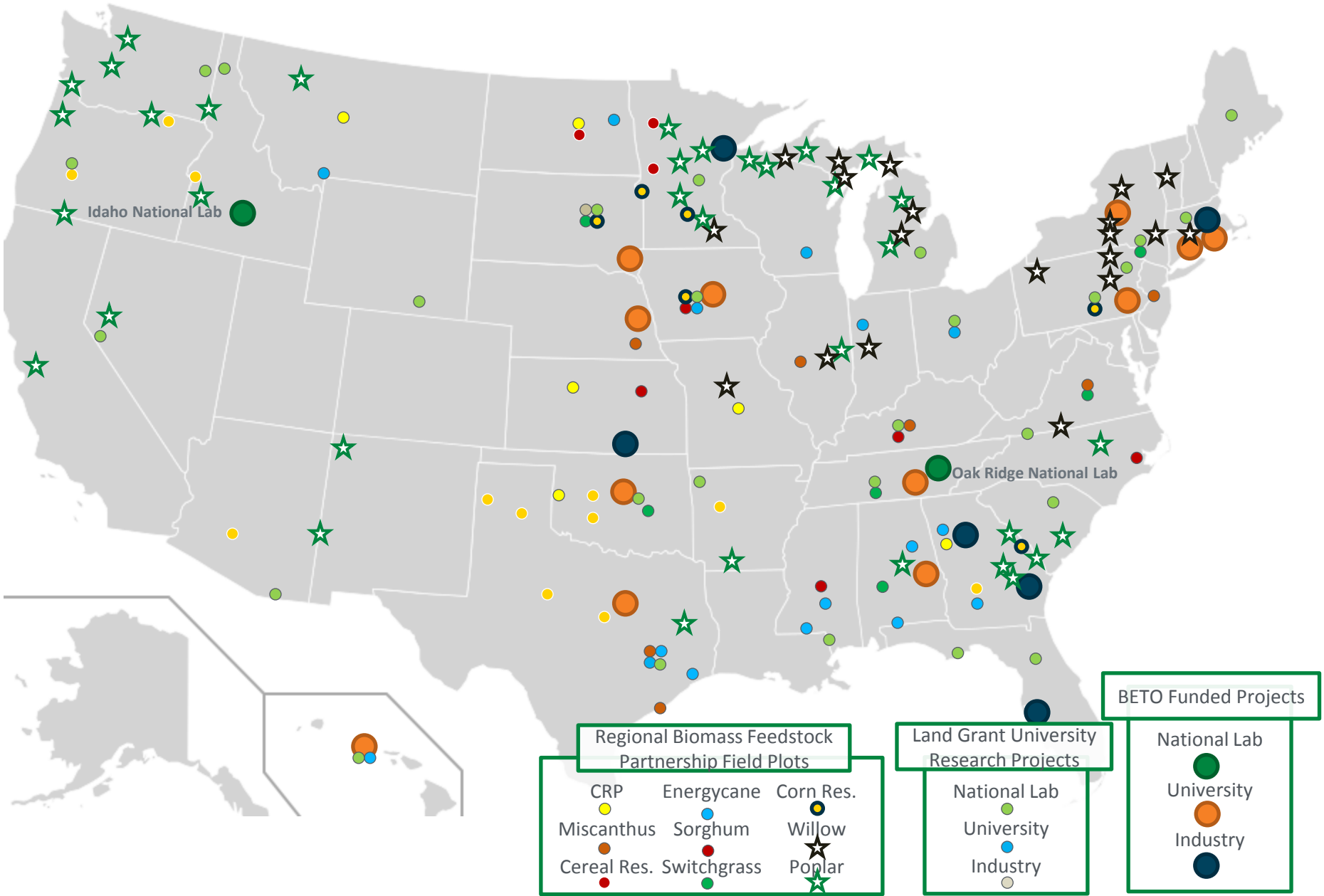
Introduction: Terrestrial and Algae Feedstocks

Feedstock supply and logistics efforts focus on RD&D to develop and optimize cost-effective and sustainable integrated systems for growing, harvesting, collecting, storing, preprocessing, handling, and transporting quality feedstock to biorefineries.

Feedstock Technology Area Partnerships

- **Sun Grant Initiative: land-grant universities in partnership with industry, National Laboratories, and U.S. Department of Agriculture (USDA)**
- **National Laboratories**
- **Universities and industry**
- **Office of Science and ARPA-E**
- **Other agencies: USDA, DoD, DoI, DoT, EPA, NASA, NSF (Biomass R&D Board)**

Terrestrial Feedstock Projects



Feedstock Demand

Projected National Feedstock Demand from Biofuel and Biopower

YEAR	2012	2013	2014	2015	2016	2017	2022	2030
EISA (bg/y)	2	3	4	6	7	9	21	21
Feedstock Demand (bt/y)	44	60	76	102	129	155	325	325

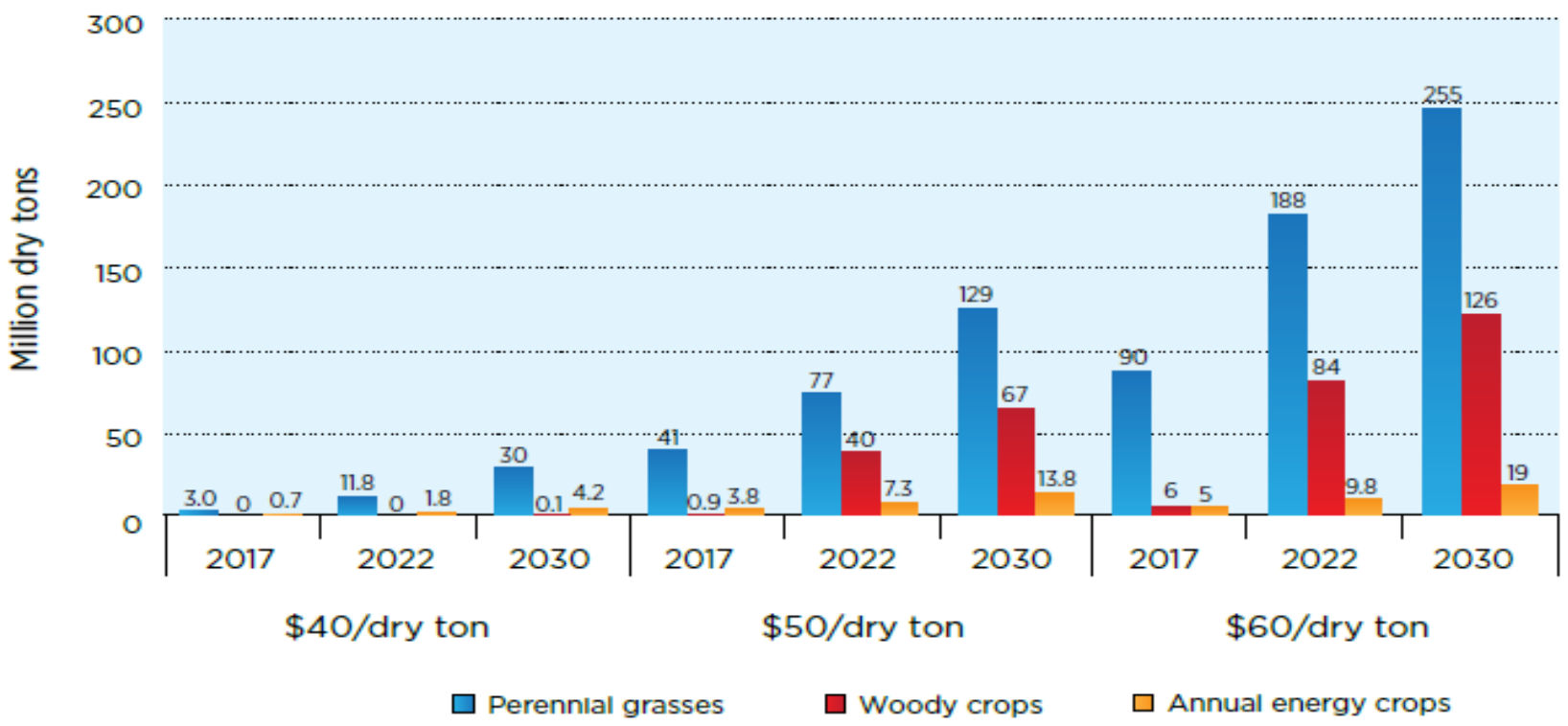
Assumption of 85 gallons per dry ton of biomass

Bioenergy Technologies Office Multi-Year Program Plan

May, 2013

Energy Crop Supply

Figure 5.16 Potential production of energy crops at various years and farmgate prices in baseline scenario



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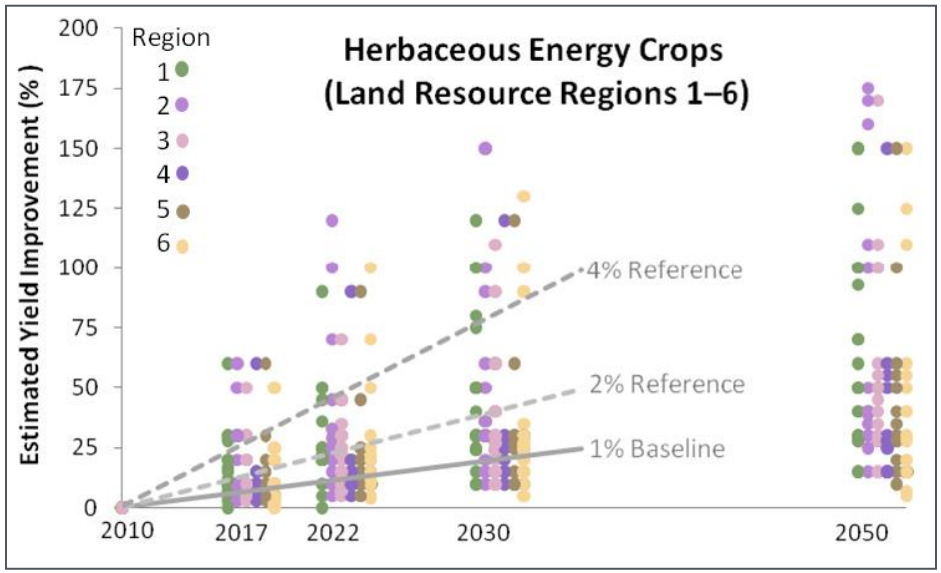
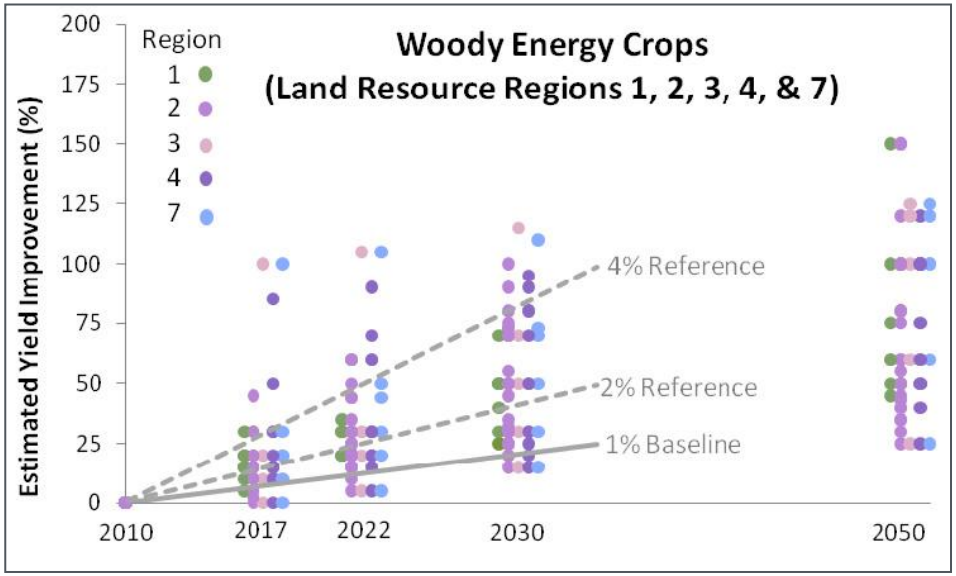
Yield Improvements





Workshop Report: High Yield Scenario Workshop Series
Prepared by Idaho National Laboratory

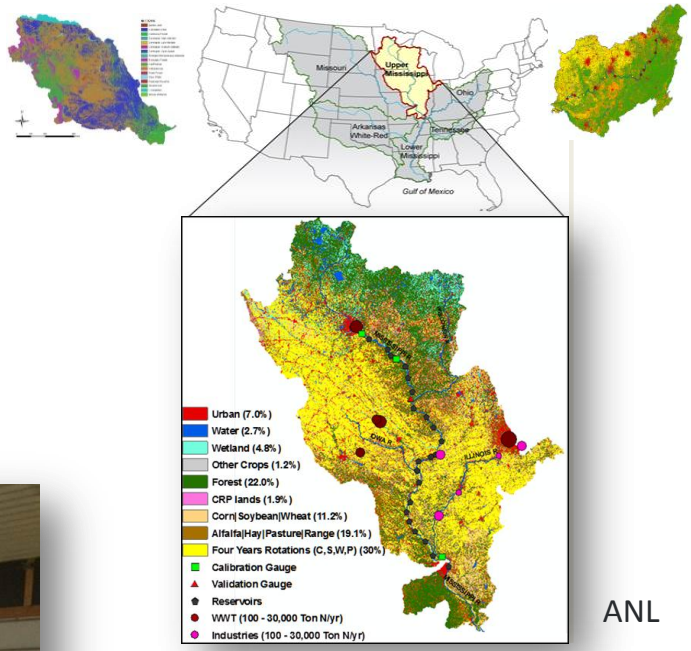
Sustainable Feedstock Production

Challenge: Expanding to commercial-scale volumes while delivering on the promise of clean renewable energy requires proactively:

1. Understanding resource availability
2. Considering complex policy, socioeconomic, market, and environmental factors
3. Developing beneficial collaborative solutions with diverse stakeholders
4. Promoting technologies and best practices that enable a viable, large-scale advanced biofuels industry

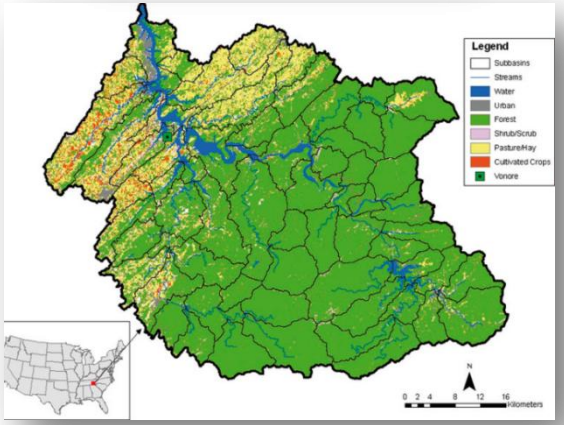
Current Efforts

- Watershed Modeling
  - Multiple scales, feedstocks, and regions
- Field Research
  - Best practices for bioenergy feedstock production



ANL

Bioenergy Crop Workshop, March 2013 in Fairbury, Illinois (ANL)



ORNL

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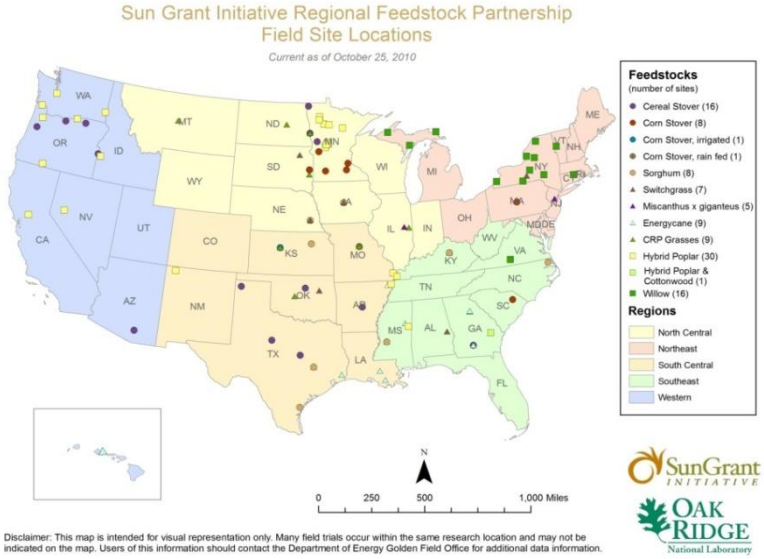
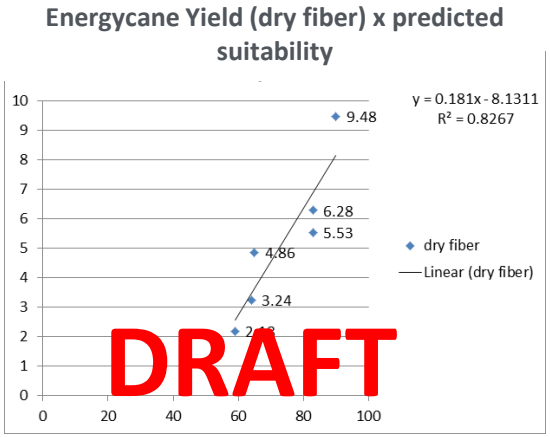
Future Directions

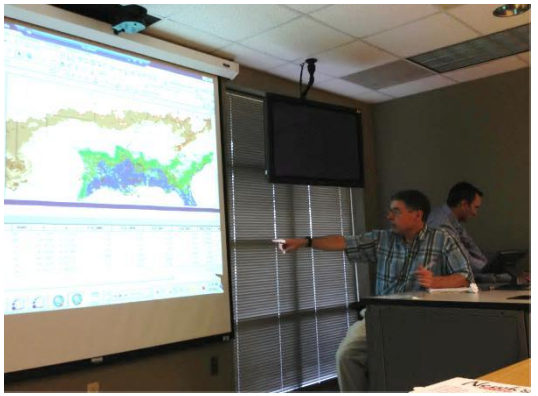
- Meet feedstock availability targets
- Meet feedstock cost targets
- Meet feedstock quality targets
- Meet sustainability
    - Improve assessments by better understanding drivers of availability and production
    - Work with partners to increase yields
    - Improve quality and reduce costs by using Uniform Format Supply system
    - Meet sustainability through management systems and landscape modeling
    - Complete techno-economics and data delivery for improved deployment

Feedstock Yield and Management Development

- New commercial varieties tested, “Best Local Varieties” identified via in SGI Regional Feedstock Partnership (40+ Institutions)
- Synthesis of field trials to create site potential yield based upon best reasonable management practices
- Expert meetings for each crop team (energy cane, switchgrass, *Miscanthus x Giganteus*, willow, poplar, CRP grasses, biomass sorghum)







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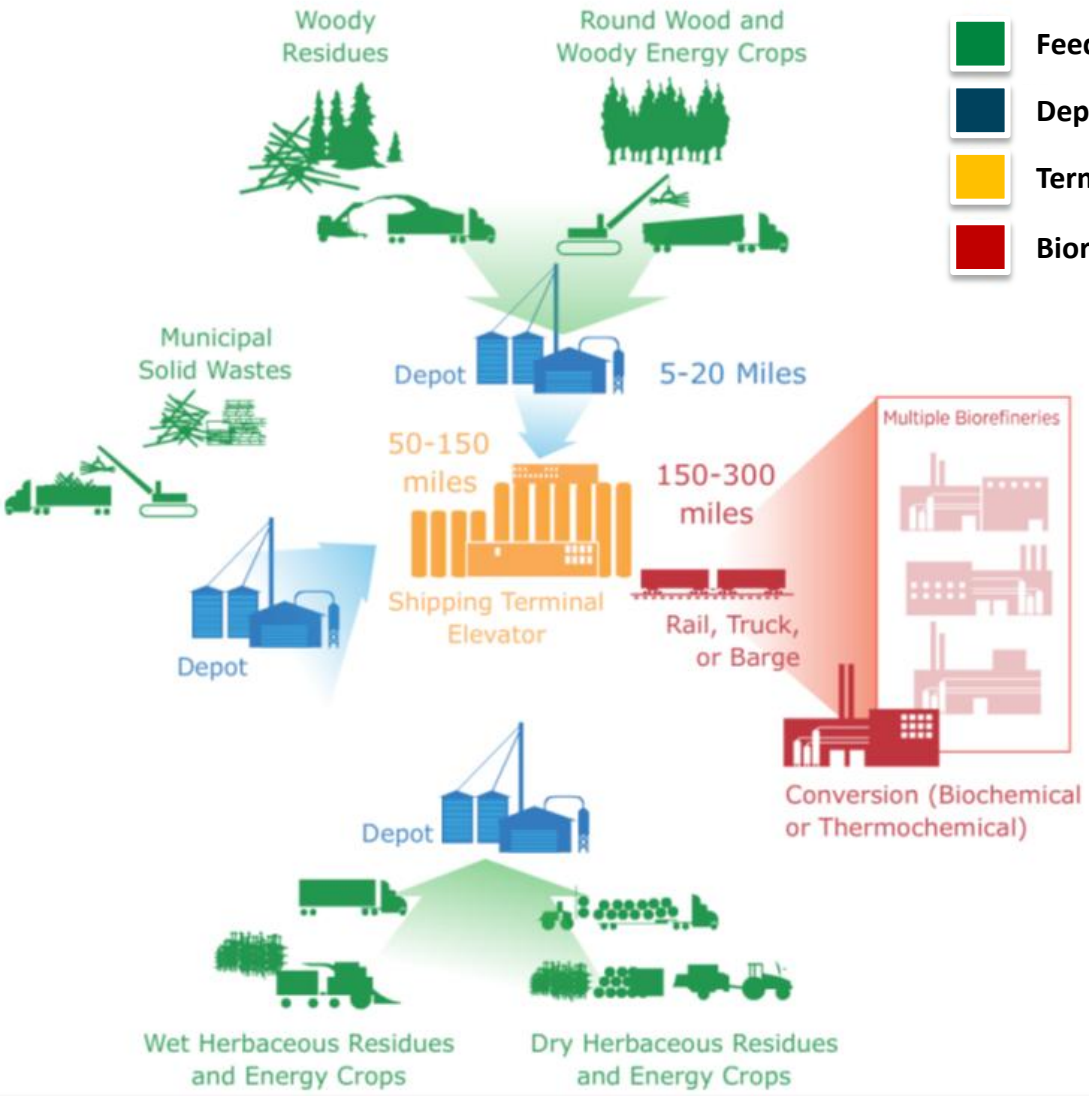
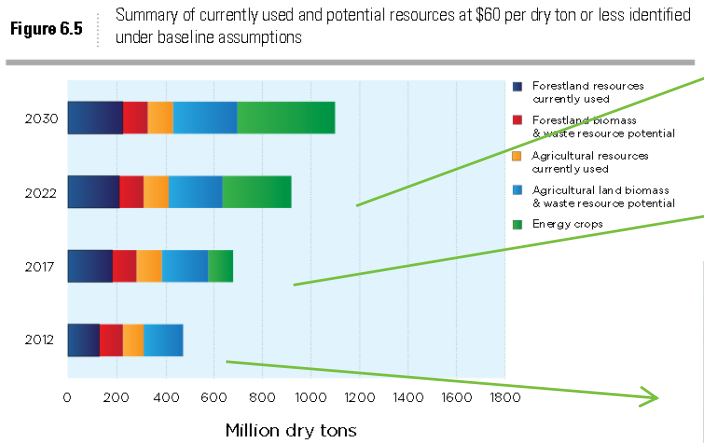
Feedstocks: Vision for the Future



Commodity feedstock supply system supports an expanding bioenergy industry by sustainably and economically supplying an on-spec feedstock to future biorefineries

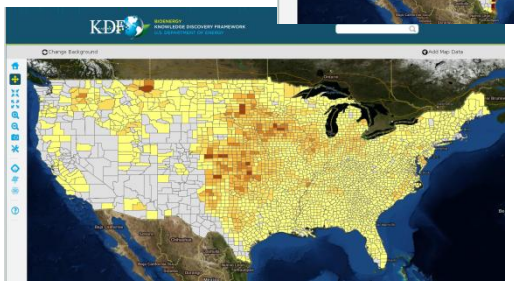
Bioenergy KDF Resources

- Composite Aggregation Tools



2022Baseline Resources

2017Baseline Resources



2012 Baseline Resources

- Data Download Tool
  - Export custom aggregations of feedstock resource types at all price points for various years
- Data on Feedstock Quality and Characteristics – INL Resource Library

https://bioenergykdf.net/

BETO Goals and Symbiosis Workshop

1. Energy crop yield is a driving factor for availability and cost. Yield also has a significant role in feedstock quality (blended and uniform format) and sustainability (less land, water, inputs, etc.).
2. Need better integration of the biological sciences with BETO's engineering, chemical, and socio-economic sciences to over come the availability, cost, and quality barriers.
3. Dependent on partners and collaborators working on yield, ecological, and environmental issues to help meet Office goals, but more importantly, overcome barriers to commercialization of energy crops and enhancement/facilitation of the bioeconomy.
4. Symbiosis workshop is such a step by developing collaborations and fostering an integrated approach to increased feedstock production at decreased costs.
5. Inclusion of climate variability and resulting impacts on feedstock performance is a novel and timely topic. Providing a solution through the utilization of mutualistic symbionts is an approach to be considered along with other genetic tools.