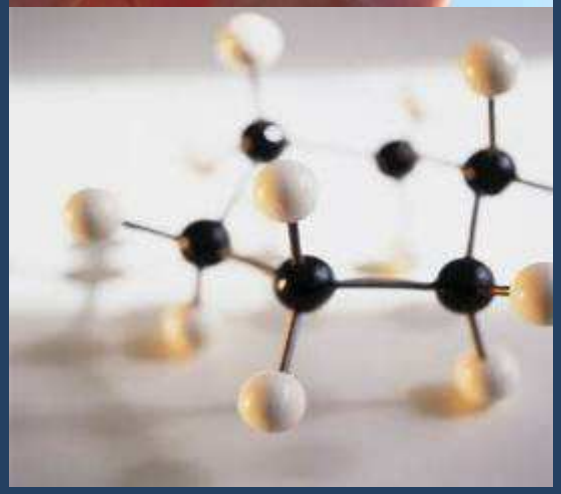


Sustainable Bioenergy Production

A U.S. Department of Energy Perspective

Alison Goss Eng
Office of the Biomass Program, US Department of Energy

June 24, 2009

Department of Energy Biomass Program

- **The Biomass Program (OBP) at the Department of Energy works closely with industry, university, and other non-profit partners to remove the barriers to cellulosic ethanol production**
  - **Over $1 billion announced within the last year for multi-year biofuels research and development projects**
  - **Technology deployment (small and commercial scale biorefinery construction) and core R&D (ethanologen) support**
- **Sustainability part of our core mission as a program**
  - **Essential to process and distribute biomass on the scale needed to support dramatically larger volumes of biofuels production over the long term**
  - **Support R&D aimed at assessing the impacts of biofuels on the environment**

Sub-Program and Key Initiative Descriptions

Strategic Objectives: Toward Sustainable Biofuels

Feedstock Production → Conversion Technologies → Integrated Biorefineries → Infrastructure

Feedstocks

Supply

2012: 130 M TPY

Costs (Dry Ton)

2012:

Herbaceous: $51

Woody: $62

Biochemical Conversion

Reduce the modeled processing cost of converting feedstocks to ethanol to $0.92/gal by 2012.

Thermochemical Conversion

Reduce the modeled processing cost of converting woody feedstocks to ethanol to $0.86/gal by 2012.

Integrated Biorefineries

Demonstrate and validate integrated biorefineries across various pathways with at least 3 plants in successful operation by 2012. Validate modeled ethanol production cost and compare to targets.

Biofuels Infrastructure

Complete standards development and testing of E15 and E20 distribution systems and vehicles. Support E85 on regional basis.

Sustainability & Analysis

Increase understanding of resources and impacts on environment and climate.

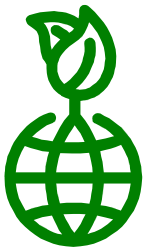
Assess extent, adequacy, and implications of resources, performance, efficiency, strategies, technologies, and impacts.

Successive Generations of Biofuels

Grain-based Ethanol

- Commercially available (no DOE research)
- Reduced GHG emissions
- Capacity constrained

Program involvement limited to facilitating market uptake via blends testing, infrastructure development, etc.



Cellulosic Ethanol

- DOE research ongoing
- Potential to lower GHG emissions >80%
- Uses biomass from waste and non-agricultural land

Ongoing RD&D activities focus on multiple pathways to affordably and sustainably produce cellulosic ethanol from a broad range of biomass resources available across the nation.

Other Advanced Biofuels

- Focus of newer DOE research
- Could minimize environmental footprint
- Energy content, fuel economy, and chemistry may be more similar to petroleum-based fuels

Expanded strategy includes advanced biofuels that require governmental support and can significantly contribute to meeting the RFS (e.g., alternative light-duty and diesel replacement fuels). Update to *Multi-Year Plan* by December 2009.

Biomass

Recovery Act Funding and Initiatives

Biomass R&D and Demonstration Projects - $800 Million in Funding

$480M **Pilot and Demonstration-Scale Biorefineries**

Validate technologies for integrated production of advanced biofuels, products, and power to enable financing and replication.

10 to 20 awards for refineries to be operational within 3 years:

- Up to $25M for each pilot-scale project
- Up to $50M for each demonstration-scale project

$176.5M **Commercial-Scale Biorefineries**

Increase in funding for prior awards; two or more projects

Expedite construction; accelerate commissioning and start-up

$110M **Fundamental Research**

$20M: Integrated Process Development Unit

$5M: Sustainability research with the Office of Science

$35M: Advanced Biofuels Technology Consortium

$50M: Algal Biofuels Consortium to accelerate demonstration

$20M **Ethanol Infrastructure Research**

Optimize flex-fuel vehicles operating on E85

Evaluate impacts of intermediate blends on conventional vehicles

Upgrade existing infrastructure for compatibility with E85

$13.5M NREL Integrated Biorefinery Research Facility: expand the pretreatment capacity

Biomass

Biomass Program's Sustainability Efforts

Our Commitment to Sustainability

The U.S. DOE Biomass Program is committed to developing the resources, technologies, and systems needed for biofuels to grow in a way that enhances the health of our environment and protects our planet. To that end, we are working to…

- **Develop diverse, non-food feedstocks that require little water, fertilizer, or new land**
- **Foster sustainable forestry practices**
- **Harvest biomass components selectively, leaving adequate soil nutrients**
- **Assess life-cycle impacts of major scale-up in biofuels production, from feedstocks to vehicles, addressing:**
  - **land use and soil health**
  - **water use**
  - **air quality issues**
  - **impacts on greenhouse gas (GHG) emissions**

Biomass

Sustainability: Priorities & Activities

Feedstocks

- Through a partnership with Sun Grant Initiative, use field trials to collect data on sustainability
- Work with Council for Sustainable Biomass Production to develop criteria

Land Use

- Quantify future land use impacts for various scenarios using Purdue's GTAP, ANL's GREET models
- Incorporate land use data and yield assumptions

Water

- Conduct LCA of water use in production
- Analyze regional variations due to climate & soil
- Evaluate mitigation potential of bioenergy crops

International Efforts

- Work with Conservation International to identify land and preserve best production locations
- Provide data and analysis to Roundtable on Sustainable Biofuels, Global Bioenergy Partnership, others
- Contribute to International Biofuels Forum

Leveraging--Great Lakes Bioenergy Research Center

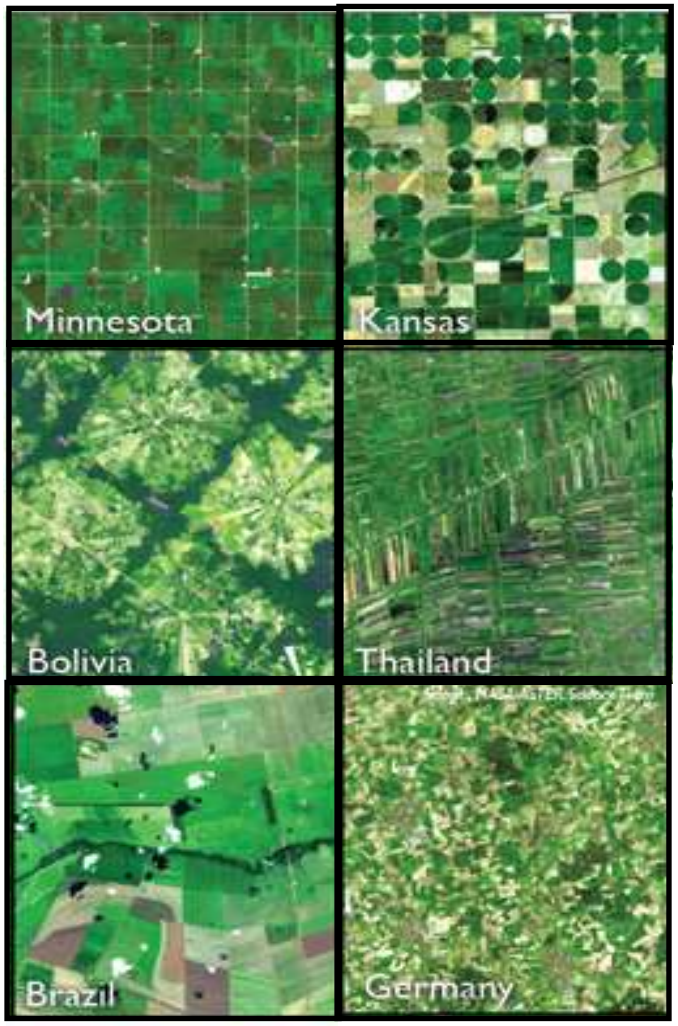
- Biogeochemical, biodiversity, and socioeconomic responses to expansion and intensification of agriculture and silvicultural practices
- Spatially explicit land use change forecast on crop area changes

Building understanding to reduce the potential impacts of biofuels production on the environment.

Biomass

Projects in Progress: Land use change

- **Indirect Effects of Biofuels**
  - Defining sustainability and its metrics
  - Evaluation of assumptions and definitions used in current analysis of land-use effects of bioenergy
  - Determination of key drivers of land-use change
  - Identification of factors not in current analysis of indirect effects
- **Land-Use Change and Bioenergy Workshop (May 2009)**
  - Data specialists
  - Researchers who explore causes of land-use change in situ
  - Modelers
  - Identification of approach to capture key drivers of land-use change by region for input into global economic equilibrium models



Biomass

Projects in Progress: Water use

- Conducting LCA of water demand for biofuel production (compares corn ethanol, sugar cane ethanol, and competing petroleum fuels).
- Determining types of alternative land and degraded water resources available with minimal logistics
  - Field project/pilot analysis in Nebraska – start regional then expand to agricultural region

Apply to biomass production the principles of green technologies:

- Resource recovery
- Water reuse
- Beneficial reuse

DOE-OBP Research: Sustainable Feedstock production

- **Regional Biomass Energy Feedstock Partnerships conducting in-field studies to determine best location for dedicated energy crops**
  - **Considering climatic conditions, soil types, water quality, and land use**
- **Series of trials focused on validation of "stover removal tool"—decision support to help farmers to ensure soil health while utilizing agricultural waste for bioenergy**

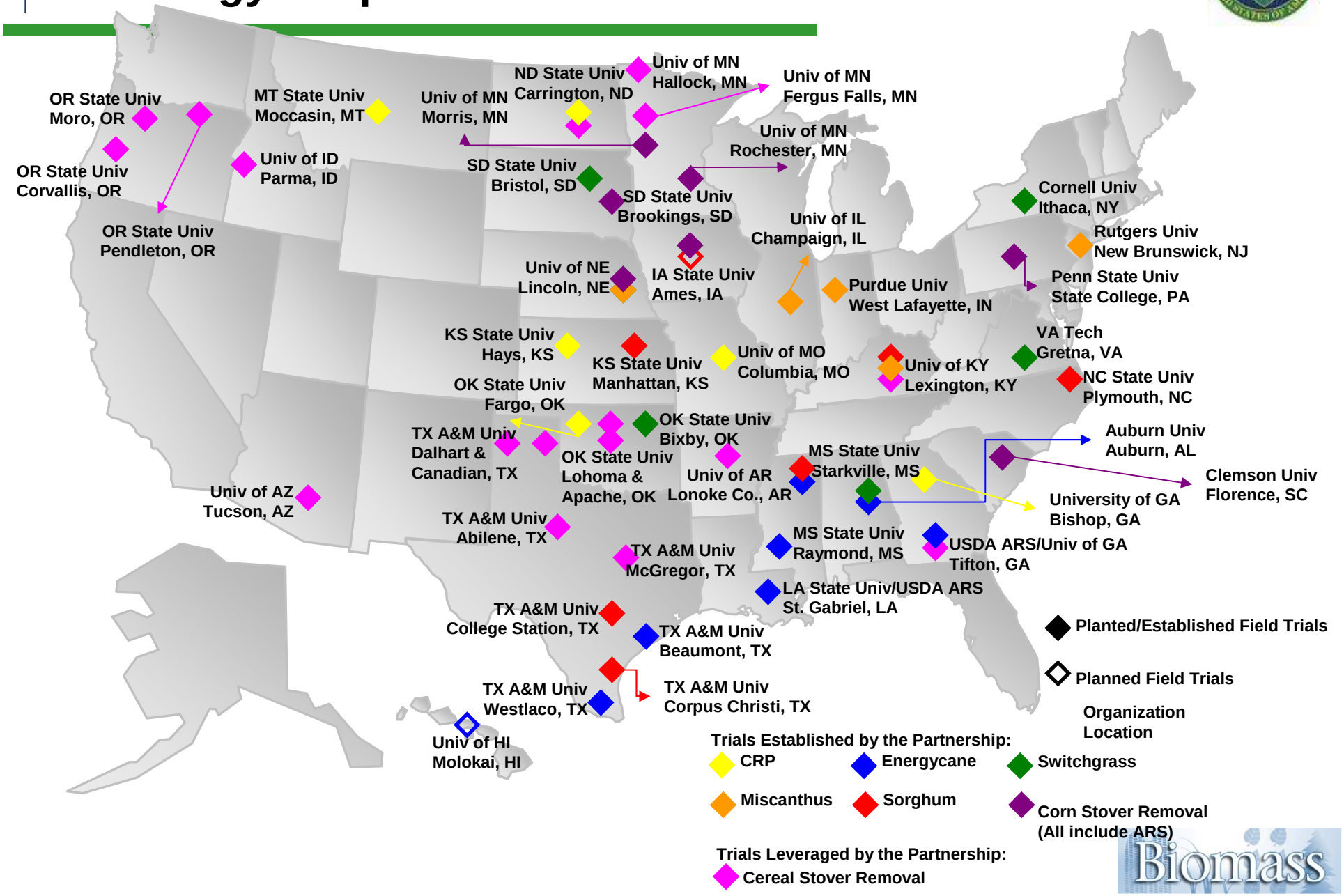
Biomass

Sustainable Feedstock production, cont.

- **The Sun Grant Initiative, as a part of the ongoing energy crop field trials carried out through the Regional Partnerships, is collecting and analyzing data on**
  - **Soil Carbon**
  - **Hydrology and Water Quality**
  - **Nutrient cycling—carbon, nitrogen, phosphorous, and potassium**
  - **Direct Green House Gas (GHG) Emissions**

Biomass

Regional Biomass Energy Feedstock Partnership
Bioenergy Crop Trials



Cross-cutting efforts: The Great Lakes Bioenergy Research Center

- GLBRC one of three Office of Science-funded centers
  - Only one focused on on-the-ground sustainability issues
- DOE-OBP leveraging existing GLBRC sustainability efforts through the American Recovery and Reinvestment Act
  - Novel production systems for perennial, native grassland systems, and integrated systems.
  - Biogeochemical, biodiversity, and socioeconomic responses to expansion and intensification of agriculture and silvicultural practices
  - Spatially explicit land use change forecast on crop area changes

GLBRC
Great Lakes Bioenergy Research Center

Cross-cutting efforts: The Great Lakes Bioenergy Research Center

- U.S. Forest Service at the Department of Energy's Savannah River Site
  - Beginning a watershed study evaluating different silvicultural options that are likely scenarios for biofuels feedstocks
  - Evaluation of different management options involving level of fertilization and weed control

Contact Information

Alison Goss Eng

Office of Biomass Program

Tel: 202-586-9109

Email: alison.gosseng@ee.doe.gov

Web Site: http://www1.eere.energy.gov/biomass/

THANK YOU