BIOENERGY TECHNOLOGIES OFFICE

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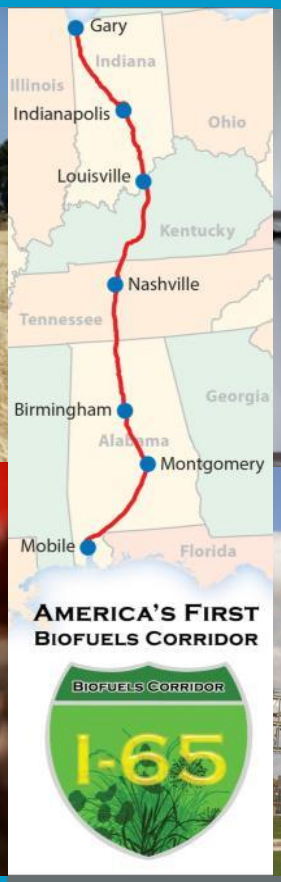
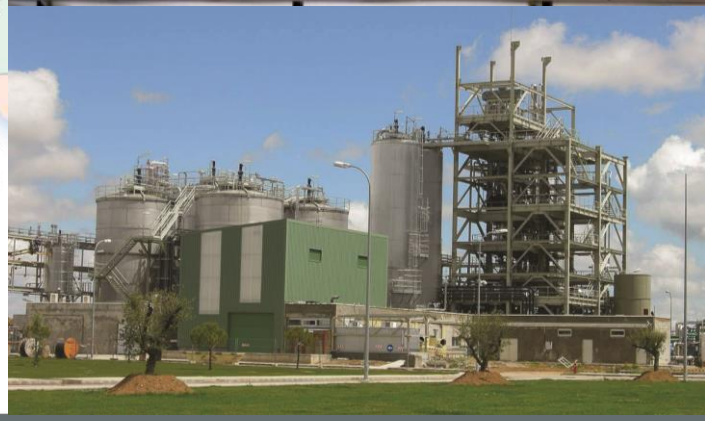




Bioenergy Technologies Office Presentation to:
Oak Ridge National Laboratory

August 20, 2014

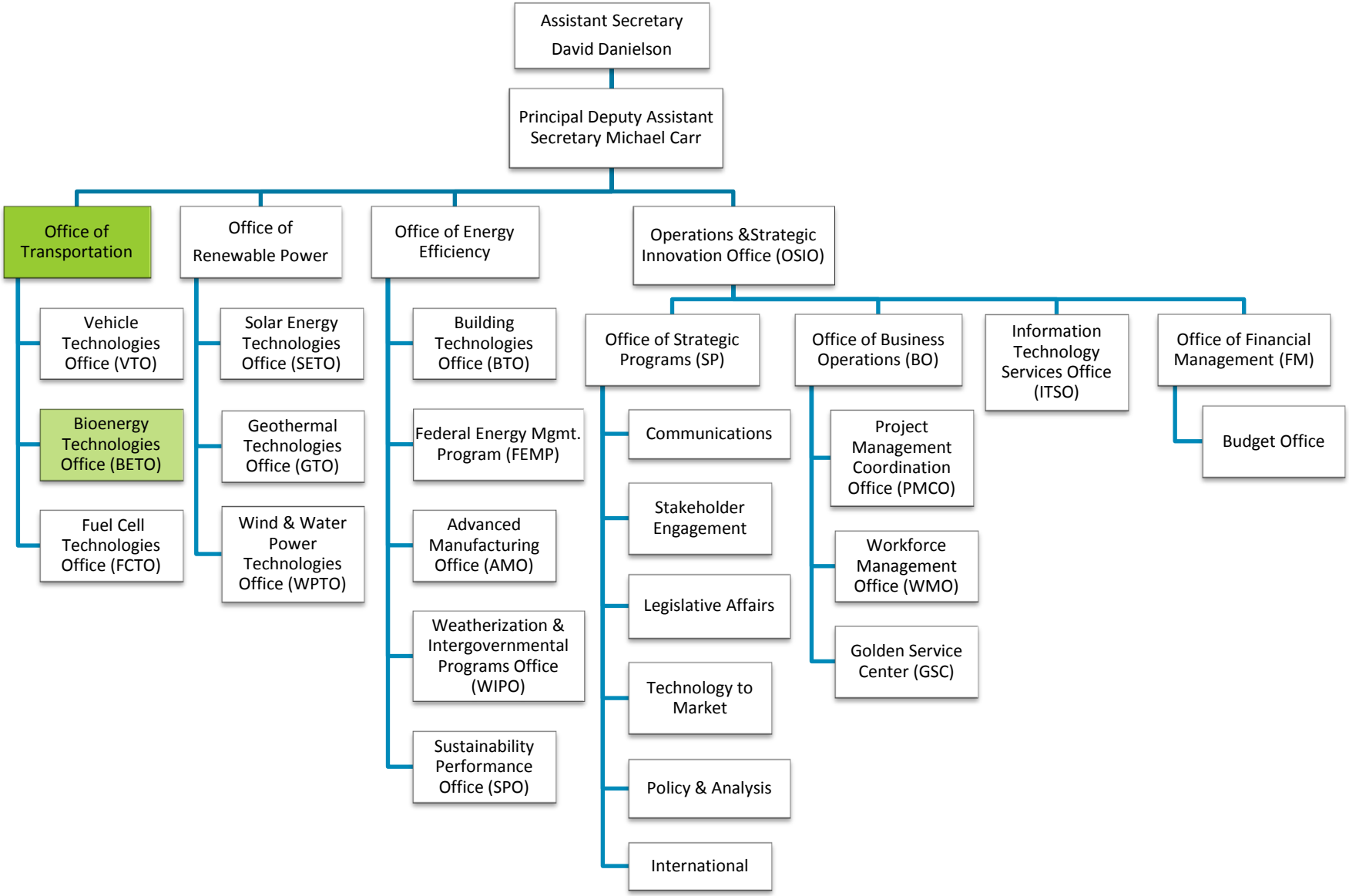
Jonathan L. Male

Director, Bioenergy Technologies Office

Outline

- Overview
- Risk and Innovation
- Accomplishments Tracker & Lab Activities
- Bioenergy In the News
- Budget Overview
- FY14 Activities
- New Initiatives
- Overview of the Bioeconomy
- Funding Opportunities

EERE Reorganization



Bioenergy Technologies Office (BETO)

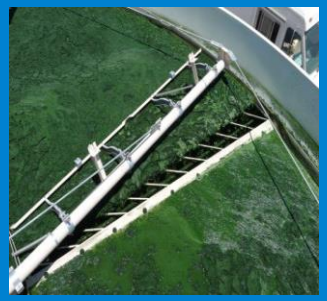
Program Portfolio Management

- Planning
- Systems-Level Analysis
- Performance Validation and Assessment
- MYPP
- Peer Review
- Merit Review
- Quarterly Portfolio Review
- Competitive
- Non-competitive
- Lab Capabilities Matrix

Research, Development, Demonstration, & Market Transformation

Feedstock Supply & Logistics R&D

- Terrestrial
- Algae
- Product Logistics Preprocessing



Conversion R&D

- Biochemical
- Thermochemical
- Deconstruction
- Biointermediate
- Upgrading

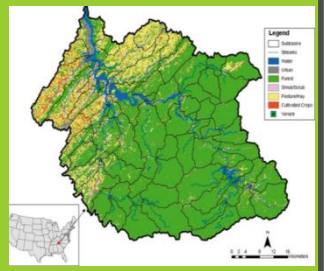
Demonstration & Market Transformation

- Integrated Biorefineries
- Biofuels Distribution Infrastructure

Cross Cutting

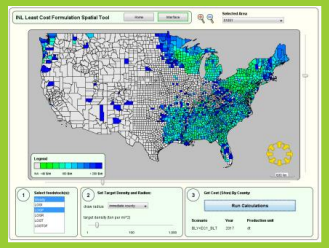
Sustainability

- Sustainability Analysis
- Sustainable System Design



Strategic Analysis

- Technology and Resource Assessment
- Market and Impact Analysis
- Model Development & Data compilation



Strategic Communications

- New Communications Vehicles & Outlets
- Awareness and Support of Office
- Benefits of Bioenergy/Bioproducts

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Mission and Strategic Goal

Mission

Develop and transform our renewable biomass resources into commercially viable, high-performance biofuels, bioproducts, and biopower through targeted research, development, demonstration, and deployment supported through public and private partnerships.

Strategic Goal

Develop commercially viable biomass utilization technologies to enable the sustainable, nationwide production of biofuels that are compatible with today's transportation infrastructure and can displace a share of petroleum-derived fuels to reduce U.S. dependence on oil and encourage the creation of a new domestic bioenergy industry.

Performance Goals

- By 2017, validate at pilot scale at least one technology pathway for hydrocarbon biofuel at a mature modeled price of $3/GGE with GHG emissions reduction of 50% or more compared to petroleum-derived fuel
- By 2022, validate hydrocarbon biofuels production from at least two additional technology pathways at pilot or demonstration scale (>1 ton/day)

The Challenge and The Opportunity

The Challenge

- More than 13 million barrels of fuel are required every day to fuel the U.S. transportation sector.[1]
- 67% of petroleum consumed in the U.S. is in the transportation sector – at a commercial value of $350 billion; only 7% of petroleum consumption is in the chemicals and products sector – at a commercial value of $255 billion.[2]

The Potential

- Biomass is a leading renewable resource with the potential to provide drop-in replacements for the 11 million barrels per day of petroleum fuels consumed in 245 million existing light and heavy duty vehicles on the road and specifically for air transportation needs (additional 1 million barrels/day) utilizing existing infrastructure. [1]
- The United States could produce more than 1 billion tons of sustainable biomass resources that can provide fuel for cars, trucks, and jets; make chemicals; and produce power to supply the grid.
- By 2030, there is the potential to develop terrestrial biomass resources to displace 30% of U.S. current petroleum usage. This does NOT take into account algae.[3]

[1] Energy Information Administration, 2012 Energy Review, U.S. Department of Energy, 2013
[2] Frost, John, Redefining Chemical Manufacture, *Industrial Biotechnology*, Spring 2005 (numbers are assumed to be annual figures for 2004)
[3] Update to the Billion-ton Study, U.S. Department of Energy, 2011

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Assistant Secretary David Danielson's Five Questions

- **HIGH IMPACT:** Is this a high impact problem?
- **ADDITIONALITY:** Will the EERE funding make a large difference relative to what the private sector (or other funding entities) is already doing?
- **OPENNESS:** Have we made sure to focus on the broad problem we are trying to solve and be open to new ideas, new approaches, and new performers?
- **ENDURING U.S. ECONOMIC BENEFIT:** How will this EERE funding result in enduring economic benefit to the United States?
- **PROPER ROLE FOR GOVERNMENT:** Why is what we are doing a proper high impact role of government versus something best left to the private sector to address on its own?

INNOVATION

-- Innovation is central to each question.

Innovation versus Invention

- Innovation is the improvement of a product or process (often in combination) which creates meaningful social/economic impact.

  "The successful translation of new ideas into tangible societal impact.'' — USC Stevens Institute for Innovation

- Innovation often involves:
  - Significant advances along an entire value chain.
  - Market demand and public acceptance.
  - Correct timing – confluence of historical factors/trends.
  - Cross-cutting, interdisciplinary inputs.
  - Longer term and significant impacts on economics and culture

- Invention is merely the starting point for innovation.

Innovation in the Bioenergy Technologies Office

Innovation is one of EERE's distinct value propositions:

- BETO has the unique role of supporting the entire value chain and driving the innovations that will have meaningful national impact over the medium- to long-term horizon.

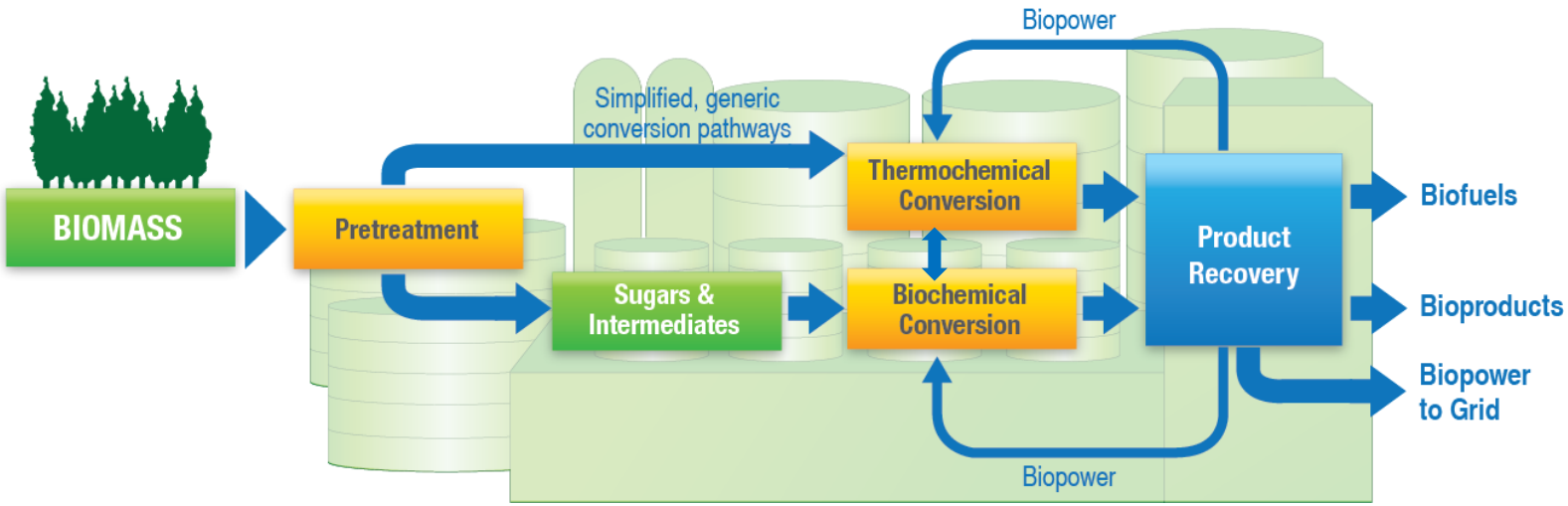
Initial Needs for the Bioenergy Technologies Office:

- Expanded understanding of the supply chain:
  - Interactions with refiners and the petroleum industry.
  - Interactions with OEMs and vehicle infrastructure.
- Innovation Metrics:
  - Impacts/job creation across office's history: IBRs, Sun Grant, Consortia, Labs, etc.
  - Other methodologies to identify and track progress are needed.
- Messaging:
  - Better ways to communicate progress on multiple fronts, not just the "ribbon-cutting" events.

Innovation is Challenging and Involves Risks

De-risking of technologies is central to R&D through demonstration, addressing greater integration and scale:

- BETO is focusing on advancing more technologies, including renewable gasoline, diesel, and jet fuels.
- Technical, construction, operational and financial/market risks.



Biomass Key Challenges	Pretreatment Key Challenges	Conversion Key Challenges	Product Key Challenges
• Reliable supply • Consistent quality • Affordable delivery	• Biomass feeding • Biomass sizing and moisture • Solids handling • Construction materials	• Products Yields • Construction materials • Catalysts • Fermentation organisms	• Separations • Catalytic upgrading • Recycle loops

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Accomplishments Tracker – Innovations Metrics

- **What is it?** The Accomplishments Tracker is an Excel database tracking tool that compiles information on Office-related accomplishments, success stories, publications, patent information, etc.
- **The Ask:** We ask that LRMs add information for their lab pertaining to:
  - Papers, publications, and citations;
  - Patents (applications and granted), and patent licenses;
  - Industry utilizing the technology developed at the Labs; and
  - Interaction with industry: MOUs, CRADAs, WFOs, etc.

For the current Year and the LAST FIVE YEARS

- **Frequency:** A request for updates will go out to all HQ, GO, and Lab staff on a Quarterly basis.
- **The Benefit:** Minimize the burden of information requests for quick turnaround tasks and other updates; maintain a central repository for future outreach efforts; develop methods to track innovation metrics and report on accomplishment statistics to EERE/DOE Leadership.
- **All Labs will continue to receive email updates from BETO/BCS**

New BETO T2M Activities Proposed For FY15

Activity	Recipient	Funding	Total
4 White Papers on Potential T2M Strategic Activities in Key Areas	5 Labs with ≥ $5M from BETO: ANL – Life Cycle Analysis for Emissions, Water and Carbon INL – Feedstocks Logistics NREL/PNNL – Conversion ORNL – Sustainable Biomass Resources	$40K per lab	$200K
Introducing Local Small Businesses to the National Labs	20 competitively selected projects	$20K per project	$400K
Enabling Invention Disclosures to Become Patent Applications	20 competitively selected projects	$10K per project	$200K
Industry/Innovation Day for all the Labs	1-2 competitively selected projects	$100-50K per project	$100K

Seventh Annual Biomass Conference

Biomass 2014: Growing the Future Bioeconomy

July 29-30, 2014, at Washington Convention Center, Washington, D.C.

- Distinguished speakers: Senator Debbie Stabenow (D-MI), Federal Environmental Executive Kate Brandt, and Captain James Goudreau of the U.S. Navy.
- Key industry speakers: LanzaTech Chief Executive Officer Jennifer Holmgren and Paul Woods, Founder, Chairman, Chief Executive Officer and President of Algenol Biofuels Inc.
- Two-day attendance: 580, a 33% increase over Biomass 2013.
- EERE Assistant Secretary David Danielson announced DOE joined Farm to Fly 2.0 to support the development of sustainable biofuels that require no jet engine modifications.
- Deputy Assistant Secretary Reuben Sarkar announced up to $11.3 million for two projects that aim to advance the production of cost-competitive, high-performance carbon fiber material from renewable, non-food-based feedstocks, such as agricultural residues and woody biomass.
  - Award recipients: Southern Research Institute (SRI) in Birmingham, Alabama, and the National Renewable Energy Laboratory (NREL) in Golden, Colorado.

Green Racing with Cellulosic Ethanol and Renewable Diesel

Green Racing

- On Friday, March 14, 2014, DOE officials participated in a green racing event at Sebring International Raceway in Florida.
- NASCAR's International Motor Sports Association uses its Green Racing series to help promote and develop renewable fuels for consumers.
- INEOS Bioenergy provided cellulosic ethanol from its DOE-supported, Vero Beach, Florida biorefinery.

INEOS Biorefinery, Vero Beach, FL

Publicity about Corn Residues

The environmental impacts of corn stover have recently received a great deal of media attention, arising from a journal article, "*Biofuels from crop residue can reduce soil carbon and increase CO_2 emissions*," published in the journal, *Nature Climate Change*:

- "Study casts doubt on climate benefit of biofuels from corn residue," *University of Nebraska Press Release*
- "Biofuels Worse than Gasoline" *E&E Publishing*
- "Ethanol made from corn stalks spews more CO_2 than gasoline," *MSN News*
- "Gasoline greener than biofuels?," *Fox News*

The research was funded via a DOE-supported Congressionally Directed Project with the University of Nebraska-Lincoln.

BETO Response – Publicity about Corn Residue

"First they ignore you, then they laugh at you, then they fight you, then you win."
— Mahatma Gandhi

- The University of Nebraska press release states that using corn stover to produce biofuels reduces soil carbon and generates more GHGs than gasoline. This is **not** what the *Nature Climate Change* article says.
- The original scientific article says that under the assumptions and modeling approach used, using corn stover to produce biofuels **can** reduce soil carbon and generate more GHGs than gasoline. The study recognizes that GHG emissions vary depending on soil type, fertilization rates, irrigation rate, tillage practice, the stover removal rate, as well as additional factors.
- The study raises several important issues regarding the impact of residue removal on soil carbon, and these issues indeed warrant continued research and improved understanding.
- DOE is supporting several independent, but coordinated efforts to more accurately model, measure, and further enhance the GHG reduction potential of biofuels from agricultural residues, like corn stover and dedicated energy feedstocks (GREET at ANL and LEAF at INL).
- BETO is coordinating a response with DOE Public Affairs and working with researchers at the University of California, Berkeley, to provide a balanced response to the article.

The article is stimulating a lot of good discussion. It illustrates how important sustainability analysis, assumptions, and communications are.

Bioenergy Technologies – FY 2015 Budget Request

Subprograms ($000's)		FY 13 Enacted	FY 2014 Enacted	FY 2015 Request
Feedstocks		**$47,359**	**46,972**	**30,500**
	Feedstock Production	$4,847	4,997	4,000
	Feedstock Logistics	$13,294	11,993	12,500
	Algae and Advanced Feedstocks	$29,128	29,982	14,000
Conversion		**$75,140**	**101,384**	**100,500**
Demonstration and Market Transformation (formerly Demonstration and Deployment)		**$43,630**	**64,790**	**105,000**
	Integrated Biorefineries	$25,733	19,790	35,000
	Biofuels Compatibility/Infrastructure	$6,500	-	10,000
	Defense Production Act (DPA)	-	45,000	60,000
	Other Projects (FY13)	$11,397	-	-
Strategic Analysis and Cross-cutting Sustainability		**$14,939**	**12,146**	**11,000**
	Strategic Analysis	$9,000	6,080	5,500
	Cross-cutting Sustainability	$3,939	6,066	5,500
	Systems Integration	$2,000	-	-
Cookstoves		**$4,122**	**1,998**	**-**
NREL Site-wide Facility Support		**$0**	**5,000**	**6,200**
Total		**$185,190**	**232,290**	**253,200**

Feedstock Accomplishments

Sun Grant Regional Feedstock Partnership

- Network of land-grant universities working in partnership with DOE, industry, national labs, and USDA to establish over 100 field trials across the country to determine biomass productivity baselines of energy crops.
- Maps of crop productivity contribute data to Oak Ridge National Laboratory's Bioenergy Knowledge Discovery Framework (KDF). https://www.bioenergykdf.net/

Advanced Logistical Systems and Harvesting Technologies

- AGCO (with partners) received an award in 2009 to demonstrate an efficient harvesting and transport system for corn stover and other herbaceous feedstocks.
- As a result of this project, several technologies were developed, including:
  - Single pass combo Combine-Baler (which increased bale density by 15%).
  - High MOG (Material Other than Grain) Combine.

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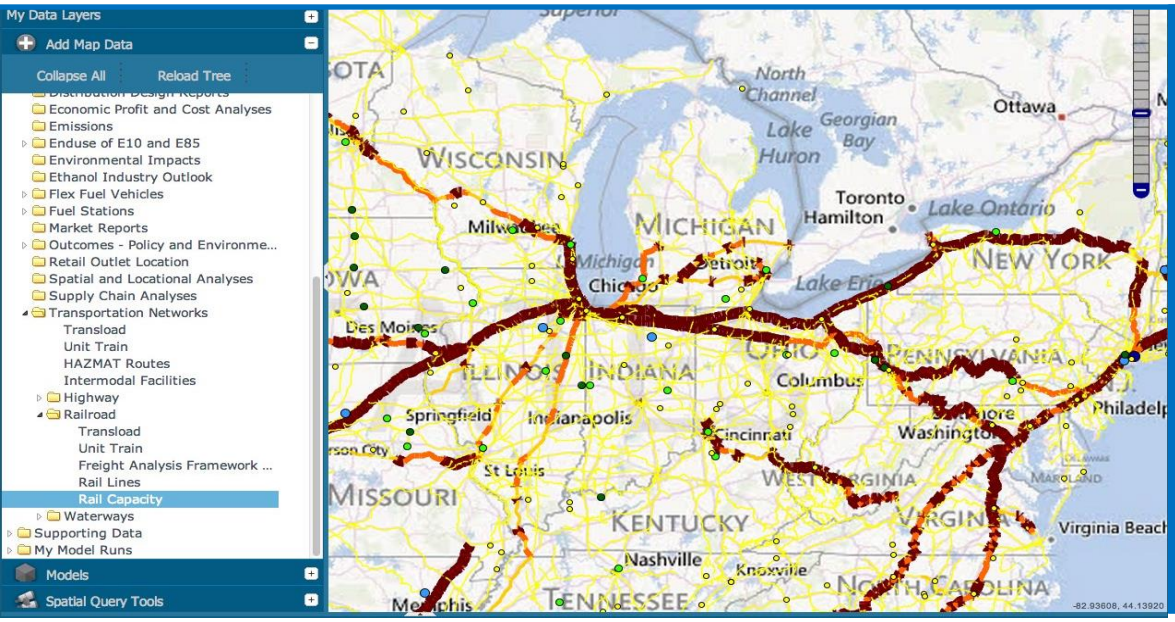
Bioenergy Knowledge Discovery Framework

- The Bioenergy KDF is a collaborative decision-support environment designed to foster bioenergy research.
- KDF integrates data, models, and visualization tools from across government, private industry, and academia.
  - Online hub for bioenergy research products (publications, data, web resources, etc.)
  - GIS visualization capabilities
  - Interactive data analysis

BIOENERGY
KNOWLEDGE DISCOVERY FRAMEWORK
U.S. DEPARTMENT OF ENERGY



KNOWLEDGE DISCOVERY

Study at the intersection of computer and data sciences which enhances decision making through the analysis of dynamic databases of information and patterns

FY14 Feedstock Supply & Logistics Activities

Interface & Production ($5M)

Understand the range of biomass quality attributes across geography and genetics; validate resource assessment projections (i.e., volume) using on-the-ground yield data.

- Biomass R&D Resource Library (>60,000 samples).
- At least five years of production data for several perennial and annual species available through the Regional Feedstock Partnership Program (Sun Grant Universities, USDA ARS, and national laboratories).
  - Cornell University, Oklahoma State University, Oregon State University, South Dakota State University, and the University of Tennessee.

Expand integration of environmental sustainability and feedstock quality criteria into biomass supply assessments for herbaceous and woody biomass.

- In partnership with Analysis and Sustainability, two workshops focusing on Incorporating Bioenergy into Sustainable Landscape Designs will be conducted to inform future Multi-Year Program Planning.

Logistics ($12M)

Reduce risks associated with supply-security and price volatility.

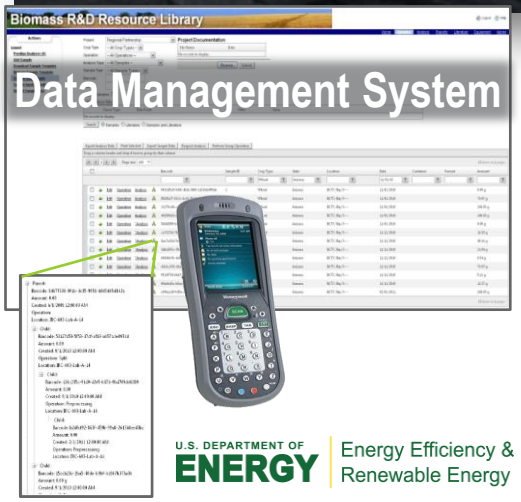
- Initiate blending and formulation strategies that upgrade feedstock quality to meet biorefinery in-feed specifications.

Establish path forward for meeting cost, quality, and volume targets; regularly gauge progress

- Delivering techno-economic analysis (TEA) showing pathway to achieve $80/dry ton for woody feedstocks by 2017.
- Annual State of Technology and Resource Assessment updates.

Reducing costs through increasing efficiencies and reducing losses through partnerships with Original Equipment Manufacturers (OEMs) (e.g., AGCO, TigerCat, Case New Holland, etc.)

- Alternate(s) from second Advanced Logistics FOA will be awarded.



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Demonstration Portfolio – Overview

- The Demonstration & Deployment Program manages a diverse portfolio of projects focused on the scale-up of biofuel production technologies from pilot- to demonstration- to pioneer-scale.
- Of the 33 biorefineries that have received funding through BETO, 3 have been completed, 5 are in close-out, and 5 have been either terminated or withdrawn.
- The remaining 20 biorefineries are considered active and utilize a broad spectrum of feedstocks and conversion techniques.

Map of BETO-funded Projects

Note: The four I-Pilot Projects do not appear on this map

Pioneer

Demonstration

Pilot

For more information visit:
www.energy.gov/eere/bioenergy/integrated-biorefineries

Demonstration Portfolio – Selected Projects

Abengoa Bioenergy, Hugoton, KS

- Expected to produce 25 million gallons per year of ethanol and 18 megawatts of green electricity at full capacity.
- Anticipated job creation: 70 during operation and >1,100 during peak construction.
- Energy self-sufficient – creates enough heat and power to support itself.
- Mechanical completion is scheduled for July 2014; Commissioning for CY2014.
- DOE Share = $100M (EERE) and $135M DOE loan guarantee; Equity: >$400 M.

POET-DSM Project LIBERTY, Emmetsburg, IA

- Expected to produce 20 million gallons per year of cellulosic ethanol at full capacity.
- Anticipated job creation: 35 during operation and >200 during peak construction
- Demonstrates commercial viability of lignocellulose-to-ethanol process.
- Major construction began in November 2012, start of commercial production is scheduled for Q4 FY2014.
- DOE Share = $100M; Cost share = $130M; joint venture with DSM.

INEOS, Vero Beach, FL

- Expected to produce 8 million gallons per year of cellulosic ethanol and 6 MW of power from wood and vegetative waste.
- DOE Share = $50M; Cost share = $82M.
- Created 400 construction jobs; 65 permanent jobs are expected for operation.
- Major construction began in October 2010, commissioning was completed in June 2013, and the facility initiated commercial production of cellulosic ethanol in July 2013.
- First commercial production of cellulosic ethanol in the U.S.

Demonstration Portfolio – Selected Projects

American Process, Inc., Alpena, MI

- Feedstock: waste hydrolyzate stream from hardboard manufacturing process (mixed northern hardwood and aspen).
- Capacity: 894,200 gallons/year of cellulosic ethanol (from C6 sugars) and 696,000 gallons/year of aqueous potassium acetate (De-Icer) (from C5 sugars).
- Accomplishments to date:
  - First batch of pure cellulosic ethanol produced in early FY14
- DOE share: $22,481,523; Cost share: $8,459,327

Haldor Topsoe, Inc., Des Plaines, IL

- Thermochemical process for the conversion of wood waste and woody biomass to gasoline.
- Expected to produce approximately 345,000 gal/year.
- Accomplishments to Date:
  - Testing shows acceptable ranges for gasoline blendstock
  - Emission level was “substantially similar” to conventional gasoline
- DOE share: $25,000,000; Cost share: $9,388,778
- Collaborative agreements with Gas Technology Institute, Andritz-Carbona, UPM-Kymmene, and Phillips 66.

Defense Production Act (DPA) Initiative

In July 2011, the Secretaries of Agriculture, Energy, and Navy signed a Memorandum of Understanding to commit $510M ($170M from each agency) to produce hydrocarbon jet and diesel biofuels in the near term. This initiative sought to achieve:

- Multiple, commercial-scale integrated biorefineries
- Cost-competitive biofuel with conventional petroleum (w/o subsidies).
- Domestically produced fuels from non-food feedstocks.
- Drop-in, fully compatible, MILSPEC fuels (F-76, JP-5, JP8).
- Help meet the Navy's demand for 1.26 billion gallons of fuel per year.
- Contribute to Navy's goal of launching "Great Green Fleet" in 2016.
- Demonstration of the production and use of more than 100 million gallons per year will dramatically reduce risk for drop-in biofuels production and adoption.

DOE has a $45M appropriation for DPA in FY14

The four projects selected under DPA are:

Company	Location	Feedstock	Conversion Pathway	Capacity (MMgpy)
Emerald Biofuels	Port Arthur, TX	Fats, Oils, and Greases	Hydroprocessed Esters and Fatty Acids (HEFA)	94.0
Natures BioReserve™	South Sioux City, NE	Fats, Oils, and Greases	Hydroprocessed Esters and Fatty Acids (HEFA)	65.8
Fulcrum Bioenergy	McCarran, NV	Municipal Solid Waste	Gasification – Fischer Tröpsch (FT)	17.0
Red Rock Biofuels	Lakeview, OR	Woody Biomass	Gasification – Fischer Tröpsch (FT)	16.0

Aviation Biofuels: Accomplishments/Milestones

The Commercial Alternative Aviation Fuels Initiative (CAAFI) has set a goal of 1 billion gallons per year of alternative jet fuel by 2018 (the commercial aviation market currently 20 billion gallons per year), and DOE is playing an active role by providing technical expertise in various high-level aviation activities, including:

- Becoming the latest partner agency for Farm to Fly 2.0, joining the aviation sector, as well as Department of Agriculture (USDA) and Federal Aviation Administration (FAA) in an agreement to enable commercially viable and sustainable jet fuels in the U.S.
- Serving on CAAFI Steering Group and as a co-host with the FAA for the Aviation Biofuels Techno-Economic Analysis Workshop, November 2012.
- Working with FAA to develop a National Alternative Jet Fuels Strategy Roadmap (Roadmap expected in December 2014).
- Supporting FAA's newly established Center of Excellence in alternative jet fuels led by Washington State University/MIT, and supported by National Renewable Energy Laboratory (NREL) and Pacific Northwest National Laboratory (PNNL).
- Increasing technical work at National Laboratories to enable achievement of alternative jet fuel goals.

What is the Bioeconomy?

"The biological sciences are adding value to a host of products and services, producing what some have labelled the "bioeconomy." From a broad economic perspective, the bioeconomy refers to the set of economic activities relating to the invention, development, production and use of biological products and processes."

OECD: The Bioeconomy to 2030: Designing a Policy Agenda, 2009

"A bioeconomy is one based on the use of research and innovation in the biological sciences to create economic activity and public benefit."

White House Bioeconomy Blueprint, 2012

"The U.S. is a world leader in technology and agricultural prowess, which puts it in a powerful position to capitalize on the vast potential of bio-based alternatives to petrochemicals. The potential markets are huge, given the importance of petrochemicals in industrial economies."

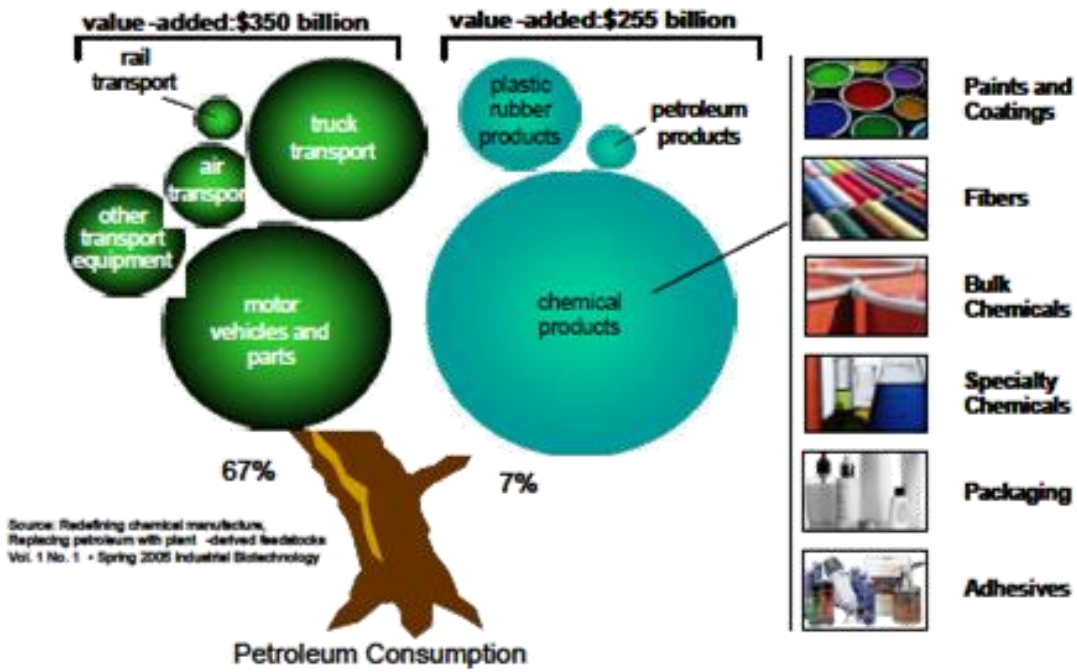
Unleashing the Power of the Bio-economy, 2013

For the purpose of this presentation, the "Bioeconomy" is the economic, environmental, and social activities associated with the production, harvest, transport, conversion, and use of biomass for biopower, bioproducts, and biofuels.

Bioproducts to Enable the Bioeconomy

Two areas not being addressed by industry that could transform the bioproducts market from ***niche to necessity:***

- Bio-based products can be molecular replacements for petroleum-based chemicals and products.
- BETO's partner Myriant is focused on producing renewable succinic acid from biomass in Louisiana.
- Enabling the use of lignin-based carbon (a 200 million ton resource that does not compete with food) enhances the value of carbon that is currently burned for heat and power.
- Utilization of carbon-fiber and development of bio-products is a key component of DOE's Clean Energy Manufacturing Initiative (CEMI).
- NREL recently published a new article in the proceedings of the National Academy of Sciences on lignin valorization - *Lignin Valorization Through Integrated Biological Funneling and Chemical Catalysis.*



Frost, J. W. Industrial Biotechnology (2005), 1, 23-24.

Bioproducts that enable biofuels through early market adoption to generate cash flows, learn smaller scale bioenergy logistics, and enhance the total margins of the biorefinery all while enhancing environmentally beneficial utilization of carbon.

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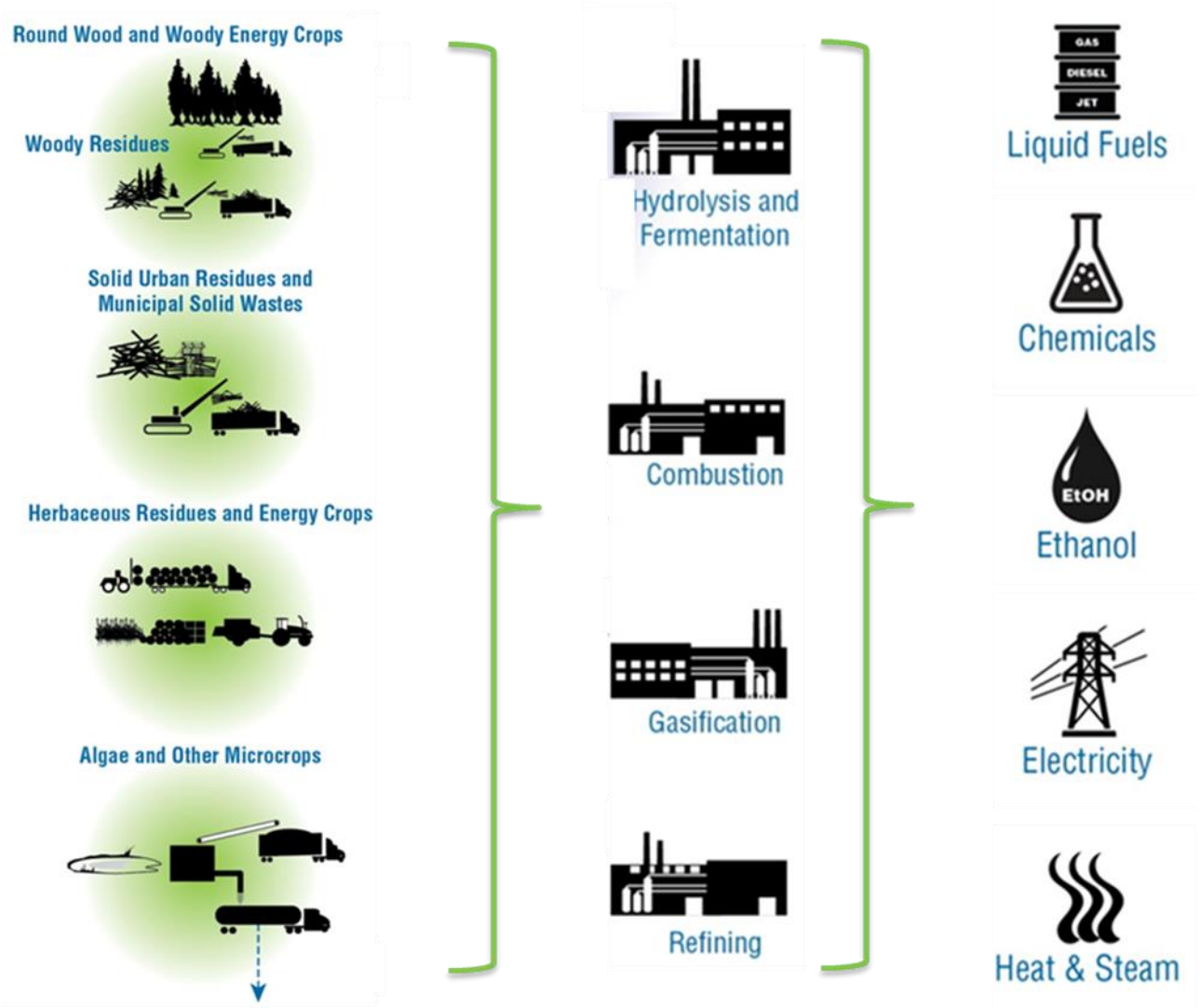
The Bioeconomy Concept



- Revenue and economic growth
- Broad spectrum of new jobs
- Rural development
- Advanced technologies and manufacturing
- Reduced emissions and Environmental Sustainability
- Export potential of technology and products
- Positive societal changes
- Investments and new infrastructure

Why Expand the Bioeconomy?

Major Motivations

- Energy security
- Environmental quality
- Economic opportunity
  - U.S. job creation
  - U.S. revenues

Other Reasons

- Reinvest in our "working lands" heritage
  - Bring marginal agricultural soils and land back into production
  - Provide market incentives for forest restoration and management
  - Keep working farms and woodlots productive
  - Support the rural community
- Provide additional environmental benefits:
  - Give farmers more conservation options
  - Improve ecological systems across the landscape
  - Restore forests

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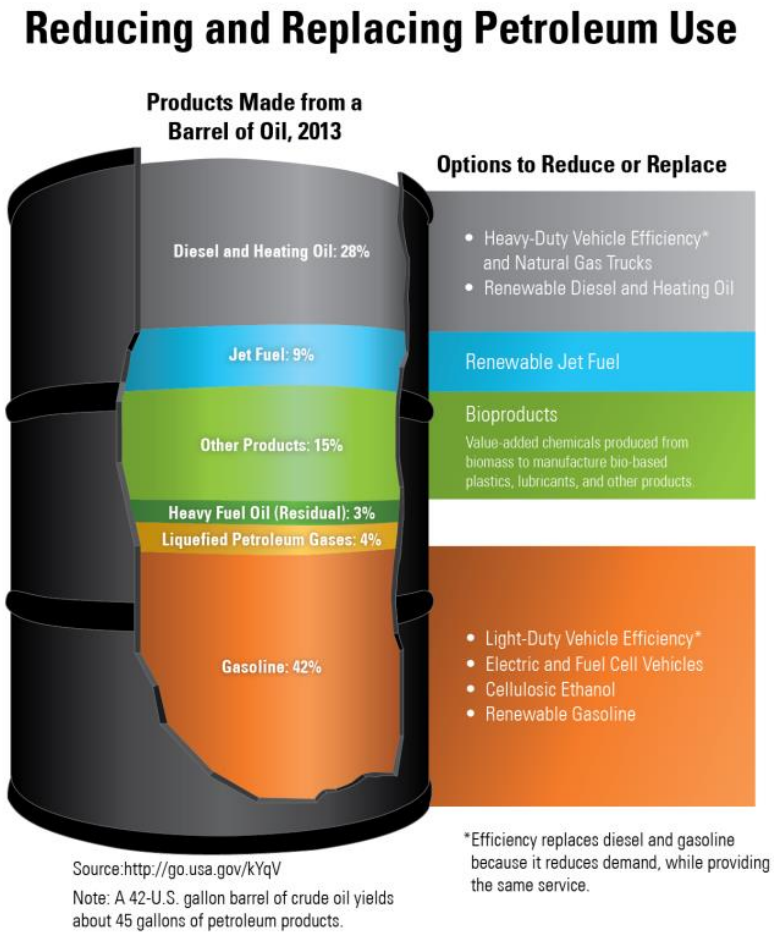
The Baseline Bioeconomy

Biofuels
- Ethanol based
- Policy driven

Biopower
- Mostly wood wastes and wood
- Historically industrial heat, steam, and electricity

Bioproducts
- Initially starch-based, transitioning to cellulosic

Bioeconomy Parameter	Current
Biomass Utilization	200 million DMT
Biopower Production (EIA)	30 billion kWh
Biofuels Production	15 billion gallons
Bioproducts Production	2.5 billion pounds
Direct Revenue	$40 billion
Total (Direct + Indirect) Revenue	$100 billion
Direct Jobs	150,000
Total (Direct + Indirect) Jobs	480,000
Estimated CO_2e Reduction	35 million tons



Estimates are 2011 and based on various assumptions and sources that may not be consistent with other published sources.

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Commitment to Sustainability

Sustainability Strategic Goal: to understand and promote the positive economic, social, and environmental effects and reduce the potential negative impacts of bioenergy production activities.

Sustainability Project Highlights

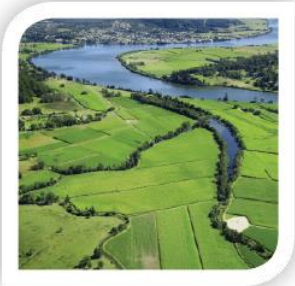
Climate Change and Air Quality

Analyzing biofuel pathways to quantify progress towards reducing lifecycle greenhouse gases, regulated emissions, and fossil energy use.

Soil Quality

Developing strategies and tools for producing biomass feedstocks while maintaining or enhancing soil quality.

Land Use and Productivity



Advancing landscape design approaches that increase biomass production while maintaining or enhancing ecosystem services and food, feed, and fiber production.

Water Quantity and Quality

Assessing the water resource use and water quality of bioenergy production, and investigating opportunities for bioenergy crops to improve water quality.

Biological Diversity

Investigating relationships between bioenergy crops and biodiversity, and engaging with diverse experts to understand and promote practices that conserve wildlife and biodiversity.

Efforts also include evaluating sustainability indicators across the bioenergy supply chain, contributing to global scientific dialogues on bioenergy sustainability, and engaging with international organizations to understand and promote more sustainable outcomes.

Useful Links

- BETO News and Announcements: http://www1.eere.energy.gov/bioenergy/news.html
- 2013 Peer Review: http://www1.eere.energy.gov/biomass/peer_review2013.html
- Biomass 2014: http://www.energy.gov/eere/bioenergy/biomass-2014-growing-future-bioeconomy
- Bioenergy KDF: https://www.bioenergykdf.net/
- EERE Funding Opportunity Exchange: https://eere-exchange.energy.gov/

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2015