

**Q3 2016 Presentation to the
Technical Advisory Committee**

Elliott Levine
Designated Federal Official
August 17-18, 2016

TAC Housekeeping

Travel Process

- Natalie Roberts is the point of contact for all questions related to TAC travel and reimbursement. She can be reached at: natalie.roberts@ee.doe.gov or 202-586-2325.
- Reimbursement deadline for this meeting: **September 9, 2016**

Future Meeting Dates

- Tentative dates for Q4 meeting have been identified below and will be confirmed during current meeting:
 - Q4: Week of November 16-17, 2016

2016 Work Plan

Meeting	Objectives
Q1 March 8-9	<ul style="list-style-type: none">• Received overview presentations on BETO, EERE Priorities, NIFA and ARS, ARPA-E, Food-Energy-Water Nexus, and the FARB.• Provided feedback on the FARB.• Developed list of potential deep dive topics for Subcommittees
Q2 June 13-14 1 ½ day meeting	<ul style="list-style-type: none">• Presentations on BETO MYPP, AFRI, and update on the Bioeconomy.• Selected topics for Subcommittees and begun identifying problem statements.
Q3 August 16-18 1 ½ day meeting (plus site visit)	<ul style="list-style-type: none">• Site visit to Virent, Forest Products Lab(USDA), and Great Lakes Bioenergy Research Center.• Work in Subcommittees to develop recommendations for agreed upon topics.
Q4 November 16-17 1 ½ day meeting	<ul style="list-style-type: none">• Finalize and vote on 2016 recommendations.

What I've Heard – Some Old, Some New

Prior Years' Recommendations:

- Continue R&D efforts to reduce required investment and operating expenses for production of biofuels and bio-products.
- Emphasize specific opportunities to develop a robust national bioeconomy.
- Suggest practices for valorizing societal benefits of the bioeconomy (e.g., rural jobs, technology leadership, national security, balance of trade, GHG-emission reductions, etc.)

2016:

- Advance tools of synthetic biology to create new products and better manufacturing methods.
- Develop new agricultural technology to enhance carbon sequestration.
- Utilize urban and agricultural wastes as feedstocks.

Q3 Meeting:

- Focus on biomass-derived jet fuel as a product.
- Combine landscape design, regional feedstocks, biomass blending, and the depot concept to improve biomass supply, storage, and distribution systems.

TAC Subcommittees

- ❑ Conversion
- ❑ Sustainable Feedstocks, Production and Logistics
- ❑ Products Markets, and Systems

Subcommittees develop:

- Problem Statements: Identify issues/challenges that must be addressed.
- Recommendations: Technical or R&D strategies that address the identified problem statements.
- Information Requests: Requests for speakers, data, reports, or other information that can be given or presented to the committee that assists them in developing their recommendations.

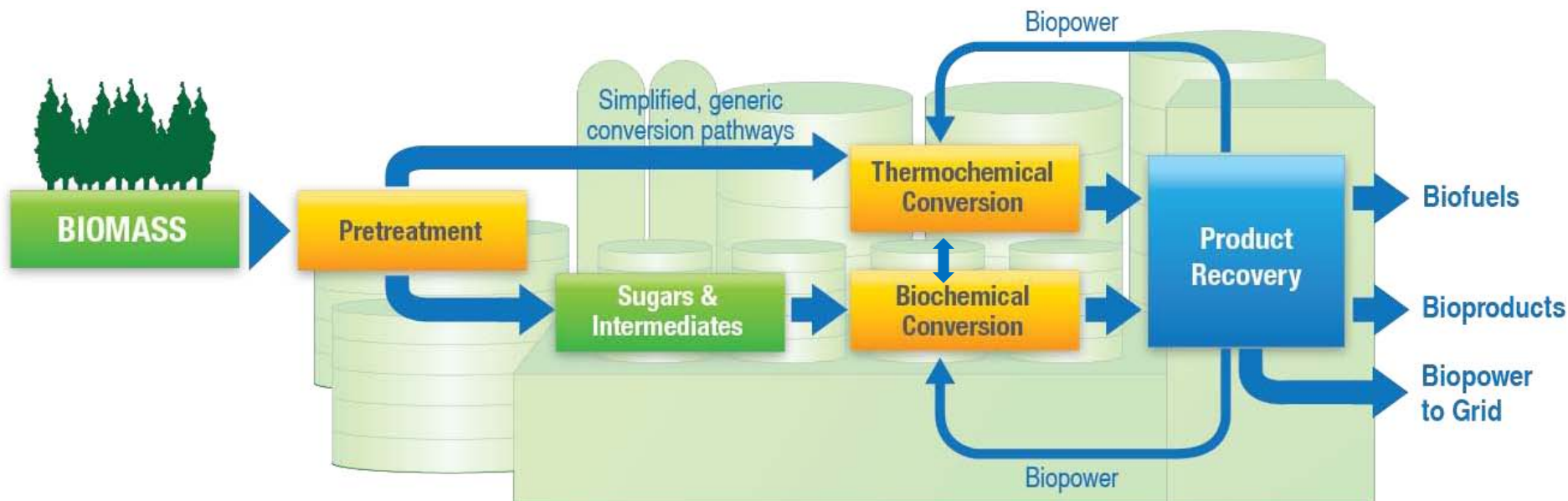
Subcommittees gain wisdom through:

- Assembly of subject matter experts to address cross-cutting challenges.
- Development of workshops and reports based on recommendations.
- Site visits to key resources.

Key Challenge for Innovation – Lowering Risks

De-risking technologies is central to R&D through **demonstration** with greater **integration** and **scale**. BETO focuses on:

- Advancing renewable gasoline, diesel, and jet fuels technologies
- Technical, construction, operational and financial/market risks



Key Challenges

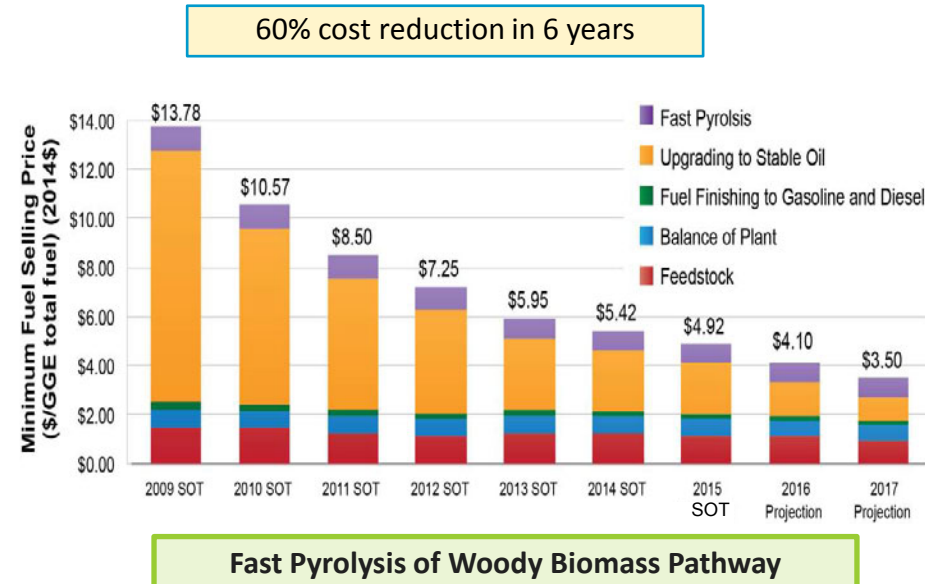
Biomass	Pretreatment	Conversion	Product
<ul style="list-style-type: none">• Reliable supply• Consistent quality• Affordable delivery	<ul style="list-style-type: none">• Biomass feeding, sizing and moisture• Solids handling• Construction materials	<ul style="list-style-type: none">• Products Yields• Construction materials• Catalysts• Fermentation organisms	<ul style="list-style-type: none">• Separations• Catalytic upgrading• Recycle loops

Bioenergy Technologies Office – Summary

Accelerate the commercialization of first-of-a-kind technologies designed to utilize the Nation's abundant biomass resources for the production of advanced biofuels and biobased products.

Portfolio with Strategies on:

- **Terrestrial Feedstock Supply:** By 2022, validate FSL systems to supply 285 million dry tons/year to a biorefinery at a cost of \$84/dry ton.
- **Conversion R&D:** By 2022, validate an n^{th} plant modeled cost of \$3/GGE for a total of 3 pathways to hydrocarbon fuels with GHG emissions of >50% compared to petroleum.
- **Demonstration and Market Transformation:** By 2027, validate mature modeled performance goals for hydrocarbon fuels using data from an operating biorefinery.



Challenges

- Feedstock Availability and Cost
- Risk of first-of-a-kind technology
- Inadequate distribution infrastructure
- Production costs and market uncertainty
- Public acceptance of bioenergy

Opportunities

- RD&D to reduce feedstock logistics costs
- Cost-shared pilot and demonstration-scale facilities
- Focus on infrastructure-compatible hydrocarbon fuels
- Co-products to improve economics of biofuels
- Robust communications strategy and engagement with public stakeholders

FY 2016 Priority Activities and Goals

- **Feedstock Supply & Logistics:** Produce an updated, fully integrated assessment of potential available feedstock supplies under previously established environmental and quality criteria.
- **Advanced Algal Systems:** Pursue new research in advanced biology and carbon dioxide utilization to address yield, productivity, and integration of downstream logistics at the pre-pilot scale.
- **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 Co-Optimization:** 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:** Make selections in October 2016 for new competitive awards for Validation Phase 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.



Projects for Algae-Based Biofuels and Bioproducts

- On July 14, 2016, BETO announced up to \$15M for three projects aimed at reducing the production costs of algae-based biofuels and bioproducts through improvements in algal biomass yields.
- These projects will develop highly productive algal cultivation systems and couple those systems with effective, energy-efficient, and low-cost harvest and processing technologies.



- ❑ **Global Algae Innovations** (San Diego, California) – Global Algae Innovations Inc., in collaboration with other organizations and national laboratories, will accelerate the commercialization of algal biofuels through development of an integrated, photosynthetic, open raceway pond system to produce algal oil.
- ❑ **Algenol Biotech LLC** (Ft. Myers, Florida) – Algenol Biotech LLC and its partners have formed a team to enhance the productivity of cyanobacteria, the conversion of biomass to a biofuel intermediate, and the cost-sensitive operation of a photo-bioreactor system.
- ❑ **MicroBio Engineering Inc.** (San Luis Obispo, California) – MicroBio Engineering Inc. will work with a national laboratory and other organizations to deliver integrated technologies that achieve high yields of biofuels, combined with treatment of wastewater, higher value co-products, and carbon-dioxide mitigation.

MEGA-BIO Projects – Bioproducts To Enable Biofuels

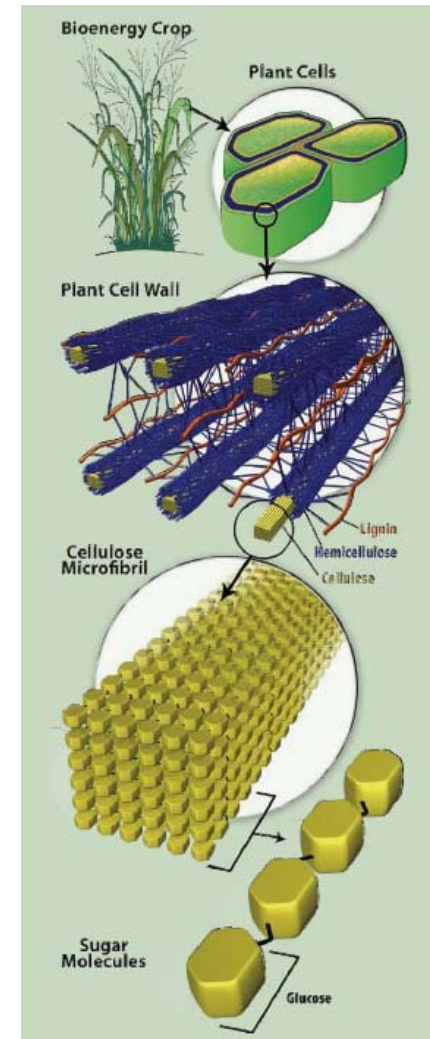
- On August 2, 2016, BETO announced \$11.3M for three projects that support the development of biomass-to-hydrocarbon biofuels conversion pathways that can produce variable amounts of fuels and/or products based on external factors, such as market demand.
 - This funding will develop new strategies for biorefineries, resulting in long-term benefits to the U.S., including chemicals and products manufacturing.
- ❑ **The Dow Chemical Company** (Midland, Michigan) – The Dow Chemical Company, in partnership with LanzaTech and Northwestern University, will develop a process for the bioconversion of biomass-derived synthetic gas (syngas) to C6-C14 fatty alcohols as a pathway to biofuels.
 - ❑ **Amyris, Inc.** (Emeryville, California) – Amyris, Inc., in cooperation with Renmatix and Total New Energies, will develop a manufacturing-ready process to produce farnesene, a hydrocarbon building block used in the manufacture of a variety of consumer products ranging from cosmetics to detergents, as well as in the transportation industry for diesel and jet fuel.
 - ❑ **Research Triangle Institute** (Research Triangle Park, North Carolina) – Research Triangle Institute will partner with Arkema and AECOM to investigate the technical feasibility and economic potential, as well as the environmental and sustainability benefit, of recovering mixed methoxyphenols from biocrude as building block chemicals, alongside the production of biofuels.

RFI: Revolutionary Biomass Supply Systems

- Request for Information (RFI), released June 8, 2016, asked for input about specific aspects in the development of large-scale supply systems and technologies to eventually supply up to one billion dry tons of biomass feedstocks annually for a variety of end uses.
- BETO sought feedback from industry, academia, research laboratories, government agencies, and other stakeholders to support a “Billion-Ton Bioeconomy.”
- The goal is to develop the components of processing and handling (unit operations) of biomass and demonstrate the viability of an Advanced Feedstock Supply Systems (AFSS) on-scale in the future.
- The RFI categories include:
 - Preprocessing technologies
 - Quality management
 - Strategies for mobilizing a billion tons of biomass resources
- Responses were due June 30, 2016

RFI: Cellulosic Sugar and Lignin Production Capabilities

- Request for Information (RFI): DE-FOA-0001615, July 20, 2016
- Seeks input from industry, academia, national labs, and other biofuels and bioproducts stakeholders to identify existing capabilities to produce lignocellulosic sugars and lignin for use by the research community.
- Many conversion technologies that produce these biofuels or bioproducts utilize cellulosic sugars or lignin in their process.
 - Both lignocellulosic sugars and lignin have become necessary intermediates for advancing research towards economically producing biofuels and bioproducts.
- The purpose of this RFI is to develop a comprehensive list of suppliers who are willing and able to produce and sell cellulosic sugar and/or lignin for use by the research community.
- Responses due August 24, 2016, 5:00 pm ET



Co-Optima Funding Opportunity Announcement

Joint BETO-VTO FOA – August 1, 2016

- Up to \$7 million in project funding to accelerate the introduction of affordable, scalable, and sustainable high-performance fuels for use in high-efficiency, low-emission engines.
- DOE seeks proposals that address one or more of the following sub-topics:
 - Fuel characterization and fuel property prediction
 - Kinetic measurement and mechanism development
 - Emissions and environmental impact analysis
 - Impact of fuel chemistry and fuel properties on particulate emissions
 - Small-volume, high-throughput fuel testing
 - Additional barriers
- Eligibility for this FOA is restricted to U.S. Institutions of Higher Education and nonprofit research institutions that operate as a division under the U.S. Institutions of Higher Education.
- Submission deadline for full applications is October 16, 2016, at 5 p.m. Eastern Time.



The Co-Optima initiative aims to simultaneously transform both transportation fuels and vehicles in order to:

- Maximize performance and energy efficiency,
- Minimize environmental impact, and
- Accelerate widespread adoption of innovative combustion strategies.

Sustainable Transportation Summit

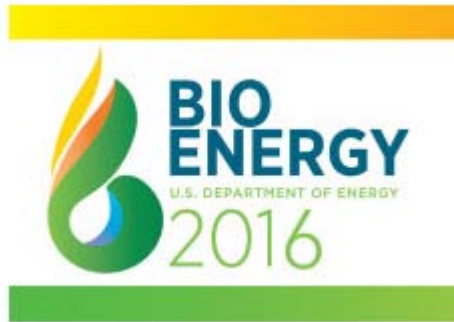
July 11-12, 2016, Walter E. Washington Convention Center, Washington, DC



- The summit highlighted progress and achievements in sustainable transportation R&D and efforts to bring new technologies to market, including the President's EV Everywhere Grand Challenge.
- Served as a forum to share ideas and perspectives on opportunities to accelerate the commercialization and deployment of advanced transportation technologies and smart mobility systems over the next decade.
- Topics included:
 - **Pathways to Deep Decarbonization in Transportation**—Meeting the administration's bold targets for reducing U.S. greenhouse gas emissions 83% by 2050.
 - **Adoption of New Vehicle Technology**—Influencing consumer decisions and behavior to support energy efficiency and low-carbon objectives.
 - **Net-Zero Carbon Fuels**—Enabling the production of new fuels from sunlight and CO₂ via scientific breakthroughs.
 - **The Future of Mobility**—Realizing an interconnected and intelligent transportation system for the safe and efficient movement of people and goods.



Bioenergy 2016 Conference



Bioenergy 2016
Mobilizing the Bioeconomy Through Innovation
July 12-14, 2016

Walter E. Washington Convention Center, Washington, DC
Partnered with Clean Energy Research & Education Foundation



- This year's conference was focused on opportunities to grow future feedstock supplies and break through technology barriers to achieve a stronger bioeconomy.
- Attendees discussed critical bioenergy issues such as: Innovation and emerging pathways; vision for a national bioeconomy; feedstocks forecasting and supply analysis; marketplace exploration; strategic public engagement.
- Keynote speakers included: **Marcy Kaptur** (D-OH), Congresswoman, U.S. House of Representatives; **Austin Brown**, Assistant Director for Clean Energy and Transportation, White House Office of Science and Technology Policy; **Catherine Woteki**, Under Secretary for Research, Education and Economics, USDA; **David Friedman**, Acting Assistant Secretary, DOE/EERE; **Adam Cohen**, Deputy Under Secretary for Science and Energy, DOE; **Dennis McGinn**, Assistant Secretary of the Navy, Energy, Installations & Environment; **Jan Koninckx**, Global Business Director for Biofuels, DuPont Industrial Biosciences; **Renato Domith Godinho**, Department of Energy, Ministry of Foreign Affairs - Brazil

Alternative Aviation Fuel Workshop

- September 14-15, 2016
- Macon Marriott City Center
240 Coliseum Drive, Macon, Georgia
- Workshop to advance the understanding of current technical barriers for increasing the competitiveness of aviation biofuels.
- The workshop will be organized into three parallel breakout sessions that will focus on the following technical areas related to aviation biofuels from lignocellulosic biomass:
 - Enhancing the economic and technical competitiveness of aviation biofuels from lignocellulosic biomass,
 - Environmental and sustainability considerations and opportunities to improve the life-cycle benefits of aviation biofuels from lignocellulosic biomass, and
 - Ensuring robust feedstock and product supply chains to support aviation biofuels from lignocellulosic biomass.



Biorefinery Optimization Workshop

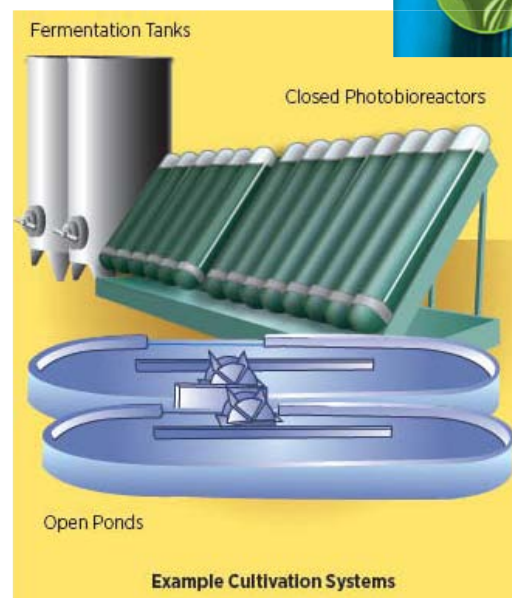
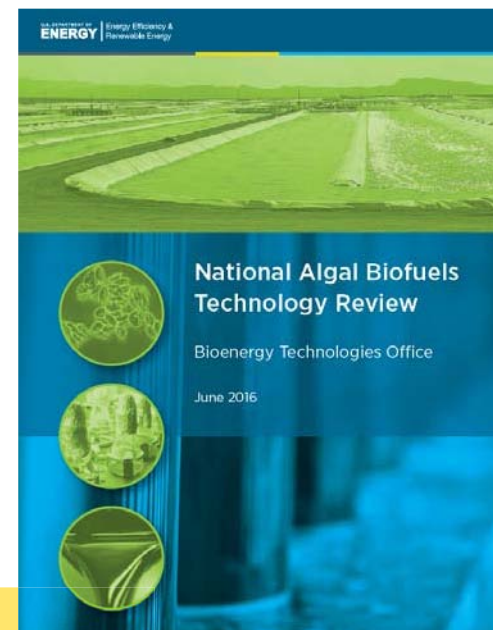
Understanding Scale-Up and Operational Challenges for Integrated Biorefinery Optimization

Workshop to be held early October 5-6, 2016 in the Chicago area

- Aims to gather information on challenges encountered with the successful scale-up and reliable operation of integrated biorefineries (IBR).
- Inclusive of all pathways, methods, and technologies employed to convert woody biomass, agricultural residues, dedicated energy crops, algae, municipal solid waste (MSW), sludge from wastewater treatment plants, and wet solids, into biofuels, biochemicals, and bioproducts.
- Topics to include:
 1. Understanding scale-up and mitigation of operational risks and challenges
 2. Developing robust handling and feeding systems for bulk solids and wet feedstocks
 3. Improving pre-processing methodologies
 4. Enabling reliable continuous operations
 5. Addressing unique pathway process limitations
 6. Developing strategies to reduce CapEx costs by reducing technical risks

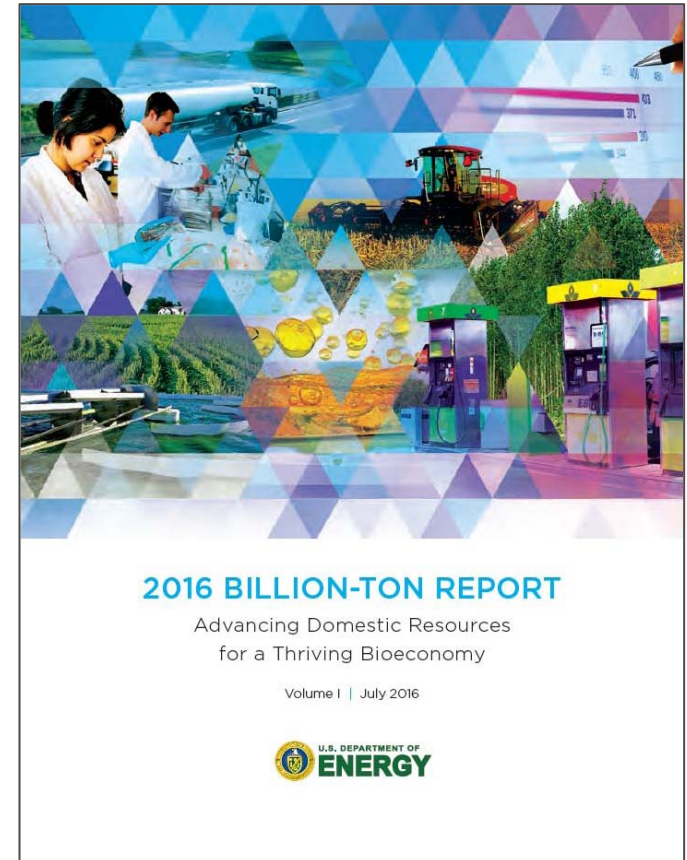
2016 National Algal Biofuels Technology Review

- Released on June 28, 2016
- Summary of algal biofuels research and development to-date, serves as one reference to inform the implementation of the BETO strategy to achieve the vision of a thriving and sustainable bioeconomy fueled by innovative technologies.
- Intended to be a resource for researchers, engineers, and decision-makers by providing a summary of algal biofuel research progress to date and the challenges that could be addressed by future RD&D activities.
- It covers the following subject areas:
 - Algal Biology, Genetics, and Development
 - Resources for Algal Research
 - Algal Cultivation
 - Harvesting and Downstream Processing
 - Extraction of Products from Algae
 - Algal Biofuel Conversion Technologies
 - Commercial Products
 - Distribution and Utilization
 - Resources and Sustainability
 - Systems and Techno-Economic Analyses.

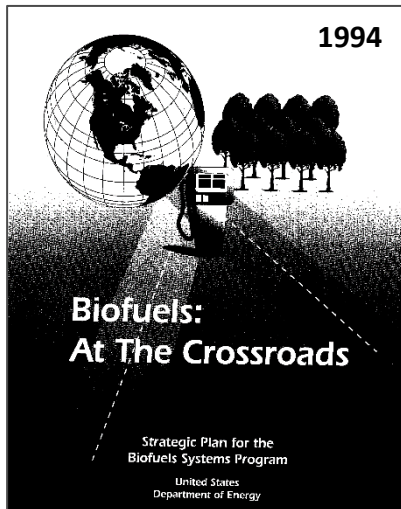
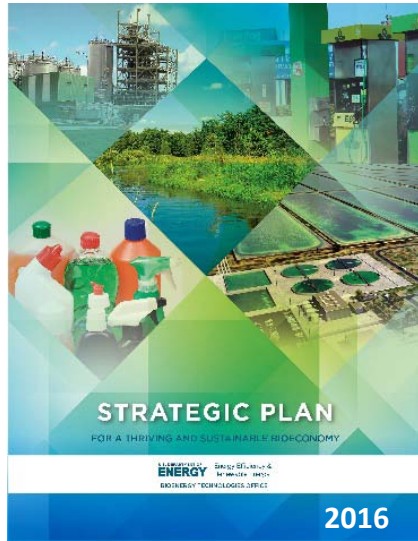


2016 Billion-Ton Report – Volume I Released July 2016

- Third in a series of national assessments of the potential supply of biomass in the U.S.
- The report concludes the U.S. has the future potential to produce at least one billion dry tons of biomass resources (composed of agricultural, forestry, waste, and algal materials) on an annual basis without adversely affecting the environment.
- This amount of biomass could be used to produce enough biofuel, biopower, and bioproducts to displace approximately 30% of 2005 U.S. petroleum consumption and would not negatively affect the production of food or other agricultural products.
- The interactive version is available on the Bioenergy KDF for data download:
<https://bioenergykdf.net/content/billiontonupdate>



BETO Strategic Plan



Vision (2040)

A thriving and sustainable bioeconomy fueled by innovative technologies

Vision: To realize the large-scale use of environmentally sound, cost-competitive, biomass based transportation fuels through the adoption and commercialization of the best technologies.

Mission

Developing and demonstrating transformative and revolutionary sustainable bioenergy technologies for a prosperous nation

1994 Strategic Plan → 2016 Strategic Plan

- 1994 Plan targeted ethanol produced from waste feedstocks to supplement the small, starch-based ethanol industry with a non-food feedstock stream, biodiesel from plant oils, and components of reformulated gas -- due to their near-term potential.
 - These markets would then enable a proof of concept that could lead to energy crop production, supplying renewable fuels for dedicated vehicles and new infrastructure.
- Focused on closing the gap between technology readiness and market opportunities; set the stage for increased industry and government sector partnership, as well as interagency collaboration.
- The RFS of 2005/2007 was a game changer and It transformed the biofuels industry and led to almost 90 million gallons/year cellulosic ethanol production capacity today.
- 2016 Plan reflects the changing energy landscape and dynamics, concerns over GHG emissions, and public demand for alternative energy sources and environmentally friendly products.
- Focuses on sustainable production biomass resources (i.e., 2016 Billion-Ton Report) and a broader range of feedstocks (e.g., gaseous resources, algae, MSW, and wet waste streams).
- Expands BETO's mission beyond cellulosic ethanol market for the opportunity to replace the "whole barrel of petroleum" for renewable drop-in fuels, jet fuels, bio-based chemicals and bioproducts.
- While both 1994 and 2016 Plans include GHG emission reductions as a goal, the 2016 Plan goes beyond to address concerns for social and environmental sustainability that include water and soil quality.

Strategic Plan Key Opportunity Areas

- **Enhancing Bioenergy Value Proposition:** Innovate, develop, and demonstrate integrated value chains for biofuels, bioproducts, and biopower with economic, environmental, and societal benefits.
- **Mobilizing Our Nation's Biomass Resources:** Reduce delivered cost and risks associated with feedstock quality and volume to accelerate widespread commercialization of sustainable biomass supply chains for a broad range of markets.
- **Developing Bioproducts That Enable Biofuels:** Develop flexible and versatile bioproduct technologies that allow the biofuels and bioproduct industries to respond agilely to market factors.
- **Cultivating End-Use Markets and Customers:** Meet early adoption market demands and catalyze new markets that affect sustainable, affordable living.
- **Expanding Stakeholder Engagement and Collaboration:** Grow an informed community of public and private stakeholders that understands and contributes to an enduring, sustainable bioeconomy, while appreciating its challenges and benefits.



from Other DOE Offices

- **Vehicle Technologies Office**
- **Office of Science (BER / BES)**
- **ARPA-E**

New Insights Near- and Long-Term Co-optimization

Recent research is providing new insight into fuel effects on advanced SI (near-term), advanced CI (long-term), and emissions controls.

Advanced Spark Ignition (SI)

- Higher heat-of-vaporization shown to help with knock resistance.
- HOV contributes to the octane sensitivity.

Advanced Compression Ignition (CI)

- Kinetic ignition delay modeling reveals temperature-pressure characteristics conducive to low temperature chemistry.
- Observations provides important new information on fuel effects on low temperature chemistry and the combustion trajectory.

Emissions Controls

- Investigation of the interactions between ethanol and aromatics in gasoline has revealed that ethanol acts to suppress aromatic distillation.
- This may lead to the aromatics more likely to form particulate matter emissions.

Office of Basic Energy Sciences (BES)

Chemical Sciences, Geosciences and Biosciences Division

The BES Biosciences programs, Photosynthetic Systems and Physical Biosciences, support basic research on the physical, chemical and molecular mechanisms that plants and microbes use for **energy capture, conversion and storage**.

- Preapplications and Proposals are solicited through the Office of Science Annual FOA.
 - This FOA is the annual, broad, open solicitation that covers all of the research areas in the Office of Science and is open throughout the Fiscal Year (until September 30, 2016).
- The goal of BES Biosciences is to provide a basic understanding of the biological and biochemical processes that can provide foundational knowledge related to DOE's mission to efficiently capture and utilize solar energy and to convert renewable resources into fuels, chemicals and other energy-enriched products.
- Example Biosciences research areas:
 - Light Harvesting in Natural Systems, Photon Capture and Transfer
 - Charge Separation, Electron Transfer, Redox Reactions
 - Structure/Function of Photosynthetic Proteins, Protein Complexes, Membranes, and Organelles
 - Self-Assembly, Dynamics, Self-Repair of Protein Complexes
 - Carbon Fixation, RuBisCO and Calvin-Benson Cycle
 - Application of Physical Science Tools to Address Structure/Function and Mechanistic Studies
 - Non-RuBisCO CO₂ Reduction, esp. in Archaeal systems
 - Active Site Chemistry, esp of Multi-Electron Redox Reactions
 - Regulation of Electron Flow through Energy-Relevant Metabolic Pathways
 - Biochemistry and Biophysics of Cell Architecture including Cell Wall

Office of Basic Energy Sciences (BES)

Chemical Sciences, Geosciences and Biosciences Division

Basic Energy Sciences Annual Open Funding Opportunity Announcement

<http://science.energy.gov/bes/funding-opportunities/>

For information on the biosciences-focused programs in BES, Photosynthetic Systems and Physical Biosciences:

<http://science.energy.gov/bes/csgb/research-areas/photosynthetic-systems/>

<http://science.energy.gov/bes/csgb/research-areas/physical-biosciences/>

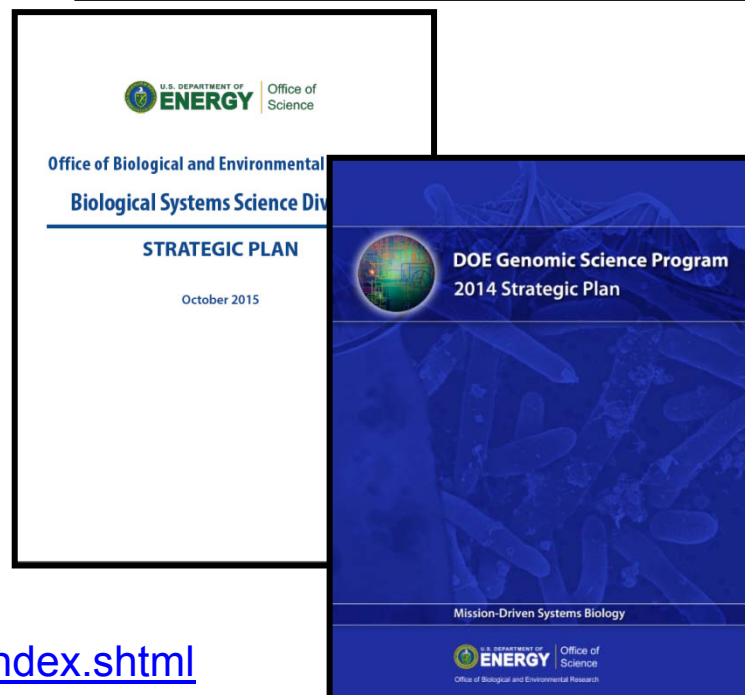
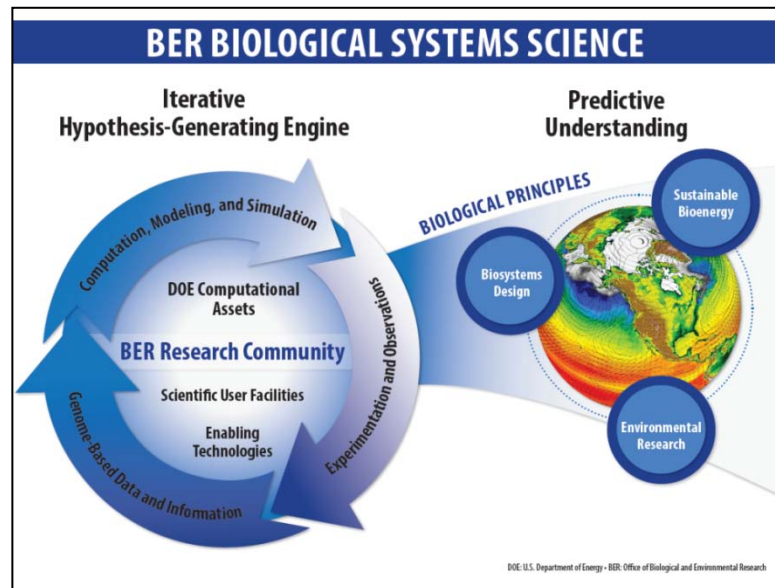
Five of the 32 Energy Frontier Research Centers are related to biosciences. For more information, see <http://science.energy.gov/bes/efrc/>

- Catalysis Center for Energy Innovation (CCEI); Dionisios Vlachos, University of Delaware
- Center for Biological Electron Transfer and Catalysis (BETCy); John Peters, Montana State University
- Center for Lignocellulose Structure and Formation (CLSF); Daniel Cosgrove, Pennsylvania State University
- Center for Direct Catalytic Conversion of Biomass to Biofuels (C3Bio); Maureen McCann, Purdue University
- Photosynthetic Antenna Research Center (PARC); Robert Blankenship, Washington University in St. Louis

Genomic Science Program

Main Program Topics

- Bioenergy Research Centers (BRCs)
- Systems Biology for Bioenergy
- Plant Feedstocks Genomics
- Biosystems Design
- Carbon Cycle/Environmental Microbiological Research
- Computational Biosciences
- Sustainability Research for Bioenergy



<http://genomicscience.energy.gov/strategicplan/index.shtml>

New Awards for FY 2016

Plant Feedstock Genomics for Bioenergy: A Joint Research Funding Opportunity Announcement USDA, DOE (DE-FOA-0001444) - \$4M (total)

- Continues research on plant responses to pathogens.
- Includes a focus on oil seed crops.

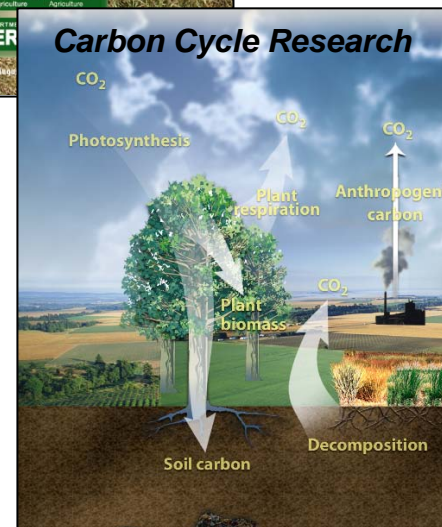
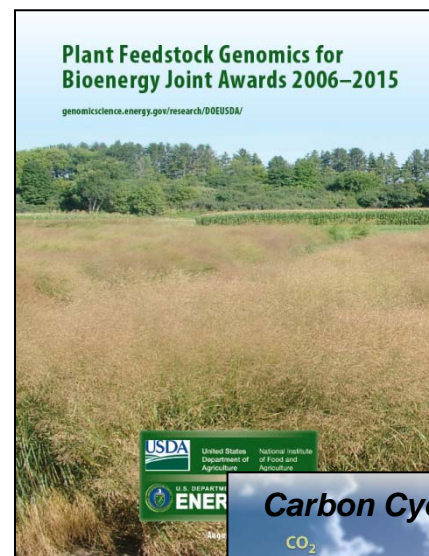
Seven new awards: energy cane, switchgrass, pennycress, brassica, camelina, sorghum.

Joint DOE-USDA announcement pending.

Systems Biology Enabled Research on the Roles of Microbial Communities in Carbon Cycle Processes (DE-FOA-0001458) - \$10M

- Research to understand the functioning of microbial communities in a wide range of environments and environmental conditions.
- Research to inform larger scale ecosystem function.

Nine new awards for research in a broad range of environments: methane cycle, rhizosphere, soil ecology, permafrost processes, nitrogen cycling. Announcements pending.



Bioenergy Research Centers Open Competition



Sustainability



*Feedstock
Development*

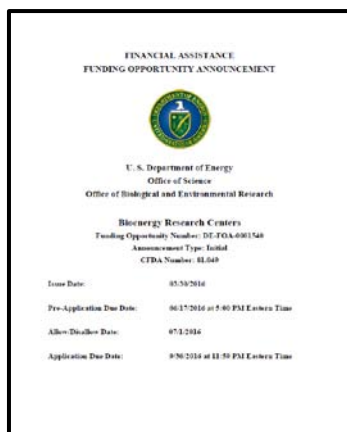


*Biomass
Deconstruction*



*Conversion
biofuels & bioproducts*

- Team-based, multi-institutional, cross-disciplinary, integrated systems research centers.
- Total requested budget of \$90 million per year.
- Center annual budgets may range from \$12.5M to \$30M for up to 5 years.
- Open competition for domestic organizations as prime applicant; open to any organization as subawardee.

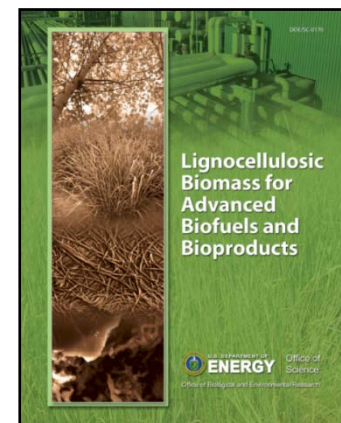


FOA (DE-FOA-0001540)

Posted - 3/30/2016

Applications due - 9/30/2016

In Progress



Potential FY 2017 FOA Topic

Microbiome (+10M, FY 17 Request)

BER supports fundamental microbiome research on plant-microbe associations relevant sustainable biomass production, soil microbiomes that impact nutrient availability and carbon cycling processes, and subsurface microbiomes that effect environmental contaminant fate and transport.

NSTC Life Sciences Subcommittee chartered a fast track interagency working group to identify current Federal R&D investments and key priorities in microbiome research

Significant recommendations:

- Development of high resolution analytical technologies is needed to characterize and quantitatively measure microbiome processes
- Databases, bioinformatics, and computational modeling will be critical to advance predictive understanding of microbiomes

New collaborative, multidisciplinary microbiome research efforts incorporating:

- Experimental systems biology
- Genome enabled environmental research
- Predictive computational modeling
- Partnerships between DOE National Laboratories, academia, and field research facilities

Goal: Understand the role of microbiomes in key DOE mission relevant environments such as:

- Biomass focused agricultural systems
- Terrestrial ecosystems particularly vulnerable to climate change variables, including permafrost, taiga, wetlands, and arid ecosystems.

Online Resources for TAC Members

The Board website (<http://www.biomassboard.gov>) contains numerous resources for TAC members:

- **Meetings**
 - Previous meeting agendas and minutes
 - Previous presentations
- **Work Plans**
 - Work plans for the last 10+ years
- **Reports**
 - Bioenergy roadmaps
 - Workshop summaries
 - DOE and USDA reports and portfolio analyses
 - Previous TAC recommendations
- **TAC Library**
 - Outlined in next slide

Online Resources for TAC Members

TAC Library:

- BRDI Materials
 - Solicitations and Awards
 - Annual Reports
 - Prior TAC Recommendations
- Related Solicitations and Awards
 - DOE FOAs
 - ARPA-E FOAs
- Additional Information
 - DOE and USDA factsheets
 - DOE and USDA roadmaps and research
 - BETO's Multi-Year Program Plan
 - BETO Strategic Plan

Links for Additional Information

- Federal Advisory Committee Act (FACA) requirements:
 - <http://www.gsa.gov/portal/content/101010>
- Biomass R&D Board and TAC Website:
 - www.biomassboard.gov
- TAC Library:
 - http://biomassboard.gov/committee/tac_library.html
- Federal Register call for new nominations to the TAC:
 - <https://www.federalregister.gov/articles/2016/05/25/2016-12319/biomass-research-and-development-technical-advisory-committee>
- Bioenergy KDF:
 - <https://www.bioenergykdf.net/>
- BETO Website:
 - <http://www.energy.gov/eere/bioenergy/bioenergy-technologies-office>
- BETO MYPP:
 - <http://www.energy.gov/eere/bioenergy/downloads/bioenergy-technologies-office-multi-year-program-plan-march-2016>
- ARPA-E Website:
 - <http://arpa-e.energy.gov/>
- Office of Science Website:
 - <http://science.energy.gov/>