

# 2017 PROJECT PEER REVIEW

U.S. DEPARTMENT OF ENERGY  
BIOENERGY TECHNOLOGIES OFFICE



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## INTRODUCTORY LETTER



Dear colleagues,

In the spring and summer of 2017, the Office of Energy Efficiency and Renewable Energy's (EERE's) Bioenergy Technologies Office (BETO or the Office) continued its longstanding commitment to transparency by implementing the seventh biennial external review of its research and development portfolio. The review was conducted in accordance with EERE Peer Review guidelines, and it was designed to provide an external assessment of the projects in BETO's portfolio and collect external stakeholder recommendations on the Office's overall scope, focus, and strategic direction. Results from the Peer Review process are used to inform programmatic decision making; enhance active project management; and modify, expand, or discontinue existing projects.

The Peer Review process is critical in evaluating past investments and demonstrating the success of BETO's new core mission: to invest in the research and development of technologies that will reduce technology uncertainty and enable industry to stand up an advanced and sustainable bioenergy sector. Our nation's abundant biomass and waste resources present a tremendous opportunity to sustainably produce high-performance, advanced biobased fuels, products, and renewable chemicals and help realize national goals for the future bioeconomy. The Peer Review process enables external stakeholders to provide feedback on the most impactful use of taxpayer funding and develop recommendations for the most efficient and effective ways to accelerate the development of an advanced bioeconomy.

The 2017 Peer Review comprised three levels of review: (1) individual projects were scored based on technical approach, relevance, progress, and future direction; (2) each technology area portfolio was evaluated for overall potential impact, innovation, synergies, focus, commercialization, and recommendations; and (3) the Office's structure and overall strategic direction was reviewed by an external Steering Committee. This report contains the results of each level of review and the inputs of more than 300 participants in the Peer Review process, including principal investigators, reviewers, Steering Committee members, and BETO staff. The Office would like to thank all of the reviewers and members of the Steering Committee who participated in this review. BETO would like to offer a special thanks for BCS, Incorporated's support in aiding the planning and implementation of this review process.

BETO is appreciative of the valuable insights and contributions that have been provided throughout the Peer Review process. Achieving the objectives of the Office is dependent on the effective management of all the projects in BETO's existing portfolio and on the appropriate focus and structure of future initiatives. BETO values the input of all the stakeholders in the bioenergy sector and looks forward to working with them in the years ahead to continue progress on the path toward building a successful advanced bioenergy industry and a sustainable bioeconomy.

Sincerely,

A handwritten signature in black ink, appearing to read "Jonathan Male".

**Dr. Jonathan Male**

Director, Bioenergy Technologies Office  
Office of Energy Efficiency and Renewable Energy  
U.S. Department of Energy

## EXECUTIVE SUMMARY

The Bioenergy Technologies Office (BETO) manages a diverse portfolio of projects across the spectrum of applied research and development within the dynamic context of developing technologies and evolving market conditions, as well as changing budgets and administration priorities. BETO's portfolio is organized according to the biomass-to-bioenergy supply chain—from feedstock source to end use—as illustrated in Figure ES-1.

The biennial Peer Review process enables external stakeholders to provide feedback on the responsible use of taxpayer funding and develop recommendations for the most efficient and effective ways to accelerate the development of an advanced bioenergy industry. BETO worked with the external Peer Review Steering Committee and Technology Area Review Panels to conduct the review process from July 2016 through July 2017. This report includes the results of both the Project Peer Review meeting held in March 2017 and the Program Management Review meeting held in July 2017.



**Figure ES-1. Biomass-to-Bioenergy Supply Chain**

## ACRONYMS AND ABBREVIATIONS

<b>3HP</b>	3-hydroxypropionate
<b>A&amp;S</b>	Analysis and Sustainability
<b>ABC</b>	Algal Biomass Conversion
<b>ABPDU</b>	Advanced Biofuels Process Demonstration Unit
<b>ABY</b>	Algal Biomass Yield
<b>ACN</b>	acrylonitrile
<b>ACSC</b>	Advanced Catalyst Synthesis and Characterization
<b>AD</b>	anaerobic digestion
<b>ADO</b>	Advanced Development and Optimization
<b>Agile BioFoundry</b>	Agile Biomanufacturing Foundry
<b>AMO</b>	Advanced Manufacturing Office
<b>ANL</b>	Argonne National Laboratory
<b>AOP</b>	annual operating plan
<b>ARPA-E</b>	Advanced Research Projects Agency – Energy
<b>ASSERT</b>	Analysis of Sustainability, Scale Economics, Risk, and Trade
<b>ASTM</b>	American Society for Testing and Materials
<b>ASU</b>	Arizona State University
<b>ATEC</b>	Algae Technology Educational Consortium
<b>ATJ</b>	alcohol-to-jet
<b>ATP3</b>	Algae Testbed Public–Private Partnership
<b>AVAP</b>	American Value-Added Pulping
<b>BAT</b>	Biomass Assessment Tool
<b>BAU</b>	business as usual
<b>BDO</b>	butanediol
<b>BETO</b>	Bioenergy Technologies Office
<b>BFNUF</b>	Biomass Feedstock National User Facility
<b>BIC</b>	Biofuels Information Center
<b>BCT</b>	Biomass Conversion Technology
<b>BMP</b>	best management practices
<b>BSM</b>	Biomass Scenario Model
<b>BT16</b>	2016 Billion-Ton Report
<b>BTEX</b>	benzene, toluene, ethylbenzene, xylenes
<b>C</b>	carbon
<b>C5</b>	five-carbon
<b>C6</b>	six-carbon
<b>CA</b>	carbonic anhydrase
<b>CAP</b>	Combined Algal Processing
<b>CAPS</b>	Coordinated Agriculture Projects
<b>CARB</b>	California Air Resources Board

<b>CBP</b>	consolidated bioprocessing
<b>CCM</b>	Catalyst Cost Model
<b>CCPC</b>	Consortium for Computational Physics and Chemistry
<b>CEMAC</b>	Clean Energy Manufacturing Analysis Center
<b>CFP</b>	catalytic fast pyrolysis
<b>CH<sub>4</sub></b>	methane
<b>ChemCatBio</b>	Chemical Catalysis for Bioenergy
<b>CO</b>	carbon monoxide
<b>CO<sub>2</sub></b>	carbon dioxide
<b>Co-Optima</b>	Co-Optimization of Fuels and Engines
<b>CRADA</b>	cooperative research and development agreement
<b>DDA</b>	deacetylation/dilute acid
<b>DISCOVR</b>	Development of Integrated Screening, Cultivar Optimization, and Validation Research
<b>DMR</b>	deacetylation/mechanical refining
<b>DMT</b>	Demonstration and Market Transformation
<b>DOE</b>	U.S. Department of Energy
<b>DOI</b>	U.S. Department of the Interior
<b>DPA</b>	Defense Production Act
<b>EERE</b>	Office of Energy Efficiency and Renewable Energy
<b>EMDS</b>	Ecosystem Management Decision Support
<b>EPA</b>	U.S. Environmental Protection Agency
<b>FAPRI</b>	Food and Agricultural Policy Research Institute
<b>FASOM</b>	Forest and Agricultural Sector Optimization Model
<b>FCC</b>	fluid catalytic cracking
<b>FCIC</b>	Feedstock-Conversion Interface Consortium
<b>FOA</b>	funding opportunity announcement
<b>FPEAM</b>	Feedstock Production Emissions to Air Model
<b>FSL</b>	Feedstock Supply and Logistics
<b>FSMA</b>	Food Safety Modernization Act
<b>F-T</b>	Fischer-Tropsch Process
<b>FY</b>	fiscal year
<b>GAI</b>	Global Algae Innovations Inc.
<b>GCAM</b>	Global Change Assessment Model
<b>gge</b>	gasoline gallon equivalent
<b>GHG</b>	greenhouse gas
<b>GMO</b>	genetically modified organism
<b>GREET</b>	Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation
<b>GTAP</b>	Global Trade Analysis Project
<b>HTL</b>	hydrothermal liquefaction
<b>IBE</b>	isopropanol, butanol, and ethanol
<b>IBR</b>	integrated biorefinery

<b>IEA</b>	International Energy Agency
<b>IH2</b>	Integrated Hydrolysis Plus Hydroconversion Technology
<b>INL</b>	Idaho National Laboratory
<b>IP</b>	intellectual property
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>JEDI</b>	Jobs and Economic Development Impact (Model)
<b>KDF</b>	Knowledge Discovery Framework
<b>kg</b>	kilogram
<b>L</b>	liter
<b>LAP</b>	laboratory analytical procedures
<b>LCA</b>	life-cycle analysis
<b>LEAF</b>	Landscape Environmental Assessment Framework
<b>LEAPS</b>	Laboratory Environmental Algae Pond Simulator
<b>LLNL</b>	Lawrence Livermore National Laboratory
<b>LUC</b>	land-use change
<b>MC</b>	membrane carbonation
<b>MFSP</b>	minimum fuel selling price
<b>MOOC</b>	Massive Open Online Courses
<b>MSS</b>	Moisture Swing Sorption
<b>MSW</b>	municipal solid waste
<b>MT</b>	Market Transformation
<b>MYPP</b>	Multi-Year Program Plan
<b>NA</b>	nanostuctured adsorbents
<b>NGO</b>	nongovernmental organization
<b>NIFA</b>	National Institute of Food and Agriculture
<b>NIR</b>	near infrared
<b>NREL</b>	National Renewable Energy Laboratory
<b>ORNL</b>	Oak Ridge National Laboratory
<b>OTA</b>	octatrienoic acid
<b>PACE</b>	Producing Algae and Co-Products for Energy
<b>PAT</b>	process analytical technologies
<b>PBR</b>	photobioreactor
<b>PDU</b>	Process Demonstration Unit
<b>PD2B3</b>	Project Definition for Pilot- and Demonstration-Scale Manufacturing of Biofuels, Bioproducts, and Biopower
<b>PHA</b>	polyhydroxyalkanoate
<b>PHB</b>	polyhydroxybutyrate
<b>PI</b>	principal investigator
<b>PNNL</b>	Pacific Northwest National Laboratory
<b>RAFT</b>	Regional Algal Feedstock Testbed Partnership
<b>R&amp;D</b>	research and development

<b>REACH</b>	Renewable Acid-Hydrolysis Condensation Hydrotreating
<b>RFS</b>	Renewable Fuel Standard
<b>RINS or RIN</b>	Renewable Identification Number
<b>RSB</b>	Roundtable on Sustainable Biomaterials
<b>SCADA</b>	supervisory control and data acquisition
<b>SCOPE</b>	Scientific Committee on Problems of the Environment
<b>SD</b>	System Dynamics
<b>SDSU</b>	South Dakota State University
<b>SNL</b>	Sandia National Laboratories
<b>SOC</b>	soil organic compound
<b>SOFC</b>	solid-oxide fuel cell
<b>SOT</b>	state of technology
<b>SRWC</b>	short-rotation woody crops
<b>STEM</b>	science, technology, engineering, and math
<b>SUNY</b>	State University of New York
<b>2016 Strategic Plan</b>	Strategic Plan for a Thriving and Sustainable Bioeconomy
<b>SWAT</b>	Soil and Water Assessment Tool
<b>TCPDU</b>	Thermochemical Process Development Unit
<b>TEA</b>	techno-economic analysis
<b>THF</b>	tetrahydrofuran
<b>TRL</b>	technology readiness level
<b>TRY</b>	titer, rate, and yield
<b>USDA</b>	U.S. Department of Agriculture
<b>USFS</b>	U.S. Forest Service
<b>USFS FIA</b>	U.S. Forest Service Forest Inventory and Analysis
<b>VGO</b>	vacuum gas oil
<b>VTO</b>	Vehicle Technologies Office
<b>w/w</b>	weight by weight
<b>WBS</b>	work breakdown structure
<b>WTE</b>	Waste to Energy
<b>wt%</b>	weight percent
<b>WWTP</b>	wastewater treatment plant



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## INTRODUCTION

The U.S. Department of Energy's (DOE's) Bioenergy Technologies Office (BETO or the Office) framed its 2017 Peer Review process in the context of two guiding documents that were released the prior year. The *Strategic Plan for a Thriving and Sustainable Bioeconomy* (2016 Strategic Plan) and BETO's 2016 *Multi-Year Program Plan* (MYPP) are referenced throughout this report. Both plans are summarized in the following section to introduce the vision, mission, goals, and structure of the Office. The 2016 Strategic Plan and 2016 MYPP overviews are followed by an overview of the Peer Review process and the format of this report. Since this project portfolio was reviewed, BETO has made a strategic shift to early-stage research and development (R&D) to build the knowledge base upon which industry can develop and deploy technologies that enable continued growth of the U.S. bioeconomy.

### 2016 Strategic Plan Overview

In 2016, BETO published a strategic plan that reflects the transformation and the advancements made in the bioenergy industry since the 1990s. The 2016 Strategic Plan expands BETO's mission beyond the cellulosic ethanol market to include renewable drop-in fuels (including diesel and jet fuels), biobased chemicals, and bioproducts. The new strategy also emphasizes the need to address environmental concerns associated with increased agricultural demand, including water and soil quality. The 2016 Strategic Plan is intended as an operational guide for managing and coordinating activities among technology areas. The plan is BETO's blueprint for tackling the challenges and opportunities associated with building a sustainable U.S. bioeconomy. While the BETO vision is set for 2040, it is important that processes are in place to verify progress, understand competing technologies, and revisit specific strategies every 5 years.

The 2016 Strategic Plan aligns with the Office of Energy Efficiency and Renewable Energy's *2016–2020 Strategic Plan and Implementing Framework* vision, mission, and relevant strategic goals. The main components of BETO's 2016 Strategic Plan include key opportunity areas, a strategic goal for each key opportunity area, and strategies for accomplishing each strategic goal. These components are intended to be crosscutting programmatic-level guidance and should be used to determine how to adapt and align BETO activities and project portfolios to best meet BETO's objectives and carry out the Office's mission in a continually changing environment.

BETO's 2016 Strategic Plan, which encompasses programmatic-level guidance, set the foundation for the projects reviewed in this portfolio. The 2016 MYPP identified research, development, and demonstration pathways and performance goals and outlined how BETO could meet its mission and vision. The projects in the portfolio reviewed during the 2017 Project Peer Review were established either through annual operating plans (AOPs) or through competitive funding opportunity announcements (FOAs). National laboratory recipients prepare AOPs for BETO review annually prior to each fiscal year (FY), and BETO develops FOAs based upon stakeholder input about R&D gaps and resources needed. Both AOPs and FOAs include project management plans that outline the implementation approach for the project to achieve strategic and performance goals.

BETO conducts R&D activities through an integrated supply chain approach addressing supply (feedstocks), conversion, distribution, and end use. Several activities underscore BETO's R&D—sustainability, strategic analysis, and communications—which enable development and dissemination of knowledge and tools related to the economic, environmental, and social dimensions of advanced bioenergy. While cellulosic biofuel production is BETO's primary focus, BETO also supports the production of chemical intermediates that are traditionally petroleum-de-

rived but can be produced from biomass. These intermediates are converted into high-value bioproducts, including bioplastics, biobased chemicals, lubricants, solvents, cosmetics, and food ingredients, such as algae oil—all of which have places in today’s commercial markets.

During Fiscal Year 2017, BETO made a strategic shift to early-stage R&D that resulted in renaming the Demonstration and Market Transformation (DMT) Technology Area to Advanced Development and Optimization (ADO). This name change reflects a reframing of the program area’s focus away from demonstration-scale projects into a lower technology readiness level (TRL) space. While BETO plans to operate within a lower TRL scale (TRL 4–6) to better leverage investments under a constrained budget, it also plans to prioritize the utilization of existing resources and to build upon past investments in order to help the industry progress.

The new role of the ADO Program has not yet been fully established, and, as such, the Office is planning to solicit stakeholder input. BETO will hold a public meeting to define the value the new ADO Program can provide stakeholders working to develop the bioenergy industry. The public meeting will also raise awareness of existing assets from past investments and identify future needs and opportunities. Through this public meeting, BETO aims to both provide clarity on BETO’s new operating constraints and mission space and to engage with stakeholders to better understand public needs and priorities within this mission space.

Figure 1 summarizes the 2016 Strategic Plan, which guided BETO’s implementation of the project portfolio reviewed in 2017. Key opportunities reflect the best paths available to support BETO’s mission, and each opportunity is aligned with a strategic goal, which will be achieved by implementing a range of strategies.

**DOE Mission**

Enhance U.S. security and economic growth through transformative science, technology innovation and market solutions to meet our energy, nuclear security and environmental challenges.

**EERE Vision**

A strong and prosperous America powered by clean, affordable, and secure energy.

**Relevant EERE Strategic Goals**

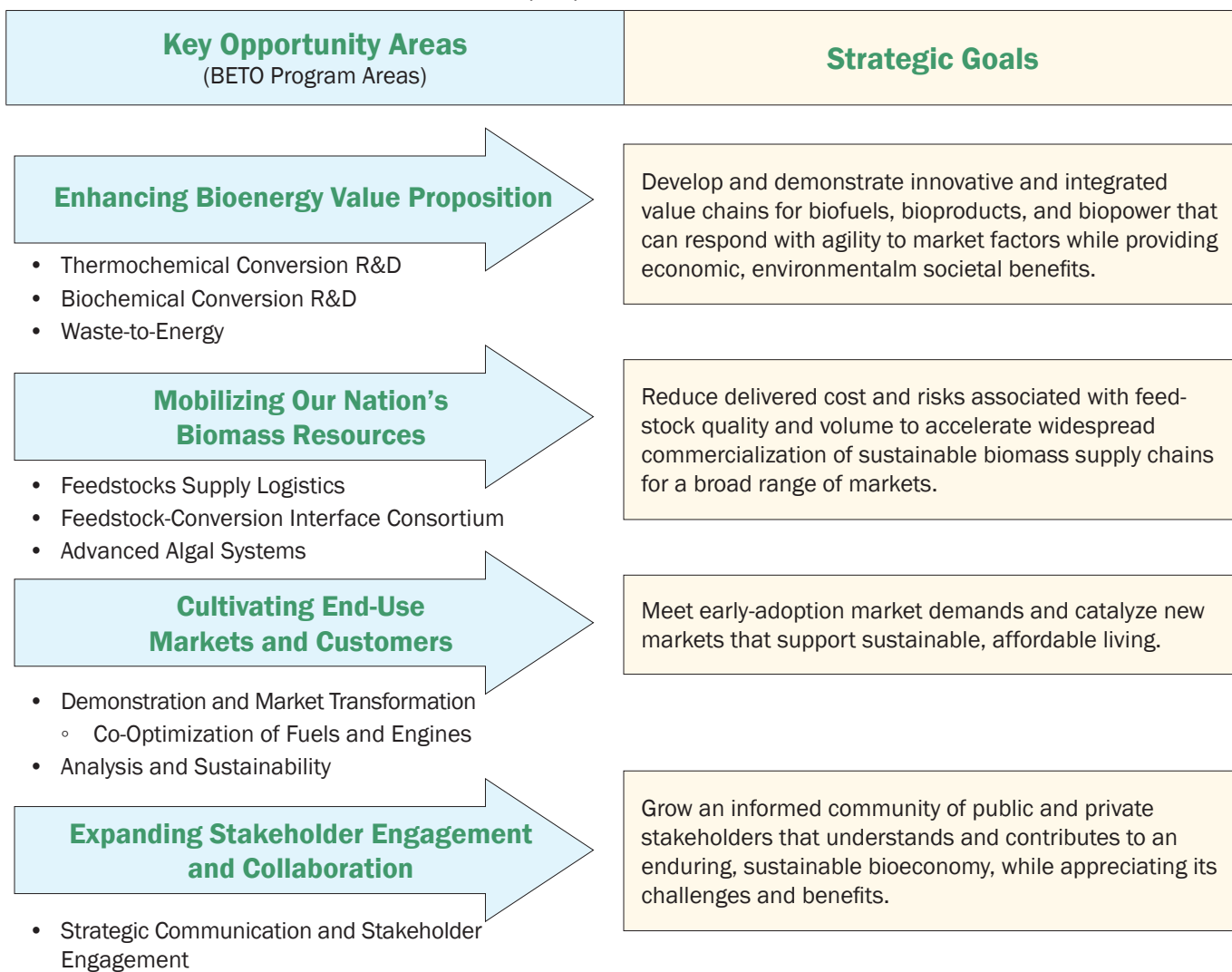
- Accelerate the development and adoption of sustainable transportation technologies.
- Stimulate the growth of a thriving domestic clean energy manufacturing industry.
- Lead efforts to improve federal sustainability and implementation of clean energy solutions.

**BETO Vision 2040**

A thriving and sustainable bioeconomy fueled by innovative technologies.

**BETO Mission**

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



**Figure 1. BETO 2016 Strategic Plan summary and program areas crosswalk**

## MYPP Overview

The MYPP, released in March 2016, sets forth BETO’s goals and structure; identifies the R&D, market transformation, and crosscutting goals and activities that BETO will focus on over the next 5 years; and describes how these activities are critical in meeting the nation’s future economic and energy challenges. The MYPP is intended for use as an operational guide to help BETO manage and coordinate its activities, as well as a resource to communicate its mission, goals, plans, and priorities to stakeholders and the public.

BETO manages a diverse portfolio of technologies across the spectrum of applied R&D within the dynamic context of developing technologies and evolving market conditions. BETO’s portfolio is organized according to the biomass-to-bioenergy supply chain—from the feedstock source to end use. The MYPP identifies technical and market challenges and barriers to be addressed for each program area, as well as those that cross the entire supply chain.

Figure 2 shows how BETO’s program areas align with supply-chain elements, with major emphases on feedstock supply and biomass conversion and how crosscutting programs support all areas. Key components of the portfolio include the following:

- Conducting R&D on robust feedstock supply systems to deliver large quantities of quality feedstocks
- Conducting R&D on high-productivity advanced algal systems
- Conducting R&D on conversion technologies able to process diverse and variable feedstocks
- Developing and verifying biorefinery technologies at minimal, scalable, engineering scale
- Addressing distribution, end-use, and market challenges and opportunities
- Performing crosscutting sustainability, strategic analysis, and strategic communications activities.

Research, Development, Demonstration, and Market Transformation			
Feedstock Supply and Logistics	Advanced Algal Systems	Conversion	Demonstration and Market Transformation
Develop high-volume distribution network of sustainable, quality biomass feedstocks.	Increase algal productivity, while maximizing the yield of products and chemicals.	Optimize conversion efficiency while improving quality of intermediates, fuels and products.	Demonstrate performance at increasing scales to enable commercial biorefineries.
Crosscutting			
Sustainability	Strategic Analysis	Strategic Communications	
Quantify effects and enhance the benefits of advanced bioenergy with regard to water, air, soil, and quality of life.	Internal and external strategic program analyses and development of tools to understand the impacts of the bioeconomy.	Disseminate research and development impacts while educating the public on environmental and economic benefits of technological advances.	

**Figure 2. BETO program area alignment with the biomass-to-bioenergy supply chain<sup>1</sup>**

<sup>1</sup> Feedstocks Supply and Logistics includes the Feedstock-Conversion Interface Consortium. Conversion R&D includes Thermochemical Conversion R&D, Biochemical Conversion R&D, and Waste to Energy. Demonstration and Market Transformation (DMT) includes the Co-Optimization of Fuels and Engines. In FY 2017, outside the scope of this review, BETO redefined activities within the DMT portfolio to align with administrative priorities and renamed this program area Advanced Development and Optimization.



## BETO 2017 Peer Review Overview

The Project Peer Review meeting took place on March 6–9, 2017, in Denver, Colorado. During the public event, project investigators (PIs) presented 182 presentations covering 277 projects in BETO's R&D portfolio. These projects were systematically reviewed by more than 40 external subject matter experts from industry, academia, and federal agencies. The Project Peer Review included simultaneous review sessions of projects within nine technology areas; some of these technology areas are primary program areas, while some are sub-categories of the primary program areas, as indicated below:

- Feedstock Supply and Logistics (FSL)
  - Feedstock-Conversion Interface Consortium (FCIC)
- Advanced Algal Systems (Algae)
- Conversion R&D
  - Thermochemical Conversion R&D (Thermochem)
  - Biochemical Conversion R&D (Biochem)
  - Waste to Energy (WTE)
- Analysis and Sustainability (A&S)
- Demonstration and Market Transformation (DMT)/ADO
  - Co-Optimization of Fuels and Engines (Co-Optima).

The Program Management Review meeting took place on July 13, 2017, in Arlington, Virginia, and provided an Office-level assessment of strategic planning and programmatic initiatives.

The projects reviewed represent a total DOE investment of more than \$700 million, approximately \$300 million of which was allocated during the period covered by this Peer Review (FY 2015–2017). Each Review Panel developed overall recommendations regarding the focus, management, and impact of the projects in each technology area. In addition, an external Steering Committee reviewed the Strategic Communications portfolio and the Review Panel summary reports from each technology area to develop overall recommendations for the Office. Results of the 2017 Peer Review have been, and will be, used to help inform programmatic decision making, modify or discontinue existing projects, guide future funding opportunities, and support other budget and strategic planning objectives.

The Peer Review brought together reviewers and BETO staff with PIs and other stakeholders along the entire bio-energy supply chain. Converging stakeholders in this way creates synergy across technology areas and enables the cross-fertilization of ideas and expertise, while providing for a more comprehensive review process. Figures 3 and 4 depict the BETO total project portfolio reviewed by technology area session and funding allocation.

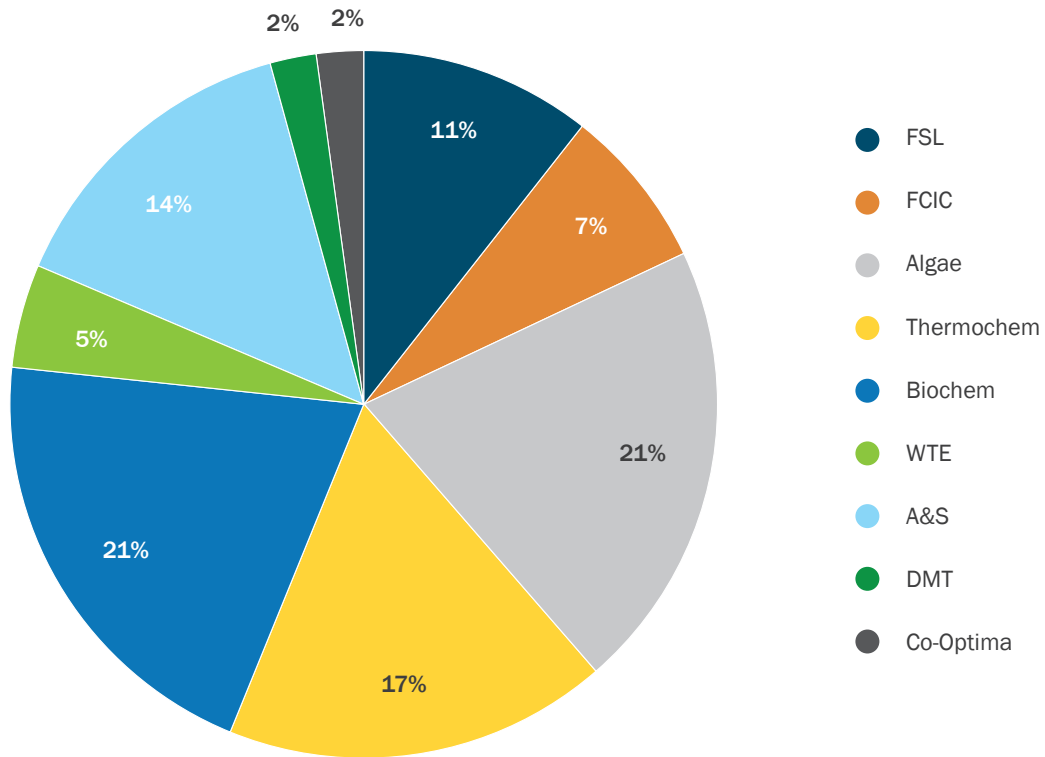


Figure 3. BETO project portfolio—number of projects by technology area session

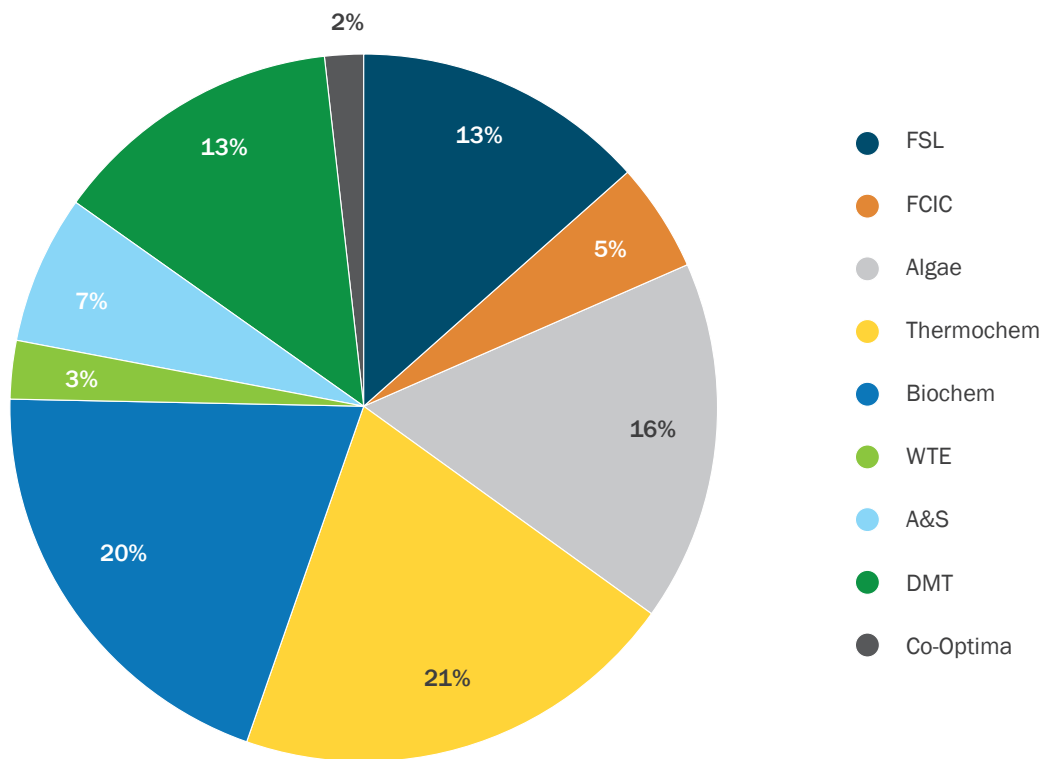


Figure 4. BETO project portfolio—total budget by technology area session. Note: Due to rounding, whole numbers in this chart do not add up to exactly 100%.

## Roles and Responsibilities

The BETO 2017 Peer Review was conducted by an internal planning committee, an external Steering Committee, and nine external Review Panels. Upon initiation of the review process, an internal BETO planning committee was designated with the responsibility for coordinating all aspects of the review process, from initiation through completion. This committee included a lead and support person for each of the nine technology areas, as well as a chair, Valerie Reed, a deputy chair, Nichole Fitzgerald, and overall coordination support. Support contractors from BCS, Incorporated provided planning support for each session, developed an online reviewer evaluation system, facilitated development of report materials, and compiled and drafted the final Peer Review Report.

At the beginning of the process, the BETO planning committee identified and recruited an external Steering Committee to represent the perspectives of academia, industry, the financial community, and non-governmental organizations. The Steering Committee provided independent and impartial guidance on planning activities and the selection of external reviewers; participated in the review process; and developed crosscutting recommendations on the Office's overall focus, scope, and strategic direction.

Review Panels for each technology area consisted of four to six external experts who were selected based on their technical expertise and high-level qualifications in their designated technology area. The BETO technology area teams proposed individual candidates, which were submitted to the external Steering Committee for input. Efforts were made to ensure a balance within each Technology Area Review Panel by including a mix of reviewers from industry, academia, and federal agencies, with a range of expertise in the many sub-focus areas within each technology area. Review Panel members were required to sign legal agreements stipulating an absence of a conflict of interest with the projects they reviewed. The internal planning committee and BETO's director made the final decisions on reviewer selection. Each Review Panel was guided by a Lead Reviewer who, in most cases, had previous experience participating in a BETO Peer Review.

Table 1 and Table 2 list the members and affiliations of the Peer Review Steering Committee and the Lead Reviewers, respectively. Members of each Technology Area Review Panel are listed within each of the technology area session summaries.

**Table 1. Steering Committee Members**

Name	Affiliation
Mike Lakeman*	Boeing
Steven Costa	U.S. Department of Transportation
John May	Stern Brothers & Co.
Shelie Miller	University of Michigan
Dawn Mullally	American Lung Association
Robert (Bob) Rummer	University of Kansas
Bob Wooley	Biomass ad <i>infinitum</i> LLC

\*Lead Reviewer

**Table 2. Lead Reviewers**

Name	Technology Area Review Panel	Affiliation
Steve Searcy	FSL	Texas A&M University
Gerson Santos Leon	FCIC	Abegnoa
Eric Jarvis	Algae	Independent Consultant
Candace Wheeler	A&S	General Motors (Retired)
Suzanne Lantz	Biochem	DuPont
Shawn Freitas	Thermochem	ThermoChem Recovery International
F. Michael McCurdy	DMT/ADO	Leidos
Luca Zullo	WTE	VerdeNero LLC

## Project Categories and Evaluation Criteria

Each project in the BETO portfolio was categorized based upon its start and/or end date. To capture projects that have been active since the 2015 Peer Review, the three project categories are as follows:

- Sun-setting (projects with end dates between October 2015 and October 2017)
- Ongoing (projects with end dates after October 2017 and start dates prior to October 2016)
- New (projects with start dates after October 2016).

Project scoring involved weighting the evaluation criteria based upon each project’s category. The weighting for project categories and evaluation criteria is illustrated in Table 3.

**Table 3. Project Evaluation Criteria Weighting**

Review Criteria Weights	Project Categories		
	Sun-Setting Projects <i>(end date between October 2015 and October 2017)</i>	Ongoing Projects	New Projects <i>(start date after October 2016)</i>
Approach	25%	25%	25%
Accomplishments/ Progress	50%	25%	0%
Relevance	25%	25%	25%
Future Work	0%	25%	50%

Review Panel members were asked to evaluate each project on specific criteria: approach, accomplishments/progress, relevance, and future work. These evaluation criteria, as described below, served as the standard template for the scores and comments provided to each project.

- **Approach**—Projects were evaluated on the degree to which they developed a thorough approach involving the following components:
  - The project performers have implemented technically sound research, development, and deployment approaches and have demonstrated the results needed to meet their targets.
  - The project performers have identified a project management plan that includes well-defined milestones and adequate methods for addressing potential risks.
  - The project performers have clearly described critical success factors that will define technical and commercial viability, and they have explained and understand the challenges they must overcome to achieve success.
- **Accomplishments/Progress**—Projects were evaluated on the degree to which they demonstrated accomplishments during the project award period:
  - The project performers have made progress in reaching their objectives based on their project management plan. The project performers have described their most important accomplishments in achieving milestones, reaching technical targets, and overcoming technical barriers.
  - The project performers have clearly described the progress since the period of the last review.
- **Relevance**—Projects were evaluated on the degree to which they contributed value to the broader BETO vision and industry development:
  - The project performers have described how the project contributes to meeting program/technology area goals and BETO objectives, as cited in the MYPP.
  - The project performers have considered applications of their expected outputs.
  - The project performers have presented the relevancy of the project and how successful completion of the project will advance the state of technology and impact the viability of commercial bioenergy applications.
- **Future Work**—Projects were evaluated on the degree to which they are positioned for further accomplishments:
  - The project performers have outlined adequate plans for future work, including key milestones and go/no-go decision points.
  - The project performers have communicated key planned milestones and addressed how they plan to deal with upcoming decision points and any remaining issues.



## Format of the Report

Information in this report has been compiled based on the following sources and is organized as follows:

- 1. Peer Review Report Introduction:** This section contains overview information on the Peer Review process, roles and responsibilities, and project evaluation criteria.
- 2. BETO Overview:** This section provides an overview of BETO's mission, vision, and goals, as well as descriptions of the Office's approach to achieving goals and the market barriers that create challenges to doing so.
- 3. Technology Area Summaries:** These nine sections represent the comprehensive evaluation for each of the nine technology areas reviewed. Each section includes the following components:
  - i. Introduction:* Overview of the technology area's project portfolio, including total funding allocated for FY 2015–FY 2016 and percentage of total BETO project portfolio.
  - ii. Program Overview:* Background information about the BETO program that operates the given technology area, including program scope, R&D activities, important definitions. This component also includes context on the program's approach for overcoming challenges and for supporting BETO strategic and performance goals.
  - iii. Review Panel Members:* A list of names and affiliations for each of the individuals who provided project evaluations and contributed to the Review Panel's summary report.
  - iv. Technology Area Score Results:* This chart depicts the average weighted score for each project in each technology area.
  - v. Review Panel Summary Report:* A summary of project evaluations that provides insight into the technology area's overall impact, level of innovation, leverage of synergies, appropriate focus, feasibility for commercialization, and top recommendations. The Lead Reviewer for each technology area drafted this summary in consultation with the full Technology Area Review Panel. Consensus among the reviewers was not required, and reviewers were asked to include differences of opinion and dissenting views within the report.
  - vi. Technology Area Programmatic Response:* The program's official response to the recommendations provided in the Review Panel's summary report.
  - vii. Project Evaluations:* The individual project reports, which constitute 2–3-page reports summarizing the results of each project evaluated during the review process. Each report includes the following elements:
    - a. Project Name and Work Breakdown Structure (WBS) Number:** The full project name is listed as the heading, with the identifying code underneath in parentheses. Project evaluations for each technology area are ordered by WBS number, from lowest to highest.
    - b. Weighted Project Score:** Each project's average weighted score is stated numerically. A box and whisker chart depicts the average scores for each evaluation criterion, as well as the range of scores given to the project by the individuals within the Review Panel. The chart also indicates the average value for each evaluation criterion across all projects within the technology area.
    - c. Summary Table:** Each report provides reference information about the project, including the recipient organization, PI name, project dates, project type, and funding values.

- 1) Recipient: The recipient indicates the organization tasked with leading the project (this may include multiple organizations in situations where the project has more than one recipient).
  - 2) Principle Investigator: The PI is the individual affiliated with the recipient organization who is assigned to lead the project.
  - 3) Project Category: Each project is categorized as sun-setting, ongoing, or new, based on its start/end date.
  - 4) Project Type: There are many types of projects within the BETO portfolio, but this review focused primarily on two types of projects: (1) AOPs, which are core R&D projects performed by DOE's national laboratories, and (2) projects awarded through a funding opportunity announcement, which are indicated in this table by listing the FOA's name, number, and fiscal year.
  - 5) Funding: The funding is the allocated project budget. Values for AOPs are available on a fiscal year basis, while competitively awarded project funding is only available as a total value.
- d. Project Descriptions: Project descriptions are compiled from the abstracts that the PIs submitted for each project.
  - e. Overall Impressions: These are verbatim comments made by the Review Panel, edited only for grammar and clarity. Each bulleted response represents the opinion of one reviewer. Reviewers were not asked to develop consensus remarks and, in most cases, did not discuss their overall comments on each project with one another. In a limited number of cases, reviewer remarks deemed inappropriate or irrelevant were excluded from the final report.
  - f. PI Response to Reviewer Comments: This is the PI's response to the reviewers' comments. In some cases, PIs chose to respond bullet by bullet to each of the reviewers' comments and, in other cases, provided only a summary response.

**4.Strategic Communications Portfolio Evaluation:** The Steering Committee provided a review of BETO's Strategic Communications efforts, with a focus on identifying strengths and limitations. Sections of this chapter cover alignment of investments with results, coordination with the Office, messaging, and audiences.

**5.Strategic Communications Programmatic Response:** This is the BETO Strategic Communications lead's response to the Steering Committee's Strategic Communications portfolio evaluation.

**6.Programmatic Evaluation:** This is the external Steering Committee's overall summary feedback and final recommendations following the conclusion of the Program Management Review. This report was based on the Steering Committee's participation in each component of the Peer Review process, as well as closed-door, facilitated review sessions following the Project Peer Review and the Program Management Review meetings. Components of this report include identification of overall strengths and weaknesses, comments on the portfolio impact, assessment of the Office's 2016 Strategic Plan, and input regarding technologies and market trends that may affect BETO's ability to achieve its goals.

**7.BETO Programmatic Response:** This is BETO leadership's official, comprehensive response to the Steering Committee's feedback and recommendations in their programmatic evaluation.