



**Biomass R&D Technical  
Advisory Committee (TAC)**  
November 18 - 20, 2015

**Elliott Levine**  
TAC Designated Federal Officer (DFO)  
**DOE Updates**

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# Day 1 Agenda (1/2)

**Day 1: Technical Advisory Committee Meeting:**

**Wednesday November 18, 2015**

- |                         |  |
|-------------------------|--|
| 8:00 a.m. – 8:30 a.m.   | <i>Breakfast (to be provided for Committee)</i>  |
| 8:30 a.m. – 8:40 a.m.   | <u>Introduction and Welcome</u><br><i>Committee Co-Chairs</i>  |
| 8:40 a.m. – 9:10 a.m.   | <u>Presentation:</u> DOE Update on Biomass R&D Activities<br><i>Elliott Levine, DFO, U.S. Department of Energy</i>   |
| 9:10 a.m. – 9:30 a.m.   | <u>Presentation:</u> USDA Update on Biomass R&D Activities<br><i>Todd Campbell, U.S. Department of Agriculture</i>   |
| 9:30 a.m. – 10:00 a.m.  | <u>Presentation:</u> Biomass Research and Development Initiative (BRDI) Update<br><i>Daniel Cassidy, NIFA, U.S. Department of Agriculture</i><br><i>Mark Elless, U.S. Department of Energy</i> |
| 10:00 a.m. – 10:15 a.m. | <i>Break</i>   |

# Day 1 Agenda (2/2)

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10:15 a.m. – 11:45 a.m.	<u>Discussion</u> : 2015 BRDI Committee Recommendations <i>Committee Co-Chairs</i>
11:45 a.m. – 12:00 p.m.	<u>Public Comment</u>
12:00 p.m. – 1:00 p.m.	<i>Lunch</i>
1:00 p.m. – 5:15 p.m.	<u>Discussion</u> : 2015 Committee Recommendations <i>Committee Co-Chairs</i>
5:15 p.m. – 5:30 p.m.	<u>Vote</u> : 2015 Committee Recommendations to Biomass Board, Secretary of Energy, and Secretary of Agriculture <i>Committee Co-Chairs</i>

# Day 2 Agenda (1/2)

## Day 2: Technical Advisory Committee Meeting:

Thursday November 19, 2015

- 7:30 a.m. – 8:00 a.m.      *Breakfast (to be provided for Committee)*
- 8:00 a.m. – 9:00 a.m.      Discussion: 2015 Recommendations to the Board Presentation and Secretaries of Energy and Agriculture  
*Committee Co-Chairs*
- 9:00 a.m. – 11:00 a.m.      Presentation: California Perspective on Biofuels and Energy
- *Jay Keasling, Chief Executive Officer, Vice President of Fuels Synthesis, JBEI*
  - *Ryan McCarthy, Chief Policy Advisory, California Air Resources Board*
  - *Tim Olson, California Energy Commission*
  - *Dan Sperling, Director, Institute of Transportation Studies at UC Davis*
- 11:00 a.m. – 11:15 a.m.      *Break*
- 11:15 a.m. – 12:00 p.m.      Presentation: *Advanced Feedstock Supply Systems Report*  
*Erin Searcy and Richard Hess, INL*
- 12:00 p.m. – 12:15 p.m.      Presentation: NAREEE Update  
*Dr. Carrie Castille*

## Day 2 Agenda (2/2)

12:15 p.m. – 12:30 p.m.	<u>Public Comment:</u>
12:30 p.m. – 12:45 p.m.	<u>Closing Comments and Thank You to Departing Members:</u> <i>Committee Co-Chairs</i>
12:45 p.m.	<u>Public Meeting Adjourn</u>
12:45 p.m.	<i>Retrieve Box Lunch and Prepare for Departure 12:15 pm</i>
12:45 p.m. – 1:15 p.m.	<i>Travel to Emeryville</i>
1:30 p.m. – 3:00 p.m.	<u>Tour(s): Emeryville</u> <ul style="list-style-type: none"><li>○ JBEI</li><li>○ ABPDU</li></ul>
3:00 p.m. – 5:30 p.m.	<u>Visits: Startup Companies</u> <ul style="list-style-type: none"><li>○ Lygos</li><li>○ Zymergen</li><li>○ Industrial Microbes</li><li>○ Ripple Foods</li></ul>
5:00 p.m. – 5:30 p.m.	<i>Travel back to Hotel</i>



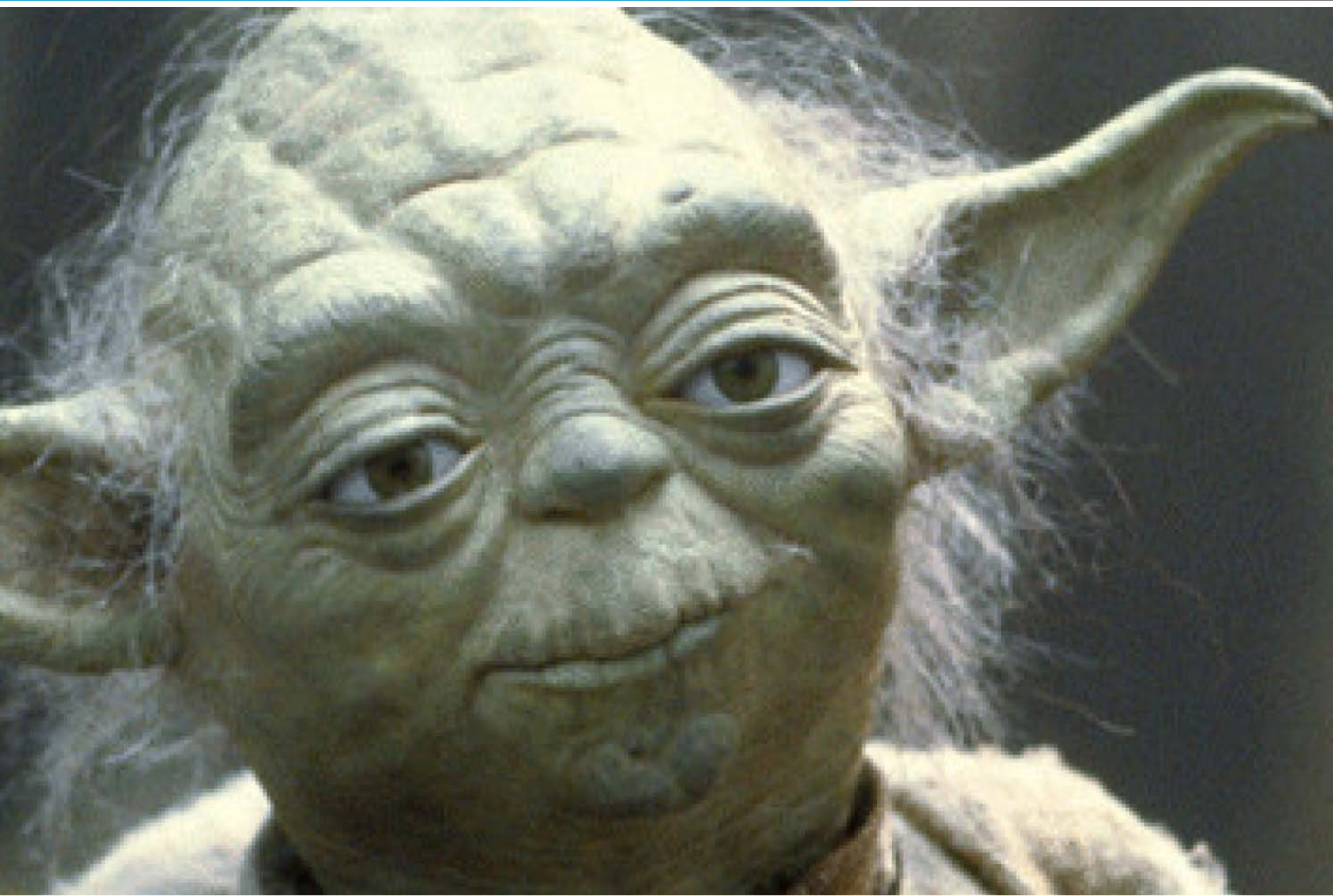
# Day 3 Agenda

## Day 3: Technical Advisory Committee Meeting:

**Friday November 20, 2015**

- |                              |   |
|------------------------------|---|
| 8:00 a.m. – 8:30 a.m.        | <i>Breakfast (to be provided for Committee)</i>   |
| 8:30 a.m. – 9:00 a.m.        | <i>Depart for Tour(s)</i>   |
| 9:00 a.m. – 11:30 a.m.       | <u>Tour: USDA Agricultural Research Service (ARS) (tentative)</u> <ul style="list-style-type: none"><li>○ Western Regional Research Center (WRRC) Pilot Plant</li><li>○ Secure Greenhouses</li></ul><br><u>Visits: Startup Companies</u> <ul style="list-style-type: none"><li>○ Mango Materials</li><li>○ <u>Kiverdi</u></li></ul> |
| 11:30 a.m. – 12:00 a.m.      | <i>Travel to Hotel</i>  |
| <br><b><i>(OPTIONAL)</i></b> |   |
| 12:30 p.m. – 1:30 p.m.       | <i>Travel to TOTAL New Energies, Emeryville, CA</i>   |
| 1:00 a.m. – 3:30 p.m.        | <u>Tour:</u> TOTAL New Energies, Emeryville, CA   |

## 2015 Final Stretch - Get Inspired





# TAC 2015 Work Timeline

Date	Committee Objectives
<b>Q1 2015</b> March 5, 2015 <b>Webinar</b>	<ul style="list-style-type: none"> <li>Receive presentation on the interactions between the Biomass Board, Operation Committees, and Interagency Working Groups.</li> </ul>
<b>Q2 2015</b> May 20-22, 2015 <b>(2 ½ day meeting)</b>	<ul style="list-style-type: none"> <li>TAC along with the attending Operation Committees and Interagency Working Group guests would list and rank topics for the TAC to consider.</li> <li>Agree on TAC 2015 topic areas.</li> <li>Adjust the TAC sub-committee structures (if necessary) to best address one or more topics per future meeting.</li> </ul>
<b>Q3 2015</b> August 27-28 <b>(1 ½ day meeting)</b>	<ul style="list-style-type: none"> <li>Work in Subcommittees to develop recommendations on agreed upon topic areas.</li> </ul>
<b>Q4 2015</b> November 18-20 <sup>th</sup> <b>(Meeting and Site Visit)</b>	<ul style="list-style-type: none"> <li>Finalize and vote on 2015 recommendations.</li> <li>Develop BRDI Recommendations.</li> <li>Site visits.</li> </ul>



# TAC Q4 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,
- Recommendations identified at Q3
- Changes and refinement by subcommittees
- Your subject matter expertise

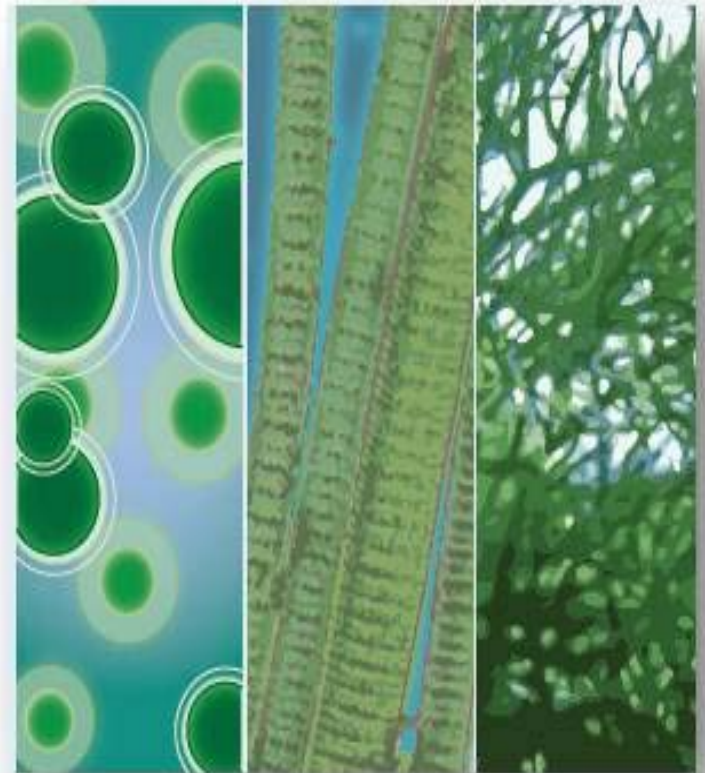
## Outputs / Deliverables

- Finalized recommendations

# Algae Program Request for Information

## High Yields through Productivity and Integration Research (HYPIR)

- Released on September 3<sup>rd</sup> to inform Algae Program strategic planning as relates to prioritizing R&D areas, defining metrics, and setting targets.
- Closed on October 15<sup>th</sup> with 26 respondents across industry, academia, and national labs.
- Majority of respondents replied that the most impactful R&D focus area is strain development, followed by integrated R&D at process-relevant scales.



# Small Engines Request For Information

- Announced June 2015, open from July 1<sup>st</sup> to August 31<sup>st</sup>
- Sought 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 watercraft, 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.

# Biomass Research & Development Initiative (BRDI)

## BRDI FOA was released on February 26, 2015

- USDA-NIFA-9008-004957 (full solicitation information [Grants.gov](https://www.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 ~**45 received.**





# Incubator 2 FOA

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

- This FOA will seeks to develop novel, non-incremental technologies that are not represented in BETO in a significant way.
- Full applications due 11/13/2015
  - Concept papers were due 09/21
  - Encourage/discourage letters sent on 10/13
  - Selection announcement targeted for late February 2016.
  - \$10M available in funding
- Topic Areas for technologies
  - Goals of Algae Program (2-4 selections, \$1-2M)
  - Goals of FSL and Conversion Portfolios (3-6 selections, \$1-2M)
- The FOA can be found on the [EERE website](#) and contains more information and updates to the program.

# Biochemical Upgrading FOA Awardees

On October 9<sup>th</sup>, DOE announced up to \$13.4 million for five projects to develop advanced biofuels and bioproducts that will help drive down the cost of producing gasoline, diesel, and jet fuel from biomass.

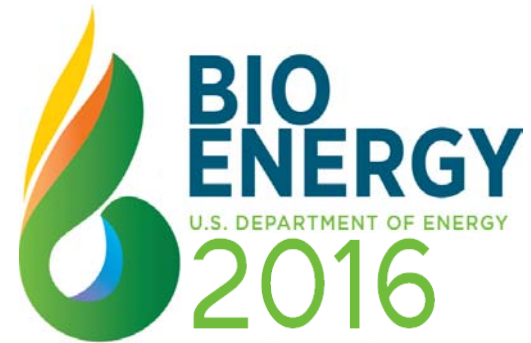
- **The University of Wisconsin** of Madison, Wisconsin will receive up to \$3.3 million to develop a process to produce high value chemicals from biomass, which can be used as plasticizers (an additive in certain plastics) and in the production of industrial chemicals and resins.
- **American Process, Inc.** of Atlanta, Georgia will receive up to \$3.1 million to develop and demonstrate processes to upgrade cellulosic sugars to solvents in their demonstration facility.
- **The National Renewable Energy Laboratory** of Golden, Colorado will receive up to \$2.5 million to develop a conversion process demonstrating the production of muconic acid from biogas. This acid can be converted into an array of bioproducts, including fuel, plasticizers, and lubricants.
- **Natureworks, LLC** of Minnetonka, Minnesota will receive up to \$2.5 million to develop a fermentation process, using biogas and bacteria, for the production of lactic acid. This process could be used for the commercialization of biomethane to fuels.
- **Vertimass LLC** of Irvine, California will receive up to \$2 million to commercialize technology to convert ethanol into diesel fuel, gasoline, and jet fuel blend stocks compatible with the current transportation fuel infrastructure.

# Bioenergy 2016 Overview

**When:** Tuesday, July 12 – Wednesday, July 13, 2016

**Where:** Walter E. Washington Convention Center  
801 Mount Vernon Place, NW  
Washington, DC 20001

**Co-host:** Clean Energy Research & Education  
Foundation (returning from 2015)



# Potential Impacts of a Billion-Ton Bioeconomy

## A BILLION DRY TONS\* OF SUSTAINABLE BIOMASS

HAS THE POTENTIAL TO PRODUCE

**1.5 MILLION JOBS**  
and keep about  
**\$200 BILLION**  
dollars in the U.S.  
and contributes over  
**\$600 BILLION**

**100 BILLION\*\***  
kWh of electricity  
to power  
**7 MILLION**  
households. Plus  
**1450 TRILLION BTUs**  
of thermal energy.

**50 BILLION**  
gallons of biofuels  
displacing almost  
**30%**  
of all transportation  
fuels.

**45 BILLION POUNDS**  
of biobased  
chemicals and bio-  
products, replacing  
a significant portion  
of the chemical  
market.

**550 MILLION TONS**  
of CO<sub>2</sub>e  
reductions  
every year.



### STEPS TO BUILDING THE BIOECONOMY

- 1 Accelerate research & technology development
- 2 Develop production, conversion and distribution infrastructure
- 3 Deploy technology
- 4 Create markets and delivery systems

#### Projections based on:

- 2011 Billion Ton Study Report
- EIA 2015 AEO
- 2013 USDA Long-Term Forecast
- Various data sources

***1 billion tons of biomass could be sustainably produced in the U.S.***

\*Estimates are based on a future usage of 1.3 billion dry tons.

\*\*Include 27 billion kWh and 90 TBtu from livestock anaerobic digestion



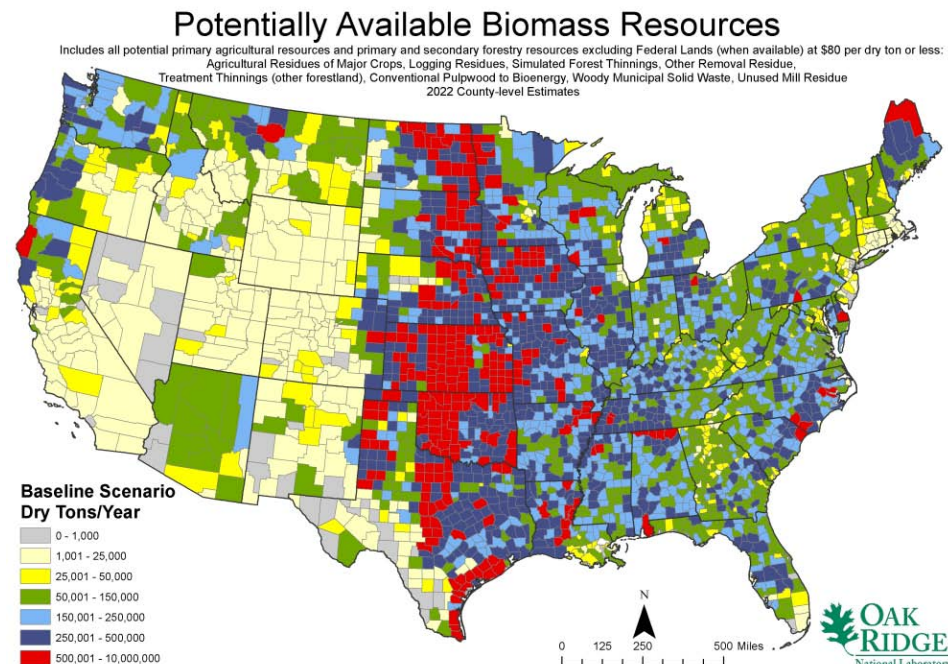
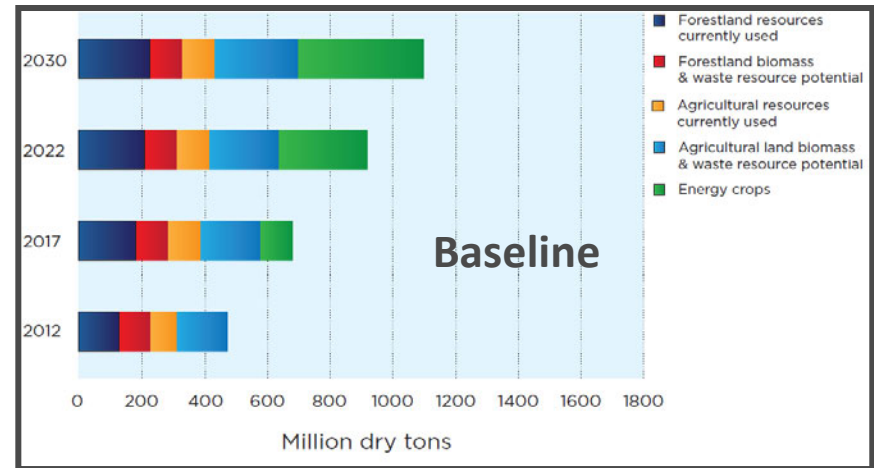
# Billion-Ton Report Update (BT16)

- Volume 1 to be published Summer 2016:

- Assess current demand of commercial biomass-to-energy feedstock
- State-of-science biomass potential supply to 2040
  - Agricultural, forestry, algal, and waste resources
  - From farm to roadside to regional delivery points

- Volume 2 to be published Fall 2016

- Environmental sustainability analysis of potential supply



Source: U.S. Department of Energy, 2011. U.S. Billion-Ton Update: Biomass Supply for a Bioenergy and Bioproducts Industry. R.D. Perlack and B.J. Stokes (Leads), ORNL/TM-2011/224. Oak Ridge National Laboratory, Oak Ridge, TN. 227p. Data Accessed from the Bioenergy Knowledge Discovery Framework, [www.bioenergykdf.net](http://www.bioenergykdf.net). [December 4, 2012].  
Author: Laurence Eaton ([laurel@ornl.gov](mailto:laurel@ornl.gov)) - December 4, 2012.



# The Value of Advanced Feedstock Supply Systems (1/2)

## Adding value to biomass

- Develop cost-effective and high-volume handling methods through preprocessing and storage systems for producing uniform feedstocks of specific quality, while creating additional value for the producer and cost-savings for the biorefinery.

**“Depot”** refers to “a system or set of processes sized at the characteristic scale of biomass (i.e., small, modular and distributed) that transforms biomass resources into merchandisable, tradable, and aggregatable intermediates.” Depots must become an economically independent business unit regardless of vertically integrated association with the biorefinery in order to create market pull.

## Mitigating risk

- Provide the "active" processes necessary to mitigate feedstock supply system risks for current biorefineries (e.g., fire, shrink, out of spec quality, weather impact, etc.).
- Stabilize and ensure supply to end users.

The depot concept provides for a "transitional" strategy of value-added preprocessing such as blending, formulation, torrefaction, and other approaches to produce intermediate products that serve biorefining and other markets.

## Developing feedstock into a commodity

- “Mobilize” biomass resources into the market place and produce value-add merchandisable biomass intermediates.
- A commodity-scale resource will pull the cellulosic biorefining industry into existence for intermediate blends and beyond. Without it, the expanding biofuels market will continue to be predominately met with corn grain.

# Outlook for Development of Advanced Feedstock Supply Systems (2/2)

	Short-term	Medium-term	Long-term
Ownership	Biorefineries (upstream investment)	+ Farmer cooperatives (prevent dockage fee)	+ Third-party (proven business model)
Location	At the biorefinery	+ High-yield areas, centralized location	+ Decentralized, low-yield, stranded feedstock areas with conglomeration in terminals
Single- vs. multi-feedstock	Single feedstock	+ Specialized depots, high-yield producing regions	+ multiple feedstock, blending option
Sizing	Pilot and small-scale (<40,000 tons p.a.)	+ Medium to large-scale (> 80,000 tons p.a.)	
Preprocessing intensity	Conventional pelleting	+ Advanced (multiple markets)	
End-use markets	Biorefineries	Multiple U.S. markets, e.g., cattle feed, biorefineries	Multiple international markets

# DuPont Cellulosic Ethanol Refinery

- Opened: Nevada, Iowa  
October 30, 2015
- Production Capacity:  
30 MGY of cellulosic ethanol  
from corn stover
- Jobs: 85 permanent jobs  
~1,000 for construction

## DOE Support

- DOE Involvement since 2003
- Pilot plant built in Vonore, TN with  
250,000 GY capacity
- To date DOE Investment: ~\$51M



# 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
  - Research and Development
  - Scale-Up and Commercialization
  - Market Penetration and Infrastructure
  - Sustainability
- **Visioning Meeting September 2015** ✓
  - Draft new 2040 Vision and Mission
- **Stakeholder Engagement: October 2015 - December 2015**
  - Stakeholders Meeting, 12/8/2015
- **Development and Approval of Strategic Plan: Summer 2016**



# Biogas Opportunities Roadmap Progress Report

## Background:

- DOE, USDA, and EPA developed *Biogas Opportunities Roadmap* in 2014 as a response to the White House Climate Action Plan's directive to develop an interagency strategy to reduce methane emissions.
- Agencies formed a Working Group with industry partners to expand the biogas industry.

## Achievements Detailed in 2015 Report:

- DOE completed an update to the Resource Assessment on Renewable Hydrogen Potential from Biogas in the U.S.
- BETO's MYPP expanded "biomass" definition to include different types of waste, which are key in biogas production.
- USDA published final rule for REAP with a new scoring criteria that benefits anaerobic digesters.
- Rural Business-Cooperative Service is providing loan guarantees for projects like commercial, municipal, and industrial biogas plant deployment.
- EPA published final rule for RFS that specifies a portion of renewable fuels volume requirements must come from cellulosic advanced fuels, which can include biogas.



## Biogas Industry Stats:

- Currently more than 2,000 sites in U.S. producing biogas, with potential for 11,000 more biogas systems.
- Achieving potential capacity would:
  - Produce enough energy to power 3 million homes.
  - Reduce methane emissions by 54 million metric tons of CO<sub>2</sub>

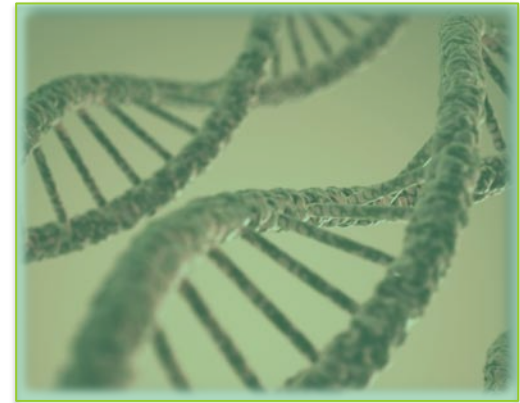


# Office of Science - Recent Biofuels Related Activities

## Office of Biological & Environmental Research (BER)

- **USDA/DOE Plant Feedstock Genomics for Bioenergy (Joint FOA)**

- DOE Genomic Science Program FOA DE-FOA-0001444.
- Genomics-based research on biomass plant traits with a long-term focus on improvement of bioenergy crops. Specific focus areas in FY 2016:
  - Identification and functional characterization of plant genes/alleles influencing plant response to pathogens.
  - Identification and functional characterization of plant genes/alleles influencing agronomic, yield, and quality traits of non-food oilseed crops.
  - Issued 11/04/2015; Pre-Application Due Date: 12/11/2015
  - Encourage/Discourage Date: 12/22/2015; Application Due Date: 02/02/2016; \$4M Available; Total Awards \$200K – \$400K each



### Award Announcements:

- Projects awarded under FOA DE-FOA-0001207 Systems Biology Research to Advance Sustainable Bioenergy Crop Development
  - [http://genomicscience.energy.gov/sustainability/SustainabilityAwards\\_15flyer.pdf](http://genomicscience.energy.gov/sustainability/SustainabilityAwards_15flyer.pdf)

# Office of Science - Recent Biofuels Related Activities

## Office of Basic Energy Sciences (BES) Chemical Sciences, Geosciences and Biosciences Division

### Current Funding Opportunity Announcement (FOA):

Proposals for the BES Biosciences programs, Photosynthetic Systems and Physical Biosciences, are solicited through the Office of Science Annual Open Funding Opportunity Announcement.

- <http://science.energy.gov/bes/funding-opportunities/>
- For more information on the BES Biosciences programs:
  - <http://science.energy.gov/bes/csgb/research-areas/photosynthetic-systems/>
  - <http://science.energy.gov/bes/csgb/research-areas/physical-biosciences/>

### Recent Principal Investigators (PI) Research Meetings:

- Photosynthetic Systems, October 19-21, 2015
  - Abstract book will be posted later this month at:  
<http://science.energy.gov/bes/csgb/principal-investigators-meetings/>
- Energy Frontier Research Centers (EFRCs), October 26-27, 2015
  - For more information on EFRCs: <http://science.energy.gov/bes/efrc/>

# The Work of the Biomass R&D TAC can be Found Online



<http://www.biomassboard.gov/>

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

- Find information 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 [http://www.energy.gov/sites/prod/files/2015/04/f22/mypp\\_beto\\_march2015.pdf](http://www.energy.gov/sites/prod/files/2015/04/f22/mypp_beto_march2015.pdf)
2. Bioenergy KDF <https://www.bioenergykdf.net/>
3. Bioenergy KDF Facebook <https://www.facebook.com/BioenergyKDF>
4. Bioenergy KDF YouTube <http://www.youtube.com/user/BioenergyKDFChannel>
5. Biomass R&D Board <http://www.biomassboard.gov/>
6. Board Resources Library [http://www.biomassboard.gov/committee/tac\\_library.html](http://www.biomassboard.gov/committee/tac_library.html)
7. Committee Resources Library <http://www.biomassboard.gov/committee/committee.html>
8. Scientific Research Access News Release <http://www.energy.gov/articles/us-department-energy-increases-access-results-doe-funded-scientific-research>
9. I-75 Clean Fuels Corridor <http://www.cleanfuelscorridor.com>
10. Research for Sustainable Bioenergy Workshop Report <http://genomicscience.energy.gov/sustainability/>
11. Water Environment Federation <http://www.wef.org/WaterEnergy/>
12. Bioenergy Technologies Office Annual Report 2014 [http://energy.gov/sites/prod/files/2015/07/f24/beto\\_2014\\_annual\\_report.pdf](http://energy.gov/sites/prod/files/2015/07/f24/beto_2014_annual_report.pdf)
13. Small Engines RFI <https://eere-exchange.energy.gov/FileContent.aspx?FileID=5e3fc287-bbc0-43f4-bd4b-83177d3f8f4a>
14. Incubator II NOI <https://eere-exchange.energy.gov/#Foaldbc2c8dc8-5e7d-466b-a21b-b6b438b4ca6e>
15. BER Whitepaper: <http://genomicscience.energy.gov/biofuels/BER-Bioenergy-WhitePaper-Final.pdf>
16. BER Genomics FOA: [http://science.energy.gov/~media/grants/pdf/foas/2016/SC\\_FOA\\_0001444.pdf](http://science.energy.gov/~media/grants/pdf/foas/2016/SC_FOA_0001444.pdf)

## Useful Links:

1. BETO Web page <http://www.energy.gov/eere/bioenergy/bioenergy-technologies-office>
2. BETO News and Announcements <http://www.energy.gov/eere/bioenergy/listings/bioenergy-news>
3. The Targeted Algal Biofuels and Bioproducts (TABB) FOA <https://eere-exchange.energy.gov/>
4. Waste-to-Energy Workshop Notes <http://www.energy.gov/eere/bioenergy/waste-energy-roadmapping-workshop>
5. [ARPA-E TERRA funding opportunity announcement](#)
6. Peer Review 2015 <http://www.energy.gov/eere/bioenergy/2015-project-peer-review>
7. DOE/EERE, Sustainable Transportation Office <http://www.energy.gov/eere/transportation>
8. ARPA-E Web page <http://arpa-e.energy.gov/>
9. Office of Science Web page <http://science.energy.gov/>