Biomass Research and Development

Technical Advisory Committee

March 30–31, 2017

Meeting Summary

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List of Acronyms

BES – Basic Energy Sciences
BETO – Bioenergy Technologies Office
Board – Biomass Research and Development Board
BRDI – Biomass Research and Development Initiative
Committee – Biomass Research and Development Technical Advisory Committee
DOE – U.S. Department of Energy
FOA – funding opportunity announcement
FY – fiscal year
IBCE – Institute of Bioenergy, Climate and the Environment
NAREEE – National Agricultural Research, Extension, Education, and Economics Advisory Board
NIFA – National Institute for Food and Agriculture
NPL – National Program Leader
QFT – Quarterly Focus Topic
R&D – research and development
RFA – request for applications
SC – Office of Science
USDA – U.S. Department of Agriculture

I. Purpose

On March 30–31, 2017, the Biomass Research and Development Technical Advisory Committee (Committee) held its first meeting of 2017. The Committee received updates from the U.S. Department of Energy's (DOE's) Bioenergy Technologies Office (BETO) and Office of Science (SC), as well as representatives from the U.S. Department of Agriculture (USDA) who delivered presentations about current USDA activities.

See Appendix A for a list of meeting attendees. See Appendix B to review the meeting agenda. Meeting presentations can be viewed on the Biomass Research and Development Initiative (BRDI) website at the following link: https://biomassboard.gov/committee/meetings.html.

Background:

The Committee was established by the *Biomass Research and Development Act of 2000*, which was later repealed and replaced by Section 9008 of the *Food, Conservation, and Energy Act of 2008*. The Biomass Research and Development Board (Board) was established under the same legislation to coordinate activities across federal agencies. The *Food, Conservation, and Energy Act* has recently been amended by the *Agricultural Act of 2014*. The Committee is tasked with advising the Secretary of Energy and the Secretary of Agriculture on the direction of biomass research and development (R&D).

II. Welcome

Kelly Tiller, Committee Co-Chair

Dr. Tiller welcomed the Committee to the first meeting of the year and called the meeting to order.

III. 2017 Committee Topics

Kelly Tiller, Committee Co-Chair

Dr. Tiller introduced a new approach to developing recommendations from the Committee in 2017. She first provided background on the Committee, discussing why the Committee exists, who makes up the Committee's members, and what the Committee does. She then started to introduce how the Committee will conduct business moving forward. The Committee and its membership form an outstanding resource for the Biomass R&D Board, multiple federal agencies, Congress, and the Administration. The Committee would like to have a more focused, efficient, and productive way to use members' precious time. The Committee can best help facilitate the transition and maintain momentum from past efforts by providing input and feedback regularly throughout the year, not just a year from now. Over the last couple of years, Committee members have been advocating for the Committee to elevate its impact to have more real-time communications related to highly relevant priorities. We hope this may be a clear way to have an actionable plan that we are working toward at each quarterly meeting, rather than a synthesis of a year's worth of diverse discussions at the end of the year. The new approach will establish a strong foundational overview on the topic choice and communicate the

Committee's collective thoughts on the topic. The information we provide would be truly actionable in very short order with a clear role for the federal government to move the needle and shift momentum. By implementing Quarterly Focus Topics (QFTs), we can plan each meeting to focus on the given topic, and we can invite speakers and outside experts to help the Committee collectively understand, frame, and discuss each QFT. During each quarterly Committee meeting, the Committee will break out into more focused subgroups (e.g., Feedstocks, Conversion, Products/ Markets/Systems) to discuss the QFT in more granular detail or from a particular perspective. Collectively, the Committee will develop a framework and key themes/ideas on each QFT for preparation and then disseminate a written brief on each QFT. Dr. Tiller then described what criteria would make a good QFT:

- The topic should be highly relevant for our stakeholders.
- The topic should be balanced in depth and scope.
- The topic should lend itself to timely distillation into an external communication.
- The topic should be actionable.

The goal of the first quarterly meeting was to agree on the second quarterly meeting's QFT and identify potential topics for the third and fourth quarterly meetings.

Patricia Scanlan stated her approval of the new approach. She felt that it would better reflect the Committee's intentions over the yearlong recommendation process.

Ray Miller felt that the new process makes the Committee's work more relevant.

Steve Csonka likes the focused topics approach but cautioned that one quarterly meeting may not be enough time on a given topic. Alan Weber stated that questions may arise at a given meeting that may need more information or require speakers to address them at a future meeting. Kelly Tiller said we could be flexible and provide more time throughout the year if needed.

IV. Committee Business for 2017 and DOE Updates

Mark Elless, Designated Federal Officer, DOE

Dr. Elless began his presentation by providing the background and authority of the Committee. He then provided an update on bioenergy-related activities and DOE. He started by highlighting the mission, vision, goals, and organization updates of BETO.

Mission: A thriving and sustainable bioeconomy fueled by innovative technologies
Vision: Developing and demonstrating transformative and revolutionary sustainable bioenergy technologies for a prosperous nation

He then provided updates on funding opportunity announcements (FOAs), requests for information, reports, and events:

Closed FOAs:

- Co-Optimization of Fuels and Engines Initiative: On December 29, 2016, the Energy Department announced up to $7 million for eight universities to accelerate the introduction of affordable, scalable, and sustainable high-performance fuels for use in high-efficiency, low-emissions engines.

- Project Development for Pilot and Demonstration Biofuels and Bio-Products Manufacturing: On December 28, 2016, DOE announced up to $12.9 million for six projects related to the manufacturing of advanced or cellulosic biofuels, bioproducts, refinery-compatible intermediates, and/or biopower in a domestic pilot- or demonstration-scale integrated biorefinery.

Open FOAs:

- Integrated Biorefinery Optimization FOA: A joint FOA with USDA, it offers up to $22.7 million in support of the optimization of integrated biorefineries (IBRs). Applications must be focused on lowering technical and financial risk and addressing challenges encountered with the successful scale-up and reliable continuous operation of IBRs. The submission deadline for full applications was April 3, 2017.

- Productivity Enhanced Algae and Tool-Kits (PEAK): This FOA offers up to $8 million in federal-share funding and was announced on December 15, 2016. The goals are to achieve an annual average algal biomass productivity of at least 18 grams/square meter/day, extrapolated from the combination of relevant seasonal data from the project and literature values for seasonal regimes not targeted by a given project, while achieving a minimum of 80 gasoline gallons equivalent per ton of biomass potential, by 2020. Applications were due on February 22, 2017.

Market-Driven Opportunities:

- The Small Business Vouchers Pilot supports small businesses in bringing new clean energy technologies to market faster by giving them access to state-of-the-art facilities and capabilities.

- Transforming “waste streams” into revenues for rural economies—BETO-funded projects have transformed industrial waste gases into jet fuels, as well as converted sewage sludge into renewable fuel. Both technologies are currently being licensed for commercial applications.

- BETO will continue to implement clean energy solutions through initiatives like the Defense Production Act, which aims to bring renewable fuels to the U.S. military.

Reports:

- BETO Strategic Plan: *The Strategic Plan for a Thriving and Sustainable Bioeconomy* was released December 29, 2016.

- *2016 Billion-Ton Report: Advancing Domestic Resources for a Thriving Bioeconomy* (*BT16*)
    - *BT16, Volume 1: Economic Availability of Feedstocks of the 2016 Billion-Ton Report* (released July 2016) concluded that the United States has the potential to produce at least 1 billion dry tons of nonfood biomass resources annually by 2040.
    - *BT16, Volume 2: Environmental Sustainability Effects of Select Scenarios from Volume 1* (released January 13, 2017) uses environmental models to investigate changes in greenhouse gas emissions, soil organic carbon, water quality and quantity, air emissions, and biodiversity for particular 2017 and 2040 biomass-production scenarios.
    - *BT16 Volume 2* is a pioneering effort to analyze a range of potential environmental effects, to identify strategies to enhance environmental benefits, and to minimize negative effects associated with a growing bioeconomy.
- In November 2016, the Board released *The Billion Ton Bioeconomy Initiative: Challenges and Opportunities* report. This report incorporates stakeholder input on the challenges to and opportunities for expanding the bioeconomy.
- *The Billion Ton Bioeconomy Initiative: Action Plan* report is targeted for release in the summer of 2017.

Events and Activities:

- *The Bioeconomy Action Plan Workshop* was held April 5–6, 2017. Its goal was to develop a roadmap of crosscutting federal activities and collaborative actions to catalyze the expansion of a sustainable domestic bioeconomy.
- *Bioeconomy 2017* will be held July 11–12, 2017, at the Sheraton Pentagon City Hotel. It will convene key representatives from across the bioenergy supply chain, including industry, federal agencies, and Congress.
- *2017 Bioenergy Technologies Office Program Management Review* will be held July 13 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.

Dr. Elless concluded by welcoming seven new members to the Committee and congratulating current Committee member Kelly Tiller on becoming a Committee Co-Chair. New members are as follows:

- Dr. Charles Abbas, Archer Daniels Midland
- Dr. Katrina Cornish, Ohio State University
- Dr. William Frey, Georgia-Pacific
- Dr. Beth Hood, Arkansas State University
- Dr. Raymond Huhnke, Oklahoma State University

- Matthew Rudolf, SCS Global Services
- Dr. Michael Wolcott, Washington State University

Don Stevens asked if Dr. Elless could elaborate on the new administration's priorities. Dr. Elless said that they would have to wait for the budget from Congress to know priorities.

Joe James asked for more details regarding the cost of feedstocks-reduction work. Dr. Elless stated that most of that work is done by Idaho National Laboratory. Blending is a key component to feedstocks-reduction work to meet 2017 targets.

Emily Heaton stated that BETO is working hard on collaboration efforts on feedstocks research. She noted that assumptions made in the Billion-Ton reports assume 100% adoption—she feels that not all producers will adopt 100%.

V. USDA Update on Biomass R&D Activities

Harry Baumes, Director, Office of Energy Policy and New Uses, U.S. Department of Agriculture

Dr. Baumes provided updates on USDA research, policies, partnerships, and Farm Bill activities.

Research:

Dr. Baumes began by stating that USDA research related to biofuels, biopower, and biobased products addresses the full supply chain. He first discussed the Biomass Research Centers that use a region-based strategy to develop sustained feedstock supplies. Then, he addressed the Forest Service's bioeconomy research contributions. Next, he discussed the Agricultural Research Service's four Regional Research Centers. Finally, he discussed the National Institute of Food and Agriculture-Agriculture and Food Research Initiative's (NIFA-AFRI's) research activities focusing on the Northwest Advanced Renewables Alliance project. This project is addressing research needs across the supply chain in the Northwest, resulting in a successful Alaskan Airlines demonstration flight using biofuels.

Policies:

Farm Bill Section 9003 Program – Biorefineries or Retrofitting of Commercial-Scale Biorefineries Using Eligible Technology: This program offers loans of up to $250 million (no minimum). The loan amount cannot exceed 80% of eligible project cost (generally 50%–60%). Letters of intent were due March 6, 2017. Phase One Applications were due April 3, 2017. Total funds available are approximately $500 million.

Biomass Corp Assistance Program: In fiscal year (FY) 2017, $1.5 million are already contracted to support deliveries of 75,000 dry tons of wood biomass and corn stover, approximately $0.5 to Iowa corn stover.

Biomass Infrastructure Partnership (BIP): BIP offers competitive grants from USDA to state-led efforts to test and evaluate innovative and comprehensive approaches to marketing higher biofuel blends, such as E15 and E85. BIP has awarded $100 million to 21 states, with a more than 1:1 match from private and state resources. USDA estimates that the BIP grants will support nearly 5,000 pumps at more than 1,400 fueling stations across the country. It has supported construction that's been initiated in 19 of the 21

states and is scheduled for completion in December 2017. More than 30% of the 1,400 stations have been completed. Environmental assessments have been conducted on nearly 60% of the targeted fueling stations.

BioPreferred Program: This program identifies and expands new markets for biobased products. The program has certified more than 2,800 products in 100 different product categories. The most recent product to be certified by USDA's BioPreferred Program is Tide detergent from Procter & Gamble. The new product, Tide purclean™, will be available to consumers in the coming months.

Designating Intermediate Categories for Federal Purchase: This proposed rule was published on January 13, 2017. It designates approximately 12 categories of intermediates for mandatory federal purchasing. USDA accepted public comments through April 13, 2017.

Partnerships:

Defense Production Act (DPA) with Navy and DOE: Title III Advanced Drop-In Biofuels Production Project Biofuels 2: The DPA Title III Office announced the FOA on January 19, 2017. The objective is to further increase the capacity of domestic advanced biofuels production by establishing additional Integrated Biofuel Production Enterprise capabilities; $55 million in funding is available. This solicitation closes May 25, 2017.

Farm-to-Fleet with Navy: There have been six fuel procurement solicitations to date: Inland/East/Gulf Coast and the Rocky Mountain/West Coast/Offshore (three of each). The Rocky Mountain/West Coast/Offshore solicitation was posted on January 6, 2017 and closed on February 21, 2017. To date, one award made under the Farm-to-Fleet Program to AltAir Fuels for 77.7 million gallons of military-specification bio-marine diesel.

Ray Miller stated that the European Union (EU) has studies that show job data based on their renewables industry. He says the United States is tracking wind and solar, but the EU is also tracking biomass. Dr. Baumes stated that the United States does not have tracking mechanisms currently for the bioeconomy, but studies are in progress.

VI. Biomass Research and Development Initialize (BRDI) Update

Daniel Cassidy, National Institute of Food and Agriculture, U.S. Department of Agriculture

Mr. Cassidy provided the latest update on the BRDI initiative. BRDI has filled a significant gap in the continuum of technology development and commercialization supported by USDA, DOE, and other federal programs. USDA had shaped the program to be a source of bridge funding for developing and emerging technologies to cross the “economic valley of death.” The intent of the program was to help develop and demonstrate technologies to the point that they might attract additional private or public financing to scale up and/or produce commercial quantities of biomass-based energy and/or materials.

For the latest solicitation, the program received 414 pre-applications. Of those 414, 47 full proposals were submitted. This resulted in a $67.72 million request for funding. Currently, USDA’s combined-year

budget from FY 2014 and FY 2015 was about $7.2 million with DOE funds of up to $3 million. Of the 47 proposals, 7 focused on Feedstock Development, 36 on Biofuels/Bioproducts Development, and 4 on Systems Analysis.

The 14-member committee that reviewed the proposals comprised 3 federal scientists, 3 industry representatives, 6 academia representatives, and 2 private consultants.

The awards made are as follows:

USDA Awards

- "Integrated Biorefinery To Produce Ethanol, High-Value Polymers, and Chemicals from Lignocellulosic Biomass," University of California-Riverside and University of Tennessee
- "Cotreatment for Low-Cost Fermentation of Cellulosic Biomass," Dartmouth College, Penn State University, Bioenergy Science Center, and Enchi Corporation
- "Development of Stochastic Techno-Economic and Life Cycle Models for Quantifying the Economic and Environmental Costs of Cellulosic Bioenergy," State University of New York
- "Forest Bioenergy and Biofuels Integration: Sustainability, Energy Balance, and Emissions from Forest Restoration in the Southern Rocky Mountains," University of Montana; Northern Arizona University; and U.S. Forest Service, Rocky Mountain Research Station
- "Mid-Atlantic Biomass Sorghum Collaborative To Optimize Agronomic Production and Grower Profitability," North Carolina State University, North Carolina Biotechnology Center; Virginia Tech; and Chemtex International.

DOE Awards

- "Improving Tolerance of Yeast to Lignocellulosic Feedstocks and Products," Massachusetts Institute of Technology
- "Biomass Gasification for Chemical Production Using Chemical Looping Techniques," Ohio State University with eight industrial partners.

The next BRDI solicitation draft for FY 2016 and FY 2017 funds has been developed and is undergoing approval. It has incorporated Committee recommendations to help streamline the process and timeline. USDA hopes to release the solicitation soon as this will be the last BRDI solicitation under the current Farm Bill.

Mr. Cassidy then provided an update on NIFA, which is the extramural funding arm of USDA on research, education, and extension. NIFA has four institutes and the Center for International Programs. NIFA Competitive Grant Programs include the following:

- Agriculture and Food Research Initiative

- Biodiesel Education Program
- Joint Feedstock Genomics with DOE
- Sun Grant Initiative
- Critical Agricultural Materials Program
- Forest Research Initiative
- Innovation at the Nexus of Food, Energy, and Water.

Recently, NIFA has hired Tim Conner as the new Division Director, National Program Leader (NPL) for Logistics, and hired Toby Ahrens as the new NPL for Agricultural Bioproducts.

Dean Benjamin asked what the expected funds are for the next BRDI solicitation. Dr. Cassidy stated he expects it to be about $9 million with DOE and USDA combined funds from FY 2016 and FY 2017.

VII. Overview of USDA Institute of Bioenergy, Climate, and Environment

Timothy Conner, National Institute of Food and Agriculture, U.S. Department of Agriculture

Dr. Conner from NIFA provided an overview and updates on the Institute of Bioenergy, Climate, and the Environment (IBCE). IBCE is one of four NIFA institutes that fund transdisciplinary, outcome-driven programs to address national science priorities. IBCE comprises three divisions: the Division of Bioenergy, the Division of Climate Change, and the Division of Environmental Systems. The IBCE works to respond to climate variability, achieve sustainable use of natural resources, minimize the impact of agriculture practices on the environment, reduce dependence on foreign petroleum, and create jobs in agriculture-based rural communities. He then walked through a history of technology platforms from the 1980s to the present that showed the evolution of technologies for solving bioeconomy challenges. He then discussed building a sustainable bioeconomy, providing a secure path toward rural opportunities, securing energy independence by shifting from volume drivers to value drivers, exploiting regional feedstock diversity, and identifying and validating growth markets. Finally, he discussed priorities outside of research funding. For strategic analyses, he highlighted disruptive technologies to address stewardship responsibility; return on investment focusing on balance, weighing strategy, and innovation; and clarity of vision in defining biomass targets. A transparent approach to targets can be achieved by facilitating partner conversations and networks.

Emily Heaton stated that more genomic research is needed in agricultural farming. It is missing the step of broad demonstrations for the new crops. Dr. Conner noted that not all crops will take the same path, and we may need innovative paths with new crops. Emily followed by saying that SunGrant funding is going away, and these types of projects are no longer covered. Dan Cassidy acknowledged that field trials are vital and that they are looking for ways to cover that research.

VIII. Overview and 2017 Direction of the DOE Office of Science

Catherine Ronning, Office of Science, U.S. Department of Energy

Dr. Ronning began the presentation by providing an overview of the Biological and Environmental Research Program within DOE's SC and provided the focus of the Biological System Science and the

Climate and Environmental Sciences areas. She then provided a detailed overview of the Genomic Science Program. Next, she discussed the three Bioenergy Research Centers and the Research Center Open Solicitation. Full applications were due in September 2016. They expect to make awards in FY 2017 and have the centers open in FY 2018. Dr. Ronning then continued to discuss Genomic Science Research activities including Plant Genomic Research for Bioenergy, Sustainability Research for Bioenergy, and Biosystems Design. She then reviewed enabling capabilities activities, including the DOE Systems Biology Knowledgebase and Bioimaging Technologies. Next, she discussed the Joint Genome Institute and the six Structural Biology Infrastructure Resources.

Current funding opportunities include the biosciences programs in Basic Energy Sciences (BES) and the Chemical Sciences, Geosciences, and Biosciences Division. Their programs in 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. Pre-applications and proposals are solicited through SC's annual FOA. This FOA is the annual solicitation that covers all of the research areas in SC and is open throughout the fiscal year (until September 30, 2018). Review of proposals for FY 2017 is currently underway. BES has 36 Energy Frontier Research Centers with 5 focused on biosciences. Finally, BES is holding a Basic Research Needs Workshop for Catalysis Science in May 2017. This workshop is to provide an assessment of the basic science bottlenecks and gaps in our fundamental understanding of issues related to catalysis. This assessment will advance energy technologies and identify basic research needs for catalytic processes that underpin energy resource conversion or utilization, with a focus on new and scientifically challenging areas with the potential to significantly impact science and technology.

Manuel Perez asked why there were so few research activities on thermochemical processing in SC. Dr. Ronning relayed that most thermochemical research is found in the BETO program and that OE's mission is more biology focused.

Shellie Miller asked about their interactions and interface between BETO and SC. Dr. Ronning said that SC staff, including herself, sit on the BRDI Interagency Working Groups along with BETO and NIFA staff. Dr. Elless also stated that the BETO incubator program also looks for unique solutions that SC projects have provided.

Don Stevens asked what the new administration's stance was on basic research. Dr. Ronning stated that no direction has been provided yet, as there are positions that still need to be filled at DOE. Dr. Elless stated that the President provided his budget proposal to Congress, which included the termination of Advanced Research Projects Agency-Energy, but we must wait for the budget proposal from Congress to know more.

IX. Update on the National Agricultural Research, Extension, Education, and Economics (NAREEE) Advisory Board

Michele Esch, NAREEE Advisory Board Executive Director

Michele Esch, the NAREEE Advisory Board Executive Director, provided an update on their activities to the Committee. First, she reminded the Committee that the NAREEE Advisory Board provides advice to the Secretary of Agriculture and land-grant colleges and universities on top priorities and policies for food and agricultural research, education, extension, and economics. The Board is made up of 25 members, each of whom represents a specific category of U.S. agricultural stakeholders, as mandated by Congress. The NAREEE Board's main objective is to contribute to effective federal agricultural research, education, and economics programs through broad stakeholder feedback and sound science in its ongoing role as advisor to the Secretary of Agriculture. She stated that NAREEE members rely on recommendations from the Biomass R&D Committee to provide insights into renewable energy. NAREEE received the 2016 Committee recommendations and found a few to be of particular relevance to NAREEE. Those included recommendations related to publicizing successes, analyzing biofuels compared to fossil fuels, reducing time from proposal submission to the announcement of awards, leveraging existing programs and resources, and determining land-management best practices.

Shelie Miller asked about workforce-development gap issues and if there are any current plans to address this issue. Ms. Esch acknowledged that this is a known issue, not just for biomass, but for all areas of agriculture. Currently, there are no specific recommendations addressing this issue, but she would take the question back to the NAREEE Board.

X. Overview of DOE Bioenergy Technologies Office 2017 Budget, New Areas, and Activities

Jonathan Male, Director, Bioenergy Technologies Office, U.S. Department of Energy

Dr. Male provided an overview of BETO, including the budget, program overview, activities, and upcoming events. Dr. Male began by providing the challenges and opportunities for the bioeconomy and stating the updated BETO mission: to develop and demonstrate transformative and revolutionary sustainable bioenergy technologies for a prosperous nation. He then reviewed the unique value that bioenergy delivers.

Since 2009, BETO is responsible for 246 laboratory patents, 916 publications, and 32 licenses, and it has produced more than 3.8 million gallons of cellulosic biofuels.

The FY 2017 budget request to Congress for BETO shows $218 million as the Senate Mark and $168.5 million for the House Mark. These are both decreased from the FY 2016 enacted budget of $225 million. Dr. Male then provided Major Goals from FY 2017 through FY 2022 for each research program area including Feedstock Supply and Logistics, Advanced Algal Systems, Conversion R&D, and Demonstration and Market Transformation.

Dr. Male then discussed key current consortia partners with BETO, including Consortium for Computational Physics and Chemistry, Chemical Catalysis for Bioenergy, Separations Consortium, Agile BioFoundry, and Feedstock-Conversion Interface. He then highlighted BETO-enabled commercial products including the Virent Inc.-developed PlantBottle™ licensed by Coca-Cola; the State University of New York and Case Now Holland single-pass harvester; and POET DMS's commercial-scale cellulosic ethanol plant. Dr. Male provided a summary of the 2017 BETO Peer Review, which reviewed 277 projects across the 5 technology areas, representing more than $300 million in research funding from FY 2015 through FY 2017.

Dr. Male discussed BETO-driven market opportunities including the Small Business Vouchers Pilot, waste streams into jet fuels, and clean energy solutions with the Navy. BETO technologies approaching the market include microbial strains to produce alcohol and renewable bio-oil to be coprocessed with petroleum sources or to sell for heating.

Dr. Male highlighted some upcoming events including:

- Bioeconomy Initiative: Action Plan Coordination Meeting
    - April 5–6, 2017, Washington, D.C.
- Second Annual National Lab Summit
    - April 18, 2017, Beltsville, Maryland
- Bioeconomy 2017 and Program Management Review
    - July 11–13*, 2017, Pentagon City, Virginia
        - Program Management Review: July 13, 2017

Finally, Dr. Male acknowledged all of the laboratory, university, and industry project partners working with BETO.

Manuel Perez asked how BETO selects which markets to work with. Dr. Male stated that DOE does not pick markets. BETO always has multiple technologies and models to offer industry and markets to allow them to make decisions.

Steve Csonka asked what research pathways are able to reach BETO targets. Dr. Male said, currently, pyrolysis research is ahead of bioconversion.

XI. Public Comment

Dr. Donald Fosnacht, Natural Resources Research Institute, University of Minnesota

The University of Minnesota's Natural Resources Research Institute has made strategic investments in facilities and equipment that prepare biomass for subsequent processing for conversion into solid and liquid biofuels. This includes both pilot- and demonstration-scale equipment to concentrate the energy value in woody and herbaceous biomass using torrefaction and hydrothermal carbonization technologies. Both technologies enable the removal of chemical components that can complicate gasification of biomass in making high-quality syngas for conversion to liquid fuels such as jet fuel and diesel. The torrefaction process effectively reduces the amount of oxygenated hydrocarbon species, and

this makes gasification simpler and more controllable. The Institute has partnered with high-pressure gasification reactor experts in the private sector and is evaluating how to best merge its pretreatment technologies with gasification and chemical conversion technologies to demonstrate the economic viability of its planned liquid fuels approach.

Minnesota has recently supported economic development activities targeting the growth and expansion of the biofuels and biobased chemicals industry. This sector has the potential to increase demand for biomass materials, crate jobs, and reduce dependence on fossil fuels through the development of integrated forest biorefineries. An IBR processes lignocellulosic biomass into fuels, chemicals, and materials in a balanced portfolio that collectively can add 10–100x the economic value to biomass harvested from the forest. Currently available technologies can produce multiple types of liquid fuels, chemical precursors, bio-plastics, and food ingredients from forest biomass, thereby greatly increasing the value and diversity of products made from forest biomass. Furthermore, this industry has the potential to utilize woody biomass residues and materials from hazardous fuels treatment, creating new markets and support for the forest industry.

Currently, emerging markets for renewable-source fuels and chemicals are expected to grow by 14% annually for the foreseeable future. This positive trend is driven by business economics and consumer demand changes that encourage a market shift from dependence on fossil fuels and petroleum-based chemicals and plastics toward renewable and sustainable sources. The value proposition in this case is both economic and emotive. Once a material is determined to meet a customer's specifications and quality criteria, price will dominate the purchase decision. In addition, there is significant emotive appeal in providing a renewable/green source for chemicals historically derived from petroleum or coal.

The conversion of biomass to solid fuels has also been an area of concentration as a partial or total replacement for fossil fuels like coal. The Institute has participated in a nationally sponsored program "Consortium for Advanced Wood-to-Energy Solutions." This effort is sponsored by the U.S. Forest Service and by the U.S. Foundation for Forestry and Communities. Specific involvement has included evaluation of the use of solid biofuels at several major electrical producers and also development of techniques to consolidate solid fuel products using briquetting and pelleting densification methods. The use of torrefied biofuels has been found to be an acceptable coal substitute—up to 100% substitution level. Continued development is underway to further improve the properties of these fuels and also to develop biofuel/coal blends that can reduce the environmental footprint associated with coal utilization.

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XII. 2016 Subcommittee Report-Outs

Subcommittees

Each subcommittee was tasked with coming up with one primary focus topic and one secondary focus topic. All three subcommittees will bring their topics back to the full Committee for synthesis and down selection to no more than three QFTs for 2017. One of those three topics will be selected as the QFT for the Committee's second quarterly meeting.

Subcommittee-suggested topics included the following:

Conversion:

- Near-term motivations for and benefits of accelerated development of a bio-based economic engine
- Disruptive and transformational technologies to cost reduce the feedstock-conversion interface for any type of refinery

Feedstocks:

- Improve feedstock supply chain cost and efficiency cost of upgrading biomass into feedstock
- Interface with fossil fuels; thermochemical upgrades to bio-oil that plugs into existing infrastructure; distillates upgrading technology methods associated with feedstocks

Products, Markets, and Systems

- Lessons learned and pathway forward for biogas opportunity
- Lessons learned and pathway forward for other thermochemical processes

Focused topics identified for the upcoming Committee meetings in 2017 are as follows:

- 2nd quarterly meeting: Near-term motivations for and benefits of accelerated development of a bio-based economic engine
- 3rd quarterly meeting: Interface with fossil fuels; thermochemical upgrades to bio-oil that plugs into existing infrastructure; distillates upgrading technology methods associated with feedstocks.
- 4th quarterly meeting: Improve feedstock supply chain cost and efficiency cost of upgrading biomass into feedstock

XII. Closing Comments

The meeting was adjourned.

Appendix A: Committee Member Attendance—March 30-31, 2017

Co-Chairs	Affiliation	Attended?
Kelly Tiller	Genera Energy, Inc.	Yes

Members	Affiliation	Attended?
Charles Abbas	Archer Daniels Midland (ADM)	Yes
Dean Benjamin	Verso Corporation	Yes
Esteban Chornet	Enerkem	Yes
Katrina Cornish	Ohio State University	Yes
Steve Csonka	Commercial Aviation Alternative Fuels Initiative	Yes
Vonnie Estes	Consultant	No
William Frey	Georgia-Pacific	Yes
Emily Heaton	Iowa State University	Yes
Beth Hood	Arkansas State University	Yes
Raymond Huhnke	Oklahoma State University	Yes
Joseph James	Agri-Tech Producers, LLC	Yes
Randy Jennings	Tennessee Department of Agriculture	Yes
Coleman Jones	General Motors	No
Man Kit Lau	BioAmber Inc.	Yes
Bruce McCarl	Texas A&M University	No
Christine McKiernan	BIOFerm Energy Systems	Yes
Ray Miller	Michigan State University	Yes
Shelie Miller	University of Michigan	Yes
Marina Moses	American Academy of Microbiology	No
Neil Murphy	State University of New York	Yes
Kimberly Ogden	University of Arizona	Yes
Manuel Garcìa Pèrez	Washington State University	Yes
Anna Rath	NEXSTEPPE	No
Matthew Rudolf	SCS Global Services	Yes
Patricia Scanlan	Scanlan Environmental LLC	Yes
Abolghasem Shahbazi	North Carolina A&T State University	No
Don Stevens	Cascade Science and Technology Research	Yes
Valerie Thomas	Georgia Institute of Technology	Yes
Alan Weber	MARC-IV Consulting/Weber Farms	Yes
Michael Wolcott	Washington State University	Yes

Total: 26 of 31 members attended

Appendix B: Agenda—March 30–31, 2017

Day 1: Technical Advisory Committee Meeting **March 30, 2017**

8:30 a.m. – 8:45 a.m.	Welcome and Introduction of New Members *Committee Co-Chair(s)*
8:45 a.m. – 9:45 a.m.	Discussion: 2017 Committee Topics *Committee Co-Chair(s)*
9:45 a.m. – 10:30 a.m.	Presentation: Committee Business for 2017 and U.S. Department of Energy (DOE) Updates *Mark Elless, Designate Federal Officer, U.S. Department of Energy*
10:30 a.m. – 10:45 a.m.	Presentation: U.S. Department of Agriculture (USDA) Update on Biomass Research and Development Activities *Harry Baumes, Directory Energy Policy and New Uses, Office of the Chief Economist, U.S. Department of Agriculture*
10:45 a.m. – 11:00 a.m.	*Break*
11:00 a.m. – 11:15 a.m.	Presentation: Biomass Research and Development Initiative Solicitation, Status, and Update *Daniel Cassidy, National Institute of Food and Agriculture, U.S. Department of Agriculture*
11:15 a.m. – 11:45 a.m.	Presentation: Overview of USDA Institute of Bioenergy, Climate, and Environment *Timothy Conner, National Institute of Food and Agriculture, U.S. Department of Agriculture*
11:45 a.m. – 12:15 p.m.	Presentation: Overview and 2017 Direction of DOE Office of Science *Catherine Ronning, Office of Science, U.S. Department of Energy*
12:15 p.m. – 1:15 pm	*Lunch (Closed Session)*
1:15 p.m. – 1:30 p.m.	Public Comment *Dr. Donald Fosnacht, Natural Resources Research Institute, University of Minnesota*
1:30 p.m. – 1:45 p.m.	Presentation: Update on National Agricultural Research, Extension, Education, and Economics (NAREEE) Advisory Board *Michele Esch, NAREEE Advisory Board Executive Director*
1:45 p.m. – 3:00 p.m.	Discussion: 2017 Committee Topics *Committee Co-Chair(s)*

3:00 p.m. – 3:15 p.m.	*Break*
3:15 p.m. – 5:00 p.m.	Breakout Session: Subcommittee Breakouts *(Closed Session)*

Day 2: Technical Advisory Committee Meeting March 31, 2017

8:30 a.m. – 8:45 a.m.	Welcome *Committee Co-Chair(s)*
8:45 a.m. – 9:15 a.m.	Presentation: Overview of DOE Bioenergy Technologies Office 2017 Budget, New Areas, and Activities *Jonathan Male, Director, Bioenergy Technologies Office, U.S. Department of Energy*
9:15 a.m. – 10:30 a.m.	Breakout Session: Subcommittee Breakouts *(Closed Session)*
10:30 a.m. – 11:45 a.m.	Presentation: Subcommittee Breakout Reports
11:45 a.m. – 12:00 p.m.	Public Comment
12:00 p.m. – 1:00 pm	*Lunch (Closed Session)*
1:00 p.m.	Meeting Adjourn