

**Biomass Research and Development  
Technical Advisory Committee**

**March 5, 2015**

***Meeting Summary***

## Table of Contents

TABLE OF CONTENTS .....	I
LIST OF ACRONYMS .....	II
I. PURPOSE .....	1
II. WELCOME .....	1
III. COMMITTEE BUSINESS FOR 2014 AND DOE UPDATES.....	1
IV. USDA UPDATES .....	2
V. OVERVIEW OF THE BOARD, OPERATION COMMITTEE, AND WORKING GROUPS .....	3
VI. BIOMASS RESEARCH AND DEVELOPMENT INITIATIVE UPDATE.....	4
VII. OVERVIEW OF DOE, BETO 2015 BUDGET, NEW AREAS, AND ACTIVITES .....	4
VII. 2014 RECOMMENDATIONS AND FEEDBACK FORM THE BOARD .....	5
VIII. 2015 COMMITTEE ACTIVITIES AND WORK PLAN .....	6
IX. PUBLIC COMMENT .....	6
XII. CLOSING COMMENTS.....	7
ATTACHMENT A: COMMITTEE MEMBER ATTENDANCE—MARCH 5, 2015.....	A-1
ATTACHMENT B: AGENDA—MARCH 5, 2015.....	B-1

## List of Acronyms

BETO – Bioenergy Technologies Office  
Board – Biomass Research and Development Board  
BRDI – Biomass Research and Development Initiative  
Committee – Biomass Research & Development Technical Advisory Committee  
DOD – U.S. Department of Defense  
DOE – U.S. Department of Energy  
DPA – Defense Production Act  
EERE – Office of Energy Efficiency and Renewable Energy  
FOA – Funding Opportunity Announcement  
gge – gallon of gasoline equivalent  
NIFA – National Institute of Food and Agriculture  
R&D – research and development  
USDA – U.S. Department of Agriculture  
VTO – Vehicle Technologies Office  
WTE – Waste-to-Energy

## I. Purpose

On March 5, 2015, the Biomass Research and Development Technical Advisory Committee (“the Committee”) held its first quarterly meeting of 2015, via webinar. The Committee received updates about the U.S. Department of Energy’s (DOE’s) Bioenergy Technologies Office (BETO), and U.S. Department of Agriculture (USDA) representatives delivered presentations about current USDA activities. The Committee also received an overview of the Biomass Research and Development Board (“the Board”), Operation Committee, and working groups. Robert Kozak, President of Atlantic Biomass LLC, provided public comment.

See Attachment A for a list of meeting attendees. See Attachment B to review the meeting agenda. Meeting presentations can be viewed on the Biomass Research and Development Initiative (BRDI) website at the following link: <http://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**Background:** The Committee was established by the Biomass Research and Development Act of 2000, which was later repealed and replaced by Section 9008 of the Food, Conservation, and Energy Act of 2008.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 (“the Board”) was established under the same legislation to coordinate activities across federal agencies. This 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

*Kevin Kephart, Committee Co-Chair*

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

## III. Committee Business for 2014 and DOE Updates

*Elliott Levine, DOE, Designated Federal Official*

Mr. Elliott Levine from BETO provided an overview of Committee activities for 2015 and DOE R&D activities related to bioenergy. Mr. Levine began by presenting a Committee 2015 work timeline that showed the goals of each Committee meeting in 2015. He then provided an overview of BETO announcements, upcoming events, and publications. These included

- The release of the BRDI Funding Opportunity Announcement (FOA) on February 26, 2015
- DOE’s announcement of up to \$10 million for seven projects to support innovative technologies as part of the BETO incubator selections
- The Advanced Supply System Validation Workshop held on February 3–4, 2015, which brought together a diverse group of stakeholders to examine, discuss, and validate analysis assumptions used to move beyond current feedstock supply systems designed to support the agriculture and forestry industries
- Awards from the Targeted Algal Biofuels and Bioproducts FOA are anticipated in June 2015.
- Awards from the Landscape Design FOA are anticipated in June 2015.

- The upcoming Bioenergy Peer Review on March 23–27, 2015 in Alexandria, Virginia
- The upcoming Bioenergy 2015 Conference on June 23–24, 2015 in Washington, D.C.
- The Waste-to-Energy (WTE) Workshop Series planned for March 18–19, 2015 and in June 2015.

Mr. Levine also provided updates on other DOE Offices' activities including the Vehicle Technologies Office (VTO), Office of Science, and Advanced Research Projects Agency-Energy.

## IV. USDA Updates

*Todd Campbell, USDA*

*Harry Schomberg, USDA*

Mr. Campbell provided updates on the following Farm Bill programs:

- Advanced Biofuel Payment Program – This program issues \$5.6 million in grants to 220 producers across the nation to support the production of advanced biofuels.
- Biodiesel Fuel Education Program – This program stimulates biodiesel consumption and development of biodiesel infrastructure. The National Biodiesel Board and Regents of the University of Idaho received \$768,000 and \$192,000, respectively.
- Sun Grant Initiative – This program encourages bioenergy and biomass research collaboration between government agencies, land-grant colleges and universities, and the private sector. South Dakota State University received \$2.3 million through the Sun Grant Program.
- Critical Agricultural Materials Program – This program supports the development of products manufactured from domestically produced agricultural materials. These strategically and industrially important products benefit the nation's economy, defense, and general well-being. Through this program, Iowa State University received \$1 million to develop new paint, coating, and adhesive products derived from acrylated glycerol, a co-product of biodiesel.
- Rural Energy for America Program – This program encourages agricultural producers and rural small businesses to improve their renewable energy systems (RES) and energy efficiency (EE) by covering up to 25% of total project costs (maximum of \$500,000 for RES and \$250,000 for EE). It also provides loan guarantees for up to 75% (maximum of \$25 million) of total improvement costs. More than \$280 million is available to eligible applicants.
- Biomass Crop Assistance Program – This program provides up to \$25 million each year in financial assistance to owners and operators of agricultural and non-industrial private forestland. To qualify, owners and operators must establish, produce, and deliver biomass to a qualifying facility for heat, power, biobased products, research, or advanced biofuels. The rule includes modifications to cost sharing, eligible types of biomass, and other definitions. Comments were due by April 28, 2015. The full program resumed on May 28, 2015.
- Biomass Research and Development Initiative – This initiative is available through a joint program between USDA's National Institute of Food and Agriculture's (NIFA's) Biomass Research and DOE. Concept papers were due by March 27, 2015, and full applications were due by July 27, 2015.

- National Agricultural Library Search Engine for USDA Research – The National Agricultural Library, part of USDA's Agricultural Research Service, unveiled PubAg, a user-friendly search engine that gives the public enhanced access to research published by USDA scientists. Intended for literature searches, the portal contains full-text access of more than 40,000 scientific journal articles by USDA researchers, with additional articles added almost daily.
- President's 2016 Budget Proposal on USDA-Led Manufacturing Innovation Institutes – This proposal includes \$80 million to support public-private partnerships to establish two innovation institutes engaging industry, leveraging funding, and facilitating technology transfer.

## V. Overview of the Board, Operation Committee, and Working Groups

*Todd Campbell, USDA*

*Alison Goss Eng, DOE*

Mr. Campbell from USDA and Alison Goss Eng from DOE, BETO provided an overview of the coordination and interaction between the Board, Operation Committee, and Working Groups. The Biomass Research and Development Act was established in 2000 and has been amended several times. Most recently, the Agricultural Act of 2014 reauthorized it. The Biomass Research and Development Act established the Interagency Biomass R&D Board and the Committee. It also authorized funds for the Biomass R&D Initiative.

The Biomass Board was created by statute to coordinate R&D activities related to biofuels and bio-based products and their commercialization with collaboration between agencies. The Board is a panel consisting of Senate-confirmed co-chairs from USDA and DOE and senior-level representatives from executive branch agencies including

- U.S. Environmental Protection Agency
- U.S. Department of Transportation
- National Science Foundation
- U.S. Department of Interior
- Office of Science and Technology Policy
- U.S. Department of Defense (DOD).

The Board Operations Committee is composed of 10 members who represent the various agencies and work closely with their Board members to carry out related tasks. Arranging quarterly Board meetings, coordinating interagency reports, and planning workshops are all activities under the purview of the Operations Committee.

The Board also established seven interagency working groups to focus on specific concentrations in bioenergy. These groups work on numerous activities, from collaborative research assessments to developing white papers and interagency reports. The seven working groups are listed below:

- *Feedstocks Production and Management*
- *Feedstocks Production—Genetic Improvement*

- *Feedstocks Logistics*
- *Conversion*
- *Transport and Distribution Infrastructure*
- *Algae*
- *Analysis*

## VI. Biomass Research and Development Initiative Update

*Daniel Cassidy, NIFA, USDA*

Daniel Cassidy provided an overview of BRDI to date. There is up to \$8.7 million in funding available to support research and demonstration efforts. Concept papers were due by March 27, 2015, and full applications were due by July 27, 2015. Proposals were solicited to address three technical topic areas:

1. Feedstocks Development
2. Biofuels and Biobased Products Development
3. Biofuels and Biobased Products Development Analysis.

## VII. Overview of DOE, BETO 2015 Budget, New Areas, and Activities

*Jonathan Male, Director, BETO*

Jonathan Male provided an overview of the DOE, BETO 2015 budget, new areas, and activities. He started by highlighting the BETO mission to accelerate the commercialization of advanced biofuels and bioproducts through targeted research, development, and demonstration supported by public and private partnerships and their strategic and performance goals. He then highlighted the BETO 2014 R&D accomplishments related to

- Cost reductions in feedstock logistics
- Conversion costs for advanced biofuels
- Environmental performance of cellulosic feedstock production
- The National Alliance for Advanced Biofuels and Bioproducts Consortium published its final report with major findings for algal research.

He then provided an overview of the 2015 BETO activities and goals:

- **Feedstocks:** Demonstrate a modeled mature delivered feedstock cost of \$115 per dry matter ton (including both grower payment and logistics)
- **Algae:** Demonstrate integrated protein and carbohydrate conversion with target of 80% of theoretical yield from proteins and carbohydrates and demonstrate an increase in algal intermediate yields (1,500 gallons/acre/year)
- **Demonstration and Market Transformation:** Increase portfolio to include three novel technology demonstrations to reduce risk of scale-up of emerging bioenergy pathways
- **Biochemical Conversion:** Reduce modeled conversion cost via a biochemical (hydrolysis) conversion route to hydrocarbon fuel blendstocks in support of the 2022 programmatic goal of

\$3/gallon for drop-in fuels such as renewable gasoline, diesel, and jet fuel (\$6.40/gallon of gasoline equivalent [gge])

- **Thermochemical Conversion:** Reduce the modeled conversion cost contribution via fast pyrolysis for converting biomass to a hydrocarbon fuel blendstock in a mature commercial-scale plant (\$3.70/gge)
- **Sustainability:** Identify practices that improve sustainability and environmental performance of advanced bioenergy, including results from a comprehensive case study of environmental, social, and economic sustainability indicators for a cellulosic feedstock production and biorefinery system
- **Collaborations with the VTO:** Test fuels and develop better engines for high-octane fuels.

He then introduced the 2016 budget request and priority activities:

- **Algae:** Pursue new research in advanced biology and carbon dioxide utilization to address yield, productivity, and integration of downstream logistics at the pre-pilot scale
- **Conversion:** Select and complete preparation of at least two pathways for validation at integrated bench or pilot scale in Fiscal Year 2017 of modeled mature \$3/gge gasoline/diesel blendstock price and progress toward Fiscal Year 2022 price goals (\$3/gge)
- **Feedstock Supply:** Focus on feedstock supply and logistics technologies to help meet biomass feedstock price targets of \$80/dry matter ton in 2017
- **New Fuels and Vehicle Systems Optima:** Establishes a link early in the R&D cycle of both fuels and engines for a systems-based approach to create optimized solutions for fuels and engines in collaboration with VTO
- **New Investments in the Integrated Production and Scale-Up of Drop-in Hydrocarbon Fuels:** New competitive awards (up to three pilot projects or one demonstration project) to scale-up integrated production systems of drop-in hydrocarbon biofuels to accelerate advanced biofuel manufacturing
- **Defense Production Act (DPA):** Support the military-specification jet fuel in collaboration with DOD and USDA through the DPA.

Finally, he listed some areas of new interest for BETO:

- Distillates (diesel and jet fuel)
- Bioproducts
- Natural gas and biogas
- Infrastructure needs.

## VIII. 2014 Recommendations and Feedback from the Board

*Kevin Kephart, Director, Committee Co-Chair*

Kevin Kephart, the Committee Co-Chair, provided a report to the full Committee on the presentation he gave to the Biomass Board in December on the 2014 recommendations. The Board appreciated the

work and effort of the Committee and thanked them for their recommendations. Follow-up discussion included how to develop a closer working relationship between the Committee and the Board.

## **IX. 2015 Committee Activities and Work Plan**

*Kevin Kephart, Director, Committee Co-Chair*

Kevin Kephart, the Committee Co-Chair, introduced the Committee plan for 2015. Based on feedback from Committee members, the Committee will look to provide recommendations in 2015 on more focused topic areas. Input on these topic areas will come from both Committee members and federal program managers. Topics will emanate from Committee subcommittees and members as well as other sources such as the Board working groups.

## **X. Public Comment**

*Robert Kozak, President, Atlantic Biomass, LCC*

*“Back to Basics” More Emphasis Needed on Catabolic Pathway and Enzyme Research*

When someone from outside of the biofuels and bioproducts community looks at the bioenergy websites of DOE or USDA or those of bioenergy firms trying to raise money, they are probably left with the impression that all the necessary discoveries have been made and commercialization is only being slowed by lack of mid or late stage funding. And while this overly optimistic approach may be useful when dealing with Wall Street or Congress, I hope the decision makers at these agencies and companies have a more realistic appreciation of our lack of understanding in critical areas and are plotting new paths to solve these core scientific problems.

Speaking from my experience in enzyme and catabolic pathway development I can clearly say we have a long way to go. In essence, the high performance cellulase enzymes such as the Novozyme Ctec3 are not the complete answer.

More importantly, the question they were built to answer wasn't the right one.

If I may, I'd like to offer three core research areas that need to be pursued if we are to conquer Biomass Recalcitrance and produce cost-effective biofuels and bioproducts.

Enzyme Recycling: As Weiss et al wrote in 2013<sup>1</sup> the recycling of enzymes offers a significant cost reduction in biomass pretreatment and saccharification costs. However, the major roadblock to efficient recycling is releasing the enzymes from the insoluble biomass<sup>2</sup> they attach to in order for the active sites of the enzymes to come in contact with the specific biomass bonds they are designed to break. In fact, some of the higher yielding enzymes compound this problem by improving or increasing the attachment points. In recent recycling work we have seen decreases of over 30 percent between runs when the biomass is in the early stages of processing. Improvements in one type of enzyme that address the attachment and related issues could result in the improvement of all categories of catabolic enzymes.

Non-Cellulose Synthesis/Catabolic Pathways: The biggest surprise I had entering the biomass processing business was how lacking our knowledge of plant cell structure is. The scale of the United States' plant

cell research is laughable in comparison to the billions spent by the US science establishment over the last half-century on animal plant cells. Without an improved knowledge of how pectin, xylose, lignin, and cellulose are formed<sup>3</sup> and how they intertwine into beautiful and incredibly strong matrixes we're kidding ourselves about economically producing "Total Biomass" fuels and products.

Pathway Enzyme Development: The consolidated organism approach to combining saccharification and fermentation was an interesting initial approach. Unfortunately in most cases the complexity of the pathways and the number of enzymes needed were greatly underestimated. Building on the original idea, such ideas as adapting catabolic organisms to specific biomass should be pursued to develop a complete catabolic/saccharification pathway. The hypothesis is that by restricting the organisms to only the target carbon sources, the organism colonies would have two reactions: 1) currently used enzymes needed to break down the biomass would be overexpressed, and/or 2) currently non expressed genes would secrete "new" enzymes. After several generations the population would have moved to expressing a new set of enzymes specifically suited to the target biomass. Again, once this process had been developed in one organism and biomass source it could be used in multiple systems.

I hope that the Biomass Research and Development Initiative Funding Opportunity Announcement that was just released as well as those in future years will be focused on solving critical core science issues such as those just listed. This is especially critical since funding is limited, and spreading it over too many unrelated projects certainly dilutes its impact.

#### References

1 Weiss, Noah, Börjesson, Johan, Pedersen, Lars Saaby, Meyer, Anne S, "Enzymatic lignocellulose hydrolysis: Improved cellulase productivity by insoluble solids recycling," *Biotechnology for Biofuels*, 2013, 6:5 <http://www.biotechnologyforbiofuels.com/content/6/1/5>

2 Xue, Ying, Jameel, Hasan, Park Sunkyoo, Strategies to Recycle Enzymes and Their Impact on Enzymatic Hydrolysis for Bioethanol Production, *BioResources*, 2012.

3 Mohnen, D, Bar-Peled, M., and Sommerville, C.: Biosynthesis of Plant Cell Walls, in Chapter 5, *Biomass Recalcitrance*, ed. Himmel, M., Blackwell Publishing, Oxford, 2008. P-113)

## **XI. Closing Comments**

The meeting was adjourned.

## Attachment A: Committee Member Attendance—March 5, 2015

<b>Co- Chairs</b>	<b>Affiliation</b>	<b>Attended?</b>
Kevin Kephart	South Dakota State University	Yes

<b>Members</b>	<b>Affiliation</b>	<b>Attended?</b>
Paul Bryan	University of California-Berkeley	Yes
Steve Csonka	Commercial Aviation Alternative Fuels Initiative	Yes
Claus Crone Fuglsang	Novozymes North America, Inc.	No
Randy Jennings	State of Tennessee	No
Kit Lau	BioAmber Inc.	No
Johannes Lehmann	Cornell University	Yes
Stephen Long	University of Illinois	No
Maureen McCann	Purdue University	Yes
Christine McKiernan	BIOFerm Energy Systems	Yes
Ray Miller	Michigan State University	Yes
David Nothmann	Battelle	Yes
William Provine	Dupont	Yes
James Seiber	University of California	Yes
Don Stevens	Cascade Science and Tech. Research	Yes
John Tao	O-Innovation Advisors LLC	Yes
Valerie Thomas	Georgia Institute of Technology	Yes
Todd Werpy	Archer Daniels Midland Company	No

**Total: 13 of 18 members attended**

## Attachment B: Agenda—March 5, 2015

### Day 1: Technical Advisory Committee Meeting

March 5, 2015

- 1:30 p.m.–1:45 p.m.      Welcome  
*Committee Co-Chair(s)*
- 1:45 p.m.–2:15 p.m.      Presentation: Committee Business for 2015 and U.S. Department of Energy (DOE) Updates  
*Elliott Levine, Designated Federal Official, DOE*
- 2:15 p.m.–2:45 p.m.      Presentation: U.S. Department of Agriculture (USDA) Update on Biomass Research and Development Activities  
*Todd Campbell, USDA*
- 2:45 p.m.–3:15 p.m.      Presentation: Overview of Biomass Research and Development Board (“the Board”), Operation Committee and Working Groups  
*Todd Campbell, USDA*  
*Alison Goss Eng, Bioenergy Technologies Office (BETO), DOE*
- 3:15 p.m.–3:30 p.m.      Presentation: Biomass Research and Development Initiative (BRDI) Solicitation, Status, and Update  
*Daniel Cassidy, National Institute of Food and Agriculture, USDA*
- 3:30 p.m.–4:15 p.m.      Presentation: Overview of DOE, BETO Office 2015 Budget, New Areas, and Activities  
*Jonathan Male, BETO Director, DOE*
- 4:15 p.m.–4:45 p.m.      Presentation: 2014 Recommendations and Feedback from the Board  
*Kevin Kephart, Committee Co-Chair*
- 4:45 p.m.–5:15 p.m.      Presentation: 2015 Committee Activities and Work Plan  
*Kevin Kephart, Committee Co-Chair*
- 5:15 p.m.–5:30 p.m.      Public Comment  
*Robert Kozak, President, Atlantic Biomass, LLC*
- 5:30 p.m.                      Close Meeting