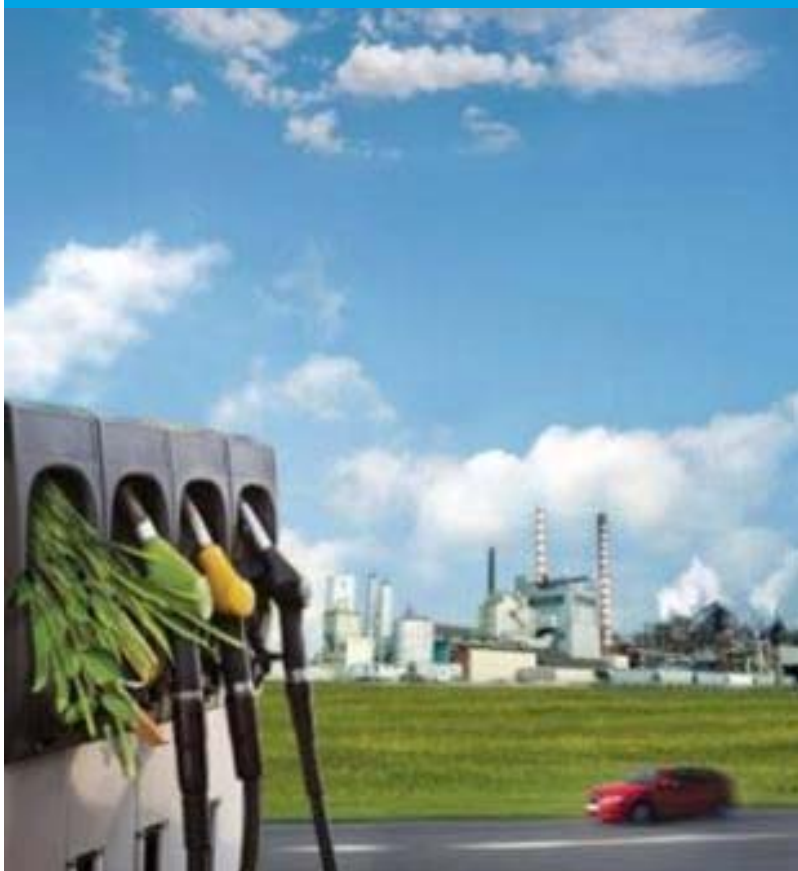


*Quantifying and managing land use effects of bioenergy*  
*A Task 38/40/43 Workshop*

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



**Data, analysis, and field studies to  
evaluate and minimize land-use  
change impacts of large-scale  
bioenergy production**

**Alison Goss Eng  
Biomass Program  
U.S. Department of Energy**

September 20, 2011

# Advancing Sustainable Bioenergy

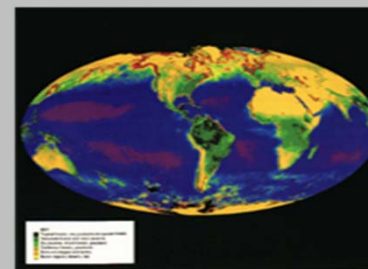
The Department of Energy is strategically investing in the science, technology, and infrastructure needed to support the emerging U.S. biofuels industry.

## Science and Discovery



## Economic Prosperity

## Clean, Secure Energy



## Climate Change

**“A viable, sustainable domestic biomass industry that:**

- produces renewable biofuels, bioproducts and biopower**
- enhances U.S. energy security**
- reduces our dependence on oil**
- provides environmental benefits, including reduced greenhouse gas emissions, and**
- creates economic opportunities across the nation.”**

# Sustainable Biofuels, Biopower, and Bioproducts

U.S. DEPARTMENT OF  
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Renewable Energy

**The Biomass Program is working to advance biomass technologies in support of DOE's mission to strengthen America's energy security, environmental quality, and economic vitality through:**



## Feedstocks

Developing lower cost feedstock logistics systems



## Conversion technologies

Improving conversion efficiencies and costs



## Integrated biorefineries

Systematically validating and deploying technology at first-of-a-kind facilities



## Infrastructure

Evaluating vehicle emissions, performance, and deployment options



## Biopower

Providing a clean, domestic, dispatchable renewable source of power

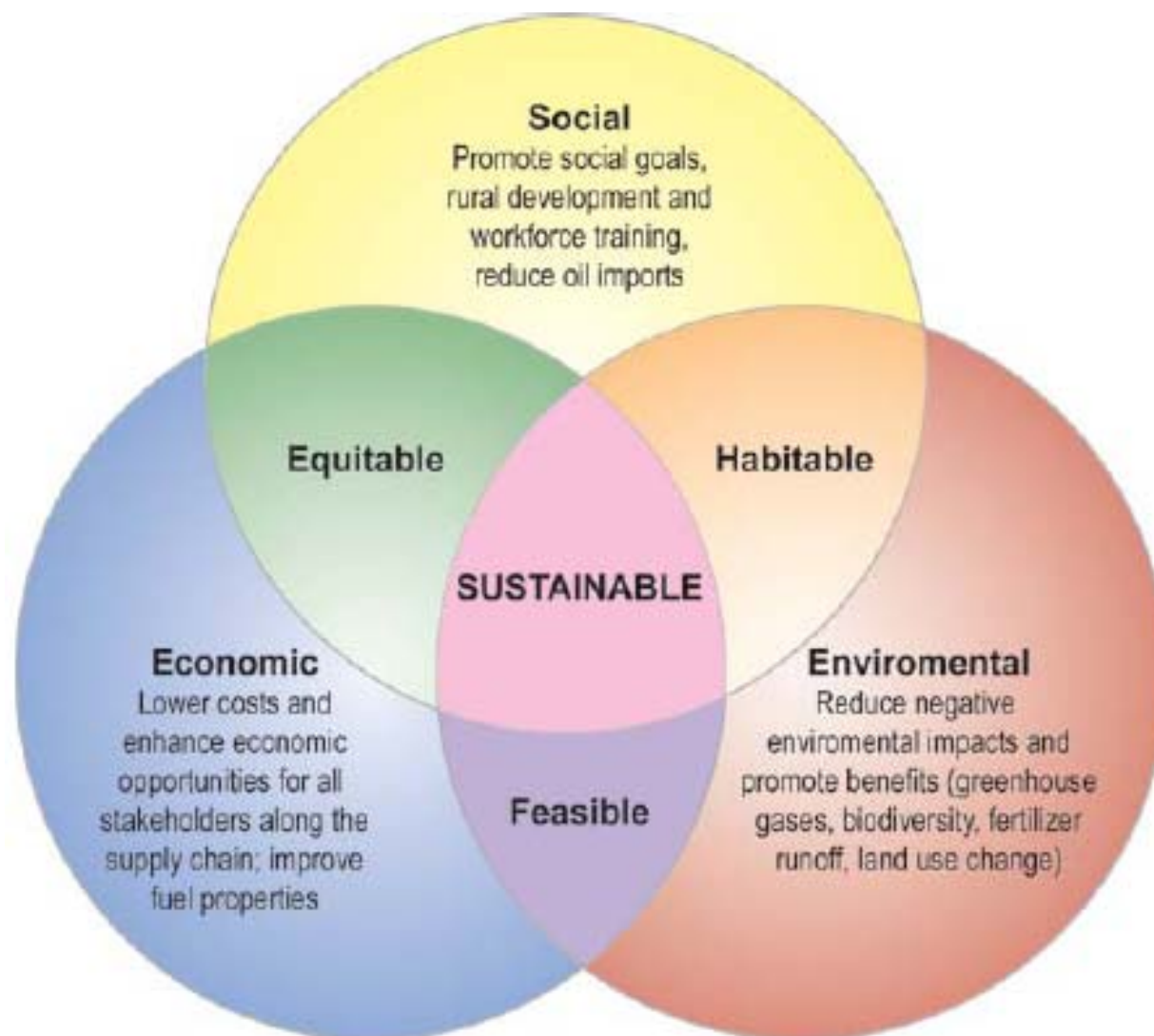


## Advanced biofuels

Expanding portfolio beyond cellulosic ethanol to hydrocarbon fuels

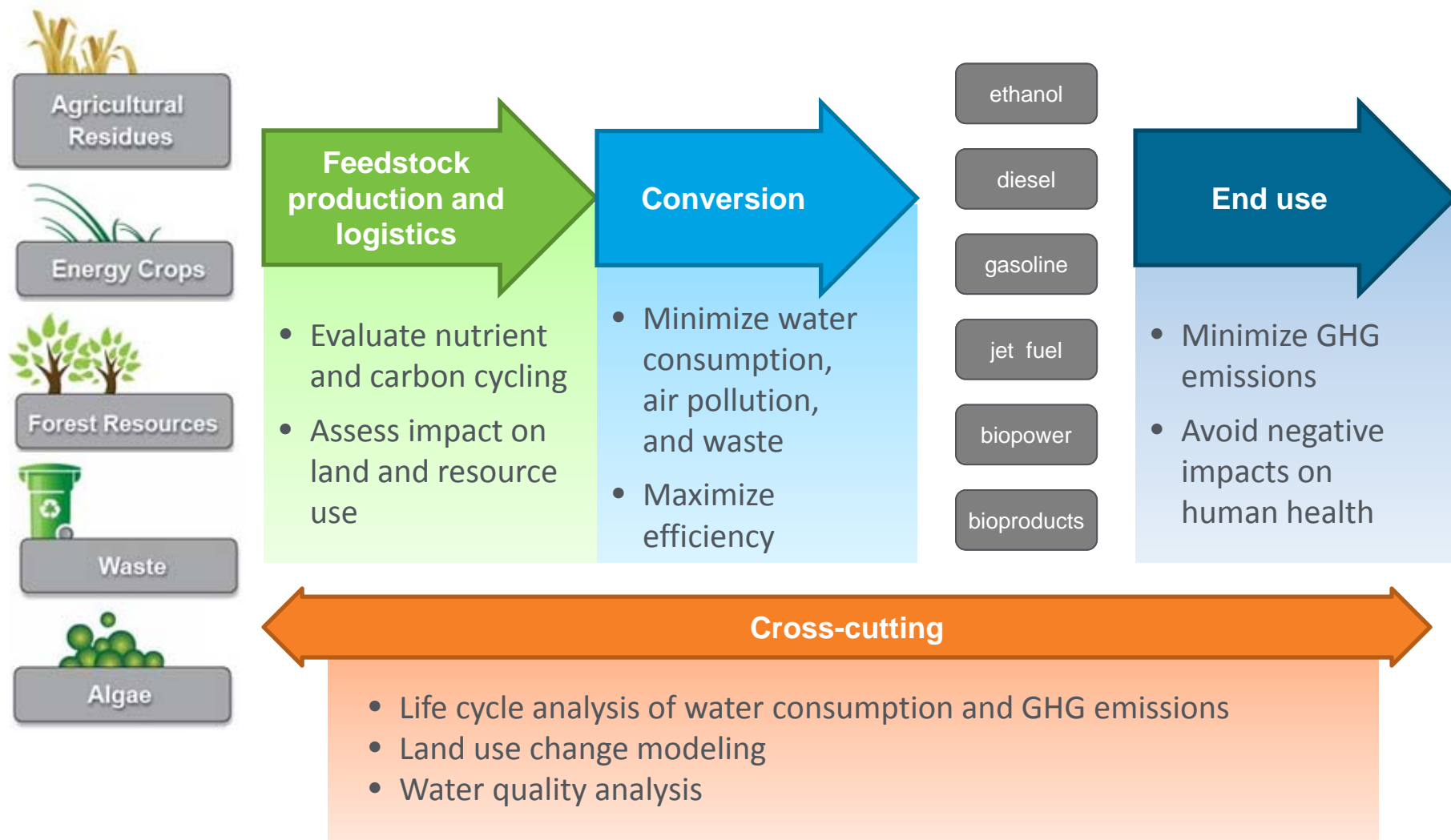


# A sustainable bioenergy industry

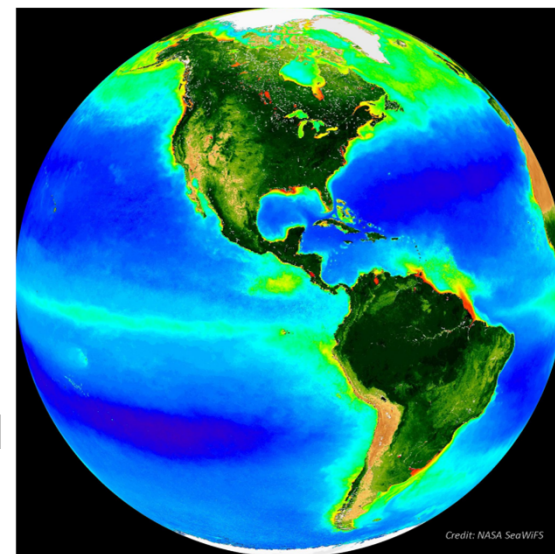


- **Biomass Program Strategic Goal**
  - Develop sustainable cost-competitive biomass technologies to enable the production of bioenergy nationwide and reduce dependence on oil through the creation of a new domestic bioenergy industry, supporting the EISA goal of 36 billion gallons per year of renewable transportation fuels by 2022 and increase biopower's contribution to national renewable energy goals through increasing biopower generating capacity.
- **Sustainability Strategic goal**
  - Understand and promote the positive economic, social, and environmental effects and reduce the potential negative impacts of bioenergy production activities.
- **Sustainability Technical Targets**
  - By 2012, identify metrics and set targets for climate, water, and land management for agricultural residues, energy crops, and forest resources pathways.
  - By 2013, identify metrics and set targets for soil quality and air quality for agricultural residues, energy crops, and forest resources pathways.
  - By 2022, validate sustainable integrated commercial pioneer plant performance along the agricultural residues, energy crops, and forest resources pathways.

# Sustainability Across the Biomass Program



- Authority
  - 2007 Energy Independence and Security Act (EISA)
  - Requires analysis of the life-cycle impacts of renewable fuels in order to assess the “aggregate quantity of greenhouse gas emissions (including direct emissions and significant indirect emissions such as significant emissions from land use changes)”
- Vision
  - Minimize negative land use change impacts
- Goal
  - By 2012, identify metrics and set targets for land management for agricultural residues, energy crops, and forest resources pathways
- Technical challenges and barriers
  - Lack of high-quality land use data with adequate spatial and temporal resolution
  - Representation of land use in existing models
  - Insufficient understanding of drivers of land use change





# Broad issues to consider

- Availability, reliability, security, and sustainability of biomass feedstocks
- Generation, distribution, and delivery of biofuels
- Unanticipated consequences of developing bioenergy supply chain
- Effect of bioenergy on climate change, economic (rural) development, national security
- Grower practices and crop dynamics/land use change
- Competition for feedstock (uses besides biofuel)

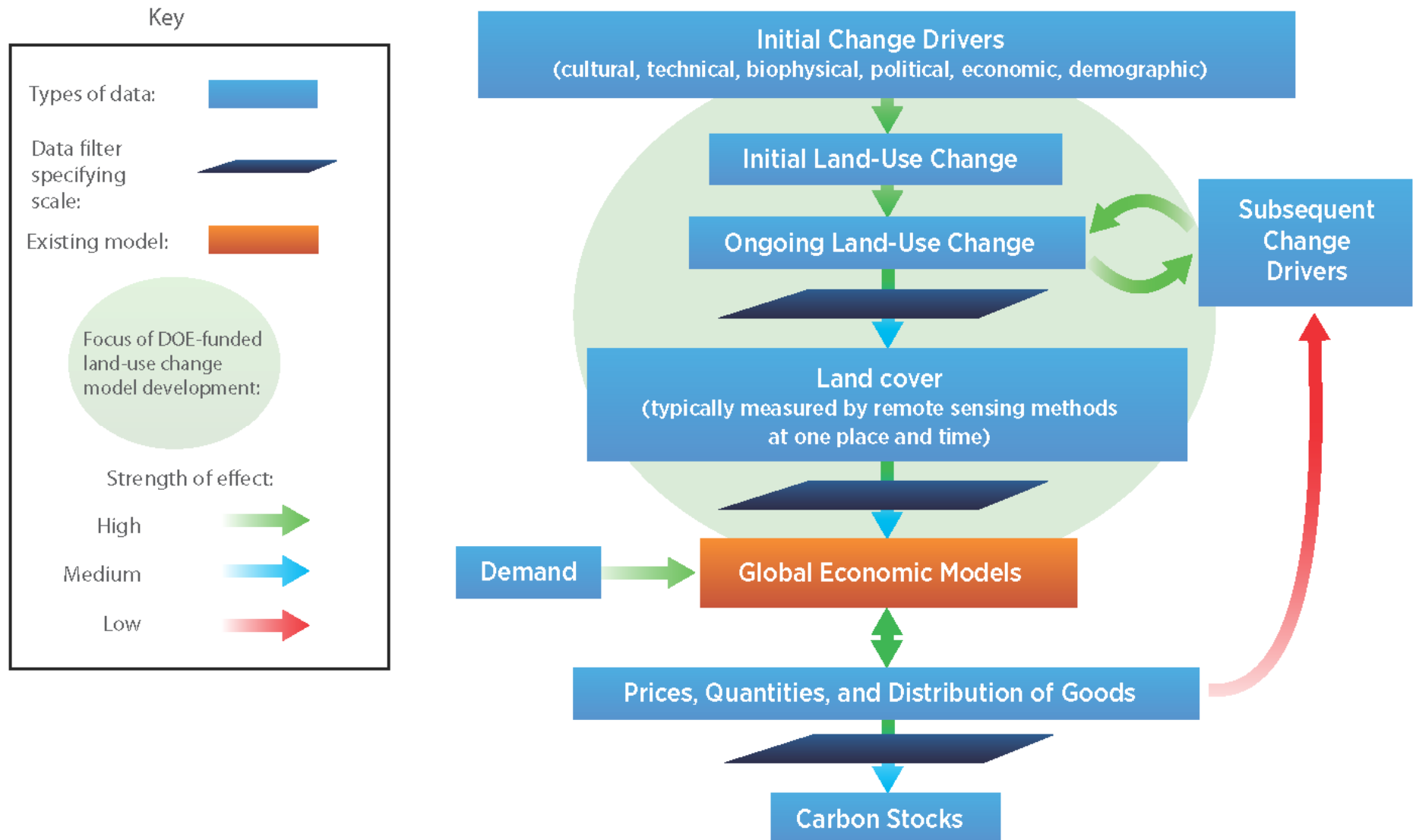


# Projects in Progress: Land-use change

- Indirect effects of biofuels (ORNL)
  - 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
  - Refining models to help study international land-use change issues due to growth of biofuels
- Land-Use Change and Bioenergy Workshop (May 2009)
  - Experts in the field gathered to prioritize next steps for research needed to address key land-use issues



# Research Framework Development



# The Great Lakes Bioenergy Research Center

- 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
- Empirical measurements of CO<sub>2</sub> release and gain from land use change and bioenergy production
- Spatially explicit land-use change forecast on crop area changes



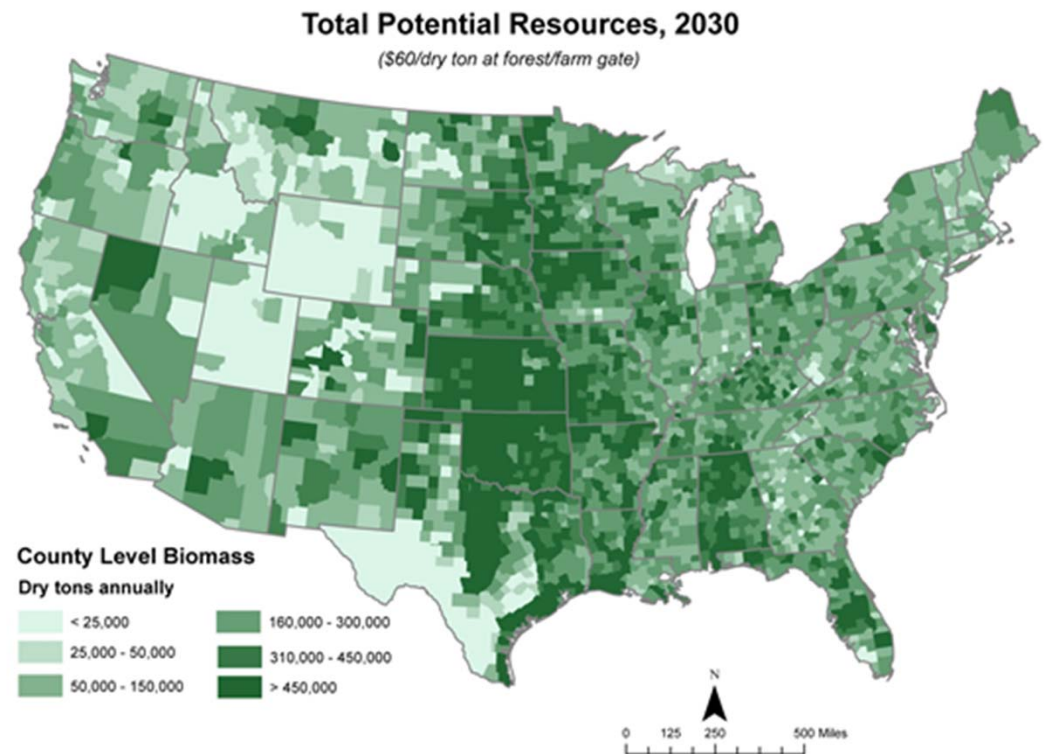
**GLBRC**  
Great Lakes Bioenergy Research Center



## Update to the 2005 Billion Ton Study

### More robust analysis:

- Sustainability criteria at the field and stand level
- Updated baseline data
- Land use change modeling for energy crops
- County-level inventory and costs for all major feedstocks
- Competition with other commodities and crops



### Key findings:

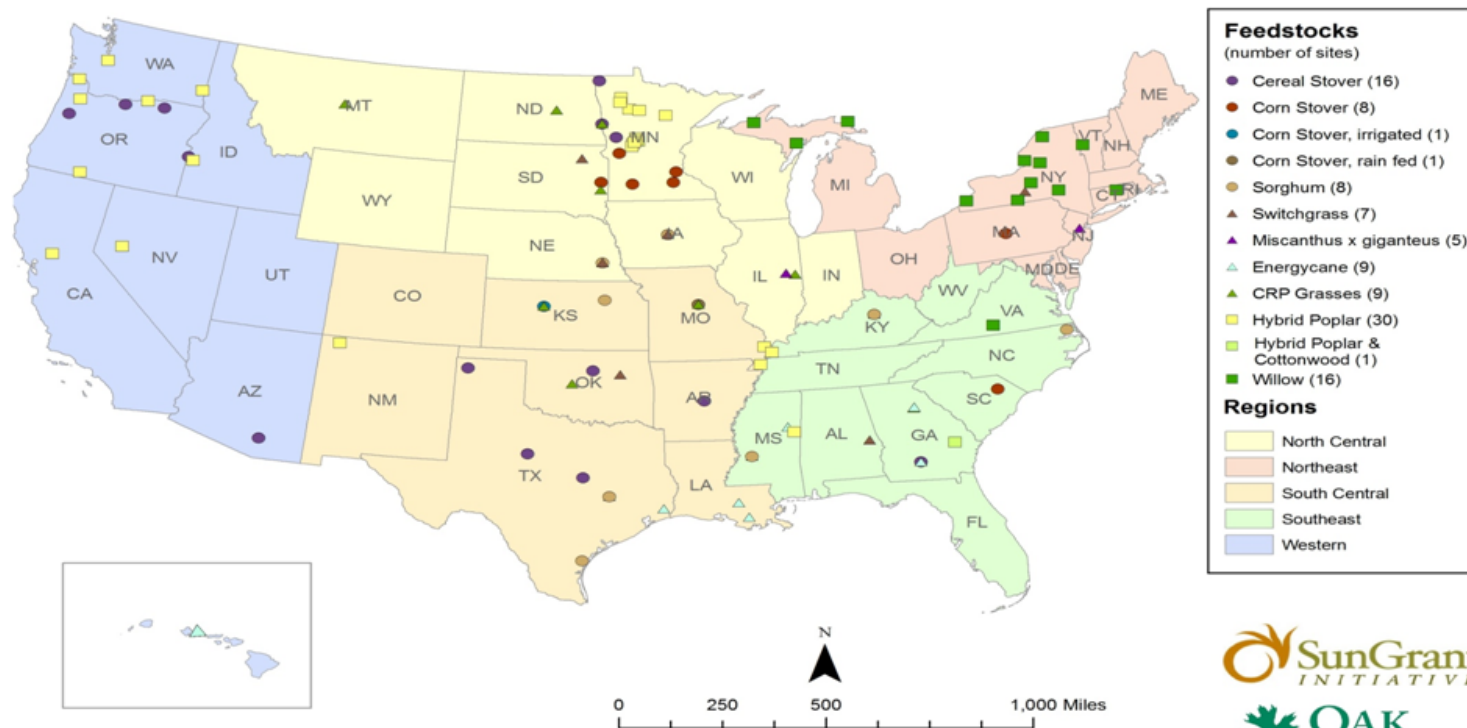
- Total biomass potential is a billion dry tons by 2022 and ranges from about 1.0 to 1.6 billion in 2030 depending on the scenario.
- Sufficient resource potential exists to meet the 2022 RFS2 advanced biofuel goals as well as significant additional biomass for electricity, chemicals, transportation fuels, and other uses.



# Project in Progress: Sustainable Feedstock Production

Regional Biomass Energy Feedstock Partnerships, part of the Sun Grant Initiative, are conducting in-field studies to:

- Determine best location for dedicated energy crops
- Validate decision support system to ensure soil health while utilizing agricultural waste for bioenergy



Disclaimer: This map is intended for visual representation only. Many field trials occur within the same research location and may not be indicated on the map. Users of this information should contact the Department of Energy Golden Field Office for additional data information.

Current as of October 25, 2010

# Sustainable Landscape Design for Feedstock Production

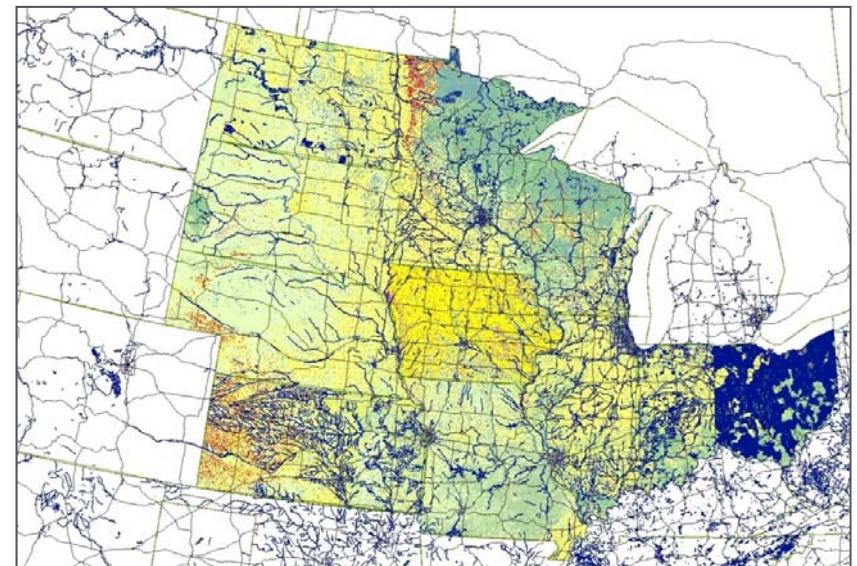
- PI: Jason Hill, University of Minnesota
- Objectives:
  - Analyze the Mississippi River watershed using a set of models to help stakeholders make informed decisions about what bioenergy feedstocks to use, where to produce or collect them, and what environmental impacts they will have in terms of climate change or other environmental shifts (such as land use)
  - Estimate the biophysical and economic impacts of different placements of feedstock production operations on the landscape in order to maximize net benefits returned to farmers, biorefineries, and the public

# Best Practices for Feedstock Production

## Biomass Production and Nitrogen Recovery

Argonne National Laboratory - *M. Cristina Negri*

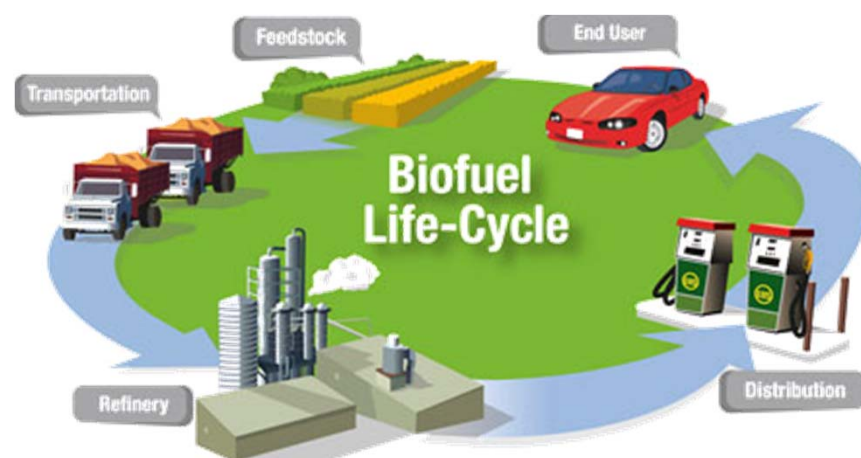
- Relevance to Biomass Program
  - Proactively developing best practices and solutions to incorporate sustainability with elevated productivity
- Approach
  - Converging spatial analysis, modeling, and field validation trials
- Major progress
  - Completed spatial analysis of marginal resources, nitrogen cycle modeling, and field proof-of-concept study
  - Now in field trials phase



Red: Fallow and Idle cropland, including CRP  
Light Green: Rangeland and grasslands  
Yellow: Cropland  
Dark green: forests  
Dark blue: Impaired surface water bodies

# Credible and integrated knowledge needed on land use change

- Many institutions and agencies make large investments in collecting and producing data and developing institutional knowledge
  - Little effort goes towards making this data and knowledge searchable, accessible and usable
  - “Reinventing the wheel” becomes a norm and not exception
- Isolated data silos leads to “information fragmentation”
  - Large data volumes, distributed sites
  - Limited access to data, information, tools
  - Difficult to form a holistic view
- Bioenergy resources, impacts, and benefits depend on local conditions
  - Need knowledge that is integrated geographically



- What models are available?
  - Community models available?
- Which model should I chose and why?
  - Appropriate spatial and temporal scales?
- How do I find data to support the model(s)?
  - Quality assurance for data? Currency?
- How do I validate my results?
  - Model output meaningful?
  - Reasons for difference?
- Has this been done already?
  - Publications exist? Lessons learned?
- Who else is interested? Who can help?
  - SME database? Services available?



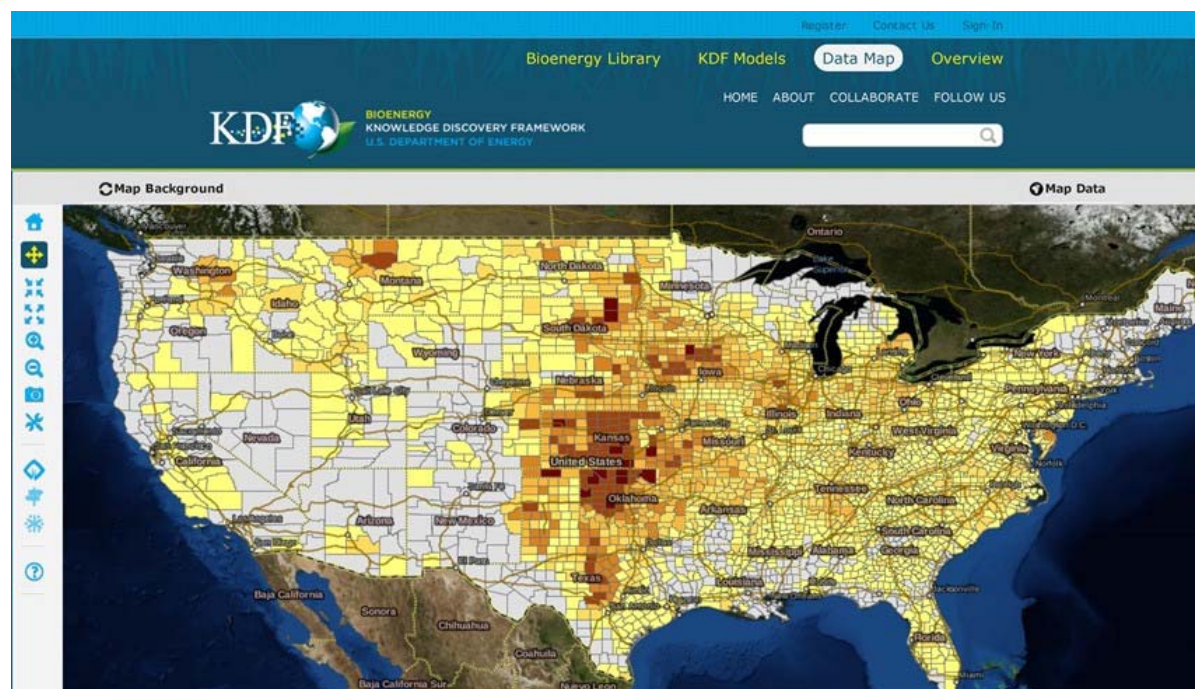
# Integration and collaboration

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## BIOENERGY KNOWLEDGE DISCOVERY FRAMEWORK U.S. DEPARTMENT OF ENERGY

An online collaboration and geospatial analysis toolkit that allows researchers, policymakers, and industry to explore and engage the latest bioenergy research. The [Bioenergy KDF](#) harnesses Web 2.0 and social networking technologies to build a collective knowledge system that facilitates collaborative production, integration, and analysis of bioenergy-related information.

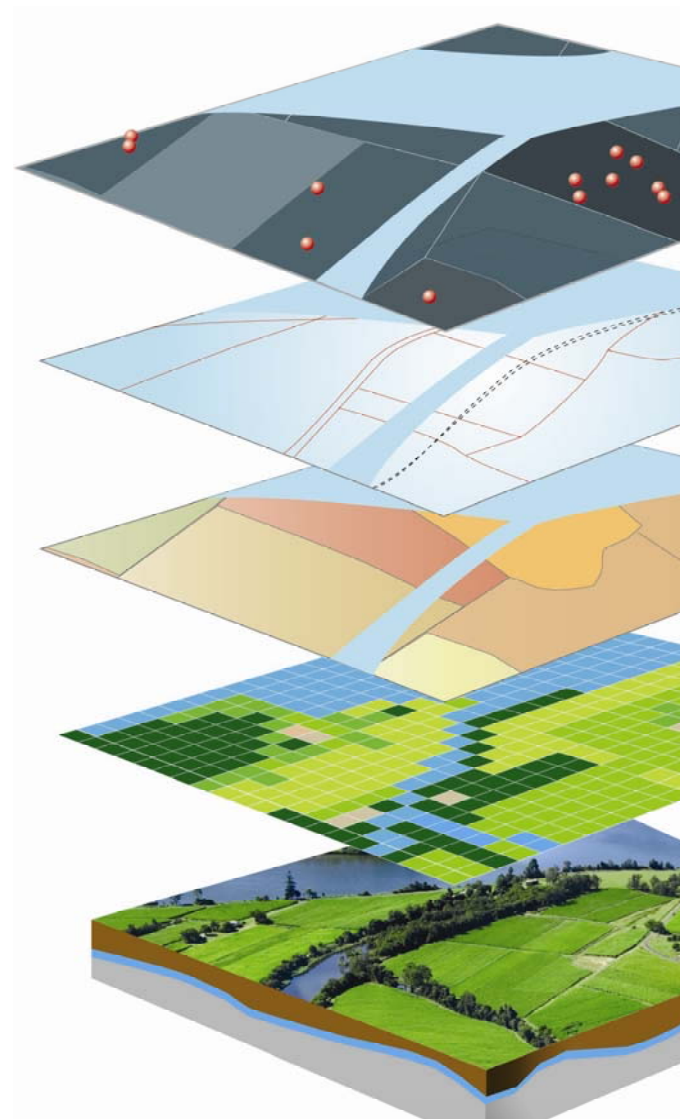


Connect with the Bioenergy KDF



# Bioenergy KDF goals and approach

- **Goals**
  - Provide data analysis, synthesis, and visualization capabilities that facilitates informed decision making
  - Enable more efficient planning, development, and management of the U.S. bioenergy infrastructure
- **Approach**
  - Promote sharing and integration of distributed resources
  - Engage various stakeholder communities
  - Offer guidance and access to comprehensive data, modeling, and visualization resources
  - Incorporate DOE-OBP and partner funded research



# Partnerships are key



Researchers  
& Engineers



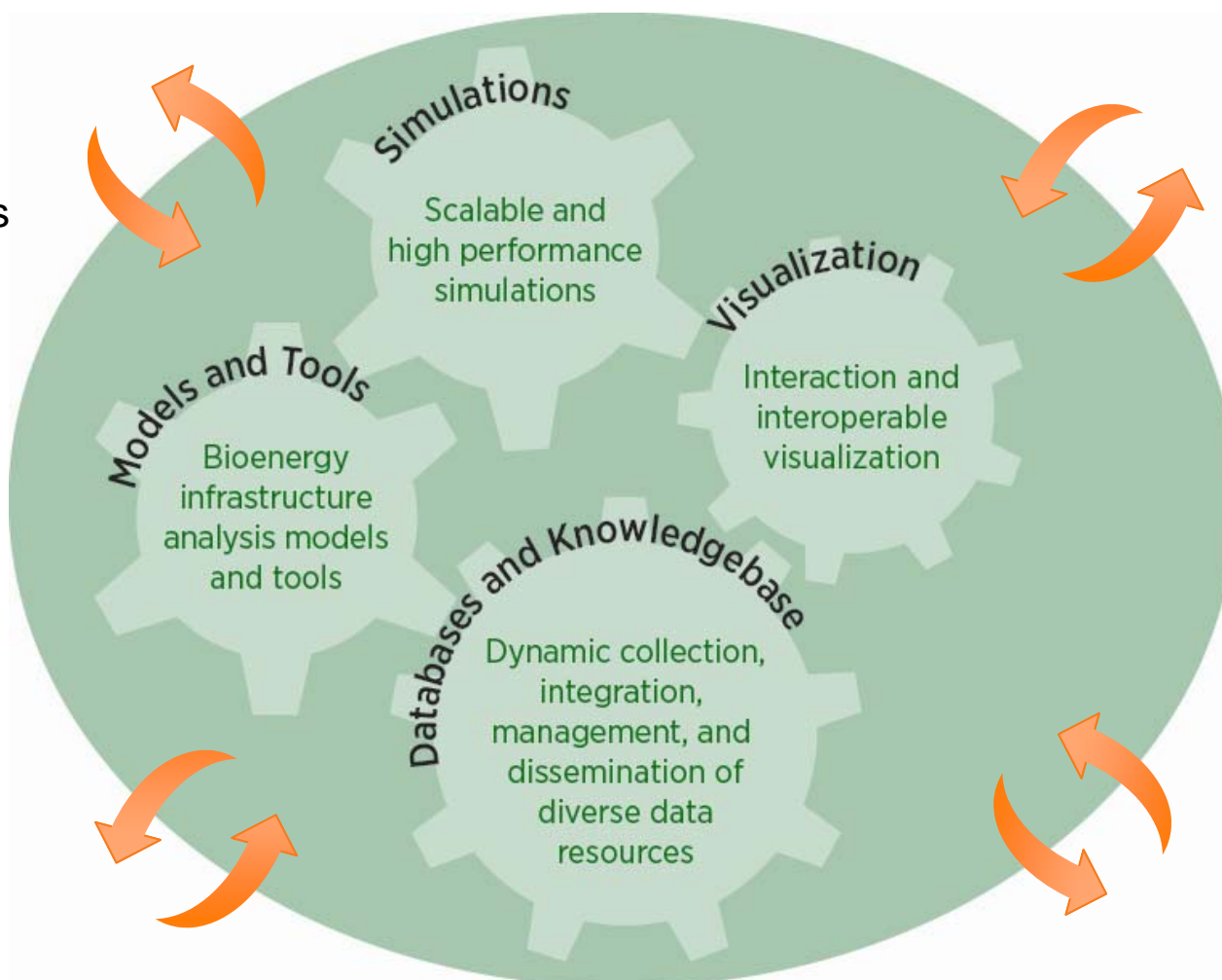
Private  
Industry



Policy  
Makers



The Public



- Working with **Conservation International** to:
  - Identify land that should not be developed into biofuel crops
  - Conduct pilot studies to identify best places for biofuel crops
  - Implement standards for biofuel crop production
- Providing data and analysis to inform a variety of international and domestic discussions on sustainability standards
  - **Roundtable on Sustainable Biofuels**
  - **Global Bioenergy Partnership**
  - **International Standards Organization**
- Bioenergy chapter of IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation
  - Released Summer 2011



# Contact Information



Energy Efficiency &  
Renewable Energy

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**<http://www1.eere.energy.gov/biomass/>**

**<http://bioenergykdf.net>**

**THANK YOU!**