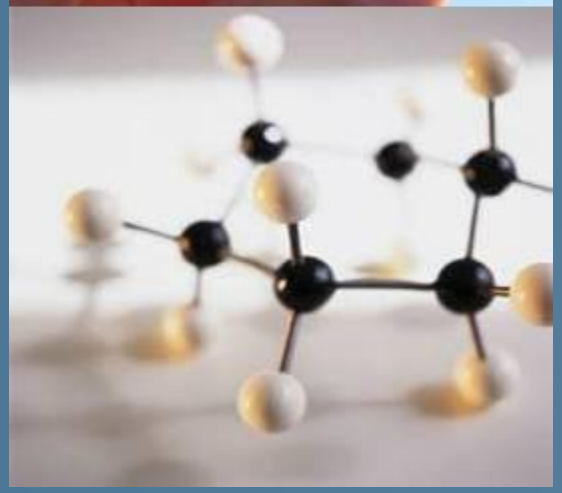


U.S. Department of Energy, Biomass Program

Growing America's Energy Future

Valri Lightner
June 3-4, 2009

Biomass Program Mission

Develop and transform our renewable and abundant, non-food, biomass resources into sustainable, cost-competitive, high-performance biofuels.

Focus on targeted research, development, and demonstration

- Support through public and private partnerships
- Deploy in integrated biorefineries

2009 Program Priorities and Goals

Advancing Presidential Objectives

Science & Discovery

- Connecting basic and applied bioscience
- Conducting breakthrough R&D:
  - Advances in enzymes and catalysis
  - Engineering of new microorganisms
  - Novel sustainability indicators

Clean, Secure Energy

- Developing & demonstrating cellulosic and advanced biofuels to meet RFS

Economic Prosperity

- Creating 50 to 75 jobs per new biorefinery
- Creating major new energy crop markets
- Reinvigorating rural economies

Climate Change

- Reducing GHG emissions by up to 90% with advanced biofuels (relative to gasoline)

Program Areas & Challenges

Research & Development

Feedstock Systems

- Diverse regional biomass resources
- Yield & price
- Water & fertilizer
- Land use

Conversion Technologies

Biochemical

- Cost & Efficiency
  - Pretreatments
  - Enzymes/yields
- Fermentation

Thermochemical

- Cost & Efficiency
- Gasification Process
- Fuel Stabilization

Demonstration & Deployment

Integrated Biorefineries

- Integrating process technologies
- Financing
- Technical expertise
- Profit potential

Infrastructure

- Transport
- Storage
- Codes & Standards (Blend wall)
- Demand/ markets
- Compatibility

Product Development

- Fuel purity & cost
- By-products/markets
- Infrastructure compatibility

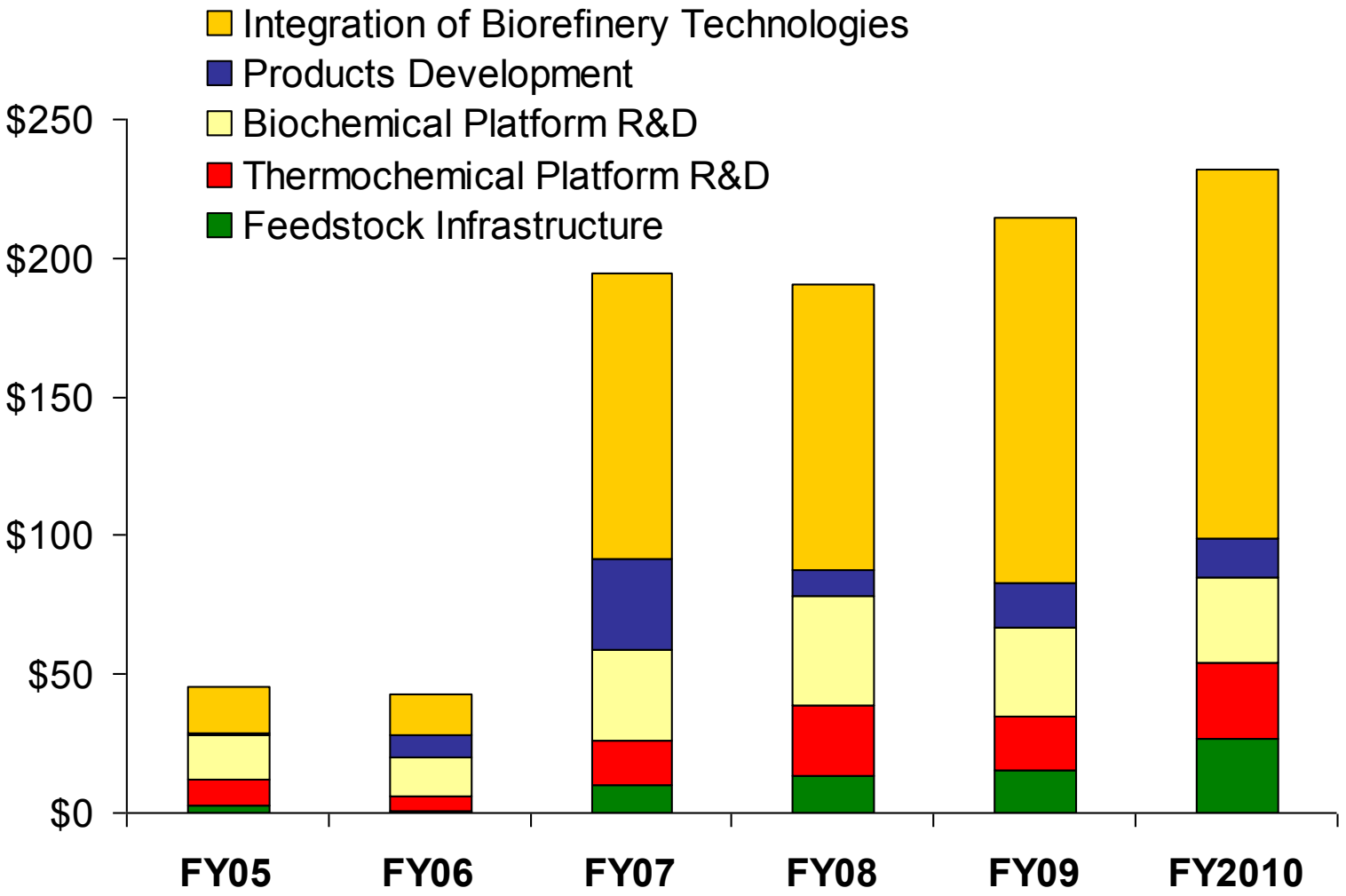
Sustainability

- GHG emissions
- Water quality
- Land use
- Socioeconomics
- Predictive Modeling
- International

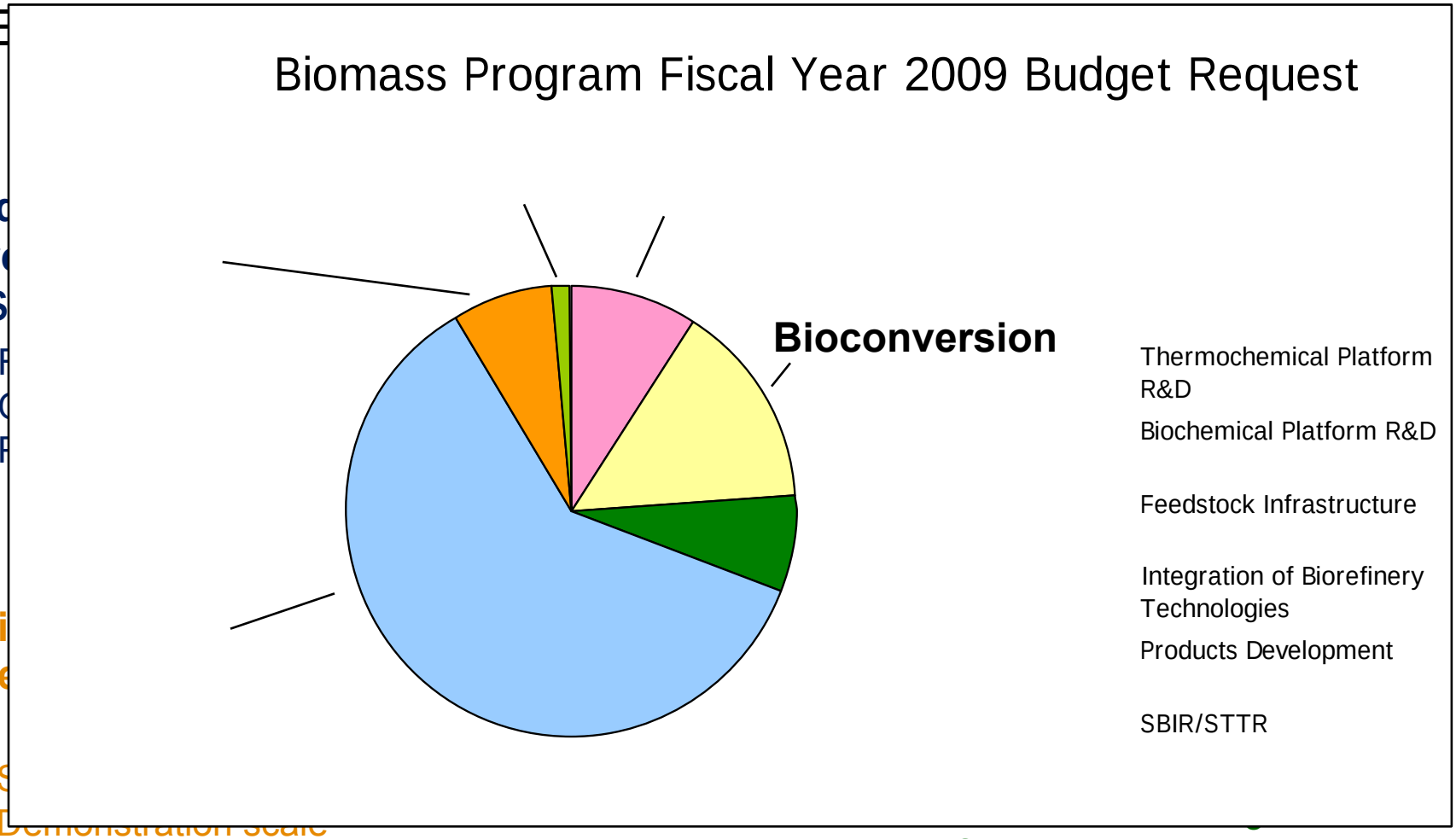
Critical Near-Term Market Hurdles

- Blend wall
  - E10 likely to saturate current markets by 2010
- Cost-effective commercial production of cellulosic biofuels
  - Cost of enzymes
  - Cost of pretreatment
  - Demonstration of thermochemical conversion
- Delivery and end-use infrastructure limitations
  - Infrastructure (rail, truck, pipeline, blending, storage) for non-compatible biofuels (e.g., ethanol)
  - Infrastructure to meet ramped up production of biofuels
  - UL approved E85 pumps

Biomass Program Budgets, FY05-10



Program Plan for FY 2009

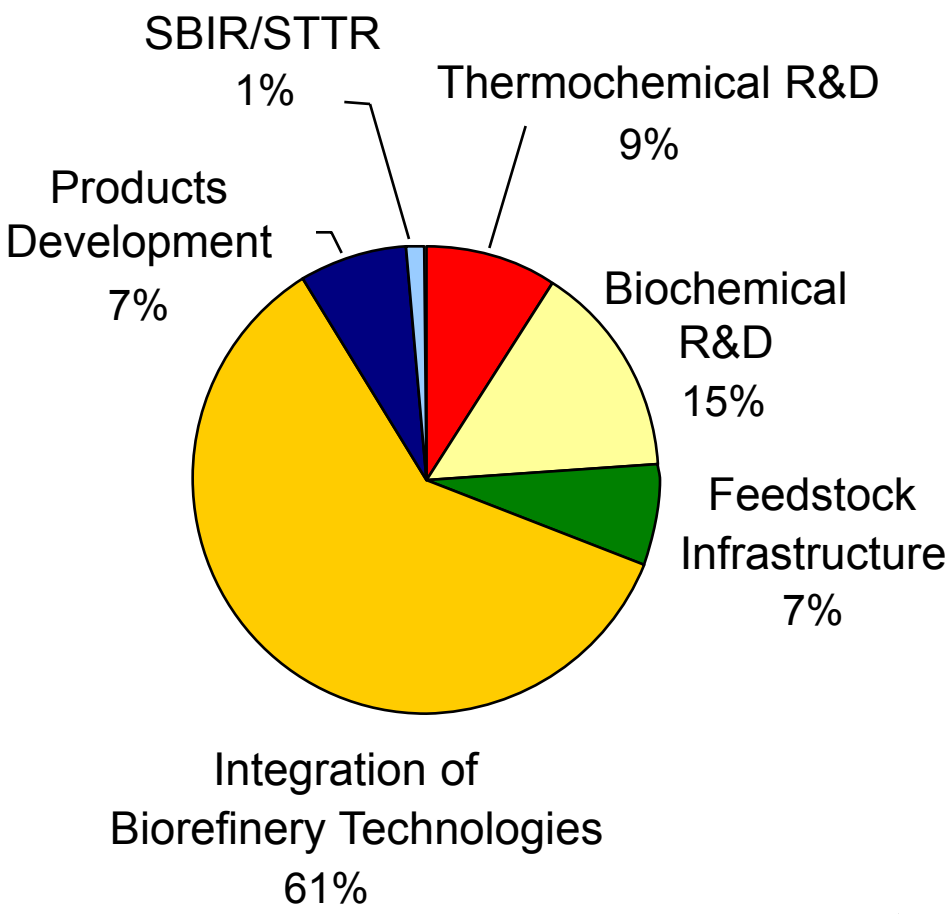


- Pilot Scale

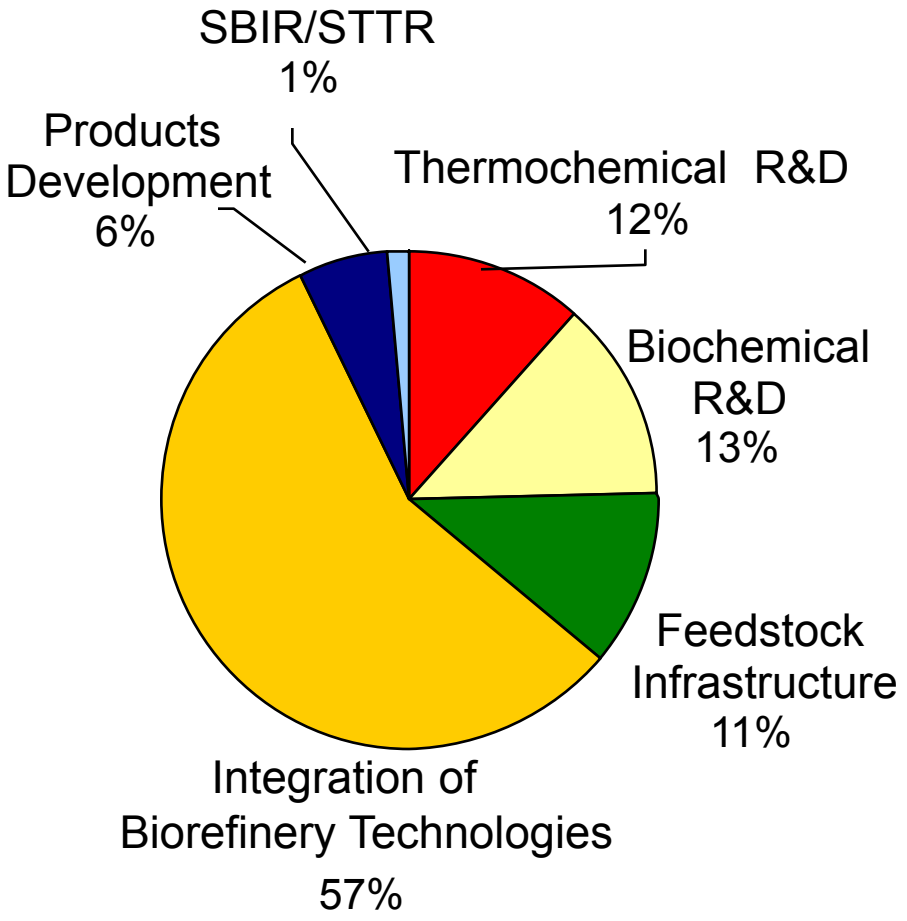
- Sustainability

Biomass Program: Comparative Budgets

FY09 Budget



FY10 Budget Request



Gains in budget share:
Thermochem R&D & Feedstock Infrastructure

Biomass Program Performance Goals

Program Performance Goals

- Make cellulosic ethanol cost competitive at a modeled cost for mature technology: $1.76/gallon by 2012*
- Help create an environment conducive to maximizing production and use of biofuels, 36 billion gallons per year by 2022

Feedstocks

Supply

2012: 130 M TPY

2017: 250 M TPY

Logistics

2012:
$0.39/gal EtOH

2017:
$0.33/gal EtOH

Biochemical Conversion

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

Thermochem. Conversion

Reduce the 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 testing of E15 & E20 distribution systems and engines. Support E85 on regional basis.

* All costs are in 2007 dollars, based on EIA's *Annual Energy Outlook* and corrected for the energy density of ethanol

Feedstocks: Priorities & Activities

FY2010 Request: $27M (includes sustainability)

Analysis

- Billion Ton update
- Economic Inter-agency Working Group Report
- Bioenergy Knowledge Discovery Framework

Plans

- Landscape-level analysis
- Collaboration with the Office of Science

Production

- Feedstock trials with Regional Biomass Energy Feedstock Partnerships

Plans

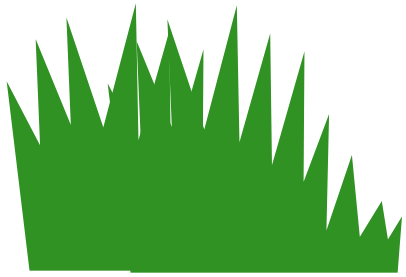
- Establish more trials (woody & herbaceous)
- Develop synthesis reports
- Collect watershed-scale data

Sustainability

- Land use studies and lifecycle assessments
- International efforts

Leveraging

- Great Lakes Bioenergy Research Center Partners (ARRA $5M, FY09-11)



Logistics

- INL lead
  - Process demo unit (PDU)
- Industrial Projects implemented

Plans

- Deploy PDU
- Support IBR partners

Biochemical Conversion: Priorities & Activities

FY2010 Request: $31M

Enzyme Conversion

- Conduct R&D to improve effectiveness and **reduce the costs** of enzymatic conversion
- Validate integrated pretreatment and enzymatic hydrolysis of corn stover (dry and wet) at pilot scale

Activities

- Enzyme solicitation
- Advanced Biofuels University solicitation

C5 Sugars Conversion

- Conduct R&D on advanced micro-organisms for fermentation of sugars

Activities

- Ethanologen solicitation

Process Integration

- Validate/optimize integrated production of ethanol from corn stover derived sugars at pilot scale
- Validate integrated pretreatment and enzymatic hydrolysis of switchgrass at pilot scale

Leveraging

Fund loan guarantees, commercial and demonstrations scale validation projects

Future efforts address obstacles to biochemical routes to biofuels, support demonstrations, and resolve infrastructure issues

Thermochemical Conversion: Priorities & Activities

FY2010 Request: $27M

Gasification

- Conduct process integration & modeling
- Syngas cleanup & conditioning
- Fuel synthesis

Activities

- Thermochemical conversion solicitation (up to $7.75 M)
- Core R&D at National Labs

Pyrolysis

- Improve bio-oil quality
- Stabilize bio-oils for transport

Activities

- Pyrolysis Oil Stabilization (up to $7.5 M)
- Core R&D at National Labs

Advanced Biofuels (thru Recovery $)

- Explore pathways to green gasoline, green diesel, cellulosic biobutanol, algal-based hydrocarbons

Leveraging

- Advanced Biofuels University Solicitation
- 1-Ton/day Pilot or 50-Ton/day Demonstration of advanced biofuels
- Core R&D at National Labs

Related Activities

Commercial-Scale Biorefineries, 10% Scale Validations, Joint DOE-USDA Solicitations

Developing technology to enable cost-effective biofuels and researching ways to Improve the quality of biofuels and intermediates

Integrated Biorefineries: Priorities & Activities

FY2010 Request: $132M (includes infrastructure)

Demonstration & Deployment

- Initiate construction of at least one additional commercial-scale IBR project
- Approve engineering design of one additional commercial-scale IBR (two in total)
- Approve prelim. engineering design, market analysis for at least 4 demo-scale IBRs selected in 2008

Leveraging

- Major partnerships with private companies
- Loan guarantees

Technical Assistance

- Conduct smaller R&D projects critical to improving biorefinery operations

Leveraging

- Expertise of National Laboratories and DOE Bioenergy Research Centers

Analysis

- Conduct technical, economic, and environmental analyses to assess progress of individual IBRs and collective status
- Verify that unit operations operate as designed and meet all performance metrics

Wider scope potentially opens IBRs to additional feedstocks and biofuels.

Biofuels Infrastructure: Priorities & Activities

FY2010 Request: about $5M (part of integrated biorefineries)

Strategic Analyses

- Cost and feasibility analysis
- Regional Plot distribution networks

Plans

- Establish cost goals for biofuel distribution
- Feed and tap Bioenergy Knowledge Discovery Framework to inform infra-structure planning

Policy & Regulation

- Conduct test program on intermediate ethanol bends

Leveraging

- Coordinating closely with EPA
- Joint initiative with Vehicle Technologies Program
- Working with Coordinating Research Council, other stakeholders

Communications & Outreach

- Conduct scoping study to identify gaps and needs for standards development

Leveraging

- Collaborate on Clean Cities solicitation
- Coordinate with State Energy Offices

Strategic Partnerships

- National Commission on Energy Policy
- BRDI Distribution Infrastructure Interagency Working Group
- Governors' Biofuels Coalition
- Standards organizations

Fostering systematic development of cost-effective competitive distribution networks and end use applications.

Sustainability: Priorities & Activities

FY2010 Request: about $1M (part of feedstocks)

Feedstocks

Leveraging

- Through Sun Grant Initiative, use field trials to collect data on sustainability

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

International Efforts

- Work with Conservation International to identify land and preserve best production locations
- Participate in Council for Sustainable Biofuels Production to develop standards
- Provide data and analysis to Roundtable on Sustainable Biofuels, Global Bioenergy Partnership, others
- Contribute to International Biofuels Forum

Leveraging

- Tap expertise of Great Lakes Bioenergy Research Center

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