

**Biomass Research and Development
Technical Advisory Committee**

June 5–6, 2014

Meeting Summary

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List of Acronyms

AFRI – Agriculture and Food Research Initiative	R&D – Research and development
ARPA-e – Advanced Research Projects Agency-Energy	REAP – Rural Energy for America Program Partnership
ARS – Agricultural Research Service	REE – Research Education and Economics
BER – Biological and Environmental Research	RFI – Request for Information
BETO – Bioenergy Technologies Office	RITA – Research and Innovative Technology Administration
Biomass Act – Biomass Research and Development Act of 2000	RMA – Risk Management Agency
BLM – Bureau of Land Management	USDA – U.S. Department of Agriculture
BMAS – Biomass Market Access Standard	Volpe – John A. Volpe National Transportation Systems Center
BRDI – Biomass Research and Development Initiative	
BTEC – Biomass Thermal Energy Council Committee – Biomass R&D Technical Advisory Committee	
DOE – Department of Energy	
DOD – Department of Defense	
DOI – Department of Interior	
DOT – Department of Transportation	
DPA – Defense Production Act	
EERE – Energy Efficiency and Renewable Energy	
EPA – Environmental Protection Agency	
FAA – Federal Aviation Administration	
FOA – Funding Opportunity Announcement	
FS – Forrest Service	
FSA – Farm Service Agency	
FRL – Fuel Readiness Level	
FSRL – Feestcok Readiness Level Tool	
GHG – Greenhouse gas	
LEAF – Landscape Environmental Assessment Framework	
LPO – Loan Programs Office	
NBAP – National Biofuels Action Plan	
NIFA – National Institute of Food and Agriculture	
NSF – National Science Foundation	
OCE – Office of the Chief Economist	
OSEC – Office of the Secretary	
OSTP – Office of Science and Technology Policy	
PEIS – Programmatic Environmental Impact Statement	
PETRO – Plants Engineered To Replace Oil Program	
RD – Rural Development	

I. Purpose

On June 5–6, 2014, the Biomass Research and Development Technical Advisory Committee (the Committee) held its second quarterly meeting of 2014. The Committee received updates about the U.S. Department of Energy’s (DOE’s) Bioenergy Technologies Office (BETO), and a U.S. Department of Agriculture (USDA) representative delivered presentations about current USDA activities. The Committee viewed presentations on the Biomass Research and Development Initiative (BRDI), DOE’s Loan Program Office, the *Update to the National Biofuels Action Plan*, and the expansion of the bioeconomy. Other presentations included a panel on feedstocks and DOE’s analysis on the bioeconomy.

See Attachment A for a list of meeting attendees. See Attachment B to review the meeting agenda. Meeting presentations can be viewed on the BRDI website:

<http://biomassboard.gov/committee/meetings.html>.

Background: The Committee was established by the Biomass Research and Development Act of 2000 (Biomass Act), which was repealed and replaced by Section 9008 of the Food, Conservation, and Energy Act of 2008. The Biomass Research and Development Board (the Board) was established under the same legislation to coordinate activities across federal agencies. This has recently been reauthorized in 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

Kevin Kephart, Committee Co-Chair
Pamela Contag, Committee Co-Chair

Dr. Kephart and Dr. Contag welcomed the Committee to the second meeting of the year and called the meeting to order.

III. Committee Business for 2014 and U.S. Department of Energy Updates

Elliott Levine, U.S. Department of Energy, Designated Federal Official

Mr. Levine began by addressing some Committee business. He informed the Committee a Federal Register Notice was released on May 19, soliciting nominations for new members. He then gave a brief overview of the Committee authorization and duties. Also, tentative dates for the third and fourth quarter meetings were identified below and will be confirmed during the meeting.

- The third quarter meeting will be held the week of August 18, 2014.
- The fourth quarter meeting will be held the week of December 1, 2014.

After addressing Committee business, Mr. Levine then provided updates on DOE R&D activities. He announced that Secretary Moniz recently announced the 2014 Strategic Plan for the Department of Energy. This is a comprehensive blueprint to guide the DOE’s core mission of ensuring America’s security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative

science and technology solutions. The Plan is organized into 12 strategic objectives and aimed at three distinct goals—Science and Energy, Nuclear Security, and Management and Performance.

He then provided updates on funding opportunities.

Recently closed BETO funding opportunity announcements (FOAs) and requests for information (RFIs) include the following:

- Renewable Carbon Fibers (DE-FOA-000096)—submission deadline was April 11, 2014.
- BETO Incubator (DE-FOA-0000974)—submission deadline was May 23, 2014.
- Biological and Chemical Upgrading for Advanced Biofuels and Products (DE-FOA-0001085)—concept paper submission closed on May 1, 2014, and full applications are due June 13, 2014.
- Input on Biofuel Pathways RFI (DE-FOA-0001124)—RFI Responses were due May 30, 2014.

Recently closed DOE Office of Science funding opportunities include the following:

- Plant Feedstock Genomics for Bioenergy: A Joint DOE-USDA Funding Opportunity (DE-FOA-0001034)—application due date was February 25, 2014.
- Systems Biology of Microbes to Enable Next-Generation Biofuels Production (DE-FOA-0001060)—application due date was March 14, 2014.

Mr. Levine also provided a list of past DOE-funded BRDI projects.

- 2002–2006 Awardees
 - ADM (\$4.1 million)
 - Cargill (\$10.9 million)
 - Natureworks (\$44.9 million)
 - Dupont (\$37.2 million)
- 2006 Awardees
 - Cleantech Partners (\$2.4 million)
 - Lucigen Corporation (\$1.5 million)
 - Edenspace Systems (\$5.5 million)
- 2007 Awardees
 - General Electric (\$1.0 million)
 - Iowa State University (\$1.4 million)
 - Purdue University (\$1.7 million)
 - University of Minnesota (\$0.7 million)
- 2010 Awardee
 - Metabolix (\$9.9 million)
- 2011 Awardee
 - Iowa State University (\$4.4 million)
- 2013 Awardee
 - Humboldt State University (\$5.8 million)

Mr. Levine next provided more details on the most recent awardee, Humboldt State, whose objective is to produce bioenergy and biobased products through effective utilization of forest residues by developing new biomass conversion technologies and optimized biomass operations logistics.

He then provided further BETO updates, which included the following:

- **Upcoming workshops**
 - BETO Process Integration and Carbon Efficiency (PRINCE) Workshop: June 11–12, 2014
 - BETO Herbaceous Feedstock Workshop (Invitational Only): June 24–26, 2014
 - ARPA-E Plant Phenotyping Workshop: June 18–19, 2014
 - *Biomass 2014: Growing the Future Bioeconomy*: July 29–30, 2014 at Washington Convention Center, Washington, D.C.
- **Recently held workshop**
 - Indirect Liquefaction Strategy Workshop, held March 20-21, 2014. The workshop's outcomes included some key challenges discussed in the areas of feedstock interface, catalyst production and validation, and accessible modeling. Further, participants highlighted the usefulness of open data and sharing past lessons learned and best practices.
- **Active waste-to-energy projects in the BETO portfolio**
 - Waste-to-Energy Life-Cycle Analysis
 - Waste-to-Energy Technoeconomic Analysis
 - Enhanced Anaerobic Digestion
 - Biogas to Liquid Fuels and Chemicals Using a Methanotrophic Microorganism.

There are multiple proposed projects for fiscal year (FY) 2015, including collaborative efforts across national laboratories. Currently, BETO is laying the groundwork through a strategic values document, opportunities matrix, resource-loaded plan, as well as a roadmapping workshop in late summer 2014.

Other DOE updates included the following:

- INEOS Bioenergy provided cellulosic ethanol from its DOE-supported, Vero Beach, Florida biorefinery for a green racing event at Sebring International Raceway, in Sebring, Florida on Friday, March 14, 2014.
- Advanced Research Projects Agency-Energy (ARPA-e), Plants Engineered to Replace Oil Program (PETRO) is conducting a Programmatic Environmental Impact Statement (PEIS) to formally address regulatory and societal risks from PETRO regarding Engineered High-Energy Crops. It will cover a variety of plants expressing energy traits in the Southeastern United States.

IV. Department of Agriculture Updates

Todd Campbell, Energy Policy Advisor, U.S. Department of Agriculture

Harry Schomberg, Senior Advisory Bioenergy and Natural Resources, REE Office of Chief Scientist, U.S. Department of Agriculture

Mr. Campbell provided updates on the following activities at USDA:

- Business and Industry Program and the BioPreferred Program Mix.
- FY 2014 BioPreferred/Biobased Product Goals
- Rural Energy for America Program Rural Development
- Biomass Crop Assistance Program Farm Service Agency
- Wood to Energy Initiative Forest Service
- Biodiesel Fuel Education Program National Institute for Food and Agriculture.

Harry Schomberg then provided an overview of USDA biomass R&D Activities. Physical and social sciences efforts are addressed through five Biomass Research Centers and the National Institute of Food and Agriculture (NIFA). The Biomass Research Centers are a regional focus on integrated energy biomass crops to increase productivity and improve quality. NIFA includes BRDI and the Agricultural Food and Research Initiative. Mr. Schomberg also provided an update on the 2012 Census of Agriculture Renewable Energy released in May 2014. Producers responding to the 2012 Census of Agriculture were asked to report on the operation of any renewable-energy-producing system, regardless of ownership. There were 57,307 energy-producing systems reported. The most common renewable energy producing system utilized by producers was solar panels. A total of 4,099 farms utilized biodiesel systems.

V. Update of the Biomass Research and Development Initiative

Daniel Cassidy, NIFA, U.S. Department of Agriculture

Mark Elless, U.S. Bioenergy Technologies Office, U.S. Department of Energy

Daniel Cassidy from NIFA updated the Committee on BRDI. From 2009–2013, \$118 million has supported 25 projects. He provided a summary of the evolution of the Initiative solicitations—noting that, starting in 2010, all three technical areas (feedstock development, fuels/product development, and analysis) must be addressed in proposals. Pre-applications are overseen by DOE, and full applications are overseen by USDA. Awards are made by each Department separately. In 2012–2013, a multi-state committee reviewed 28 projects. Mr. Cassidy then provided some of the successes, accomplishments, and outputs of the BRDI projects.

DOE’s Mark Ellis then provide an overview of all of DOE-awarded projects from 2002 to the present.

VI. U.S. Department of Energy, Loan Programs Office, Renewable Energy and Energy Efficiency Projects

Valri Lightner, Loan Programs Office, U.S. Department of Energy

DOE’s Valri Lightner provided an overview and update on the Loan Programs Office (LPO). LPO’s mission is to accelerate the U.S. commercial deployment of innovative clean energy and advanced vehicle manufacturing. The office provides project debt for clean energy projects and encourages co-lending with commercial lenders. LPO has more than 30 projects, with more than \$32 billion of total loan/loan guarantee amount committed, and more than \$50 billion total economic investment leveraged. LPO currently has more than \$40 billion in remaining loan authority. LPO has financed the deployment of groundbreaking projects, including the Abengoa Bioenergy Biomass of Kansas project in Hugoton,

Kansas, where the plant will convert approximately 300,000 metric tons of corn stover into about 23 million gallons of cellulosic ethanol per year and includes a 20 MW gross co-generation plant that produces steam and electricity for the plant.

Ms. Lightner also announced the Draft Renewable Energy & Efficiency Energy Projects Solicitation issued by LPO. The office will consider all eligible projects under Title XVII for Renewable Energy Projects and Energy Efficiency Projects, and it has five key technology areas: Advanced Grid Integration and Storage, Drop-In Biofuels, Waste-to-Energy, Enhancement of Existing Facilities, and Efficiency Improvements.

VII. Update on the National Biofuels Action Plan

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

Harry Baumes, Director of the Office of Energy Policy and New Uses, at the U.S. Department of Agriculture gave an update on the *National Biofuels Action Plan (NBAP) Update*. He started by providing a background on the 2008 *NBAP*. The October 2008 *NBAP* outlined a plan for a coordinated federal interagency effort to advance domestic biofuel production and deployment. It identified five areas for interagency collaboration, including Feedstock Production, Feedstock Logistics, Conversion, Distribution, and End Use. The 2012 *NBAP Update* reflects changes in overall strategic direction and landscape since the 2008 *NBAP* was issued. The 2012 *NBAP Update* is intended to inform and coordinate federal agencies' biofuels R&D. Major changes in the 2012 *NBAP* include the following:

- Expanding focus to include advanced hydrocarbon fuels in addition to ethanol
- Including algae as a potential biomass feedstock
- Adding a new feedstock logistics approach
- Assessing the impacts of advanced hydrocarbon fuel on Conversion approach and Distribution Infrastructure needs
- Coordinating the federal role in the area of Transport and Distribution Infrastructure
- Integrating issues of Sustainability and Environment, Health, and Safety into all sections rather than as separate sections.

Agencies that participated in the 2012 update include:

- USDA
 - Agricultural Research Service (ARS)
 - Rural Development
 - Research Education and Economics
 - Forrester Service
 - Office of the Secretary
 - Office of the Chief Economist
 - Farm Service Agency
- DOE
 - Office of Energy Efficiency and Renewable Energy

- Office of Science
- EPA
- Department of Transportation
 - Research and Innovative Technology Administration (RITA)
 - John A. Volpe National Transportation Systems Center
- National Science Foundation
- Office of Science and Technology Policy
- Department of Defense
- Department of Interior
 - Bureau of Land Management

VIII. Feedstocks Panel

- *Fuels from Corn Stover, Doug Karlen, Ames, Regional Feedstock Center, Midwest*
- *Example Application of the Feedstock Readiness Level Tool: Perennial Grasses in the Great Plains and Midwest, Rob Mitchell, Central/East Regional Biomass Research Center, U.S. Department of Agriculture*

Doug Karlen from the USDA-ARS National Laboratory for Agriculture & the Environment started with a presentation on the R&D needs for sustainable corn stover harvest. EPA and others identified corn stover as an economical feedstock because of the extensive area on which corn is grown (planted on an average of 97,272,000 acres in 2011–2013). It has a relatively high crop productivity (an average of 11.9 billion bushels of grain for those years) and has a 0.5 harvest index which indicates an average stover production of 282 million tons per year. It also has the potential to reduce crop residue management costs by harvesting a portion of the stover. However, stover is also important for soil health related to erosion and reduced soil productivity.

The Rural Energy for America Program Partnership (REAP) has compiled 239 site-years of stover harvest data to learn the effects on subsequent grain and stover yields, soil organic carbon and aggregation, microbial community, and greenhouse gas emissions. The partnership also developed the Landscape Environmental Assessment Framework (LEAF) and other tools to estimate available residue, quantify economics, and ensure ecosystem service benefits are sustained. Strategies identified to ensure sustainability include encouraging the entire biomass industry to understand the economic driver—limiting factor model. Further, the REAP Regional Partnership supports the development of self-regulating strategies such as the Biomass Market Access Standard. Long-term, multi-location, trans-disciplinary research through public-private-partnerships should be continued, as well as the development of management tools such as LEAF.

Following Mr. Karlen’s presentation, Rob Mitchell from USDA-ARS, Central-East Regional Biomass Research Center provided an overview of the Feedstock Readiness Level Tool (FSRL) and included examples of perennial grasses in the Great Plains and Midwest. The FSRL tool was developed by USDA, the Federal Aviation Administration, and RITA to describe the steps involved in bringing plant-based feedstocks to market for aviation biofuels production. Candidate feedstocks are assigned an FSRL level

(1 to 9), indicating maturity toward commercialization. The FSRL level communicates a feedstocks state of development concurrent with its readiness for use with a conversion process. There are four components to the FSRL: production, market, policy, and linkage to conversion process. Each component has one to four tollgate descriptions per readiness level. The FSRL tool was structured to complement the Fuel Readiness Level tool used by the aviation industry as an internationally recognized best practice for communication. The FSRL identifies gaps in any feedstock supply chain designed for any biofuel or conversion process that provides a market for feedstocks.

Mr. Mitchell then walked through the FSRL checklist using switchgrass for cellulosic ethanol in the Central-East Region as an example. After progressing through all four components of the tool (Production, Market, Policy, and Linkage to Conversion Parameters), the results showed switchgrass for cellulosic ethanol has completed all activities in the pre-commercial assessment phase and is ready to begin the commercial deployment phase as determined by the Feedstock Readiness Level Tool. Switchgrass is the most advanced herbaceous perennial biofuel feedstock.

IX. Expansion of the Bioeconomy

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

Bryce J. Stokes, Senior Advisor, CNJV

Michael Talmadge, Senior Process Engineer, NREL-SI

BETO Director Jonathan Male started by listing some definitions of the bioeconomy from various sources. For the purpose of this presentation, the “bioeconomy” is the economic activities associated with the production, harvest, transport, conversion, and use of biomass for biopower, bioproducts, and biofuels. He then discussed the challenge facing the bioeconomy and the possible potential. He also provided a snapshot and baseline of the current bioeconomy as it relates to biofuels, biopower, and bioproducts. Mr. Male then discussed the drivers and motivations for expanding the bioeconomy and asked the Committee to consider the following questions in their discussions:

- What needs to be accomplished to get a self-sustaining, profitable bioeconomy for advanced biofuels and bioproducts and biopower in the United States?
- What are the major hurdles that will need to be addressed in growing the bioeconomy over the next 5 years? 10 years? 30 years?
- How can the bioeconomy build off the lessons learned from the corn ethanol industry and the emerging RFS to arrive at a robust bioeconomy?
- What are barriers to commercialization and how do we reduce these barriers for sufficient critical mass where market forces pull the bioeconomy instead of policy?
 - How should we address an effort to grow the bioeconomy in the current economic environment that builds on the RFS?

- How would government-facilitated tours, workshops, or matchmaking of financiers with new technologies be received?
- What technology advances are needed to grow the bioeconomy for biofuels? For bioproducts and biopower technologies needed to enable biofuels?

Bryce Stokes and Michael Talmadge then provided an overview of the analysis done to identify the potential of an expanded bioeconomy. The analysis is a collaborative effort involving the Analysis Interagency Working Group of the Biomass R&D Board. The analysis is a general assessment of the potential expansion of the bioeconomy and is subject to additional changes and impacts from policy, technology, and market dynamics that were not considered. This is a first-order analysis, with continued improvements expected to be made based on additional inputs, other perspectives, feedback, and increased information collected from interested stakeholders. The bioeconomy analysis is based on the *U.S. Billion-Ton Update* (DOE, 2011) and recent POLYSYS model runs from Oak Ridge National Laboratory for biomass availability at a selected cost with transportation and preprocessing costs added to supply curves. The bioeconomy analysis provides results for only 2030. The analysis was completed using a wide range of analytical tools. Primarily, an Excel spreadsheet was used to complete the primary calculations and to present and maintain the data. The spreadsheet tool was reviewed by the Analysis Interagency Working Group and other agency personnel. Other models and tools used in the analyses were:

- POLYSYS – Policy Analysis Framework (POLYSYS) provides a comprehensive economic characterization of the U.S. agricultural sector and is calibrated to the USDA Long-Term Forecast (i.e., Baseline) [USDA OCE, 2014]. POLYSYS was utilized by Oak Ridge National Laboratory to generate supply curves.
- Biomass Logistics Model – Feedstock logistics and preprocessing costs were provided by Idaho National Laboratory’s model (2014).
- Bioeconomy AGE – (Air emissions, Greenhouse gas emissions, and Energy consumption) was developed by Argonne National Laboratory to estimate the energy and environmental impacts of the bioeconomy as compared to a business-as-usual baseline case. (Internal model based on and relying on the GREET model.)

They then discussed a number of assumptions made during the analysis, including the following:

- Based on the *U.S. Billion-Ton Update* modified to use the 2013 USDA Long-Term Forecast.
- Modified biomass supply curves to include transportation, preprocessing, and storage/handling.
- Used an average cost of \$80 per dry ton to the throat of the convertor based on BETO Multi-Year Program Plan targets.
- Included all feedstock types, as well as “currently used” and “potential.”
- Applied a 10% loss factor.

They then went through some of the results for the 2030 bioeconomy, including revenue, job creation, displacement of revenue to oil imports, emissions, and direct land-use change.

X. Subcommittee Breakout Summaries

The subcommittees discussed and reported back on discussion related to the following topics.

BRDI

- More research on lignin.
- Independent outside analysis of DOE/USDA progress to date.
- Ideas to stand up operating feedstocks supply chains by region.
- Support separation of various elements (Feedstocks, Conversion, and Analysis/Life-Cycle Assessment) for BRDI solicitation.
- Combination of 2014 and 2015 funds is acceptable in order to increase funding pool.
- Support idea of smaller awards: \$0.5–\$2 million level.
- Recommend that DOE increase contributions of funds for at least a direct match with USDA (estimated at \$6 million for FY 2014/FY 2015).
- Continue to be thoughtful on reviewer expertise, include more science backgrounds, as well as engineers.
- Support widespread inclusion of participants not currently eligible for BRDI awards.
- BRDI should solicit proposals for work to demonstrate the current and potential societal benefits of the bioeconomy (job creation, reduced oil imports, positive regional impacts).
- DOE/USDA to produce reports that support the bioeconomy
 - These need to be made more visible in popular/strategic media outreach
 - Research needs to be moved to the top of Google searches
 - Minority groups need to be included in communications/outreach to share the research.
- DOE/USDA to coordinate and support private sector advocates.

Feedstock

- The corn stover model should be validated at fields where actual data such as Eddy covariance have been collected in real time and continuously throughout the year.
- Modeling similar to the corn stover model should be duplicated for other biomass feedstocks, utilizing real field data, and should include model validation. This data should be uniform to be used by multiple end users such as Risk Management Agency (RMA). DOE Regional Feedstocks Partnership should be used as an example to manage the model development. (State Experiment stations). Long-term studies are difficult to sustain with current 13 year R&D programs.
- For bioenergy feedstocks, all field test and model crop yield data (including results from BRDI funded projects) should be made available through the Bioenergy KDF or www.betydb.org. The Bioenergy KDF needs to make data available uniformly.
- More field trial data must be collected and made available to be used by RMA.
- New technologies and programs must be developed for the deployment of new crops to targeted end users.

- For the Feedstock Readiness Tool, the United States must identify criteria that may be “show stoppers” such as crop insurance to indicate an immediate score of zero.
- More socio-economic analyses are needed on land owners.
- Field tests must be long term for data collection.

Bioeconomy Expansion

What needs to be accomplished to get a self-sustaining, profitable bioeconomy for advanced biofuels and bioproducts and to expand the biopower and cellulosic biofuels in the bioeconomy?

- In order to get a successful biofuels industry on line, we need either a major policy to drive this forward (maintaining RFS) or a major increase in R&D programs dedicated to crossing major technical barriers.
 - Structure of RFS should continue to be in place to help drive industry and provide incentive.
 - Create momentum for the bioeconomy in the short term through executive orders (for example, reference Powering Forward doc).
 - Need to demonstrate executive commitment by implementing EISA as commonly understood.
 - Direct federal power marketing administrations and authorities need to develop and demonstrate policies/practices necessary for electric utilities to incorporate renewable energy and distributed generation into their rates, infrastructure, and management practices
- Markets for bioproducts/chemicals will be larger than has been identified. This should be a source for potentially driving a market force for a bioeconomy. If at least a 40% penetration of fuels is considered, than at least 40% of products/chemicals should be considered as well.
- The United States needs regulations that clearly and stably define and enforce a level playing field where societal costs are evenly apportioned across all feedstock sources (including fossil); bioproducts don't benefit from the same criteria as biofuels.
- Need better consideration on integration of biofuels/chemicals on petroleum economy. Need to work with current petroleum producers and refiners to consider impact on jobs. Also need to focus on impacts on coal and natural gas, as well as petrochemical industries. Evaluation on jobs and quality should be included in analysis, along with trade issues.
- There will not be one set model for job creation when growing the bioeconomy, so separate models should be set up for biofuels, bioproducts, and biopower jobs.

What are major hurdles that will need addressing in growing the bioeconomy over the next 5 years? 10 years? 30 years?

- R&D funding should be focused on developing biochemicals through the least-steep path. Optimization period for chemicals is ongoing; the United States needs a driver for convergence on successful pathways. Consider policy along the lines of an RFS2 specifically for chemicals.
- Need to address how to make the best use of agricultural land if we are going to get close to the current estimates of 26 million acres converted for energy crops for the bioeconomy. Refer back to 2013 recommendation on virtual acres.
- A technology roadmap is needed to help develop and bring bioproducts/chemicals to market. Issues like cost competitiveness with petroleum remains a key barrier. The government should focus on developing products that have competitive edge in market.
- The government needs to examine successful biofuels programs around the world and determine what their success factors were, and how they can be applied in the United States.
 - Employ federal communications campaign to build constituency (rural and urban) in order to gain public buy-in/increase understanding.
 - Regulations that clearly and stably define and enforce a level playing field where societal costs are evenly apportioned across all feedstock sources (including fossil); bioproducts don't benefit from the same criteria as biofuels.
 - Involve coal-mining states in a beneficial way; incentivize those states for buy in and participation, and lessen adverse impacts of a growing bioeconomy on coal states.
- Encourage retail savings that pass along to the consumer; establish biobased retail infrastructure.
- The government should help industry replicate better-performing plants and continue to drive costs down through effective technology sponsorship. Develop low-risk plants to replicate appeal of "turn-key" ethanol plants.

How can the Bioeconomy build off the lessons from the corn ethanol industry and RFS to arrive at a robust bioeconomy?

- Baseline bioeconomy needs to be clarified in what is actually included in the definition, which could change the actual numbers accounted for in the current baseline. The current bioeconomy is approximately \$40–\$50 billion industry and the federal DOE R&D funding is 0.4%–0.5% of this amount. To achieve a future \$200 billion bioeconomy, an order of magnitude increase of funding dedicated to R&D is needed.
- A better, more realistic, understanding of both the current baseline, as well as what could be brought online with a future bioeconomy. An understanding of:

- The current agriculture/forest economy
 - The current bioeconomy industry
 - The future for both the bioeconomy industry and the agriculture/forest industry
 - Comparison with the current and future petroleum industry.
- DOE/Board agencies should use more realistic capital and contingency rates of return to better reflect the capital environment facing the stage of technology development. Need to drive capital prices down—the number one barrier to commercialization. Current technologies have inherently high capital costs. More funding should be focused on technology breakthroughs that would reduce capital costs long term.
 - Corn ethanol is \$2 per installed gallon; Cellulosic is approximately \$8–\$10 per installed gallon. Reasonable target is \$4 per installed gallon.
 - Consider how to intensify current processes.
 - The government should lessen the divide between corn ethanol and cellulosic ethanol in order to move toward an integrated bioeconomy and take advantage of all successful technology gains.
 - Conduct and learn for life-cycle assessments in the early development stage.
 - Need to be aware of different market drivers that may be associated with bioproduct/biopolymer area.

What are and how do we reduce the barriers to commercialization for sufficient critical mass where markets forces drive the bioeconomy instead of policy?

- Need to review past recommendations on lignin utilization.
- Need to concentrate resources on developing feedstocks to be storable, hedge-able, and transportable (bio-STUFF).

How should we address an effort to grow the bioeconomy in the current economic environment that operates under the RFS?

- Drive technology to make products and fuels economically attractive to drive capital investment.
- Consider relaxing the blend wall and promoting vehicles that are warranted for higher blends than E10, which will require dedicated infrastructure investment to support this effort.

How would government-facilitated tours, workshops, or matchmaking of financiers with new technologies be received?

- Concentrate efforts to break down perception that this is only a carbon reduction effort, and therefore, a blue-state initiative. Show crosscutting appeal of bringing a stable bioeconomy online (jobs). Show that this achieves longstanding national goal of eliminating the import of petroleum/energy security.

XI. Public Comment

Nancy Heimann, President/CEO, Enginuity Worldwide

Nancy Heimann, President/CEO of Enginuity Worldwide, gave an overview of Enginuity Worldwide and the company's process to use non-woody, annually renewable agricultural materials (like corn stover, grass, and energy crops) to create engineered solid fuel that can be burned in coal-fired boilers without modification to the feed and boiler systems of power plants. The fuel then supplements coal and enables plants to meet emissions requirements without expensive expenditures (e.g., new boilers).

Heimann's presentation can be found on the Committee website:

http://www.biomassboard.gov/pdfs/enginuity_tac_2014_q2.pdf.

XII. Closing Comments

Meeting was adjourned.

Attachment A: Committee Member Attendance — June 5–6, 2014

Co- Chairs	Affiliation	Attended?
Kevin Kephart	South Dakota State University	Yes
Pamela Reilly Contag	Cygnnet Biofuels	Yes

Members	Affiliation	Attended?
Dean Benjamin	NewPage Corporation	Yes
David Bransby	Auburn University	Yes
Paul Bryan	UC-Berkeley	Yes
Steve Csonka	Commercial Aviation Alt. Fuels Initiative	Yes
Claus Crone Fuglsang	Novozymes North America, Inc.	Yes
Joseph James	Agri-Tech Producers, LLC	Yes
Randy Jennings	State of Tennessee	Yes
Coleman Jones	General Motors	Yes
Craig Kvien	University of Georgia	Yes
Kit Lau	BioAmber Inc.	Yes
Johannes Lehmann	Cornell University	No
Stephen Long	University of Illinois	Yes
Maureen McCann	Purdue University	No
Bruce McCarl	Texas A&M	No
Christine McKiernan	BIOFerm Energy Systems	Yes
Ray Miller	Michigan State University	Yes
Neil Murphy	State University of New York,	Yes
David Nothmann	Battelle	No
William Provine	Dupont	No
James Seiber	University of California	Yes
Abolghasem Shahbazi	North Carolina A&T State University	No
Don Stevens	Cascade Science and Tech. Research	Yes
John Tao	O-Innovation Advisors LLC	Yes
Valerie Thomas	Georgia Tech	No
Alan Weber	MARC-IV Consulting / Weber Farms	Yes
Todd Werpy	Archer Daniels Midland Company	Yes

Total: 21 of 28 members attended

Attachment B: Agenda — June 5–6, 2014

Day 1: Technical Advisory Committee Meeting

June 5, 2014

- 8:00 a.m. – 8:30 a.m. *Breakfast (to be provided for Committee)*
- 8:30 a.m. – 9:00 a.m. Welcome
Committee Co-Chairs
- 9:00 a.m. – 9:45 a.m. Presentation: U.S. DOE Updates
Elliott Levine, U.S. Bioenergy Technologies Office, U.S. Department of Energy
- 9:45 a.m. – 10:15 a.m. Presentation: USDA Update on Biomass R&D Activities
Harry Schomberg, U.S. Department of Agriculture
- 10:15 a.m. – 10:30 a.m. *Break*
- 10:30 a.m. – 11:15 a.m. Presentation: Biomass Research and Development Initiative (BRDI) Update
 - *Daniel Cassidy, NIFA, U.S. Department of Agriculture*
 - *Mark Elless, U.S. Bioenergy Technologies Office, U.S. Department of Energy*
- 11:15 a.m. – 11:45 a.m. Presentation: LPO Solicitation
Valri Lightner, Loan Programs Office, U.S. Department of Energy
- 11:45 a.m. – 12:45 p.m. *Lunch (to be provided for Committee)*
- 12:45 p.m. – 1:15 p.m. Presentation: Update to the National Biofuels Action Plan
Harry Baumes, U.S. Department of Agriculture
- 1:15 p.m. – 2:00 p.m. Presentation: Feedstocks Panel
 - *Fuels from Corn Stover, Doug Karlen, Ames, Regional Feedstock Center, Midwest*
 - *Example Application of the Feedstock Readiness Level Tool: Perennial Grasses in the Great Plains and Midwest, Rob Mitchell, Central/East Regional Biomass Research Center, U.S. Department of Agriculture*
- 2:00 p.m. – 2:45 p.m. Presentation: Expansion of the Bioeconomy
Jonathan Male, Bioenergy Technologies Office Director, U.S. Department of Energy

- 2:45 p.m. – 3:15 p.m. Presentation: Overview of Bioeconomy Analysis
Bryce Stokes, CNJV
Michael Talmadge, NREL Systems Integration
- 3:15 p.m. – 3:30 p.m. *Break*
- 3:30 p.m. – 3:45 p.m. Public Comment:
Nancy Heimann, President/CEO, Enginuity Worldwide LLC
- 3:45 p.m. – 4:00 p.m. Discussion: Instruction for Subcommittee Breakouts Plan
Committee
- 4:00 p.m. – 5:30 p.m. Subcommittee Breakouts:
Subcommittees

Day 2: Technical Advisory Committee Meeting

June 6, 2014

- 8:00 a.m. – 8:30 a.m. *Breakfast (to be provided for Committee)*
- 8:30 a.m. – 9:00 a.m. Discussion: Instructions to Committee Breakouts
Committee Co-Chairs
- 9:00 a.m. – 11:00 a.m. Breakouts: Subcommittees
- 11:00 a.m. – 12:00 p.m. Discussion: Subcommittee Report Outs
Committee
- 12:00 p.m. – 12:15 p.m. Discussion:
Committee
- 12:15 p.m. – 12:30 p.m. Public Comment:
Corinne Young
Corinne Young LLC
- 12:30 p.m. – 1:00 p.m. Closing Comments: Site Visits
Co-Chairs
- 1:00 p.m. – 2:00 p.m. *Lunch (to be provided for Committee)*
- 2:00 p.m. Adjourn