

## U. S. Department of Energy, Biomass Program

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Feedstock and Sustainability Platform

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# AGENDA

- Overview of DOE Biomass Program Mission
- Description of Demonstration and Deployment Activities
- Accelerating Deployment of Biofuels in a Sustainable Manner
- Promoting Sustainable Development of the Biofuels Industry over the Life Cycle of Biofuels



## Advancing Presidential Objectives

### Science & Discovery

- Connecting basic and applied science
- Conducting breakthrough R&D

### Economic Prosperity

- Creating jobs and reinvigorating rural economies
- Supporting the emerging U.S. bioenergy industry

### Climate Change

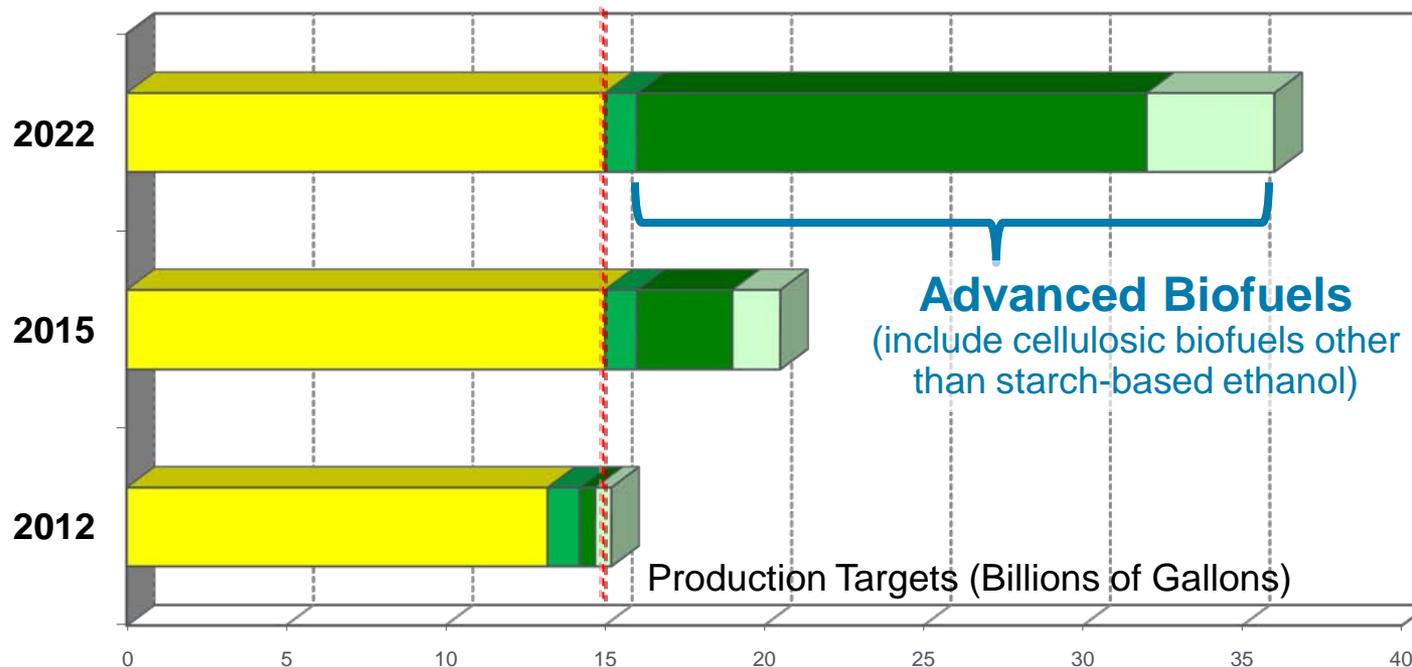
- GHG reductions: 50% (advanced) / 60% (cellulosic) biofuels
- Low-carbon power generation technologies
- Development of criteria for sustainable biofuel production

### Clean, Secure Energy

- Developing & demonstrating advanced biofuels technologies



## 15 BGY Cap on Conventional (starch) Biofuels



### Renewable Fuel Standard (RFS2)



Conventional (Starch) Biofuels



Biomass-based diesel



Cellulosic Biofuels



Other Advanced Biofuels

# Biomass Program Mission, Objectives, Goals

Develop and transform our renewable and abundant biomass resources into cost competitive, high performance biofuels, bioproducts, and biopower.

## R&D Priorities

- Achieving biofuel cost targets (modeled)
  - <\$2/gal for cellulosic ethanol;
  - <\$3 for cellulosic drop-ins
- Developing bio-power and bio-products for important supporting roles
- Meeting the EISA Renewable Fuel Standard
- Investing to meet targets (~\$200M/yr)

## Moving Markets

- Close collaboration with USDA, EPA, DOD
- Pilot and commercial demonstrations
- Infrastructure for delivery (including fuel dispensers)
- Subsidies and other policy drivers

## Research, Development, and Demonstration

Feedstocks

Biochemical and Thermochemical Conversion

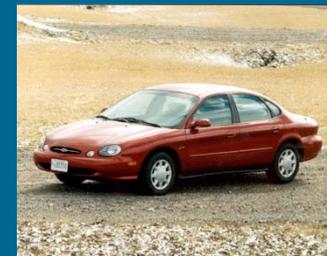
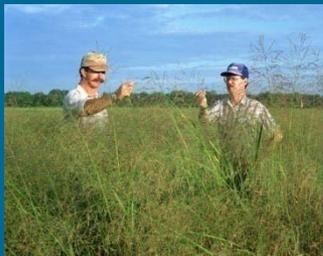
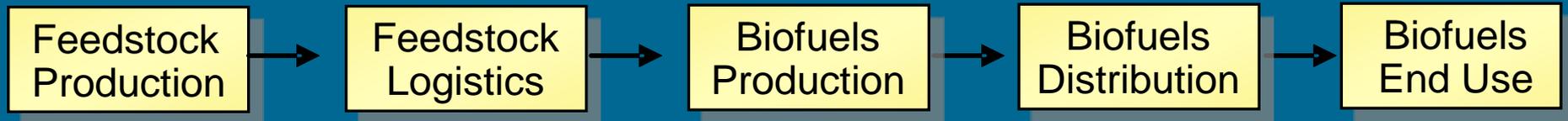
Biopower  
Biofuels  
Bioproducts

Integrated Biorefineries

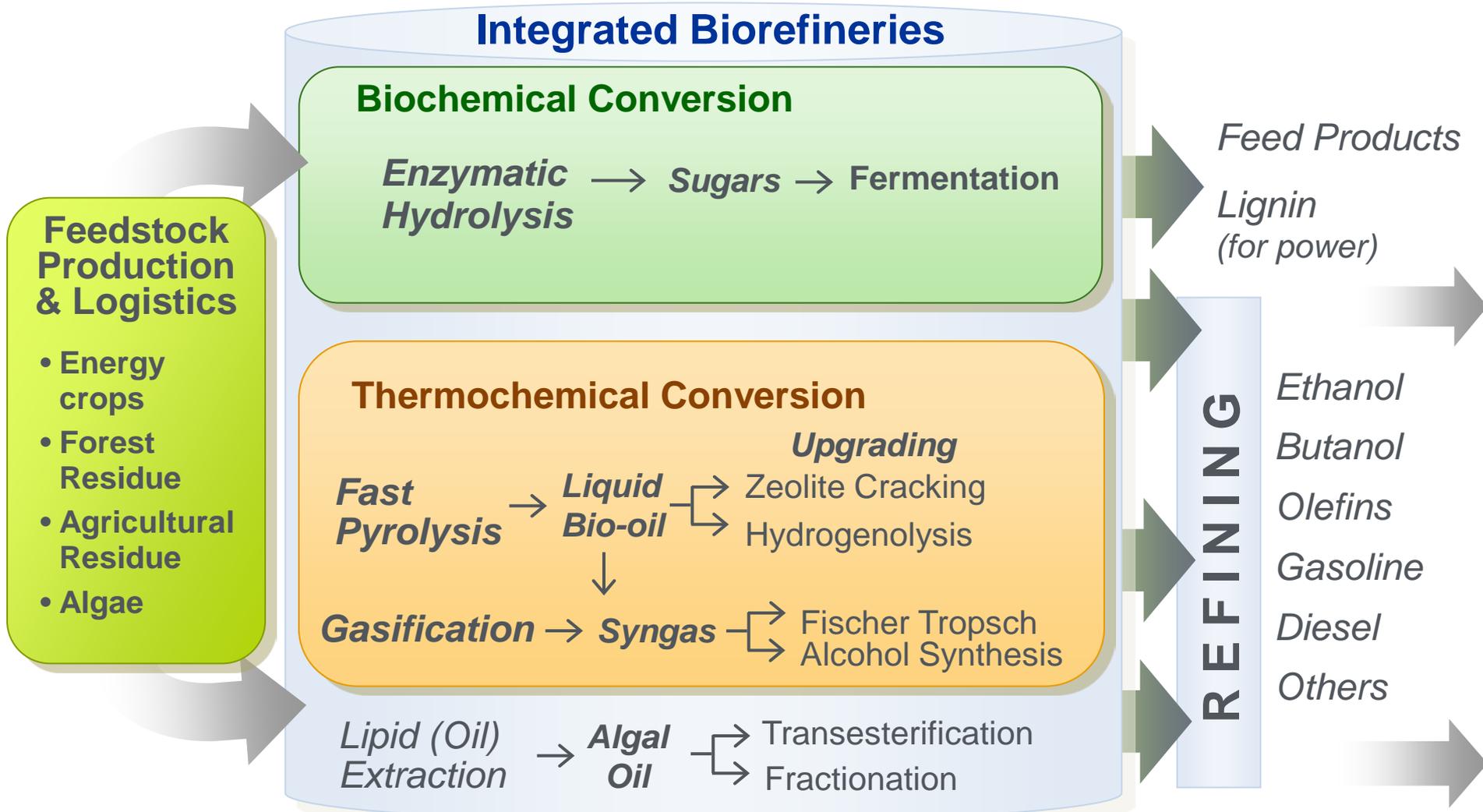
Infrastructure

## Crosscutting Activities

Analysis; Sustainability; Partnerships, Communications, and Outreach



- **Cellulosic Ethanol:** Historically, the primary focus of the program has been on the conversion of lignocellulosic biomass to fuel ethanol. This work can be fully leveraged and applied to renewable hydrocarbon fuels.
- **Alternative Light-Duty and Diesel Replacement Fuels:** Over past few years, Biomass Program has expanded its technology portfolio to include the production of renewable hydrocarbon fuels from lignocellulosic biomass, including renewable gasoline, diesel and jet fuel, which will be required to meet the EISA goal.



Research on multiple conversion pathways aims to improve the efficiency and economics of biofuels production.

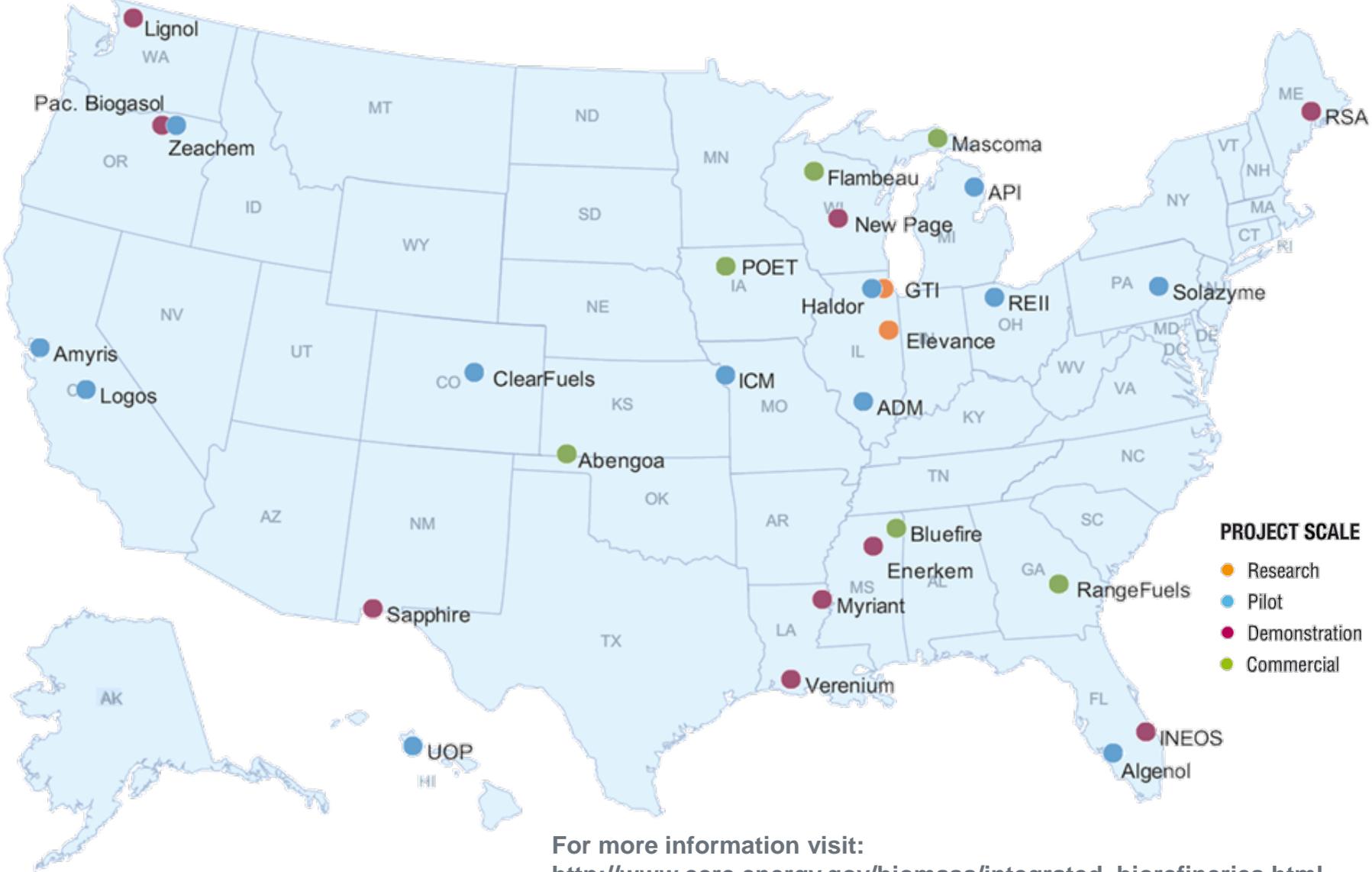
# Description of Demonstration and Deployment Activities

# Integrated Biorefineries and Major Research Thrusts

- **29 R&D, pilot, demonstration, and commercial-scale projects selected to validate IBR technologies**
  - **Diverse feedstocks represented**
  - **Multiple transportation fuels and bio-based products**
- **Fundamental Research**
  - **Drop-in biofuels consortium**
  - **Algae consortia (4)**
- **Deployment**
  - **Expansion of Integrated Biorefinery Research facility at NREL**
  - **Integrated Process Development Unit to reduce cost of feedstocks logistics**



# Biomass Program's Integrated Biorefinery Project Portfolio



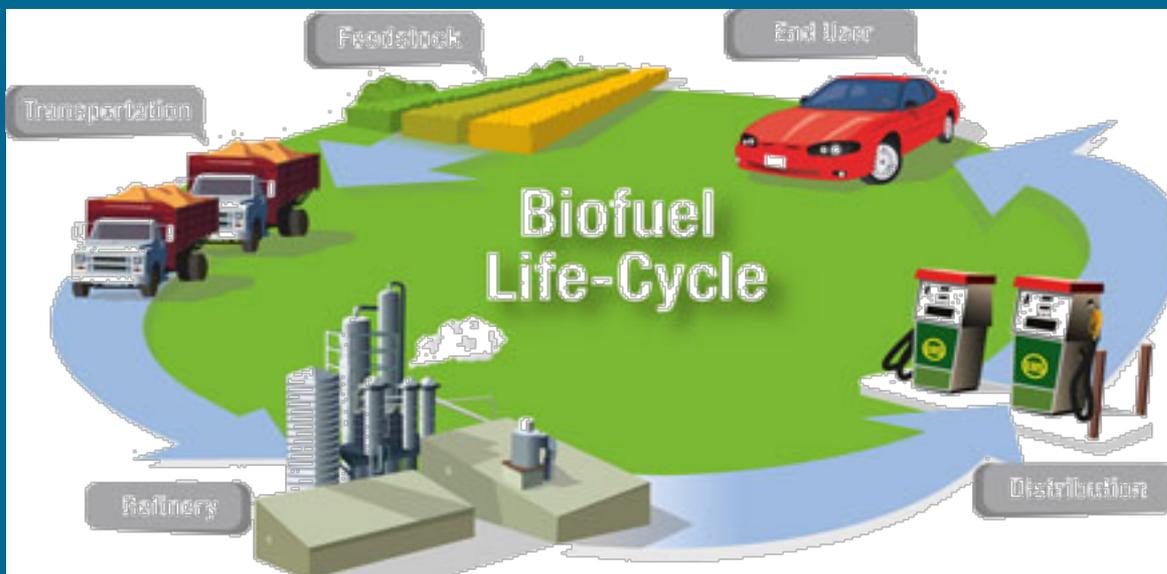
For more information visit:  
[http://www.eere.energy.gov/biomass/integrated\\_biorefineries.html](http://www.eere.energy.gov/biomass/integrated_biorefineries.html)

**The 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



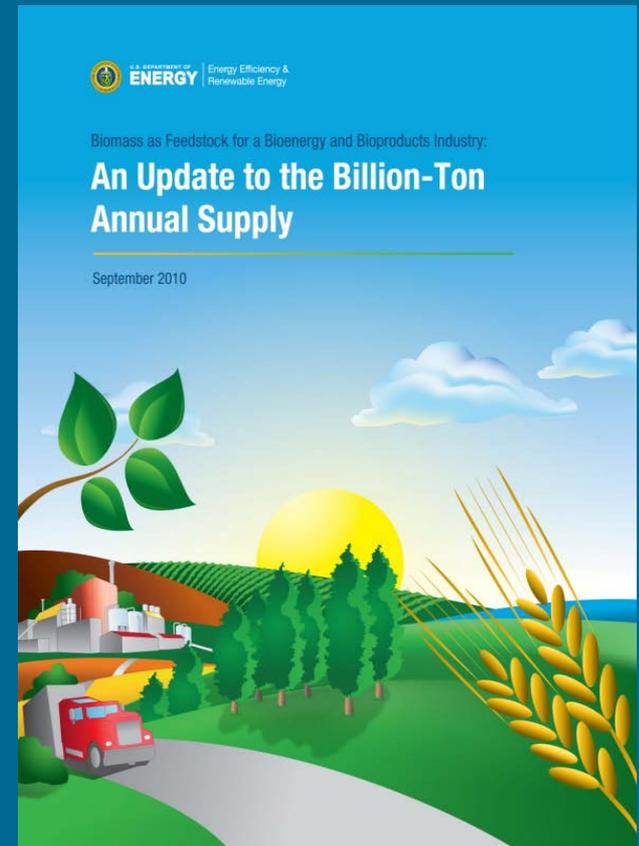
- **State-of-technology assessment conducted by NREL, ORNL, PNNL, SNL, INL**
- **Land-use Change Model Development conducted by NREL, University of Minnesota, ORNL, PNNL, ANL, Purdue University**



- **Well-to-wheels analysis and expansion of Greenhouse Gases Regulated Emissions and Energy Use in Transportation (GREET) model for emerging biofuels production pathways, conducted by ANL**

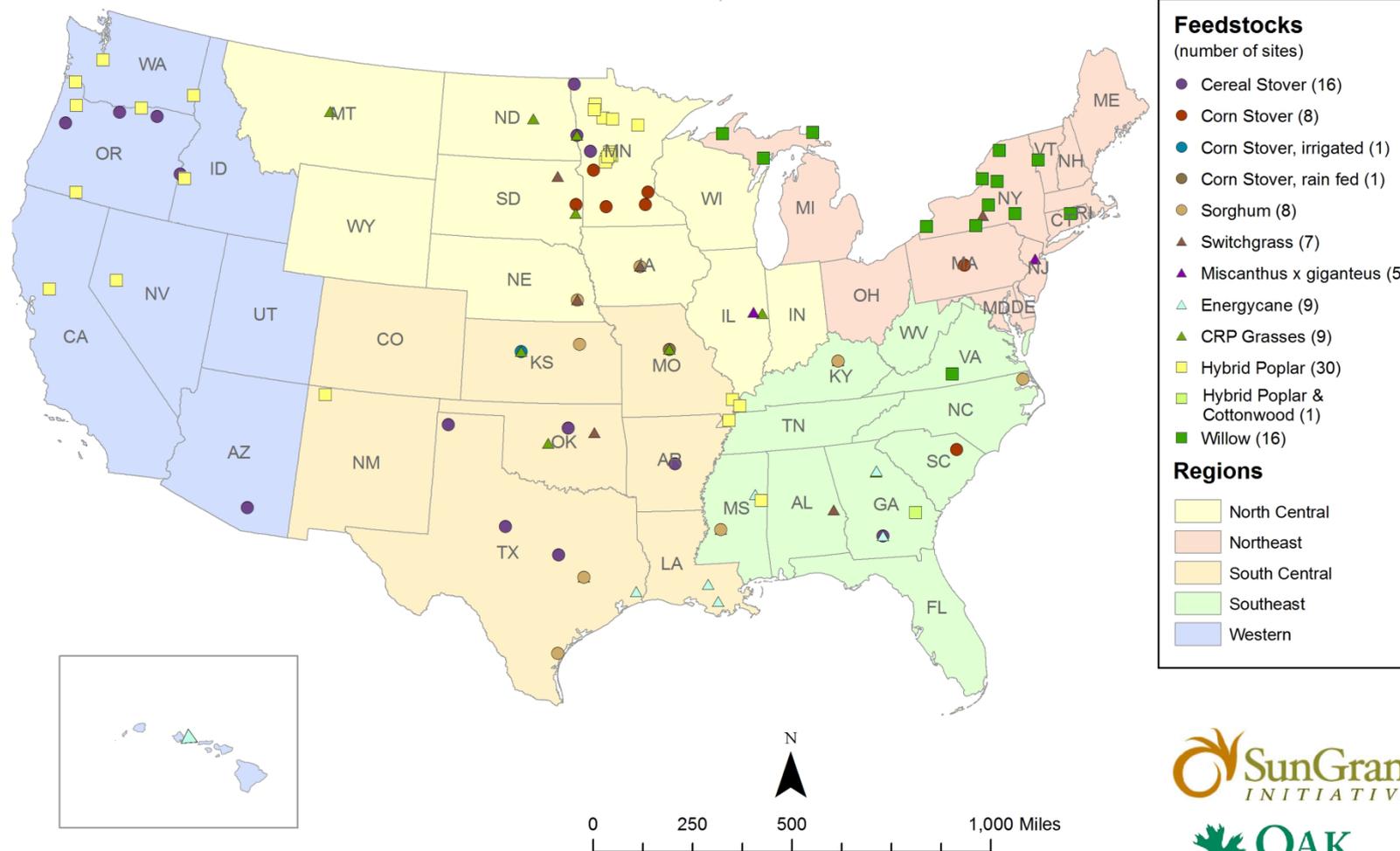
## Update to the 2005 Billion Ton Study

- Baseline and “high yield” scenarios included
- Workshops to gain industry perspective were held in December 2009
- County-level inventory and costs for all major feedstocks
- Used POLYSYS agriculture and new forestry economic models
- Added sustainability criteria
- Data and maps to be available in KDF
- Expected publication in early 2011 (currently undergoing internal DOE review)



### Sun Grant Initiative Regional Feedstock Partnership Field Site Locations

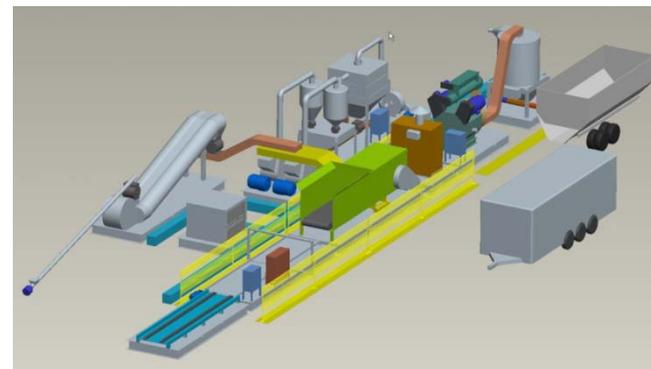
Current as of October 25, 2010



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.

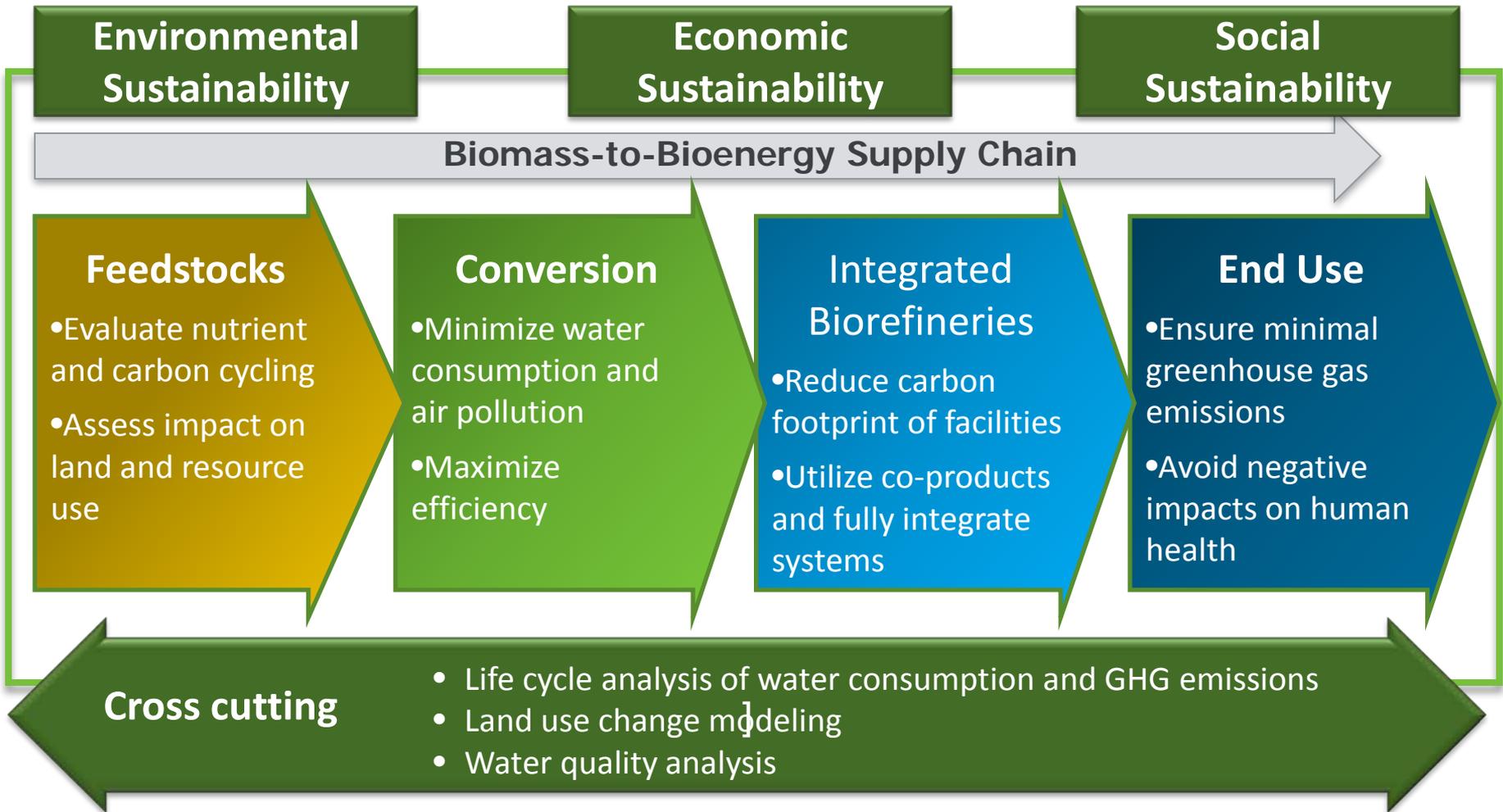


- **INL Deployable Process Development Unit Goals and Objectives**
  - D-PDU will test and validate new equipment and concepts to support OBP's feedstock core R&D, Biochemical and Thermochemical Conversion, and Integrated Biorefineries platforms.
  - Will produce engineered feedstocks that meets commodity-scale performance metrics and advanced conversion characteristics.
  - Anticipated completion in FY2011
  - Deployment will begin in FY2011 on a limited basis
- **Feedstock Logistics Projects will develop systems to handle and deliver high tonnage biomass feedstocks**
  - Agco Corporation of Duluth, GA (up to \$5 million) for agricultural residues
  - Auburn University of Auburn, Alabama (up to \$4.9 million) for woody biomass
  - FDC Enterprises Inc. of Columbus, Ohio (up to \$4.9 million) for energy crops
  - Genera Energy, LLC of Knoxville, Tennessee (up to \$4.9 million) for energy crops
  - The SUNY College of Environmental Science and Forestry of Syracuse, New York (up to \$1.3 million) for woody biomass



# Promoting Sustainable Development of the Biofuels Industry over the Life Cycle of Biofuels

Develop and invest in bioenergy resources, technologies, and systems that enhance the health of our environment, economy, and communities.



- OBP has traditionally collaborated with several other programs and agencies, including VTP, OSC, ARPA-E, USDA, EPA, NSF, DOT, DOD.
- OBP participates in the IPCC, helping the program assess potential impact on GHG emission reductions and anthropomorphic climate change
- OBP supports the IEA's Bioenergy Agreement. Participation on Task 33: "Thermal Gasification of Biomass," and Task 39: "Commercializing 1st- and 2nd-Generation Liquid Biofuels from Biomass", allows the program to maintain its position as a global technology leader at the forefront of emerging technologies
- OBP participates in collaborative projects with partners in Brazil, China, Conservation International, the EU, India, and Israel that assist in accelerating market acceptance, understanding in-direct land use issues, and partnering on technology development

## Sustainability Standards Development

- **Participating in Council for Sustainable Biomass Production: developing principles and standards for bioenergy feedstocks**
- **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**

## North Carolina State University

- Project sites in Mississippi, Alabama, and North Carolina
- Project Objectives:
  - Evaluate impacts on hydrology, water quality, wildlife, plant diversity, soil productivity, carbon budgeting, economics, and safety of biomass feedstock cultivation
  - Investigate biomass production options compatible with forest management

## Purdue University

- Project Objectives:
  - Conduct a sustainability assessment of multiple species of energy crops and drop residue removals within two watersheds representative of conditions in the Upper Midwest
  - Gauge sustainability in relation to soil erosion, biomass yield, and aquatic biodiversity impacts and develop methods to optimize watershed landscapes to improve water quality and associated ecosystem services

## University of Minnesota

- Project Objectives:
  - Analyze the Mississippi River watershed using a set of models: 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
  - 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

## Algae Research

- Halophyte Algae Consortium
- Reduction of Water Intensity or Nutrient Input
- Storage and Transport of Algal Biomass and Biofuel Intermediates
- Integrated Process Improvements; from Pretreatment to Substitutes for Petroleum-based Feedstocks, Products and Fuels
- Non-ethanol products (including fuels, chemicals and intermediates) – 2 - 3 projects with \$20M government investment, with an 80/20 cost share, over 3 years

*For more information, visit:  
[www.fedconnect.net/FedConnect](http://www.fedconnect.net/FedConnect)  
or [www.grants.gov](http://www.grants.gov)*

## Biopower

- Improvements to densify and enhance biomass for efficient combustion
- R&D to improve efficiency levels for cofiring densified biomass with coal in utility boilers

## Biomass Research and Development Initiative

- Annual Joint Solicitation between DOE and USDA -- feedstocks development, biofuels and biobased products development, and biofuels development analysis (FY11 FOA)

## Reverse Auction

- Accelerate deployment and commercialization of biofuels in delivering the first billion gallons in annual cellulosic biofuels production by 2015

- Office of the Biomass Program - <http://www.biomass.energy.gov>
- Biomass Publication Library – <http://www.biomass.energy.gov/publications.html>
- Biofuels Atlas - <http://maps.nrel.gov/bioenergyatlas>
- Energy Empowers - <http://www.energyempowers.gov>
- DOE on Twitter - <http://twitter.com/energy>
- Secretary Chu on Facebook - <http://www.facebook.com/stevenchu>
- EERE Info Center - <http://www1.eere.energy.gov/informationcenter>
- Alternative Fuels Data Center <http://www.eere.energy.gov/afdc/fuels>
- Bioenergy Feedstock Information Network - <http://bioenergy.ornl.gov/>
- Biomass R&D Initiative – <http://www.usbiomassboard.gov/>
- Grant Solicitations - <http://www.grants.gov>
- Office of Science - <http://www.science.doe.gov>
- Loan Guarantee Program Office - <http://www.lgprogram.energy.gov>
- Loan Guarantee Final Rule - <http://www.lgprogram.energy.gov/lgfinalrule.pdf>

*"Developing the next generation of biofuels is key to our effort to end our dependence on foreign oil and address the climate crisis -- while creating millions of new jobs that can't be outsourced. With American investment and ingenuity -- and resources grown right here at home -- we can lead the way toward a new green energy economy."*

**- Secretary of Energy Steven Chu**