BIOENERGY TECHNOLOGIES OFFICE

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

NASEO

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Outline

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III. Demonstration Portfolio
IV. New Initiatives
V. FY15 Awards and Funding Opportunities
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The Challenge and The Opportunity

The Challenge

- More than 13 million barrels of petroleum based fuels are required daily for the U.S. transportation sector – 8.5 million barrels of gasoline for the motor vehicles alone.[1]
- 67% of U.S. petroleum consumption is in the transportation sector ($350 billion) [2]
- 7% of U.S. petroleum consumption is for chemicals and products sector ($255 billion) [2]
  - Relative value is much higher for chemicals and products.

The Opportunity

- Biomass is the leading renewable resource that can provide drop-in fuel replacements utilizing existing infrastructure for light and heavy duty vehicles and air transportation[1]
- More than 1 billion tons of sustainable biomass could be produced in the U.S. which can provide fuel for vehicles and aviation, make chemicals, and produce power for the grid.
- 30% of U.S. petroleum usage could be displaced using terrestrial biomass by 2030 [3]
  - This does NOT take into account algae
- High value chemicals and products from biomass can stimulate biofuels production.

[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

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

BETO's Core Focus Areas

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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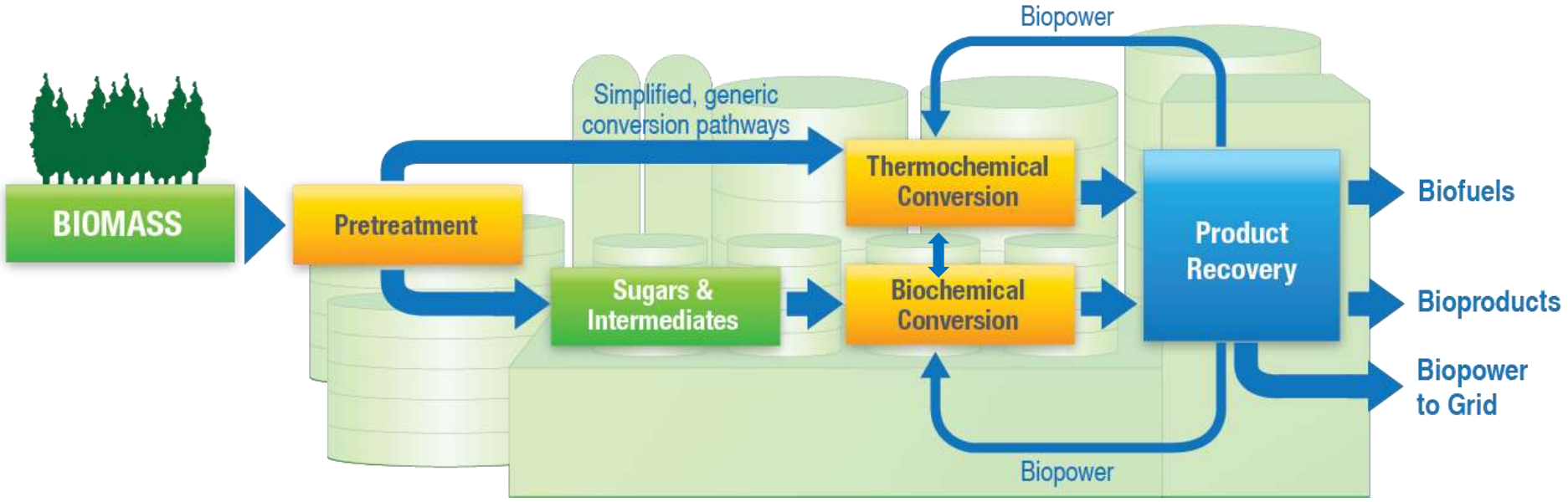
Key Challenge for Innovation Involves Lowering Risks

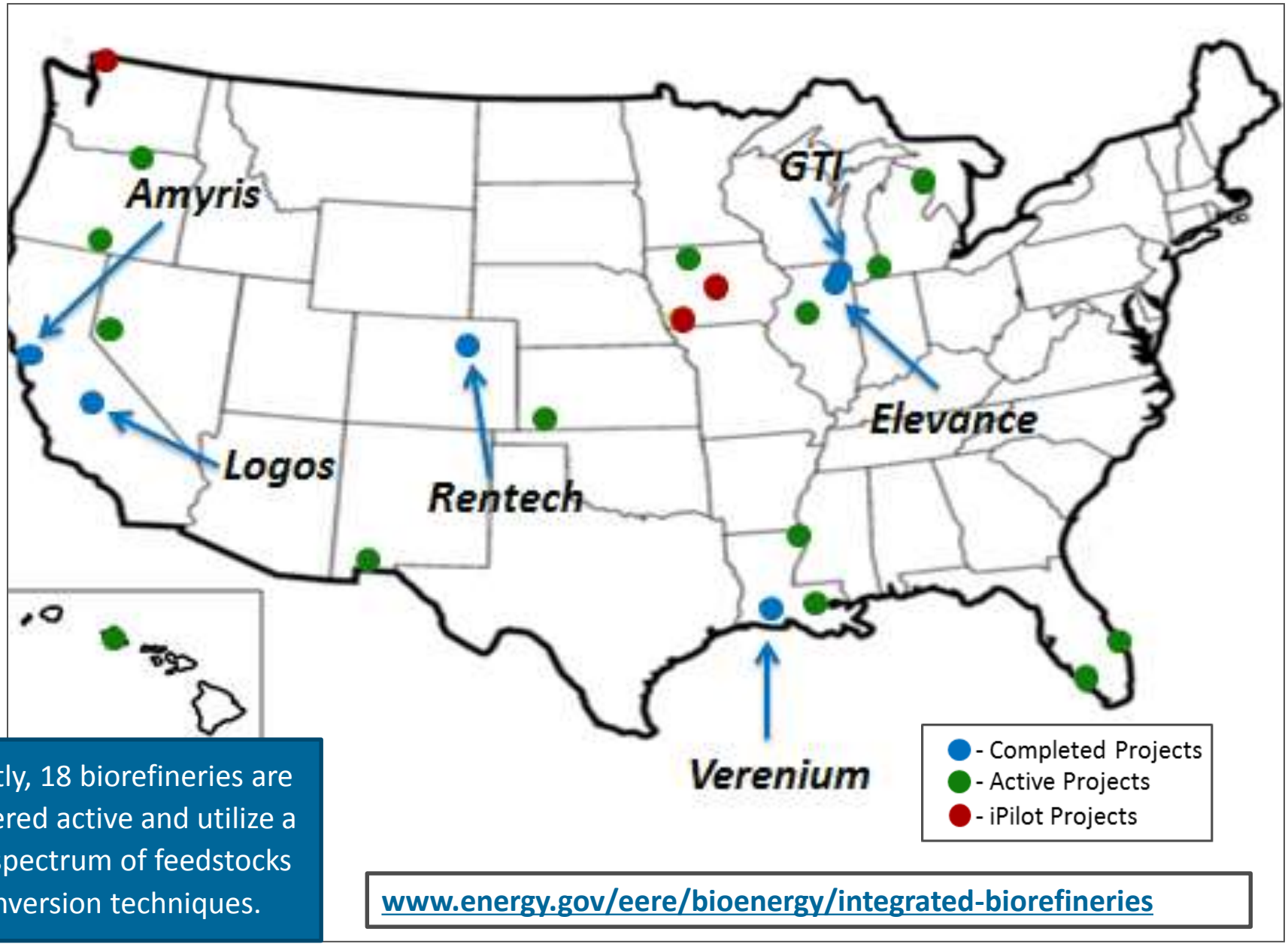
De-risking technologies is central to R&D through demonstration that addresses greater integration and scale:

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



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

Demonstration Portfolio (Active and Completed Projects)



Currently, 18 biorefineries are considered active and utilize a broad spectrum of feedstocks and conversion techniques.

www.energy.gov/eere/bioenergy/integrated-biorefineries

Major Commercial-scale Cellulosic Ethanol Projects

POET-DSM's Project LIBERTY

- Grand opening on September 3, 2014, in Emmetsburg, Iowa.
- Once operating at full, commercial-scale, the plant will produce 25 million gallons of cellulosic ethanol per year – enough to avoid approximately 210,000 tons of CO_2 emissions annually.
- Developed with the support of approximately $100 million in investments and research from DOE.

Abengoa Bioenergy Biomass of Kansas

- Grand opening on October 17, 2014, in Hugoton, Kansas.
- The plant will produce cellulosic ethanol from non-edible corn stalks, stems, and leaves harvested within a 50-mile radius of the plant.

Defense Production Act (DPA) Initiative

In 2011, DOE, USDA, and the Navy signed an MOU for $510 M to build commercial-scale biorefineries to produce:

- Cost-competitive (w/o subsidies)
- Drop-in fuels for military applications
- From non-food biomass feedstocks

In September 2014, 3 projects were selected:

Company	Location	Feedstock	Capacity	Groundbreaking	Off-Take Agreements
EMERALD BIOFUELS	Gulf Coast	Fats and Greases	82.0 MM g/y	TBA	TBD
Fulcrum BIOENERGY	McCarran, NV	MSW	10.0 MM g/y	Spring/Summer of 2015	CATHAY PACIFIC
Red Rock Biofuels	Lakeview, OR	Woody Biomass	12.0 MM g/y	TBA	SOUTHWEST AIRLINES

Aviation Biofuels

DOE is actively engaged in the commercialization of bio-based jet fuels, by:

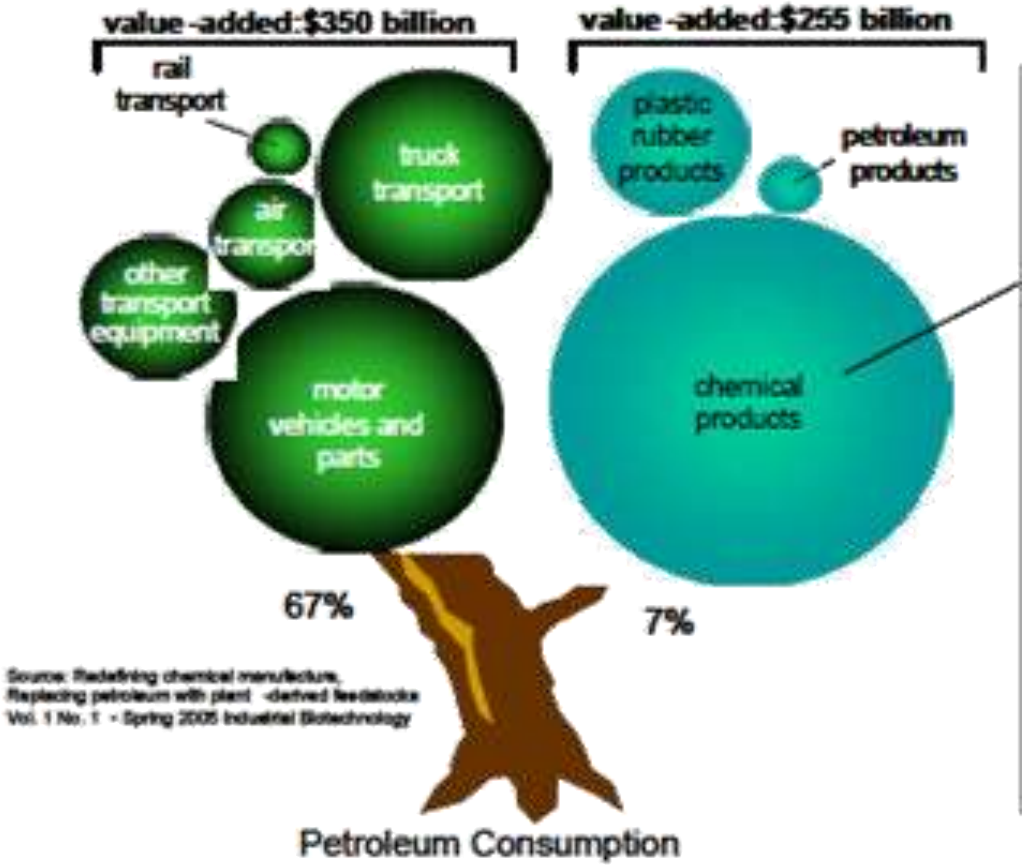
- Joining USDA and the FAA to support Farm-to-Fly 2.0
- Working with the Commercial Alternative Aviation Fuels Initiative to produce 1B gallons of renewable aviation biofuel by 2018
- Supporting the FAA's Center for Excellence in aviation jet fuels, with MIT, NREL, PNNL, WSU, and others

CAAFI®

Bioproducts to Enable the Bioeconomy

Bioproducts are moving from niche to necessity

- Bioproducts can replace petroleum-based chemicals and products
- Bioproducts make biofuels more economically viable and enhance environmental benefits
- Carbon-fiber and bioproducts are part of DOE's Clean Energy Manufacturing Initiative (CEMI)



Bioproducts enhance the economics of biofuel production

FY15 Funding Opportunities and Awards

Upcoming Award Announcements

- **Targeted Algal Biofuels and Bioproducts FOA**
  - The FOA seeks to reduce the cost of algal biofuels from $7 per gallon – the current projected state of technology for 2019 – to less than $5 per gallon algal biofuel by 2019.
  - **STATUS:** Awards anticipated June 2015
- **Landscape Design for Sustainable Bioenergy Systems FOA**
  - DOE announced up to $14 million to support landscape design approaches that enhance the environmental and socio-economic sustainability of cellulosic bioenergy through the improvement of feedstock production and logistics systems.
  - **STATUS:** Awards anticipated May 2015

Potential Funding Opportunities

- Incubator II
  - Up to 5 awards will be selected to support off-roadmap technologies to accelerate an advanced biofuels industry.
  - **STATUS:** Awards anticipated September 2015
- USDA/DOE Biomass Research and Development Initiative (BRDI)
- Manufacturing Biofuels at Increasing Scale
- Fuel Testing and Engine Development for High Octane Fuels

FY 2016 Priority Activities

- **Algae:** Pursue new research in advanced biology and carbon dioxide utilization to address yield, productivity, and integration of downstream logistics at the pre-pilot scale.
- **Feedstock Supply:** Focus on feedstock supply and logistics technologies to help meet biomass feedstock price targets of $80/Dry Matter Ton in 2017.
- **Conversion:** Select and complete preparation of at least two pathways for validation at integrated bench or pilot scale in FY 2017 of modeled mature $3/gge gasoline/diesel blendstock price and progress toward FY 2022 price goals ($3/gge).
- **New Fuels and Vehicle Systems Optima:** Establishes a link early in the R&D cycle of both fuels and engines for a systems-based approach and to create optimized solutions for fuels and engines. Collaboration with Vehicles Technologies.
- **New Investments in the Integrated Production and Scale-Up of Drop-in Hydrocarbon Fuels:** New potential competitive awards (up to three pilot projects or one demonstration project) to scale-up integrated production systems of drop-in hydrocarbon biofuels to accelerate advanced biofuel manufacturing.
- **DPA:** Support the military-specification jet fuel in collaboration with DoD and USDA through the Defense Production Act.

FY16 Budget Request to Congress

Program Area	FY 2014 Enacted*	FY 2015 Enacted*	FY 2016 Request*	FY 2016 vs. FY 2015*
Feedstocks	46,972	32,000	38,800	+6,800
Conversion Technologies	101,384	95,800	99,186	+3,386
Demonstration and Market Transformation	64,790	79,700	87,514	+7,814
Strategic Analysis and Cross-Cutting Sustainability	12,146	11,000	14,000	+3,000
Biopower	1,998	0	0	0
NREL Site-Wide Facility Support	5,000	6,500	6,500	0
Total, Bioenergy Technologies	232,290	225,000	246,000	+21,000

*Dollars in thousands

Biomass Feedstock National User Facility at INL

Feedstock Process Demonstration Unit

- Produce feedstock – any feedstock, and specification, any scale.
- Develop and test preprocessing unit operations.
- Develop and test fully integrated,
- fully instrumented, full-scale preprocessing systems.

Biomass Analytical Library

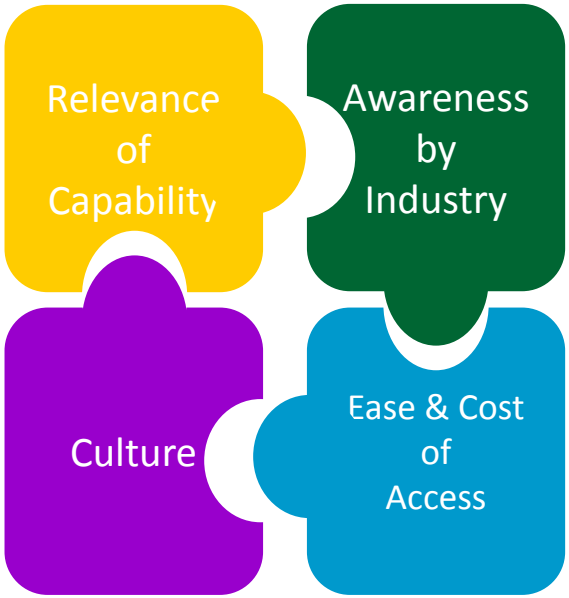
- Characterize biomass physical and chemical properties.
- Access feedstock properties database, nearly 70,000 samples.
- Analyze and model feedstock supply and logistics designs.

A unique capability of the Feedstock PDU is to test and develop fully integrated and instrumented industrial-scale preprocessing systems.

Tech-to-Market Activities for the National Labs

BETO Activity	Recipient	Funding	Total	Deadlines
Introducing Local Small Businesses to the National Labs	20 competitively selected projects	$20K per project	$400K	Feb. 26th
Industry/Innovation Day for all the Labs	1-2 competitively selected projects	$100-50K per project	$100K	Feb. 26th

EERE National Lab Small Business Voucher Program



- Encourage labs to reach out to and assist small businesses.
- Strengthen U.S. economic competitiveness.
- Broaden access to national laboratory capabilities
- Small business projects for up to $300K per voucher.
- Deadline for proposals: March 2015

Upcoming Events

2015 Peer Review

- March 23-27, 2015 at the Hilton Mark Center in Alexandria, VA.
- A combined 1-week simultaneous biennial review of BETO funded projects.

http://www.energy.gov/eere/bioenergy/2015-project-peer-review

Bioenergy 2015

- Planned for June 23-24, 2015 returning to the Washington Convention Center.
- Bioenergy 2015 will convene key representatives from across the bioenergy supply chain, including industry, federal agencies, and Congress.
- Focus on what is needed to sustain the growth and success of the advanced bioenergy industry now, and into the future.

Upcoming Events and Publications

Waste-to-Energy (WTE) Workshop Series

- WTE Workshop was held in November; Report will be published in May
- WTE-Fuel Cells Workshop planned for March 18-19, 2015
- Water Environment Research Foundation Workshop in June 2015

Publications

- Multi-Year Program Plan (MYPP)
  - Updated version of the Office's Multi-Year Program Plan was released in November. http://www.energy.gov/eere/bioenergy/downloads/bioenergy-technologies-office-multi-year-program-plan-november-2014-update
  - New version is scheduled for release in April; will contain an assessment of additional pathways.
- 2016 Update to the Billion Ton Study
  - A new version of the Update to the Billion-Tony Study is under-development.