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- Other DOE Offices: Vehicle Technologies Office, Office of Science, and ARPA-E Updates
- References and Useful Links
## Agenda at a Glance: Day 1

**Day 1: Technical Advisory Committee Meeting**

### August 27, 2015

<table>
<thead>
<tr>
<th>Time</th>
<th>Agenda Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 a.m. – 8:30 a.m.</td>
<td>Breakfast (to be provided for Committee)</td>
</tr>
<tr>
<td>8:30 a.m. – 9:00 a.m.</td>
<td>Welcome, Meeting Direction, and Agency Updates</td>
</tr>
<tr>
<td></td>
<td><strong>Committee Co-Chairs</strong></td>
</tr>
<tr>
<td></td>
<td>Elliott Levine, Bioenergy Technologies Office, U.S. Department of Energy</td>
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<tr>
<td></td>
<td>Todd Campbell, U.S. Department of Agriculture</td>
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<tr>
<td>9:00 am – 9:30 am</td>
<td>How do RINS work? Sandra Dunphy, Director-Energy Compliance, Weaver</td>
</tr>
<tr>
<td>9:30 am – 10:30 am</td>
<td><strong>Panel: Assessment Tools and Measuring Environmental Externalities</strong></td>
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<td></td>
<td>• Environmental Sustainability Indicators, Virginia Dale, ORNL</td>
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<td></td>
<td>• Environmental Assessment Tools and How Are They Used? Jennifer Dunn</td>
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<td></td>
<td>Argonne National Laboratory</td>
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<tr>
<td>10:30 a.m. – 10:45 a.m.</td>
<td>Break</td>
</tr>
<tr>
<td>10:45 a.m. – 12:15 p.m.</td>
<td><strong>Panel: Biomass Resource Development and National Security Considerations</strong></td>
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<td></td>
<td>• Landscape Agriculture, Strategic Biomass Resource Utilization, Doug Karlen, USDA ARS</td>
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<td></td>
<td>• Strengthening National Security, Chris Tindal, US Navy</td>
</tr>
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<td></td>
<td>• Impact of Developing and Utilizing our Biomass Resources, Laurence Eaton-ORNL</td>
</tr>
<tr>
<td>12:15 p.m. – 1:15 p.m.</td>
<td>Lunch (to be provided for Committee)</td>
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</tbody>
</table>
Panel: Bioeconomy Market Development and Economic Impact
- What does the future fuels market look like and how do biofuels fit? Tony Radich, EIA
- USDA Biofuels Infrastructure Partnership, Katina Hanson, USDA
- Biorefinery Assistance Program (BAP), Mark Brodziski, USDA
- An Economic Impact Analysis of the U.S. Biobased Products Industry, Robert Handfield, North Carolina State University

Public Comment

Break

Subcommittee Breakouts: (closed session)
Day 2: Technical Advisory Committee Meeting

August 28, 2015

8:00 a.m. – 8:30 a.m.  Breakfast (to be provided for Committee)
8:30 a.m. – 11:30 a.m.  Subcommittee Breakouts: (closed session)
                          Break at 9:45 a.m.
11:30 a.m. – 12:00 p.m. Public Comment
12:00 p.m. – 12:30 p.m. Subcommittee Report outs
12:30 p.m. – 1:00 p.m.  Discussion: Q4 Meeting Logistics
1:00 p.m. – 2:00 p.m.  Lunch (to be provided for Committee)
2:00 p.m.  Meeting Adjourn
# TAC 2015 Work Timeline

<table>
<thead>
<tr>
<th>Date</th>
<th>Committee Objectives</th>
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<tr>
<td><strong>Q1 2015</strong>&lt;br&gt;March 5, 2015 Webinar</td>
<td>• Receive presentation on the interactions between the Biomass Board, Operation Committees, and Interagency Working Groups.</td>
</tr>
</tbody>
</table>
| **Q2 2015**<br>May 20-22, 2015 (2 ½ day meeting) | • TAC along with the attending Operation Committees and Interagency Working Group guests would list and rank topics for the TAC to consider.  
  • Agree on TAC 2015 topic areas.  
  • Adjust the TAC sub-committee structures (if necessary) to best address one or more topics per future meeting. |
| **Q3 2015**<br>August 27-28 (1 ½ day meeting) | • Work in Subcommittees to develop recommendations on agreed upon topic areas. |
| **Q4 2015**<br>November 19th (Meeting and Site Visit) | • Finalize and vote on 2015 recommendations.  
  • Possible site visit. |
TAC Q3 Meeting Inputs and Outputs

Inputs

– Six identified focus areas from Q2
– Committee questions from Q1 + Q2 meetings
– Inputs from presentations in Q1, Q2, and Q3
  • RINS
  • Environmental Externalities
  • National Security Considerations
  • Bioeconomy Market Development
– Your subject matter expertise

Outputs / Deliverables

– Discuss and develop recommendations for 2015.
  • To be finalized at Q4
Incubator NOI Announcement

On June 23, an Notice of Intent (NOI) was announced for an Incubator II Program

• The anticipated FOA will seek to develop novel, non-incremental technologies that are not represented in BETO in a significant way.
• Focused in two topic areas:
  – Topic area 1 will focus on proposals related to the algae portfolio.
  – Topic area 2 will focus on proposals in the current feedstocks and conversion portfolios.
• The program aims to make multiple awards in the form of cooperative agreements, with an estimated period of performance for each award of approximately 12-24 months.
• Proposals anticipated at TRLs 2-4
• The NOI can be found on the EERE website and contains more information and updates to the program.
2015 Peer Review

- March 23-27, 2015, Hilton Mark Center Alexandria, VA
- 190 Projects with 48 Reviewers / Steering Committee Members
  - Thermochemical, Biochemical, Terrestrial Feedstocks, Algae, DMT, Cookstoves, and Sustainability and Strategic Analysis
  - Reviewers from industry (52%), Universities (17%), Government (19%), and non-profit (12%).
  - Projects representing $403M from FY13 – FY14

2015 Program Management Review

- June 25th at the Washington Convention Center
- Lead Reviewers & Steering Committee Members
  - Lead Reviewers presented compiled feedback
  - PMs responded to feedback
  - Steering Committee & BETO Staff discuss next steps for 2015 - 2016
Program Management Review Feedback (2/2)

• **Positive Feedback**
  – Integrated Biorefineries successfully constructed and commissioning or operating.
  – Analysis and Sustainability efforts are making great progress.
  – Program addresses entire supply chain of challenges.
  – Algae program now has data to support refocusing upstream to algal biomass yields and overcoming productivity limits.

• **Constructive Criticism**
  – Program not positioned to respond to the magnitude and speed of price volatility in the fuels markets. Need to communicate the “long view.”
  – More funding for DMT. Pilot and demo projects are costly, but vital.
  – Need to increase the emphasis on high value co-products to improve cost-effectiveness of relatively low-and-volatile-price transportation fuels.
  – Less emphasis on algae conversion technologies and maintain or increase emphasis on algal biomass production technologies.
  – Need to better communicate with the public, decision makers, the financial community and other stakeholders
<table>
<thead>
<tr>
<th>BETO Subprograms ($K)</th>
<th>FY 2015 Enacted</th>
<th>FY 2016 Request</th>
<th>FY 2016 House</th>
<th>FY 2016 Senate</th>
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<td>Feedstocks</td>
<td>32,000</td>
<td>46,500</td>
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<td>Feedstocks Supply and Logistics</td>
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<td>17,800</td>
<td>16,500</td>
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<td>Advanced Algal Systems</td>
<td>-</td>
<td>21,000</td>
<td>30,000</td>
<td>30,000</td>
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<td>Conversion Technologies</td>
<td>95,800</td>
<td>99,186</td>
<td>75,500</td>
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<td>Demonstration and Market Transformation</td>
<td>79,700</td>
<td>87,514</td>
<td>25,800</td>
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<td>Strategic Analysis and Cross-Cutting Sustainability</td>
<td>11,000</td>
<td>14,000</td>
<td>11,000</td>
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<tr>
<td>NREL Site-Wide Facility Support</td>
<td>6,500</td>
<td>6,500</td>
<td></td>
<td></td>
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<tr>
<td>Total, Bioenergy Technologies Office</td>
<td>225,000</td>
<td>246,000</td>
<td>165,300</td>
<td>225,000</td>
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</table>
**Targeted Algal Biofuels and Bioproducts Funding Opportunity**

- **Goal:** The Targeted Algal Biofuels and Bioproducts (TABB) FOA seeks to reduce the cost of algal biofuels from $7 per gallon – the current projected state of technology for 2019 – to less than $5 per gallon algal biofuel by 2019.

- **Selections announced July 9, 2015**

<table>
<thead>
<tr>
<th>Recipient</th>
<th>Up to Amount ($K)</th>
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<tbody>
<tr>
<td>Producing Algae and Co-Products for Energy (PACE) Colorado School of Mines</td>
<td>9,000</td>
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<tr>
<td>Marine Algae Industrialization Consortium (MAGIC), Duke University</td>
<td>5,200</td>
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<tr>
<td>Global Algae Innovations, Inc.,</td>
<td>1,000</td>
</tr>
<tr>
<td>Arizona State University, Mesa, AZ</td>
<td>1,000</td>
</tr>
<tr>
<td>University of California, San Diego</td>
<td>760</td>
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<tr>
<td>Lawrence Livermore National Laboratory, Livermore, CA</td>
<td>1,000</td>
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*Photo credits FSU and NREL*
Sustainability of Cellulosic Bioenergy Systems - FOA

DOE Announced up to $9M for design of sustainable bioenergy systems

- Improvement of feedstock production, logistics systems, and technology development
- Work to involve landowners and multi-disciplinary stakeholders in the landscape design process.
- Will establish field research to quantify and improve sustainability metrics, and assess logistics systems needed to provide high quality cellulosic feedstocks to conversion facilities for bioenergy

Antares Group, Inc. (Lanham, Maryland)

- Design system to enable more stable and diverse future feedstock supplies for three cellulosic biorefineries in Iowa and Kansas while increasing both profitability and ecological benefits in those areas.
  - Corn stover
  - Switchgrass
  - Warm season grasses
BRDI FOA was released on February 26, 2015

- USDA-NIFA-9008-004957 (full solicitation information [Grants.gov](https://grants.gov))
- This opportunity addresses USDA and DOE programmatic objectives, administrative roles, and areas of interest in implementing Biomass Research and Development Initiative grants.
  - USDA anticipates awarding grants and DOE anticipates awarding Cooperative Agreements under this FOA
  - Anticipated funding level: $8.7M (USDA: $5.7M, DOE: $3.0M)
  - Awards range: $500K – $2.0M
- Concept Papers were requested to address one of three technical topic areas:
  1. Feedstocks Development
  2. Biofuels and Biobased Products Development
  3. Biofuels and Biobased Products Development Analysis
- Concept Papers were due: 03/27/2015 – 379 received
- Full Applications were due: 7/27/2015
Bioproducts to Enable Biofuels Workshop

Public workshop held 7/16 in Westminster, CO

• 94 stakeholder attendees were asked to provide feedback on BETO’s bioproducts strategy in anticipation of a forthcoming FOA related to how bioproducts can enable the production of biofuels.

Major Takeaways

• Considerable discussion on the economic merits of bioproducts and how they help diversify the risks that new IBRs face when coming online
• Additional stakeholder input was gathered on platform chemicals and R&D strategies that show strong potential for both standalone and co-production of bioproducts

Next Steps

• Workshop report to be made public in early FY16

Criteria participants felt were most important when selecting target bioproducts:

• The product is produced via a conversion technology that is broadly applicable to multiple products and/or fuels
• The product could serve as a building block/platform chemical for a biorefinery
• The product is a direct substitute for an existing petrochemical
Factoids:

• The US produces 15% of global chemicals and chemicals comprise 12% of all US exports.

• The US produces: ethylene, propylene, polyethylene, butadiene, butanol, polystyrene, Ethylene Oxide, Mono-ethylene glycol.

• These petroleum derived chemicals are converted to: plastics, cosmetics, pharmaceuticals, detergents, packaging, clothing, car parts.

• Fuel makes up 76% of the volume of US oil products and is worth $935 bn.

• Chemicals make up 16% of the volume of US oil products and is worth $812 bn.

Source: Bloomberg New Energy Finance, EIA, American Chemical Council
**BETO’s Focus for Bioproducts for R&D**

- Innovative approaches for bioproducts:
  - Molecular replacements for petroleum derived chemicals.
  - Performance replacements for petroleum derived chemicals.
    - Infancy stage – play to the strength of the oxygenated polymers in biomass.
  - Lignin and waste streams to value added products (X2 the cost of biofuels on a mass basis).

**AMO Application**

Modified from Werpy and Peterson 2008
Bioenergy Technologies Office – Manufacturing-Related Activities

**Renewable Carbon Fiber FOA** (negotiated selections to start FY15)
- Technologies to enable manufacture of bio-derived acrylonitrile.
- Joint work with Advanced Manufacturing Office / Vehicle Technologies Office

**Lignin Valorization** (Ongoing projects – NREL & Others)
- Convergent strategies for funneling lignin to intermediates & Refinery Integration.

**Biochemical Upgrading FOA** (selections to start FY15)
- Expected total of $13M awarded.
- NREL Muconic acid (platform intermediate) from biogas.
- Natureworks lactic acid from biogas.

**Targeted Algal Biofuels and Bioproducts** (FY15 FOA)
- Six projects selected July 2015 for total of $18M
Additional FOAs

**Bioproducts to enable fuels FOA – Will have two objective areas:**

- Improve upon a process/single unit operation to produce a biofuel or bioproducts
  - Applicant presents a compelling TEA that demonstrates 1) a biomass to fuels process that could produce commercial biofuels in the near- to mid-term and 2) a technology deficiency in that process that, when improved upon, could generate cost-competitive biofuels.

- Applicant will take a consortia approach to tackling a biomass to biofuels pathway
  - The applicant will conduct R&D to integrate and validate a pathway toward biofuels.

**DMT FOA 2015/FY 2016**

- The 2015 DMT FOA will target the development of demonstration scale facilities that produce biofuels. Bioproducts that are produced alongside fuels will be encouraged.

- ≥ 50% reduction of carbon intensity in biofuels & commercialization plant.
The Bioeconomy Concept

- Revenue and economic growth
- Broad spectrum of new jobs
- Rural development
- Advanced technologies and manufacturing
- Reduced emissions and Environmental Sustainability
- Export potential of technology and products
- Positive societal changes
- Investments and new infrastructure
BETO’s Expected Role Within The Bioeconomy: Framework

**Biomass**
- 1B Tons
- Compositions
- Regional
- Time Horizons

**Intermediate Platforms**
- Sugars
- Syn Gas
- Pyrolysis Oils
- Lipids
- 12 Primary (PNNL Study)
- + Lipids & Pyrolysis Oil
- Couple of behemoths

**Building Blocks**

**Conversion (BETO)**

**Building Blocks**
- Sugars
- Syn Gas
- Pyrolysis Oils
- Lipids

**Intermediate Platforms**
- 12 Primary (PNNL Study)
- + Lipids & Pyrolysis Oil
- Couple of behemoths

**Exploration and Production (USDA/BETO)**
- 1B Tons
- Compositions
- Regional
- Time Horizons

**Chemicals (BETO/AMO)**

**Secondary Chemicals**

**Intermediates**

**Products**
- Fuels
- Products

**Refined Petroleum Products**

**Market Players & New Entrants**
- By segment
- How do they view R&D

**Constraints & Risks**
- Technical Risk
- Market Risk
- Required Capital
  - R&D
  - Infrastructure

**Objectives**
- Economic (Jobs, GDP)
- Biomanufacturing
  - Novel Processes
  - CHP,
  - Process Intensification
- Energy Security (Net Oils Imports)
- Environmental (GHG)

Cost effectively optimize energy security, environmental, and economic gains made available through cultivation and use of 1B tons of available biomass towards bio-based fuels & products
BETO Strategic Planning Update

- **Why:** To align the program with evolving energy landscape and EERE and DOE goals
- **SWOT Analysis Completed: July 2015**
- **Focus Groups Meetings with Stakeholders Completed: August 2015**
  - Feedstocks
  - Market Penetration and Infrastructure
  - Research and Development
  - Scale-Up and Commercialization
  - Sustainability
- **Strategic Planning Meeting October 2015**
  - Draft Goals / Strategies
- **Stakeholder Engagement: October 2015 - November 2015**
- **Development and Approval of Strategic Plan: Summer 2016**
Optima: Co-Optimization of Fuels and Engines

• The nation requires new low carbon fuels and advanced engines that are *co-optimized*—designed in tandem to work for maximum performance and carbon efficiency.

• The Optima initiative will accelerate the widespread deployment of significantly improved fuels and vehicles (passenger to light truck to heavy-duty commercial vehicles) by 2030.

• Optima goals include:
  
  – Develop new fuels and vehicles with higher performance that can be produced affordably, sustainably, and at scale.
  – Identify and mitigate barriers to wide-scale deployment of new fuels and vehicles.
  – Through a coordinated DOE and national lab effort, maximize value to widest range of stakeholders.

• Stakeholders Listening Day, June 16-17, 2015, Golden, CO

• Plenary held for Vehicle and Fuel Optimization at Bioenergy 2015
Small Engines Request For Information

- Announced June 2015
- Seeking Industry / Academia input on:
  - Potential to optimize and/or modify small engines to utilize ethanol blends greater than 10% (E10)
  - Barriers limiting the expansion of overall biofuel consumption in the small engine industry.
- Multiple Engine Types:
  - Spark-ignition, internal combustion engines such as those found in small tractors, chainsaws, hand-held line trimmers, off-road motorcycles, generator sets, personal water craft, snowmobiles, and all-terrain vehicles.
- BETO will address challenges related to:
  - The use of ethanol blends greater than E10 in small engines
  - Increased biofuels availability in related markets
- RFI text available online on EERE Website
2015 Biogas Progress Report

• Report on developments under **Biogas Opportunities Roadmap**
  – Component of Climate Action Plan - Strategy to Reduce Methane Emissions
  – Aimed at managing methane emissions through biogas energy solutions
  – Collaboration between USDA/EPA/DOE
  – Published August 2014

• Technical and Policy achievements
  – Agencies, Private Industry
  – Identification of major challenges

• Ongoing Projects can be found online.

• Expected publication September 2015
ARPA-E TERRA Program Awards Six Projects

- Aimed at developing high throughput field sensing platforms for bioenergy crops and analytic tools to mine the phenotyping data from the field and correlate phenotypes with genetic loci.

<table>
<thead>
<tr>
<th>Recipient and Project</th>
<th>Award Amount (K)</th>
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<tbody>
<tr>
<td><strong>Clemson University:</strong> Breeding High Yielding Bioenergy Sorghum for the New Bioenergy Belt</td>
<td>6,000</td>
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<tr>
<td><strong>Donald Danforth Plant Science Center:</strong> A Reference Phenotyping System for Energy Sorghum</td>
<td>8,000</td>
</tr>
<tr>
<td><strong>Pacific Northwest National Laboratory:</strong> Consortium for Advanced Sorghum Phenomics</td>
<td>3,300</td>
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<tr>
<td><strong>Purdue University:</strong> Automated Sorghum Phenotyping and Trait Development Platform</td>
<td>6,500</td>
</tr>
<tr>
<td><strong>Texas A&amp;M AgriLife Research:</strong> Automated Phenotyping System for Genetic Improvement of Energy Crops</td>
<td>3,100</td>
</tr>
<tr>
<td><strong>University of Illinois at Urbana-Champaign:</strong> Mobile Energy-Crop Phenotyping Platform</td>
<td>3,100</td>
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Sustainable Transportation Day

- Held June 22, 2015 at the West Forrestal Plaza and Median, Washington, D.C.
- Collaboration between BETO, VTO, and FCTO
- Included EERE Staff, public, industry representatives, stakeholders, and Bioenergy 2015 attendees
  - Hundreds of visitors throughout day
  - Networking opportunity for conference attendees
- Included exhibits from each participating agency.
  - SuperTruck
  - Green Racing Simulator
  - 3D Printed Cobra
  - Flex Fuel Vehicles
  - Fuel Cell Electric Vehicles
- Hundreds of Stakeholders attended
  - Potentially recurring event
http://www.biomassboard.gov/

http://www.biomassboard.gov/committee/committee.html

• Find info on:
  – Previous work and recommendations;
  – Meeting summaries;
  – TAC membership list; and
  – Key “library” documents and referenced materials.
References and Useful Links

References:

1. Bioenergy Technologies Office Multi-Year Program Plan  
2. Bioenergy KDF  https://www.bioenergykdf.net/  
4. Bioenergy KDF YouTube  http://www.youtube.com/user/BioenergyKDFChannel  
7. Committee Resources Library  http://www.biomassboard.gov/committee/committee.html  
9. I-75 Clean Fuels Corridor  http://www.cleanfuelscorridor.com  
14. Incubator II NOI  https://eere-exchange.energy.gov/#FoaIdbc2c8dc8-5e7d-466b-a21b-b6b438b4ca6e  

Useful Links:

1. BETO Web page  http://www.energy.gov/eere/bioenergy/bioenergy-technologies-office  
2. BETO's Meetings Web page  http://www.energy.gov/eere/bioenergy/meetings  
3. BETO News and Announcements  http://www.energy.gov/eere/bioenergy/listings/bioenergy-news  
4. The Targeted Algal Biofuels and Bioproducts (TABB) FOA  https://eere-exchange.energy.gov/  
6. ARPA-E TERRA funding opportunity announcement  
8. DOE/EERE, Sustainable Transportation Office  http://www.energy.gov/eere/transportation  
9. ARPA-E Web page  http://arpa-e.energy.gov/  
10. Office of Science Web page  http://science.energy.gov/