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

2017 BETO Peer Review

3/6/2017

Jonathan L. Male

Director,

Bioenergy Technologies Office

Outline

I. Welcome To BETO Peer Review

II. Overview

III. BETO Portfolio

IV. Response to the 2015 BETO Peer Review

V. Program Management Review and Bioeconomy2017

2017 PROJECT PEER REVIEW

U.S. DEPARTMENT OF ENERGY
BIOENERGY TECHNOLOGIES OFFICE

March 6-9, 2017, Sheraton Downtown Denver
Denver, CO

2017 Steering Committee

A Special Thanks To:

PEER REVIEW STEERING COMMITTEE	
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Steven Costa	U.S. Department of Transportation
Robert Graham	Ensyn
John May	Stern Brothers & Co.
Shelie Miller	University of Michigan
Dawn Mullally	American Lung Association
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Bob Wooley	Biomass *ad infinitum*, LLC.

Program Peer Reviewers

A Special Thanks As Well To:

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Luca Zullo	VerdeNero, LLC.

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Timothy Brandvold	Abbott Molecular
Jeffrey J. Scheibel	Independent Consultant
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** Lead Reviewer*

From Challenge to Opportunity

THE CHALLENGE

More than $350 million is spent **every day** on foreign oil **imports**. Dependence on **foreign oil** can leave us vulnerable to disruptions in supplies and contributes significantly to our trade deficit.

Transportation accounts for 67% of petroleum consumption and 26% of emissions in the United States.

THE OPPORTUNITY

More than **1 billion tons of biomass** could be domestically converted into biofuels and products.

Biomass could displace **25%** of U.S. petroleum use annually by 2030, **keeping $260 billion in the United States**, adding **1.1 million direct jobs,** and reducing annual CO_2 emissions by 450 million tons or 7% of U.S. energy emissions.

BETO's Mission and Vision

Vision

A thriving and sustainable bioeconomy fueled by innovative technologies

Mission

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

Strategic Goals

Develop industrially relevant technologies to enable domestically produced biofuels and bioproducts without subsidies

BETO reduces risks and costs to commercialization through RD&D

Bioenergy Delivers Unique Value

- **Biomass** is an energy resource **derived from non-food** plant-, algal-, and waste-based materials that includes crop residues (corn stover), purpose-grown grass crops, woody plants, industrial wastes, algae, wood waste, and sorted municipal solid waste.

- Only renewable energy source that offers a **viable substitute** for petroleum-based liquid transportation **fuels** in the near term and can be used to produce **chemicals** for manufacturing, as well as supply **power** for our electrical grid.

- Can contribute to a more secure, sustainable, and economically sound future by providing **domestic** clean **energy** sources, **reducing** U.S. dependence on **foreign oil**, generating **U.S. jobs**, and revitalizing **rural and urban America**.

- BETO is focused on developing price-competitive bioenergy and bioproducts technologies to enable the United States to emerge as the **global leader in the clean energy economy**.

America's biomass resources could provide domestic energy, revenue, and jobs

BETO's Critical Program Areas

Production & Harvesting

Feedstock Supply & Logistics
Works to reduce the cost, improve the quality, and increase the volume of sustainable feedstocks available for delivery to a biorefinery.

Advanced Algal Systems
Focuses on improving the productivity of algal biomass and enhancing the efficiency of cultivation and harvesting.

Conversion & Refining

Conversion
Develops technologies to convert non-food feedstocks into biofuels, bioproducts, and biopower.

Conversion
Intensification - at bench and sub-pilot scale, conduct feedstock blend testing, separations, materials compatibility evaluations, and techno-economic driven verification tests

Distribution & End Use

Demonstration and Market Transformation
Aims to reduce investment risk in bioenergy production technologies by developing, building, and operating integrated biorefineries and helps address the final links of the supply chain to enable demand for end products.

Crosscutting Areas: Sustainability, Strategic Analysis, & Communications

BETO works to address risks and reduce costs across the supply chain

Potential FY17 Budgets

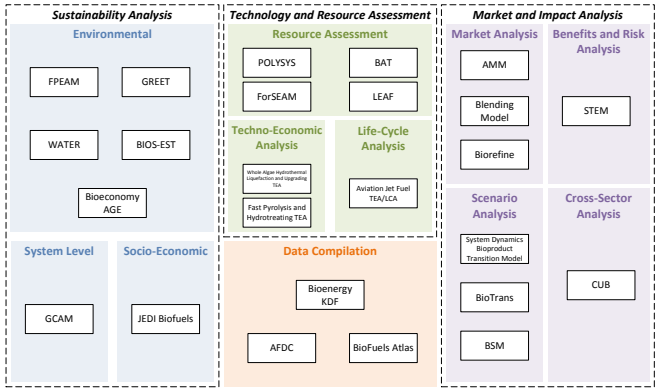
Program Area	FY 2015 Enacted*	FY 2016 Enacted*	FY 2017 Senate Mark*	FY 2017 House Mark*
Conversion Technologies	95,800	85,500	98,971	64,371
Demonstration and Market Transformation	79,700	75,100	60,000	45,000
Analysis and Sustainability	11,000	11,000	10,229	10,229
Advanced Algal Systems	25,000	30,000	30,000	30,000
Feedstocks Supply and Logistics	7,000	16,500	12,000	12,000**
NREL Site-Wide Facility Support	6,500	6,900	6,900	6,900
Total, Bioenergy Technologies	225,000	225,000	218,100	168,500

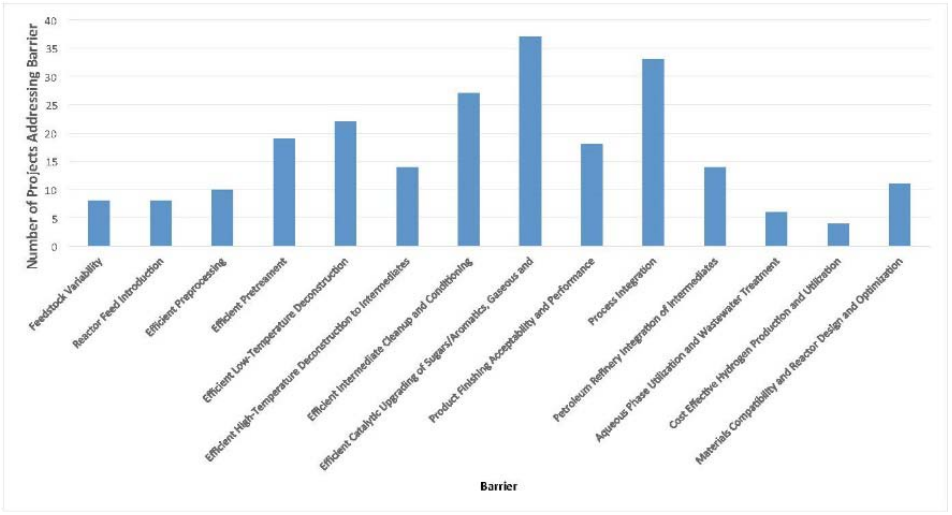
*Dollars in thousands, **Request for additional flexibility

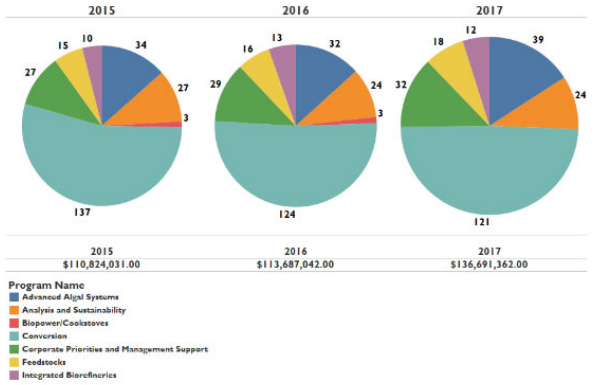
BETO Portfolio Analysis

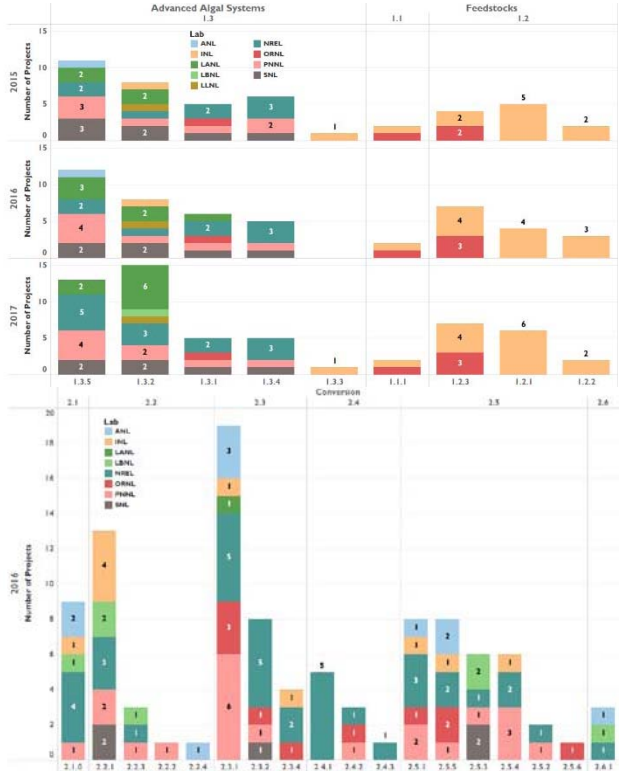
Purpose: Enable BETO to assess portfolio balance against relevant Office-level dimensions to better inform planning and decision-making

- 2017:
  - Establish data requirements and assess gaps
  - Design data capture and reporting mechanisms
- 2018:
  - Develop data capture and reporting protocols
  - Integrate into standard BETO operations









EERE National Laboratory Impact Initiative

- **Mission:** To significantly increase the industrial impact of DOE national labs on the clean energy sector
  - Increase and enhance lab-private sector relationships
  - Increase and streamline access to national lab capabilities
  - Communicate the value of lab-developed science and technology
- **Mechanisms for Lab Impact:**
  - Dedicated funding: at least 1% of AOPs devoted to T2M activities
  - Small Business Vouchers (EERE administered): https://www.sbv.org
    - $200-300K per project (given to a lab to assist specific need of a small business) + 20% cost share from small business
    - 7 bioenergy projects (small business-lab pairs) selected over first two rounds ; Round 3 in progress
  - Industrial Seedlings (BETO administered)
    - "Junior version of SBV": $40K per project (given to lab to assist small business need) – intended to demonstrate lab capability to NEW small businesses (prioritized)
    - 22 projects funded to date
  - Lab Corps: 8 week entrepreneurial boot-camp modeled after successful NSF I-corps
    - https://energy.gov/eere/technology-to-market/lab-corps
    - 15 BETO/bioenergy related teams have gone through program

Results of the 2015 BETO Peer Review

What changes has BETO made based on the results of the 2015 Peer Review?

Lessons Learned on BETO Portfolio

Peer Review 2015 Comments & Programmatic Suggestions

"Social elements, including water and public health, are lacking from analysis models and guidance."

Actions to date

- Initiated Antares project selected under FY15 FOA Sustainable Landscape Design:
  - Through continuous stakeholder engagement, this project is developing an adaptive framework and tool set for evaluating environmental, social, and economic priorities in biomass supply sheds (including water quality, soil quality, biodiversity, social well-being, profitability, and other aspects of sustainability)
- Completed *Billion Ton 2016, Volume 2: Environmental Sustainability Effects of Select Scenarios from Volume 1*
  - This study analyzes a range of potential environmental effects associated with illustrative near-term and long-term biomass-production scenarios

Plans moving forward

- Continuation of Antares Landscape Design Project. This project will:
  - Create subfield analysis business and conservation tools for farm-level landscape planning which are applicable to targeted cellulosic feedstocks
  - Provide outreach to biomass end-users and growers to increase implementation
  - Identify and monitor key environmental sustainability indicators over time, along with the impacts from conservation practices being implemented
- Analysis & Sustainability Program projects are developing models and tools to support evaluation and decision-making with regard to environmental and socio-economic elements. For example:
  - ANL enhancement of GREET and WATER
  - NREL's F-PEAM
  - ORNL 's sustainability visualization tool
  - PNNL and ORNL's forest restoration and fuels reduction analysis framework

Lessons Learned on BETO Portfolio

Peer Review 2015 Comments & Programmatic Suggestions

"Need to better capitalize on leveraging societal permission and opportunities with other federal agencies, states, communities, interest groups, and industry in the U.S. and abroad to build out the bioeconomy."

Actions to date

- In February 2016, the Biomass Research & Development (BR&D) Board released the Federal Activities Report on the Bioeconomy in order to educate the public on the wide-ranging, federally funded activities across the biomass supply chain that are helping to bolster the bioeconomy.
- From February to May 2016, the BR&D Board engaged with over 400 stakeholders through 4 in-person Bioeconomy Listening Sessions, held in conjunction with major bioenergy industry events, and 1 public webinar.
  - Stakeholder feedback was compiled in the Billion Ton Bioeconomy: Challenges and Opportunities report.
- Additionally, BETO has collaborated external agencies through DPA/DPA II, USDA, FAA, the Lab Summit of USDA

Plans moving forward

- BETO plans to host a Bioeconomy Initiative Action Plan Workshop on April 5-6, 2017 in Washington, DC to develop a roadmap of cross-cutting federal activities and collaborative actions to catalyze the expansion of a sustainable domestic bioeconomy.

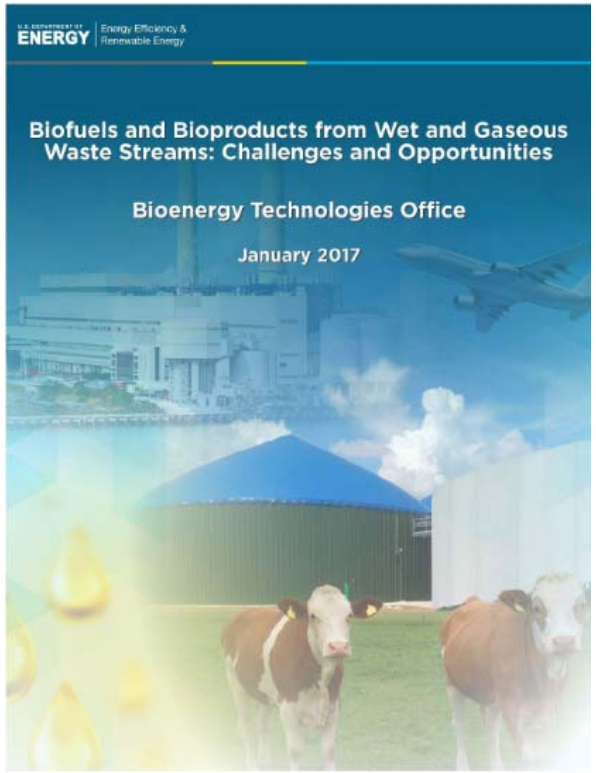
Lessons Learned on BETO Portfolio

Peer Review 2015 Comments & Programmatic Suggestions

"Addressing Portfolio gaps: High moisture biomass supply chains for conversion processes desiring high moisture feedstocks- biochem, HTL, HTC, and algae; as well as waste streams to fuels, power and products"

Actions to date

- BETO has invested in several projects that cover this suggested gap area:
  - In collaboration with others PNNL successfully made renewable diesel from municipal sludge.
  - Completed and published the complete resource assessment and technical evaluation of Biofuels and Bioproducts Wet and Gaseous Waste Streams: Challenges and Opportunities
  - SBIR projects: 14 phase 1 projects in the last 18 months
  - PD2B3 FOA Topic 3: Production of biopower, bioproducts, and biofuels from biosolids and other waste streams



Lessons Learned on BETO Portfolio

Peer Review 2015 Comments & Programmatic Suggestions

"Need to increase the emphasis on high value co-products to improve cost-effectiveness of relatively low-and-volatile-price transportations fuels ."

Actions to date

- BETO has sought to increase the emphasis on high value co-products through the following initiatives:
  - MEGA-BIO: Bioproducts to Enable Biofuels FOA
  - Targeted Algal Biofuels and Bioproducts (TABB) FOA
  - Pilot and Demo Scale Manufacturing of Biofuels, Bioproducts, and Biopower (PD2B3) FOA
  - Advancements in Algal Biomass Yield Phase 2 (ABY2) FOA

  All of these Funding Opportunity Announcements enable co-products to improve the cost-effectiveness of relatively low-and-volatile-price transportation fuels

Plastic packing materials can be manufactured from biomass-derived polyethylene terephthalate (PET)

Carpeting made from biomass-derived propanediol

Lessons Learned on BETO Portfolio

Peer Review 2015 Comments & Programmatic Suggestions

"Need to identify the common core elements that span pathways, common science, technology, environmental impacts, etc."

Feedstock-Conversion Interface

Co-Optimization of Fuels and Engines
(Co-Optima)

Agile BioFoundry
(ABF)

Separations Consortium

Chemical Catalysis for Bioenergy
(ChemCatBio)

Bioeconomy 2017 and Program Management Review

The 2017 Program Management Review

- Will be held July 13th at the Sheraton Pentagon City Hotel
- Results of the Project Peer Review will be presented by Lead Reviewers, along with an overall assessment of BETO's portfolio presented by the Steering Committee
- The Program Management Review will take place the day after BETO's annual conference, Bioeconomy 2017

Bioeconomy 2017

- Will be held July 11-12, 2017 at the Sheraton Pentagon City Hotel
- Convene key representatives from across the bioenergy supply chain, including industry, federal agencies, and Congress

BIO ECONOMY
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2017

Extra Slides

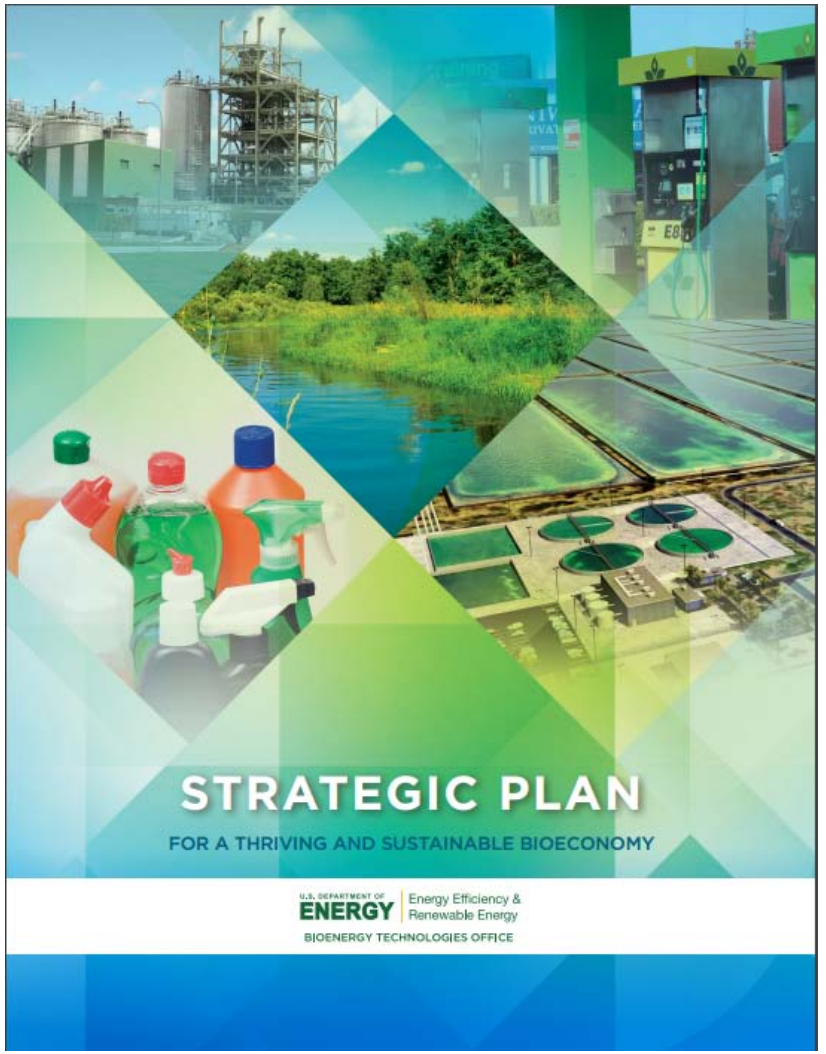
Project Partners

BETO works with partners in industry, universities, and the national labs

BETO Strategic Plan

- The *Strategic Plan for a Thriving and Sustainable Bioeconomy*
- Framework to realize BETO's mission to develop and demonstrate transformative and revolutionary sustainable bioenergy technologies for a prosperous nation
- Released December 29th, 2016
- Deputy Director Valerie Reed to follow up with a Strategic Plan Deep Dive Plenary Presentation

Link to Strategic Plan



EERE's Bioenergy Technologies Office (BETO)

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

BETO funds research, development, and demonstration activities that reduce the price of production of biofuels and bioproducts which enable:

- Increasing domestic bioenergy production to support America's national ***security*** interests
- Creating American ***jobs***, boosting ***economic growth***, and encouraging ***investment*** across the nation
- Advancing U.S. ***competitiveness*** in global energy and bioproduct markets
- Maximizing the use of America's abundant biomass ***resources***
- Improving the ***quality of life*** for Americans

Lessons Learned on BETO Portfolio

Peer Review 2015 Comments & Programmatic Suggestions

"Place less emphasis on algae conversion technologies and maintain or increase emphasis on algal biomass production technologies"

Actions to date

- BETO has worked to increase emphasis on algal biomass production by making available the following funding opportunities :
  - Algal Biomass Yield, Phase 2 (ABY2) – Up to $15M for three projects aimed at:
    - Reducing the costs of production of algae-based biofuels and bioproducts through improvements in algal biomass yields
  - Productivity Enhanced Algae and tool-Kits (PEAK) – Up to $8M to advance the algal biofuels state of technology by:
    - Biological strategies to improve to productivity and yield
    - Novel algal toolkits and methods