Biomass Research and Development

Technical Advisory Committee

August 15–16, 2017

Meeting Summary

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List of Acronyms

BETO – Bioenergy Technologies Office
BIP – Biofuels Infrastructure Partnership
BRDI – Biomass Research and Development Initiative
Committee – Biomass Research and Development Technical Advisory Committee
DOE – U.S. Department of Energy
EPA – U.S. Environmental Protection Agency
FY – fiscal year
HVO – hydrotreated vegetable oil
R&D – research and development
RIN – Renewable Identification Number
RTP – Rapid Thermal Processing
SB – Senate Bill
USDA – U.S. Department of Agriculture

I. Purpose

On August 15–16, 2017, the Biomass Research and Development Technical Advisory Committee (Committee) held its third meeting of 2017. The Committee received updates from the U.S. Department of Energy's (DOE's) Bioenergy Technologies Office (BETO) and from the U.S. Department of Agriculture (USDA), who delivered a presentation about current USDA activities. Other presentations were given by the University of California, San Diego, Honeywell UOP, and the California Energy Commission.

See Appendix A for a list of meeting attendees and Appendix B for the meeting agenda. Meeting presentations can be viewed on the Biomass Research and Development Initiative (BRDI) website.

Background:

The Committee was established by the Biomass Research and Development (R&D) Act of 2000, which was later repealed and replaced by Section 9008 of the Food, Conservation, and Energy Act of 2008. The Biomass R&D 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 R&D.

II. Welcome

Kelly Tiller, Committee Co-Chair

Dr. Tiller welcomed the Committee to the second meeting of the year and called the meeting to order. The third quarterly meeting's focus was "Biomass Integration with Existing Fossil Fuel Infrastructure."

III. DOE Updates and Biomass R&D Activities

Mark Elless, Designated Federal Officer, DOE

Dr. Elless started his presentation by providing an update on the BETO budget request for fiscal year (FY) 2018. The president's budget request was $56.6 million, the House mark was $90.0 million, and the Senate mark was $190.0 million. The Senate mark is a 7% decrease in funding from FY 2017 funds. BETO will now wait for the Senate and House to go to conference and agree to a number to send to the president for signature. The Senate mark included language, that they would like BETO and Fossil Energy to continue to collaborate with each other on carbon capture sequestration, to advance carbon-negative transportation fuels, and to support projects that utilize carbon dioxide in the production of algae and other potentially marketable products.

Dr. Elless then provided some Biomass R&D Board updates, including announcing the new Board co-chairs. Daniel Simmons, Acting Assistant Secretary for DOE's Office of Energy Efficiency and Renewable Energy, and Dr. Ann Bartuska, Deputy Under Secretary for Research, Education, and Economics at USDA, have accepted the positions. Dr. Elless also announced that the Deputy Assistant Secretary for Transportation in the Office of Energy Efficiency and Renewable Energy has departed.

Dr. Elless provided some updates on BETO R&D. The Advanced Algal Systems program selected three awardees to increase the productivity of—and thereby reduce the cost associated with—algal biofuels and bioproducts. The awardees are as follows:

- **Lumen Biosciences** (Seattle, Washington): Lumen Biosciences is focusing on agricultural production of algae on otherwise non-productive land in rural eastern Washington State, with the ultimate goal of creating new agricultural jobs in that region.

- **Global Algae Innovations** (El Cajon, California): Global Algae Innovations will deliver a tool for low-cost, rapid analysis of pond microbiota, gather data on the impacts of pond ecology, and develop new cultivation methods that utilize this information to achieve greater algal productivity.

- **Los Alamos National Laboratory** (Los Alamos, New Mexico): Los Alamos National Laboratory will evaluate rationally designed pond cultures containing multiple species of algae, as well as beneficial bacteria, to achieve consistent biomass composition and high productivity.

In addition, DOE announced on August 2 that it will award a fourth project up to $1.8 million under the MEGA-BIO: Bioproducts to Enable Biofuels funding opportunity. In August 2016, BETO selected three projects for an initial round of funding. The total funding for the four MEGA-BIO awards is $13.1 million. DOE selected Michigan State University to manage the fourth project. The university will partner with the University of Wisconsin – Madison and MBI International to optimize a two-stage process for deconstructing biomass into two clean intermediate streams: (1) sugars for producing hydrocarbon fuels and (2) lignins for producing multiple value-added chemicals. The project will work to overcome several existing challenges, such as lignin's low susceptibility to depolymerization, to help capture lignin’s full potential as an economically viable feedstock for renewable chemicals. The three original MEGA-BIO projects support the development of biomass-to-hydrocarbon biofuels conversion pathways that can produce variable amounts of fuels and/or products based on external factors:

- **The Dow Chemical Company** (Midland, Michigan): The Dow Chemical Company, in partnership with LanzaTech and Northwestern University, will develop a process for the bioconversion of biomass-derived synthetic gas (syngas) to C6–C14 fatty alcohols as a pathway to biofuels.

- **Amyris, Inc.** (Emeryville, California): Amyris, Inc., in cooperation with Renmatix and Total New Energies, will develop a manufacturing-ready process to produce farnesene, a hydrocarbon building block used in the manufacture of a variety of consumer products, ranging from cosmetics to detergents, as well as in the transportation industry for diesel and jet fuel.

- **Research Triangle Institute** (Research Triangle Park, North Carolina): Research Triangle Institute will partner with Arkema and AECOM to investigate the technical feasibility and economic potential, as well as the environmental and sustainability benefits, of recovering mixed methoxyphenols from biocrude as building block chemicals alongside the production of biofuels.

Finally, Dr. Elless provided a summary of the *Bioeconomy 2017* conference and BETO Program Management Review. BETO held *Bioeconomy 2017* on July 11–12, 2017. The conference convened key representatives from across the bioenergy supply chain, including industry and federal agencies. Keynote speakers came from leading companies in the bioeconomy, including LanzaTech, Coca-Cola, Impossible Foods, Ford Motor Company, ICM, and many more Plenary topics included corporate and international interests in the bioeconomy, creating and communicating the bioeconomy value proposition, and a special extended Shark Tank–style session. Breakouts covered 13 different topics, including, aviation, performance-advantaged replacements and many more!

BETO held its Program Management Review on July 13, 2017. Lead Reviewers presented the results of the Project Peer Review, and the Steering Committee presented an overall assessment of BETO's portfolio. The *2017 Peer Review Report* is expected to be published in November 2017.

Joe James asked when the Small Business Innovation Research awards will be announced. Dr. Elless stated that DOE has recently begun announcing awards, with six released last week, and that he hoped the SBIR awards would be announced soon.

IV. USDA Update on Biomass R&D Activities

Toby Ahrens, National Program Leader, Agricultural Bioproducts, National Institute of Food and Agriculture, USDA

Mr. Ahrens provided an update on the 2017 BRDI solicitation. The funding opportunity announcement was issued on June 5, 2017, concept papers were due on July 7, 2017, and full applications were due Sept. 22, 2017. The total available funding is $9 million—with USDA providing $6 million and DOE providing $3 million.

The National Institute for Food of Agriculture made two $15 million project awards that will be announced in late August. In June 2017, both the Sustainable Bioenergy and Bioproducts Challenge and the Agriculture and Food Research Initiative Foundation Program closed their funding opportunity announcements.

USDA's joint solicitations with DOE include the Plant Feedstock Genomics for Bioenergy and the Integrated Biorefinery Optimization funding opportunity announcements. USDA's contribution to the Integrated Biorefinery Optimization funding opportunity was up to $2.9 million and DOE's contribution was up to $19.8 million. Concept papers were due in February 2017, with full applications due in April 2017. The merit review is complete, and decisions will be announced in the fall of 2017.

Also, USDA held the Bioeconomy Initiative Action Plan Workshop in April 2017. The goal of the workshop was to develop a roadmap of crosscutting federal activities and collaborative actions to catalyze the expansion of a sustainable domestic bioeconomy. The Action Plan is scheduled to be released in late summer or early fall 2017.

V. Rewiring Carbon Reduction

Ian Rowe, Technology Manager, Office of Fossil Energy and BETO, DOE

Mr. Rowe began by presenting the life cycle of traditional carbon sources in the bioeconomy. A renewable carbon bioeconomy puts pressure on the land sector. To avoid land-use issues, one can simplify deconstruction and upgrading, reduce carbon dioxide emissions, and increase energy security by rewiring the carbon cycle to produce our renewable carbon. There are currently nine large-scale carbon capture and sequestration units in operation in the United States: four natural gas–processing units, two fertilizer producers, one steam-methane reforming for hydrogen production, one ethanol facility, and one power-generating facility. Carbon capture and sequestration has been demonstrated to work; however, it is too expensive and needs enabling technology. DOE is currently funding seven projects with renewable hydrogen as the source of reductant. There are four projects using electricity more directly and two projects reducing carbon via electricity. BETO is providing the Office of Fossil Energy with bioengineering expertise from their work at the national laboratories. Currently, there are four projects working on non-photosynthetic carbon reduction. Also, there is an active funding opportunity for engineered systems for innovative wet and gaseous waste valorization.

Kit Lau stated that the organism used for processing units is only the first step and asked if mass transfer is still a problem that must be addressed. Mr. Rowe stated that LanzaTech is working on scale and mass transfer issues.

VI. Biomass Gasification for the Production of Fuels

Reinhard Seiser, Univeristy of California, San Deigo

Dr. Seiser began by stating the differences between biomass and fossil feedstocks, including oxgygen content, minerals content, reserve concentration, uniformity, and renewability. He then defined the types of biofuels, including co-processing feedstock, fuel blendstocks, drop-in fuels, and alternative fuels. He further discussed the different types of conversion technologies used in the gasification process. Gasification has many benefits—for example, it is a relatively fast process that creates a known set of gaseous species. It also has a variety of fuels and chemicals that can be produced by fuel synthesis and has a low level of contaminants in the final products. Its disadvantages include a large number of process steps, resulting in a less-efficient, more-costly process. Gasification often relies on several catalysts and is a large-scale process, which feedstock availability and product distribution need to match. Dr. Seiser then focused on the advantages and disadvantages of specific gasification processes, including fast internally circulated fluidized bed, Fisher-Tropsch systhesis, mixed-alcohol synthesis, and fluidized-bed methanation. He ended his presentation discusing hydrogen production from biomass for use in fuel upgrading.

Manuel Perez asked if they are looking at municipal solid waste. Dr. Seiser stated that municipal solid waste has more separation cost over the feedstock cost itself.

Don Stevens asked what the federal agencies could do to assist in addressing the challenges. Dr. Seiser said that access to bigger equipment and collaborations would be helpful. Also, information sharing on prior research, especially failures, to help direct future research would be helpful.

VII. Overview of Honeywell UOP Biomass Activities

Jim Anderson, Honeywell UOP

Mr. Anderson started by explaining the Honeywell UOP biofuels vision. The vision builds on UOP's 100+ years of expertise in refining crude oil. They are looking to produce real "drop-in" fuels, chemically identical to petroleum fuels. They leverage existing refining/transportation fuel infrastructure to lower capital costs, minimize value-chain disruptions, and reduce investment risk. He then listed their technology portfolio, which includes UOP Ecofining™, Renewable Jet Process™, and Rapid Thermal Processing (RTP®). He listed operating plants using UOP's renewable technologies, including the Diamond Green Diesel Ecofining Unit in Norco, Louisiana; ENI Ecofining Unit in Venice, Italy; and AltAir Renewable Jet Fuel Unit in Paramount, California.

Mr. Anderson then discussed the potential feedstocks for the Ecofining and UOP Renewable Jet Processes from plant oils, animal fats, waste greases, and algal and microbial oils. Next-generation feedstocks for the Econfining and Renewable Jet Process include cover/non-food crops and algal and micro oils. These feedstocks are in various stages of development—many have the capability to ramp up production when demand requires, filling the feed gap with high-value feedstocks. Second-generation feedstocks for RTP include the forest residues and agricultural residues and purpose-grown energy crops. UOP continues to explore technology solutions for neat upgrade of RTP green fuel. The issue is not whether it can be done, but rather how to do it economically.

Mr. Anderson concluded his presentation by reviewing the details of the AltAir Renewable Jet Fuel project in nearby Paramount, California. The technology used in UOP's Renewable Jet Fuel Process produces green jet fuel and green diesel. AltAir retrofitted part of an existing petroleum refinery. Currently, United Airlines and World Fuels offtake a substantial portion of the products generated. AltAir is also producing Renewable F76 for the Naval Distillate Contract to the Defense Logistics Agency for use by the U.S. Navy's "Great Green Fleet."

Steve Csonka asked about the potential for retrofitting existing facilities. Mr. Anderson said that there is a large potential, but the constraint is feedstock supply. He also said that U.S. refineries are reluctant to make investments and are pushing the responsibilities to blenders.

Matt Rudolf asked what challenges remain for the RPT process. Mr. Anderson said that their focus is on drop-in fuels and that RTP output is not fully a drop-in fuel yet. There are some impurities, and acid content is higher. These are issues that can be addressed through utilization, and RTP output can be a good source of on-demand power, such as heating oil.

Coleman Jones asked if it is tough in California to get a permit to produce drop-in fuels through these processes. Mr. Anderson said that it is possible to get permits in California because it is producing a renewable product and is using existing plants that were previously shut down.

Kelly Tiller asked what the production costs were if you removed the cost of the feedstock. Mr. Anderson said that conversion costs were small compared to feedstocks.

Kelly Tiller also asked about the offtake agreements with the airlines for the AltAir fuel. Mr. Anderson stated that they are 3–5-year, long-term deals.

Kelly Tiller stated that UOP has been working on these projects for over 10 years and asked what the payback was. Mr. Anderson stated that UOP has still not recovered their investment.

Dr. Tiller asked what the federal agencies could do to assist in addressing existing challenges. Mr. Anderson said that the uncertainty of the renewable fuels policy is still an issue. The U.S. Environmental Protection Agency (EPA) must understand how to set production targets and timeframes that will motivate the industry.

VIII. Biomass in California's Energy Portfolio: Advancement through Research and Development

Rizaldo Aldas, Program Lead, Energy Research and Development Division, California Energy Commission

Dr. Aldas presented to the Committee on California's energy portfolio, including electric generation and fuel statistics. He then focused on the bioenergy facilities in California, which currently has 34 operating solid fuel biomass power plants. Biomass is considered to be available on a technically sustainable basis for 35 million bone dry tons/year.

Dr. Aldas then provided an overview of key policies driving bioenergy in California:

- Senate Bill (SB) 350 (Clean Energy and Pollution Reduction Act of 2015)
- Renewables Portfolio Standard (SB X1-2)
- SB 107
- SB 1078
- Assembly Bill 32 (The Global Warming Solutions Act of 2006)
- Executive Order B-30-15
- SB 1122—Bioenergy Feed-in Tariff
- Proclamation of a State of Emergency 10-30-15.

Dr. Aldas provided an overview of various bioenergy R&D projects. He then went on to describe new challenges facing California and biomass. California's pursuit of a low-carbon future will hit a critical milestone in 2030. The pace of technological progress will need to increase exponentially to overcome challenges for meeting the state's energy and climate goals in 2030. The Energy Commission submitted its Electric Program Investment Charge 2018–2020 Proposed Investment Plan to the California Public Utility Commission on May 1, 2017. Bioenergy plays a role in the 2018–2020 EPIC Investment Plan. This role includes managing biomass wastes from forests—including sustainable forestry management strategies to reduce wildfire risk and agricultural and other organic wastes while helping to achieve the state's renewable portfolio standard. The plan's emphasis on the thermochemical conversion of biomass

is due to the unprecedented issue of dead and dying trees and the closure of a number of biomass power plants. It supports the full realization of biomass gasification potentials and other conversion strategies that are clean, efficient, and cost-effective, and that will help address location-challenged biomass resources. It also includes technologies and strategies that reduce the levelized cost of electricity and help bring bioenergy into cost parity with fossil fuels and low-emission generation technologies, pollution control, and other technologies that can cost-effectively utilize low-quality biogas for bioenergy.

The Energy Commission also submitted its Natural Gas Budget Plan for FY 2017–2018 to the California Public Utility Commission on March 31, 2017. In FY 2017–2018 the proposed funding initiatives are specific to biomass targets piloting pipeline quality renewable natural gas from California's forest biomass resources.

Finally, California has the Alternative and Renewable Fuel and Vehicle Technology Program. Since the first investment plan, the Energy Commission has invested $606 million in projects that will support alternative and renewable fuels and advanced vehicle technologies. The Alternative and Renewable Fuel and Vehicle Technology Program had funded over 180 new E-85 fueling stations in California by 2016. The Energy Commission has invested over $23.5 million for diesel substitute infrastructure. They have also invested more than $50.9 million in 16 biomethane feasibility, demonstration, and production projects for biomethane and renewable natural gas.

IX. Public Comment

Daniel Shafer, Chief Operating Officer, Nikua Training Center

Re: Comments to the Biomass Research and Development Technical Advisory Committee for the U.S. Department of Energy. Presented in Los Angeles.

Nikua Training Center, a USA non-profit corporation, is dedicated to the benefit of isolated communities in need of economic development and energy independence. We are committed to providing an open-source solution in the form of training and equipment for production of international quality standard biofuel, integrated with sustainable agriculture. Nikua means "Today" in native Fijian language.

Nikua will demonstrate economic viability of community-scale production for Hydrotreated Vegetable Oil fuel - HVO fuel, commonly called renewable diesel – RD, which meets or exceeds the regular diesel fuel quality specification ASTM D975. Nikua RD projects intend to operate without reliance on subsidy by capturing the maximum spread between reduced production cost and improved selling price of premium quality renewable diesel fuel.

At community-scale, logistics costs are minimized on stranded supplies of low cost recycled cooking oil, virgin vegetable oil, and tallow raw material. Revenue is maximized on sale of premium quality renewable diesel in critical maritime, land transportation, power generation, and aviation markets to communities faced with risk of supply disruption on imported diesel fuel.

Nikua is the project manager for design & build of two facilities for production of Hydrotreated Vegetable Oil, for use as renewable diesel transportation sector fuel.

1. GO Bio Co. plant in Redmond Oregon for production of #2 grade renewable diesel meeting the ASTM D975 diesel fuel quality specification. GO Bio Co. is currently a collector of 200,000 gallons annually of recycled cooking oil. The plant is designed for 400,000 gallons per year of HVO fuel production.
2. Institute of Applied Science - University of the South Pacific, Laucala Campus in the capital city of Suva in the Republic of Fiji. The USP will receive the contribution of a field engineering laboratory for production for #2 grade ASTM D975 renewable diesel and biodiesel. The Nikua - University of the South Pacific Field Engineering Lab will be co-located with the University of the South Pacific Biofuel Analytical Laboratory, capable of supporting production of biofuels in isolated island communities across the Asia-Pacific region.

Renewable diesel is a premium quality drop-in fuel which requires no special storage or distribution infrastructure. Used as a fuel additive renewable diesel will upgrade petroleum diesel fuel inventory. A notable advantage of renewable diesel over biodiesel is that renewable diesel is approved for use at 100% concentration in modern diesel engines, whereas biodiesel blends are typically limited to 5%. Renewable diesel at 100% makes the maximum contribution to rural energy security and provides a foundation for economic development. Rural production enhances family income and worker training in chemical production and business management.

Nikua's hydrotreating production system employs an innovative microscale reactor design, with inherent gains in reaction rate and heat transfer. Modular design numbers-up rather than scales up, allowing for standardized automation for process control on multiple systems in isolated communities. The result of standardized, mobile production modules, tailored to local supply & demand is reduction in capital cost, streamlined operator training, reduced project lead time, reduced economic risk, and superior return on investment.

Nikua renewable diesel production systems are integrated with on-site production of renewable hydrogen, which is a necessary inclusion in the hydrotreating process. Village scale systems can come on-line quickly using solar photovoltaic powered electrolysis of water. Village scale systems are strongly net-positive on fuel production using diesel-electric generators to power electrolysis production of hydrogen, when driven by the propane byproduct of hydrotreating reaction and by use of straight vegetable oil diesel fuel. Both are suitable for use in stationary diesel engines.

Microscale reactor architecture is well suited to production of renewable hydrogen via steam reforming of stranded supplies of organic waste biogas and glycerol arising from biodiesel production. Larger community-scale renewable diesel production systems can capture biogas from waste water treatment plants, animal manure recycle processing, and landfill gas. In the case where biogas would ordinarily go to the atmosphere, then renewable diesel production can be net-negative on greenhouse gas impact, taken on a carbon dioxide equivalent basis.

Production economics for renewable diesel will depend on minimizing onsite production cost for renewable hydrogen. We show that renewable diesel production cost is competitive with biodiesel production cost using electrolysis powered by grid electricity from hydro-electric sources. Renewable hydrogen production cost is further reduced on steam reforming of biogas.

The directors of Nikua have experience as process engineers of US EPA registered biodiesel production plants and on raw material procurement. We serve as a consultant to the World Bank, the United Nations Development Program, the Global Green Growth Institute, and to governments in the South pacific, including the Fiji Department of Energy and the Samoa Electric Power Corporation.

Dramatically lower cost microscale reactors and complete reactor assemblies for production of renewable diesel and renewable aviation fuel, integrated with production of renewable hydrogen in automated modular production system, in a community-scale platform represents an opportunity for export earnings on USA technology and USA jobs.

X. Draft Q3 Meeting Recommendations

Full Committee

Source: Biomass R&D Technical Advisory Committee

Advisory To: Biomass R&D Board

Report Date: September 2017

Issue: ***Biomass integration with existing fossil fuel infrastructure***

Opportunities:

- ☐ Publish co-processing regulations
- ☐ Develop action plan for bio-oils
- ☐ Expedite Renewable Identification Number (RIN) pathway approvals
- ☐ Initiate standards for blending biogas
- ☐ Develop fossil overlay to the *2016 Billion-Ton Report*
- ☐ Explore bioproducts/fossil relationship

Context

Biobased energy and product development can benefit substantially from improved integration with the fossil energy industry. Over the last 50+ years, billions of dollars have been invested in the United States to develop existing fossil fuel facilities, infrastructure, and human capital. Effectively leveraging and utilizing this existing fossil energy capability can accelerate the development of next-generation biobased energy and products technologies. This acceleration rapidly promotes national security, energy diversity, and job growth benefits arising from a more diverse energy and products portfolio. Advanced biomass technologies simultaneously reduce the energy and chemical industry's impact on our nation's

water, air, and land resources. Feeding bio-derived streams into existing fossil refineries benefits the nascent biomass industry by reducing both capital costs and technology risk, while accelerating deployment at commercial scale. Co-feeding biomass can also potentially benefit the fossil sector by increasing asset utilization rates, expanding market reach, and diversifying risk.

Synergies to Leverage

- ✓ Highly trained workforce already in place (operators/safety/maintenance/testing)
- ✓ Existing storage and distribution infrastructure
- ✓ Existing pipelines, transport systems, logistics, and delivery systems for final products
- ✓ Opportunities for enhanced utilization of onsite hydrogen production
- ✓ Increased control of fossil energy producers over policy obligations (Renewable Fuel Standard, Low-Carbon Fuel Standard, Renewable Portfolio Standard)
- ✓ Net new investments in economic opportunities for rural America

Key Challenges to Integration

- *Refinery Scale vs. Biomass Scale*. Petroleum refineries and other fossil facilities require massive quantities of reliable feedstock (e.g., crude) to sustain continuous operations at low margins. Localized biomass with low bulk density is challenging to scale in its raw (field/forest edge) format.
- *Homogeneity and Consistency*. The reliable and well-understood properties of relatively homogeneous fossil resources facilitate continuous, efficient operation of capital-intensive refineries. Commercial biomass conversion is challenging given the diversity, seasonality, and heterogeneity of the feedstock and differences in chemical properties.
- *Risk Aversion*. The high capital cost and continuous operation requirements of fossil energy facilities cause owners and operators to be risk averse and reluctant to undertake any new biomass activities that could potentially impact the viability, efficiency, reliability, or longevity of the existing plant.
- *Policy Stability*. A number of biobased technologies (≥ TRL 6) have potential to integrate with or enhance existing fossil operations, but policy uncertainty undermines ability to finance and deploy.

Opportunity 1

Local supplies of cost-advantaged biomass could be aggregated and upgraded to a homogeneous biocrude at one location for subsequent transport for co-processing at existing refineries. However, refineries have no incentive to accept such bio-intermediates because current RIN qualification requires processing at a single location.

⇒ ***Encourage EPA to finalize and publish the co-processing provisions currently drafted as part of the Renewables Enhancement and Growth Support rule that allow co-processing at different locations.***

Opportunity

Specific issues need to be addressed to allow decentralized production of stable and energy-dense bio-oils that are fully compatible with existing refinery infrastructure.

2

⇒ ***Develop a report and action plan on the potential manufacturing of bio-oils, identifying key industry challenges and target characteristics/specifications.***[1]

⇒ ***Solicit and support efforts to further develop pretreatment technologies for bio-oils, addressing energy density, stability, and liquid feedstock compatibility issues that improve direct processing opportunities in existing petroleum refineries.***

Opportunity 3

There is a backlog of pathway applications addressing co-processing with fossil energy currently awaiting EPA approval, which are required to collect RINs.

⇒ ***The DOE and USDA are encouraged to propose an agenda item at the next meeting of the Administration's Interagency Task Force on Agriculture and Rural Prosperity to encourage EPA to expedite the pathway evaluation process.***

Opportunity 4

The *2016 Billion-Ton Report*[2] provides detailed information about biomass availability, cost, types, impacts, and other characteristics, but it does not include sufficient information relating biomass data to existing fossil-based assets or infrastructure.

⇒ ***Enhance the usefulness of the* 2016 Billion-Ton Report *by identifying specific fossil-based resources, infrastructure, and assets (particularly small or underutilized) in a format that can be used as a spatial baseline overlay to identify where common biomass/fossil opportunities exist for integration.***

Opportunity 5

Unifying, industry-accepted standards and specifications are needed for the insertion of renewable natural gas into the existing network of natural gas pipelines.

⇒ ***As a first step, DOE is encouraged to host a listening day to bring expertise from industry stakeholders (pipelines, producers, regulators, etc.) and national laboratories together to discuss steps toward the creation of specifications and their organizational management (e.g., Federal Energy Regulatory Commission, ASTM, other).***

Opportunity 6

Fossil refineries produce multiple products. A better understanding of opportunities for co-producing bioproducts that can enhance fossil refinery profitability and utilization is needed.

⇒ ***Evaluate ways to better integrate fossil- or biomass-derived intermediates in integrated processing. Examples include the use of excess ethanol production capacity to feed fossil refineries for producing bioethylene, or co-feeding of biogas with fossil-derived methanol to achieve economies of scale for production of Polyhydroxyalkanoates as a biobased plastics precursor.***

[1] See, for example, M. Talmadge, et al., "Analysis for Co-Processing Fast Pyrolysis Oil with VGO in FCC Units for Second Generation Fuel Production" (presented at the 2016 Symposium on Thermal and Catalytic Sciences for Biofuels and Bio-Based Products, Raleigh, NC, November 1, 2016), https://projects.ncsu.edu/mckimmon/cpe/opd/tcs2016/pdf/oral/Day%201%20Plenary/1130_Day1Plenary_Talmadge.pdf.

[2] U.S. Department of Energy, *2016 Billion-Ton Report: Advancing Domestic Resources for a Thriving Bioeconomy* (Oak Ridge, TN: Oak Ridge National Laboratory, 2016), https://energy.gov/eere/bioenergy/2016-billion-ton-report.

XI. Closing Comments

The meeting was adjourned.

Appendix A: Committee Member Attendance—Aug. 15–16, 2017

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

Members	Affiliation	Attended?
Charles Abbas	Archer Daniels Midland	No
Dean Benjamin	Verso Corporation	No
Esteban Chornet	Enerkem	No
Katrina Cornish	Ohio State University	No
Steve Csonka	Commercial Aviation Alternative Fuels Initiative	Yes
Vonnie Estes	Consultant	No
William Frey	Georgia-Pacific	No
Emily Heaton	Iowa State University	Yes
Beth Hood	Arkansas State University	Yes
Raymond Huhnke	Oklahoma State University	No
Joseph James	Agri-Tech Producers, LLC	Yes
Randy Jennings	Tennessee Department of Agriculture	Yes
Coleman Jones	General Motors	Yes
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	No
Marina Moses	American Academy of Microbiology	No
Neil Murphy	State University of New York	No
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	No
Abolghasem Shahbazi	North Carolina A&T State University	Yes
Don Stevens	Cascade Science and Technology Research	Yes
Valerie Thomas	Georgia Institute of Technology	No
Alan Weber	MARC-IV Consulting/Weber Farms	Yes
Michael Wolcott	Washington State University	No

Total: 16 of 31 members attended

Appendix B: Agenda—Aug. 15–16, 2017

Day 1: Technical Advisory Committee Meeting Tuesday, Aug. 15, 2017

1:00 p.m.–1:10 p.m.	Welcome and Introduction of Quarterly Focus Topic: Biomass Integration with Existing Fossil Fuel Infrastructure *Committee Co-Chairs*
1:10 p.m.–1:30 p.m.	Presentation: DOE Update on Biomass R&D Activities *Mark Elless, Designated Federal Officer, DOE*
1:30 p.m.–1:50 p.m.	Presentation: USDA and BioEconomy Update on Biomass R&D Activities *Toby Ahrens, National Program Leader, Agricultural Bioproducts, National Institute of Food and Agriculture, USDA*
1:50 p.m.–2:30 p.m.	Presentation: Rewiring Carbon Reduction *Ian Rowe, DOE*
2:30 p.m.–3:15 p.m.	Presentation: Biomass Gasification for the Production of Fuels *Reinhard Seiser, University of California, San Diego*
3:15 p.m.–3:30 p.m.	*Break*
3:30 p.m.–3:45 p.m.	Public Comment *Daniel Shafer, Chief Operating Officer, Nikua Training Center*
3:45 p.m.–4:00 p.m.	Discussion: Subcommittee Instructions *Committee Co-Chairs*
4:00 p.m.–5:30 p.m.	Breakout Session: Subcommittee Breakouts

Day 2: Technical Advisory Committee Meeting: Wednesday, Aug. 16, 2017

8:30 a.m.–8:45 a.m.	Welcome Back *Committee Co-Chairs*
8:45 a.m.–9:30 a.m.	Presentation: Overview of Honeywell UOP Biomass Activities *Jim Andersen, Honeywell UOP*
9:30 a.m.–10:15 a.m.	Presentation: Biomass in California's Energy Portfolio: Advancement through Research and Development *Rizaldo Aldas, Program Lead, Energy Research and Development Division, California Energy Commission*
10:15 a.m.–12:00 p.m.	Breakout Session: Subcommittee Breakouts

12:00 p.m.–1:00 p.m.	*Lunch*
1:00 p.m.–1:30 p.m.	Discussion: Subcommittee Breakout Status Reports
1:30 p.m.–3:00 p.m.	Breakout Session: Subcommittee Breakouts
3:00 p.m.–3:15 p.m.	*Break*
3:15 p.m.–4:15 p.m.	Presentation: Subcommittee Breakout Reports
4:15 p.m.–5:30 p.m.	Action: Recommendations on Biomass and Its Interface with Fossil Fuels
5:00 p.m.–5:30 p.m.	Discussion: Next Steps for Q4 Meeting *Committee Co-Chair(s)*