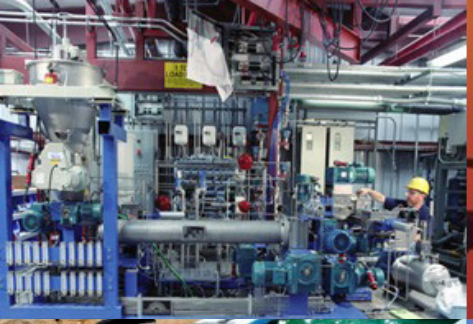




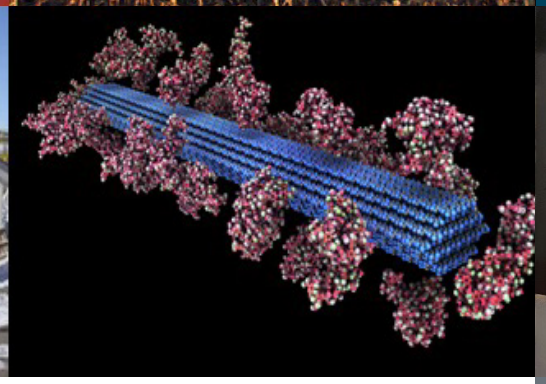


U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Plastics Introduction

Tuesday March 9th, 2021

Gayle Bentley
Technology Manager
Peer Review 2021

Outline

- Schedule walk-through
- Reviewer welcome
- Plastics overview
- BETO efforts

Start Time ET	End Time ET	Min.	Title	Organization	Speaker
DAY 2 – Tuesday, March 9, 2021					
10:00 AM	*10:20 AM*	*20*	*Gather, Tech Check, Networking Questions*	*BETO + Reviewers*	
10:20 AM	10:30 AM	10	Plastics - Session Overview	BETO	Gayle Bentley
10:30 AM	11:15 AM	45	Bio-Optimized Technologies to keep Thermoplastics out of Landfills and the Environment (BOTTLE)	Various	Gregg Beckham
11:15AM	*11:45 AM*	*30*	*Q&A / Break*	*All*	
11:45 AM	12:30 PM	45	Bio-Optimized Technologies to keep Thermoplastics out of Landfills and the Environment (BOTTLE)	Various	Gregg Beckham
12:30 PM	*12:55 PM*	*25*	*Q&A / Break*	*All*	
12:55 PM	1:00 PM	5	BOTTLE Consortia vs FOAs	BETO	Gayle Bentley
1:00 PM	1:30 PM	30	Bioconversion of Heterogeneous Polyester Wastes to High Value Chemical Products	University of Massachusetts Lowell	Margaret Sobkowicz-Kline
1:30 PM	2:00 PM	30	ResIn: Responsible Innovation for Highly Recyclable Plastics	Northwestern University	Linda Broadbelt
2:00 PM	*2:30 PM*	*30*	*Lunch*	*All*	
2:30 PM	3:00 PM	30	Recyclable Thermoset Polymers from Lignin Derived Phenols	Spero Renewables, LLC	Ian Klein
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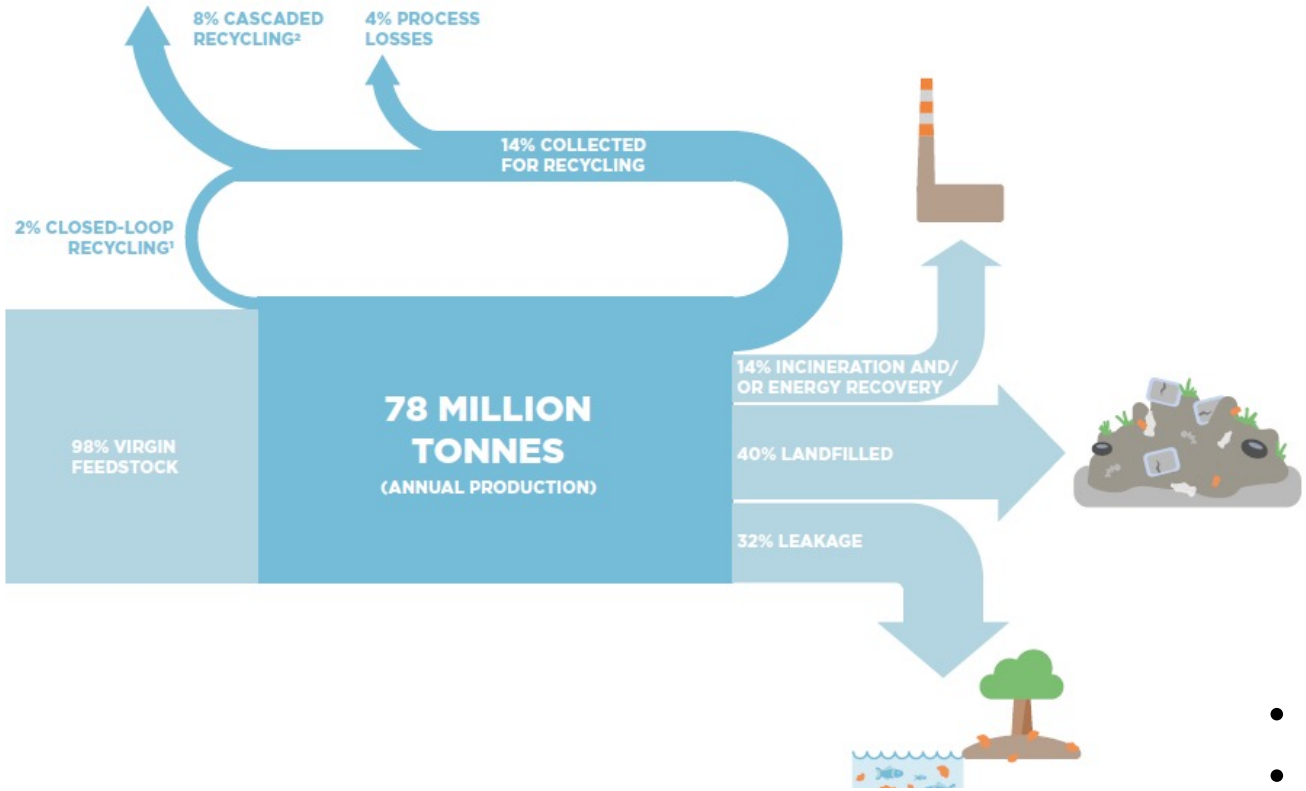
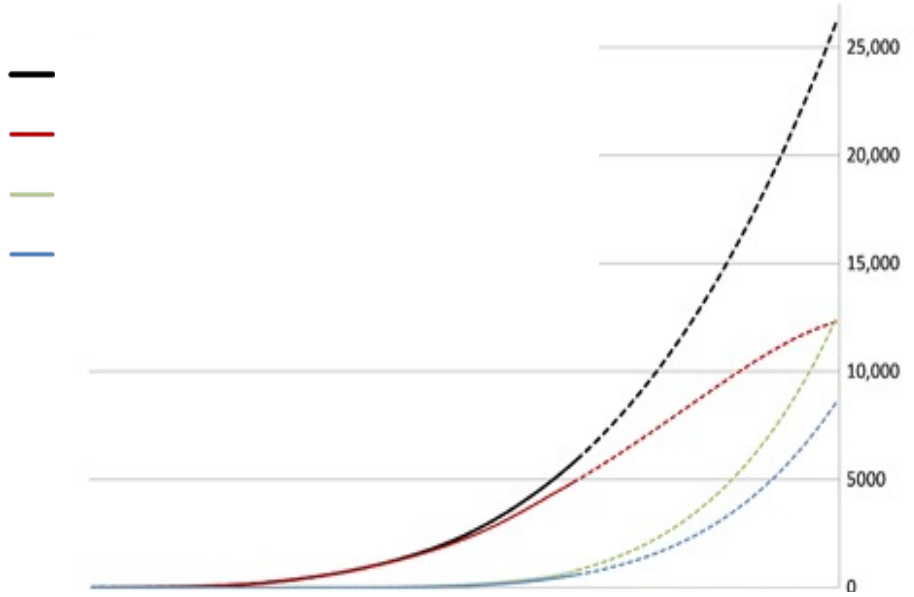
3:30 PM	3:45 PM	15	Comment Review Session	All Reviewers	

Welcome to our Reviewers!

Name	Affiliation	Previous Peer Review Experience
Matt Tobin (Lead Reviewer)	Independent Consultant - Formerly Lygos, Amyris, and Codexis	2019 Panel
Peter Keeling	Purdue University	2019 Panel
Karen Draths	Michigan State University	New this year
Ray Miller	Independent Consultant – Formerly DuPont and PDO	2019 Panel
Bill Orts	USDA	New this year
Sharon Haynie	Independent Consultant, Formerly DuPont	New this year
Paul Bryan	Independent Consultant – Formerly BETO, Sandia, and Chevron	BETO longtimer

The Challenge: A linear carbon economy for plastics





- Plastic is made from non-renewable feedstocks
- Plastic waste is increasingly accumulating[1]
- Most of that plastic waste ends up in landfills and the environment[2]
- Plastic production currently consumes 6% of global oil and is anticipated to increase to 20% of global oil by 2050[3]

[1]Geyer et al. Science Advances 2017
[2]Zheng and Suh. Nature Climate Change 2019
[3]Jambeck et al. Science 2015 and Ellen MacArthur Foundation

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BOTTLE National Lab-Led Consortium

BOTTLE **vision:** deliver selective and scalable technologies that enable cost-effective recycling, upcycling, and increased energy efficiency for plastics.

BOTTLE **mission**: develop robust processes to upcycle existing waste plastics, and new plastics and processes that are recyclable-by-design

METRICS

Energy/Emissions:

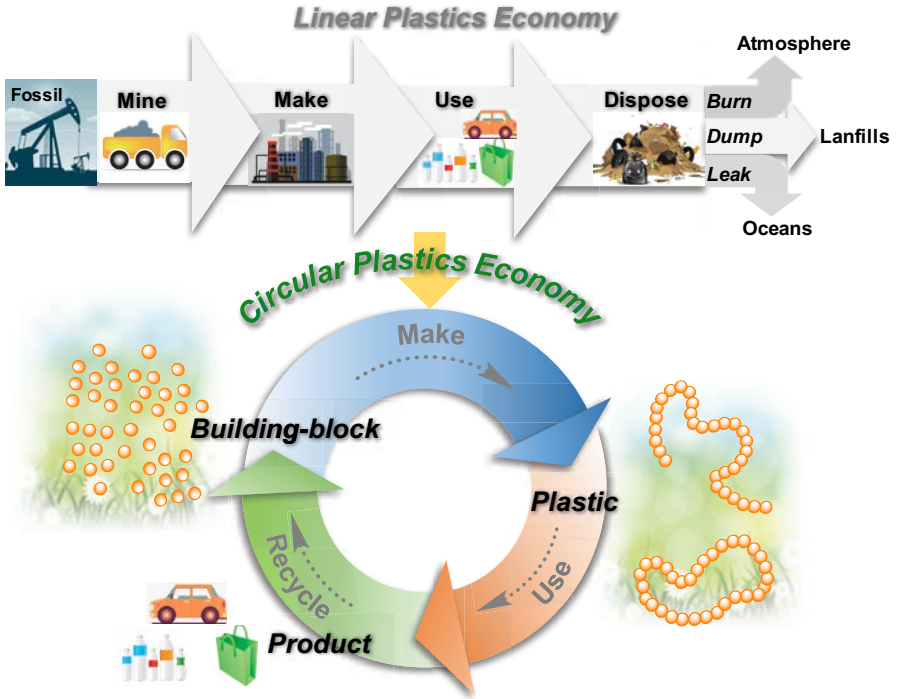
- ≥**50% energy savings** relative to virgin material production

Carbon:

- ≥**75% carbon utilization** from waste plastics

Economics:

- ≥ **2x economic incentive** above price of reclaimed materials



Eugene Chen

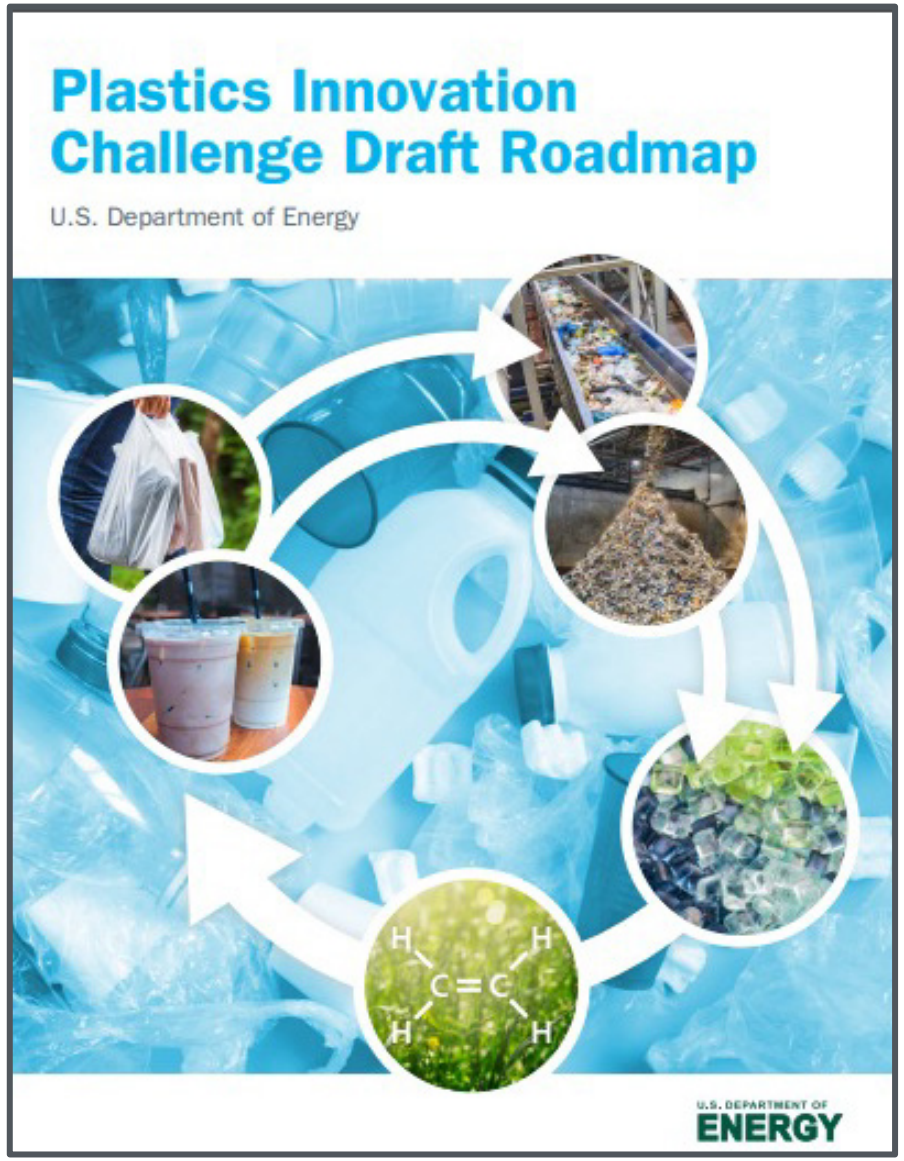
DOE's Plastics Innovation Challenge: A Low Carbon, High Reuse Vision for Plastics

Vision

For the United States to lead the world in developing and deploying technologies that minimize plastic waste and promote energy-efficient and economic plastic and bioplastic design, production, reuse, and recycling.

Objectives/Metrics by 2030

- Address **end-of-life fate for >90%** of plastics
- **≥50% energy savings** relative to virgin material production
- Achieve **≥75% carbon utilization** from waste plastics
- Develop **cost-competitive** recyclable-by-design plastic.
- *In Development*: A GHG reduction metric.



Plastics Innovation Challenge Draft Roadmap, January 19th 2020

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Goals and Targets | Plastics Strategy

- BETO program goals broken down into BETO Level Barriers and challenges
- Feedstock Supply & Logistics R&D Barriers and Challenges
- Advanced Algal Systems R&D Barriers and Challenges
- Conversion R&D Barriers and Challenges
- Advanced Development and Optimization Barriers and Challenges
- Analysis and Crosscutting Sustainability Barriers and Challenges

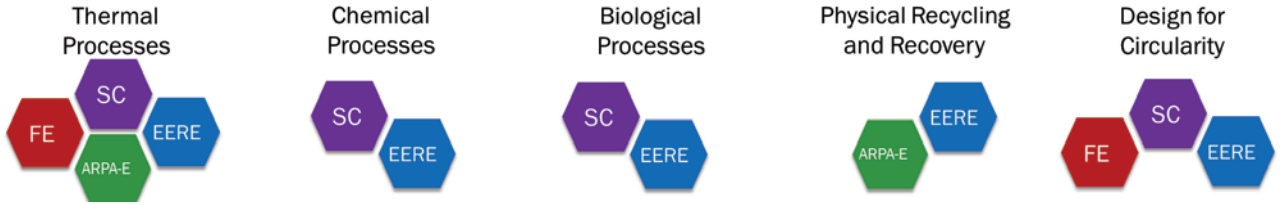
Goals and Targets | Plastics Strategy

- BETO Program Barriers
  - Barrier Ot-B Cost of production: “As with petroleum refineries, product slates will need to include bioproducts to spread the costs of production across biofuels and higher-valued bioproducts to be competitive in commodity markets.”
- Conversion R&D Barriers and Challenges
  - Barrier Ct-C- Process Development for Conversion of Lignin. Lignin conversion to valuable bioproducts.
  - Barrier Ct-J. Identification and Evaluation of Potential Bioproducts: “To more efficiently realize the full value of biomass feedstocks, conversion processes need to integrate bioproduct production with that of drop-in fuels.”

Engagement | Technology Area Strategy

Stakeholder feedback has been solicited to ensure BETO's Plastics work is positioned for success

DOE PIC entails active coordination



bottle
changing the way we recycle™
U.S. DEPARTMENT OF ENERGY

Active industry engagement is integral to BOTTLE efforts

Cross-agency coordination

National Recycling Strategy

Plastics EFRI

OES Marine Waste Management

Save Our Seas Act, NIST Plastics Research

A Request for Information (RFI) was released to solicit stakeholder feedback on the PIC Draft Roadmap

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Approach | How has BETO invested to overcome these barriers?

BOTTLE Consortium

- BOTTLE started with NREL, LANL, ORNL, CSU, MIT, MSU in FY20.
- A lab call invited other national laboratory researchers to contribute to the Consortium's goals in FY20. The lab call recipients added ANL, SLAC, & NU as Consortium members

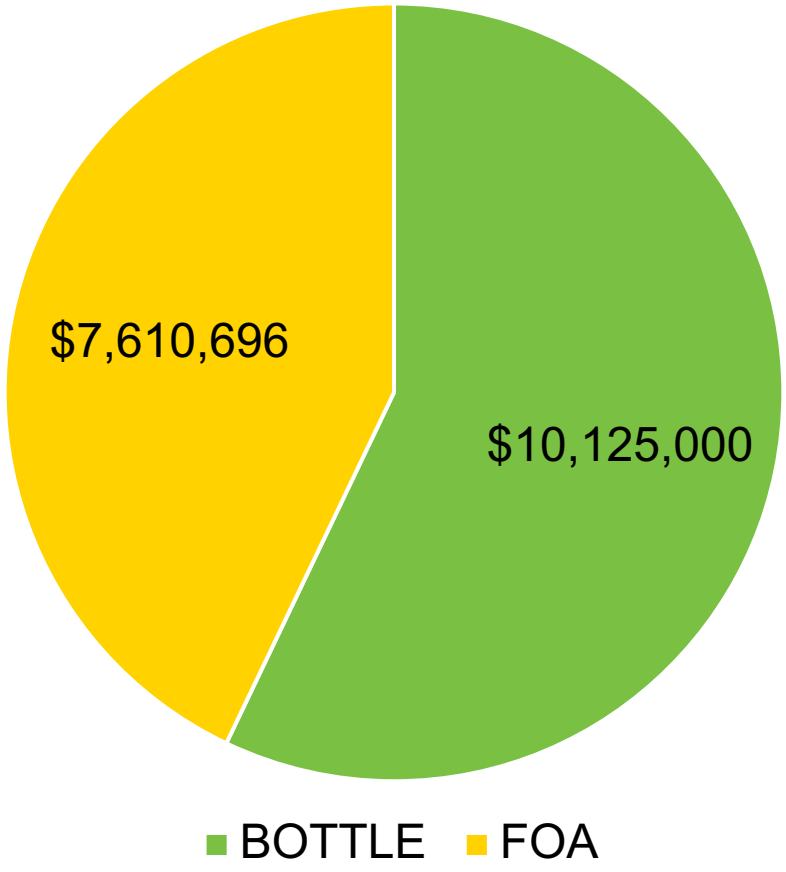
Funding opportunity announcements (FOA) open to all:

- FY19 BETO-Wide FOA: Plastics in the Circular Carbon Economy Topic Area
- FY20 BOTTLE FOA
- Small Business Innovation Research (SBIR) Calls:
  - FY2020: Phase 1 Novel Utilization Strategies for Ocean Plastic Waste
  - FY2020: Phase 2 Reshaping Plastic Design and Degradation for the Bioeconomy
  - FY2021: Phase 1 compatibilizers of existing plastics

Portfolio and Active Management | Technology Area Strategy

In this Plastics panel, we are reviewing

4 FOA projects and 1 Consortium



BOTTLE Consortium is actively managed by BETO technology managers

- Quarterly reports and update meetings
  - Quarterly Financial reporting
- Monitor progress toward milestones
- Go/No-Go decision points

Let's get started!

To begin, we will start the BOTTLE Consortium

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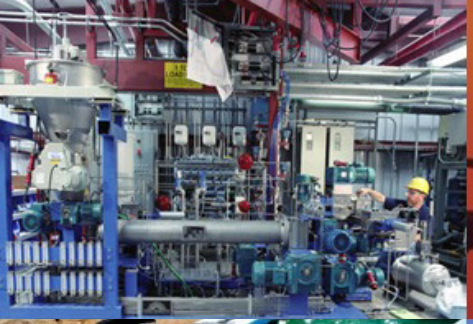




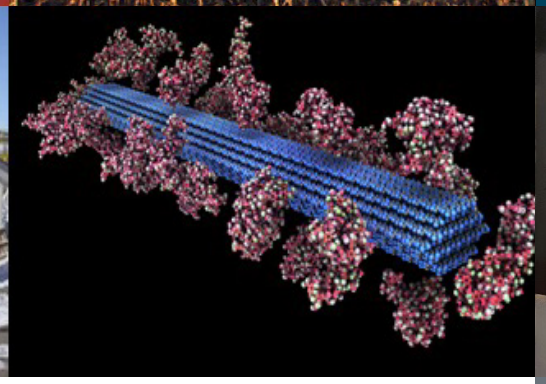


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FOA vs AOP Interlude

9 March 2021

Gayle Bentley

Technology manager

Approach | Funding Types

	FOA	AOP
Selection Method	Competitive	Lab Call
Open to the Public	✓	☒
National Lab Participant	Only as Subrecipient	✓
Go/No-Go Decision Points	✓	✓
Verifications	✓	☒
Award Modifications Method	Contracting Officer (CO)	AOP Tool Change Control

FOA = Funding Opportunity Announcement

AOP = Annual Operating Plan

All competitive projects reviewed in this panel were funded by the 2019 Multi-Topic FOA

Title	Recipient	Award Type	Presenter
Bioconversion of Heterogeneous Polyester Wastes to High Value Chemical Products	University of Massachusetts Lowell	FY19 - BETO wide FOA: DE-FOA-0002029,Topic 8b	Margaret Sobkowicz-Kline
ResIn: Responsible Innovation for Highly Recyclable Plastics	Northwestern University	FY19 - BETO wide FOA: DE-FOA-0002029,Topic 8a	Linda Broadbelt
Recyclable Thermoset Polymers from Lignin Derived Phenols	Spero Renewables, LLC	FY19 - BETO wide FOA: DE-FOA-0002029,Topic 8a	Ian Klein
Upcycling of CFRP Waste: Viable Eco-friendly Chemical Recycling and Manufacturing of Novel Repairable and Recyclable Composites	Washington State University	FY19 - BETO wide FOA: DE-FOA-0002029,Topic 8b	Jinwen Zhang

Topic 8: Plastics in the Circular Carbon Economy

FOA Overview – Topic 8a Designing Highly Recyclable Plastics

Recipients:

- Northwestern University
- Spero Renewables, LLC

Specific Areas of Interest:

- Development of novel biobased plastics that have improved performance attributes over a comparable incumbent plastic and can be cost effectively chemically recycled (e.g., catalytically deconstructed into monomers)
- Applicants may use model compounds for initial testing of their plastic; however, the plastic synthesized and tested at the end of the project must be synthesized from biobased feedstocks
- Applicants are encouraged to explore performance-advantaged plastics that, in addition to superior end-of-life considerations, can outperform traditional plastics for a specific, chosen application

Topic 8a Metric	Unit	Minimum	Stretch
Biobased Content	% by Mass	50%	100%
Chemically Recyclable, as Measured by % Recovered Monomers	% Improvement	10%	30%
Performance Advantage (Outperform Traditional Plastics for a Specific Application)	Variable	10%	20%

Topic 8b Designing Novel Methods for Deconstructing and Upcycling Existing Plastics

Recipients:

- University of Massachusetts Lowell
- Washington State University

Specific Areas of Interest

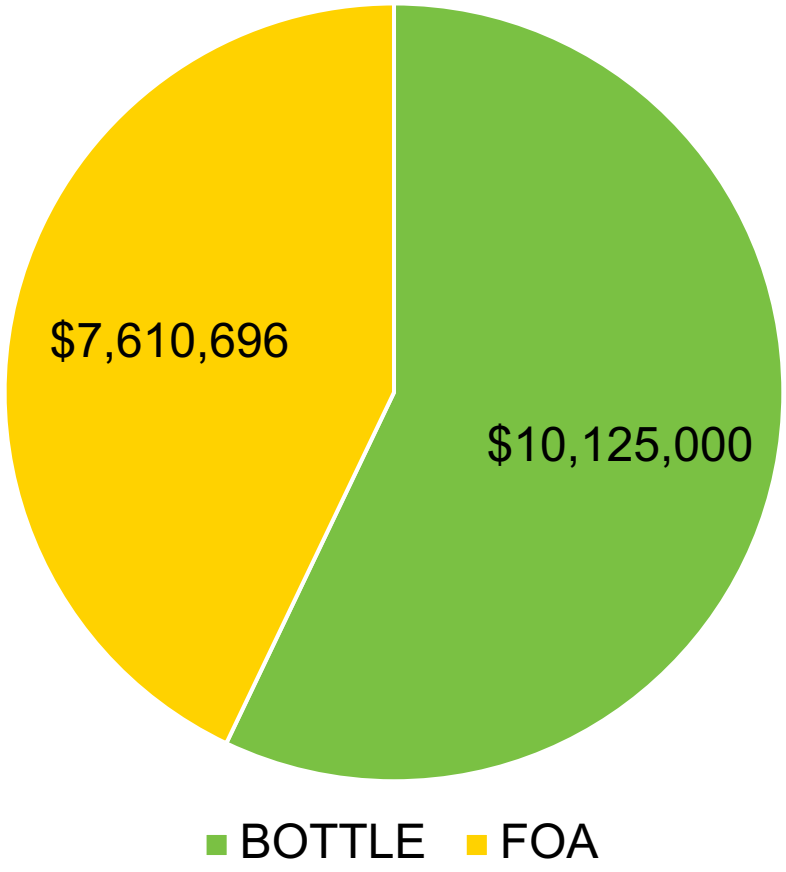
- Biological, low-temperature (<300 C) chemical, or hybrid systems capable of one of the following:
  - Breaking plastics down into low molecular weight streams which are either consumable by an organism, or are easily separable
  - Breaking down a plastic stream into intermediates which can be upgraded into high value products
  - Breaking down multiple plastic streams simultaneously or sequentially
  - Tolerating contaminants generally found in mixed plastic waste streams

Topic 8b Metric	Unit	Minimum	Stretch
Increased Rate of Degradation Over State of Technology	Mass or Time	20%	100%
Ability to Degrade Mixed Plastic Streams Simultaneously or Sequentially (>2 Plastic Streams)	Mass of Each Plastic Stream at the End of 7 Days	50%	20%

Portfolio and Active Management | Technology Area Strategy

In this Plastics panel, we are reviewing

4 FOA projects and 1 Consortium



FOA projects are actively managed by BETO technology managers

- Quarterly reports and update meetings
  - Quarterly Financial reporting
- **Initial, intermediate, and final verifications**
- Monitor progress toward milestones
- Go/No-Go decision points

Exciting progress to be showcased by our presenters!

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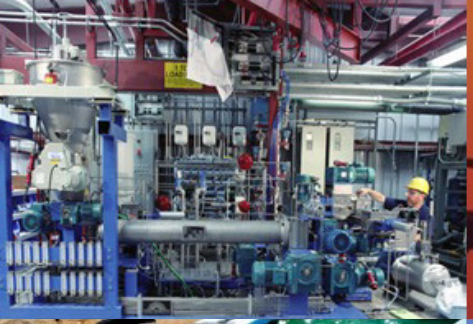




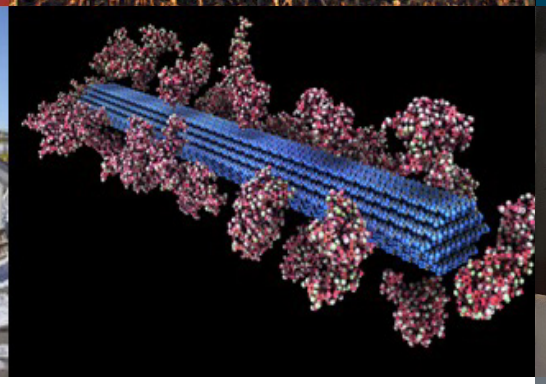


U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Performance-Advantaged Bioproducts Introduction

Wednesday March 10th, 2021

Gayle Bentley
Technology Manager
Peer Review 2021

Outline

- Schedule walk-through
- Reviewer welcome
- PABP overview

DAY 3 – Wednesday, March 10, 2021					
10:15 AM	*10:35 AM*	*20*	*Gather, Tech Check, Networking Questions*	*BETO + Reviewers*	
10:35 AM	10:45 AM	10	PABP - Session Overview	BETO	Gayle Bentley
10:45 AM	11:15 AM	30	Renewable Carbon Fibers Consortium	NREL	Adam Bratis
11:15 AM	11:45 AM	30	Melt-stable engineered lignin thermoplastic: a printable resin	ORNL	Amit Naskar
11:45 AM	12:15 PM	30	Bio-Insecticides from Thermochemical Biomass Conversion	NREL	Nolan Wilson
12:15 PM	*12:30 PM*	*15*	*Break*	*All*	
12:30 PM	1:00 PM	30	Performance-Advantaged Bioproducts via Selective Biological and Catalytic Conversions	NREL	Gregg Beckham
1:00 PM	1:30 PM	30	Inverse biopolymer design through machine learning and molecular simulation	NREL	Nolan Wilson
1:30 PM	*1:40 PM*	*10*	*Break*	*All*	
1:40 PM	1:45 PM	5	AOP vs FOA Overview	BETO	Gayle Bentley
1:45 PM	2:15 PM	30	Identifying Performance Advantaged Biobased Chemicals Utilizing Bioprivileged Molecules	Iowa State University	Brent Shanks
2:15 PM	2:45 PM	30	Cellulose-Chitin Composites for Performance Advantaged Barrier Packaging Bioproducts	Georgia Institute of Technology	Carson Meredith
2:45 PM	*3:15 PM*	*30*	*Lunch*	*All*	
3:15 PM	3:45 PM	30	Fermentative production of Tulipalin A: a next-generation, sustainable monomer that drastically improves the Performance of pMMA	Arzeda	Alex Zanghellini
3:45 PM	4:15 PM	30	Design and development of bio-advantaged vitrimers as closed-loop bioproducts	University of California, Berkeley	Jay Keasling
4:15 PM	4:30 PM	15	Comment Review Session	All Reviewers	

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Ray Miller	Independent Consultant – Formerly DuPont and PDO	2019 Panel
Bill Orts	USDA	New this year
Sharon Haynie	Independent Consultant, Formerly DuPont	New this year
Paul Bryan	Independent Consultant – Formerly BETO, Sandia, and Chevron	BETO longhauler

Definitions

- **Drop-in replacement:** a bio-derived compound that is chemically identical to its petroleum counter part
- **Functional replacement:** a bio-derived compound that has a different chemical structure than a petroleum counter part, but performs the same function/has the same performance attributes
- **Performance-advantaged bioproduct:** a bio-derived compound that does not resemble an existing petroleum-derived compound in structure, function, or performance attributes. The bio-based compound offers novel functionality or improved performance attributes.

Why Pursue Performance Advantaged Biobased Chemicals?

Product Design Benefits

- Biomass contains functionality not present in other feedstocks
- Opportunity to design and bring new products to market

Economic Benefits

- Increase value of domestic feedstock; revitalize rural economies
- Provide additional source of revenue for existing bioprocessing facilities

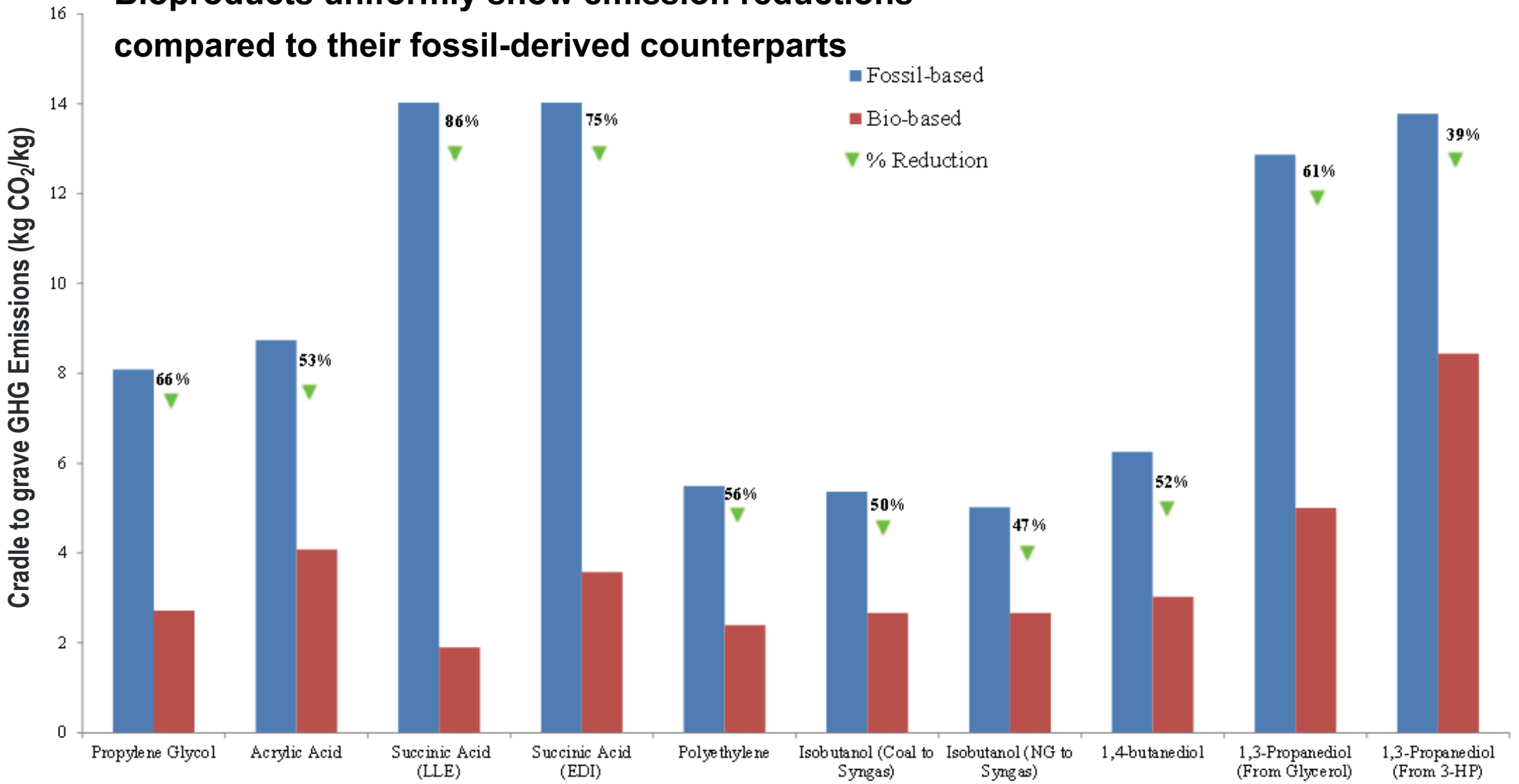
Environmental Benefits

- Potential for lower toxicity
- Reduced life cycle impact
- Reduced energy requirements

Photos: National Renewable Energy Lab

Why is BETO interested in biobased products?

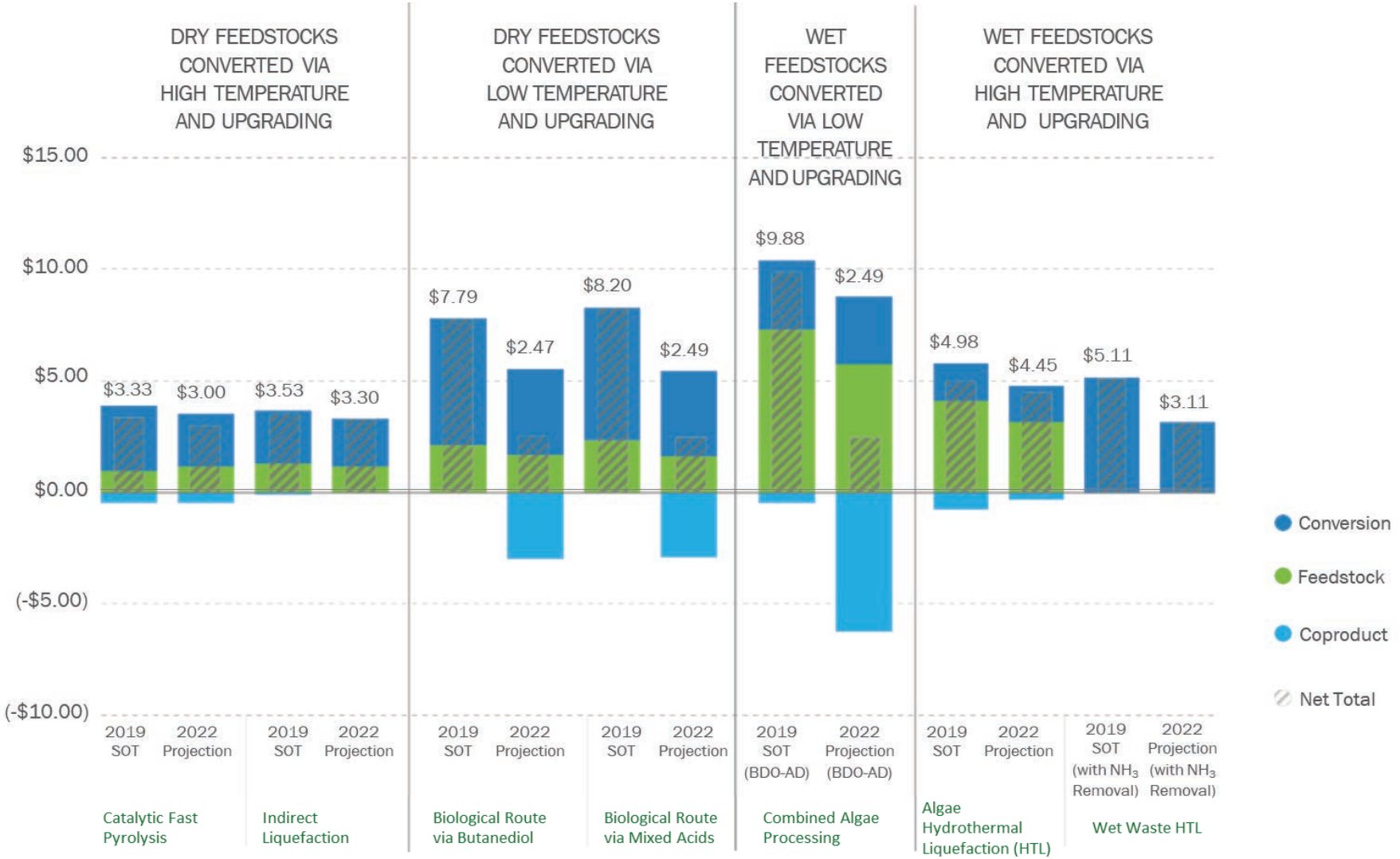
Bioproducts uniformly show emission reductions compared to their fossil-derived counterparts



Life-Cycle Fossil Energy Consumption and Greenhouse Gas Emissions of Bioderived Chemicals and Their Conventional Counterparts – Felix Adom, Jennifer Dunn, Jeongwoo Han, and Norm Sather.

Why is BETO interested in biobased products?

Bioproducts can enable a bioprocess by reducing the MFSP

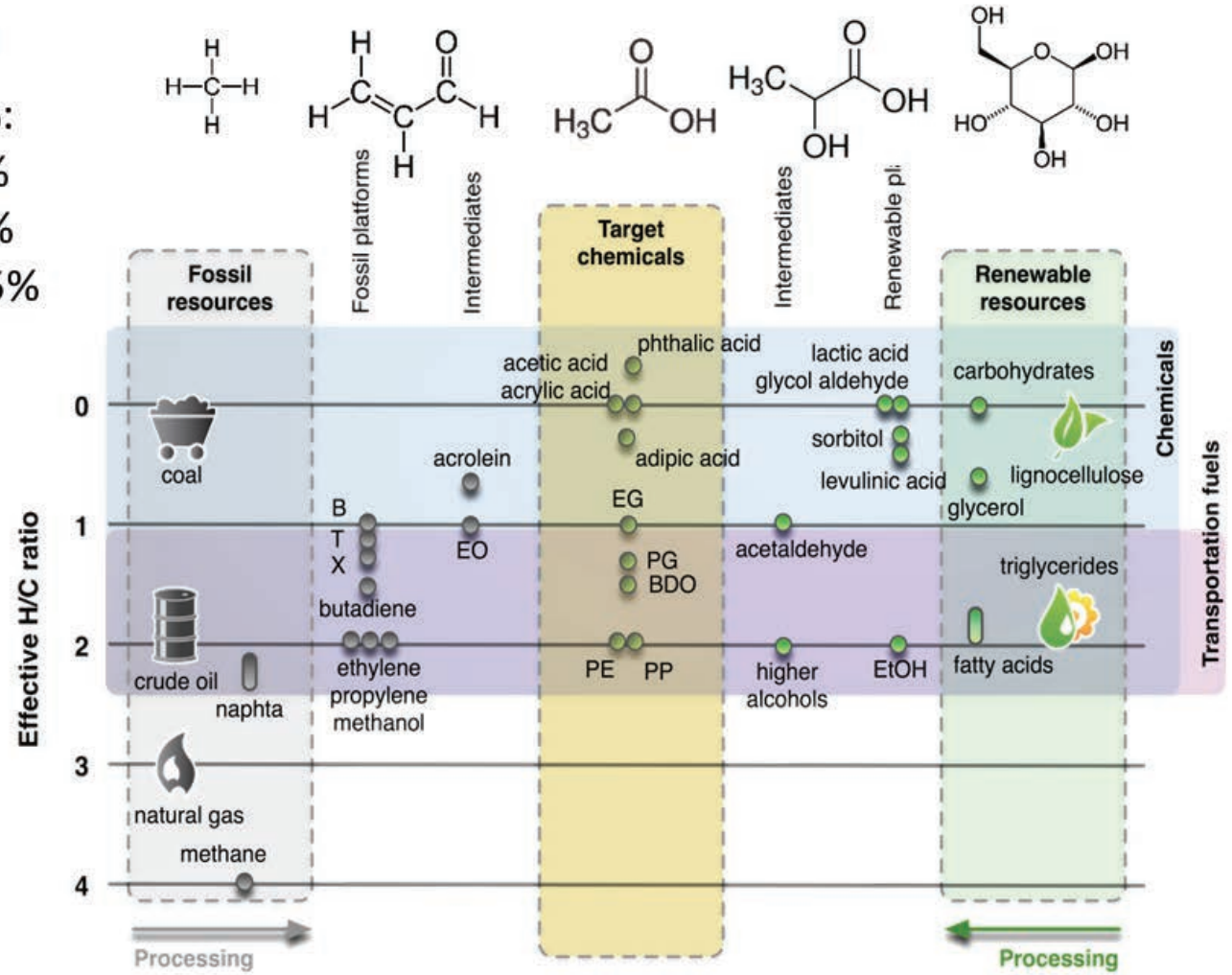


BETO State of Technology, 2019

Biomass provides functionalized chemistry to support new material design

Crude oil

Avg. wt%:
C 83-87%
H 10-14%
O 0.1-1.5%



Biomass

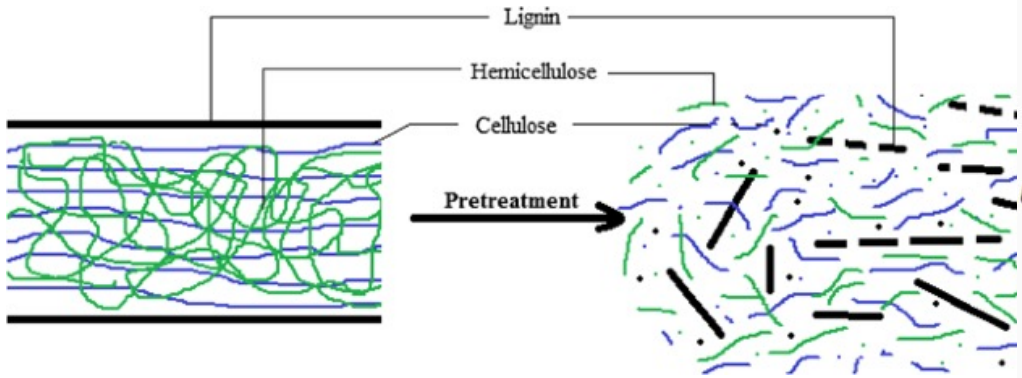
Avg. wt%:
C 36-53%,
H 5-7%,
O 31-48%

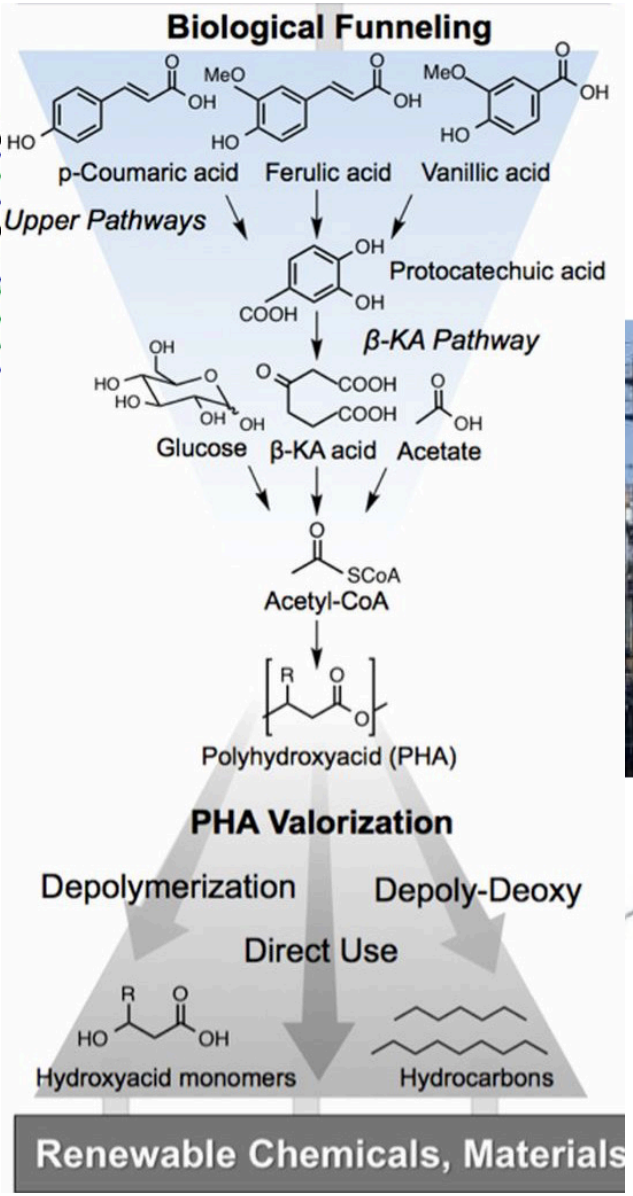
Consider the oxidation state of chemicals – retain what nature provides

Vennestrøm, P.N. R. *et al Angew. Chem. Int. Ed.* **2011**, *50*, 10502-10509

Shen, J. *et al Energy Conversion and Management* **2010**, *51*, 983–987

Microbial organisms are talented at funneling biomass to products





Linger J., et al. 2014. PNAS

Performance-Advantaged Bioproducts Strategy – Goals and Targets

- BETO program goals broken down into BETO Level Barriers and challenges
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- Advanced Algal Systems R&D Barriers and Challenges
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- BETO Program Barriers
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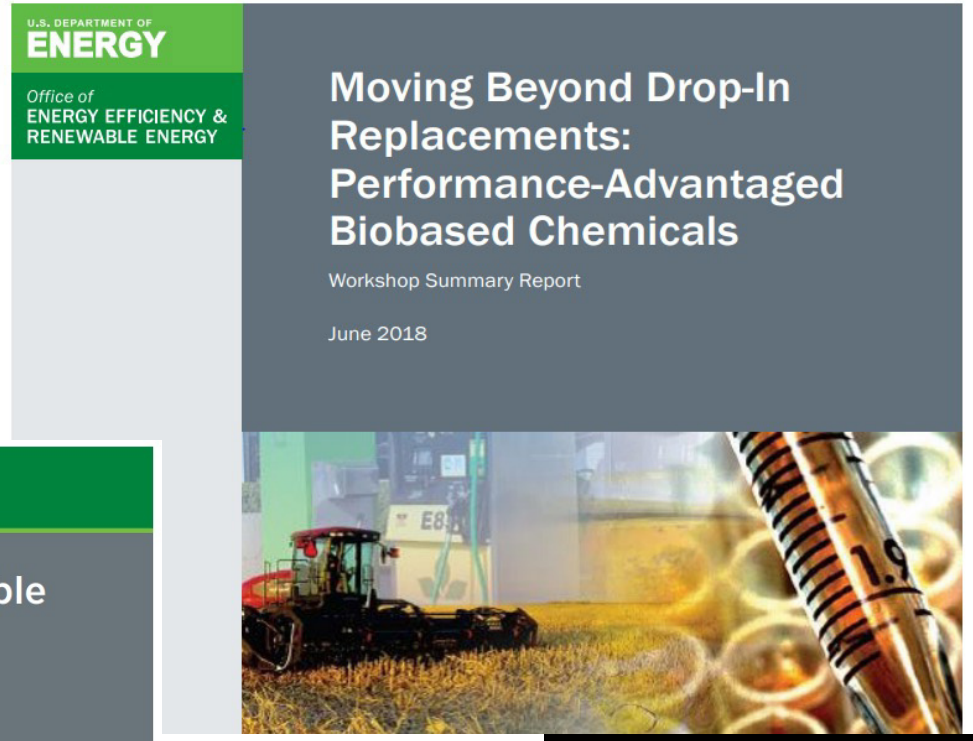

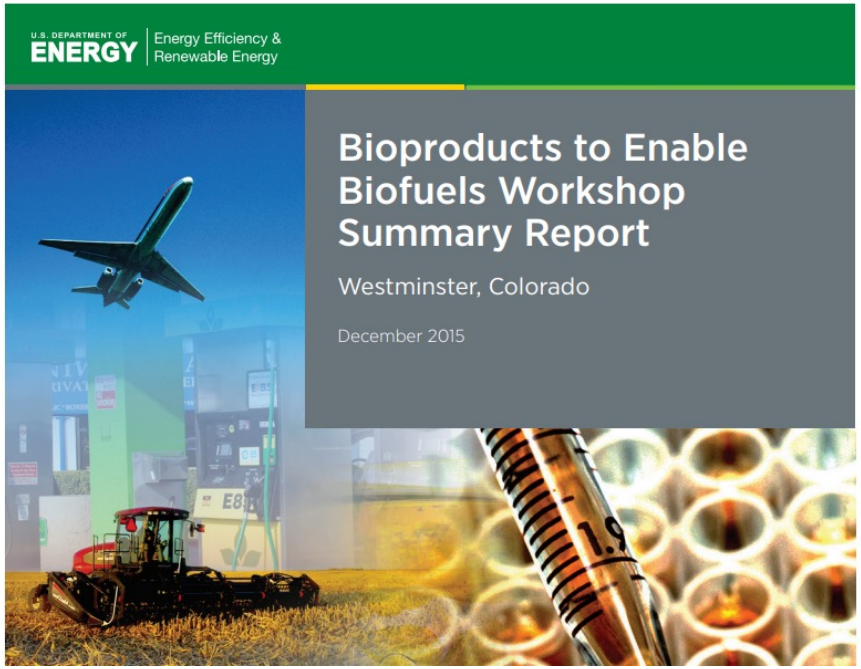

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Approach | How has BETO invested to overcome these barriers?

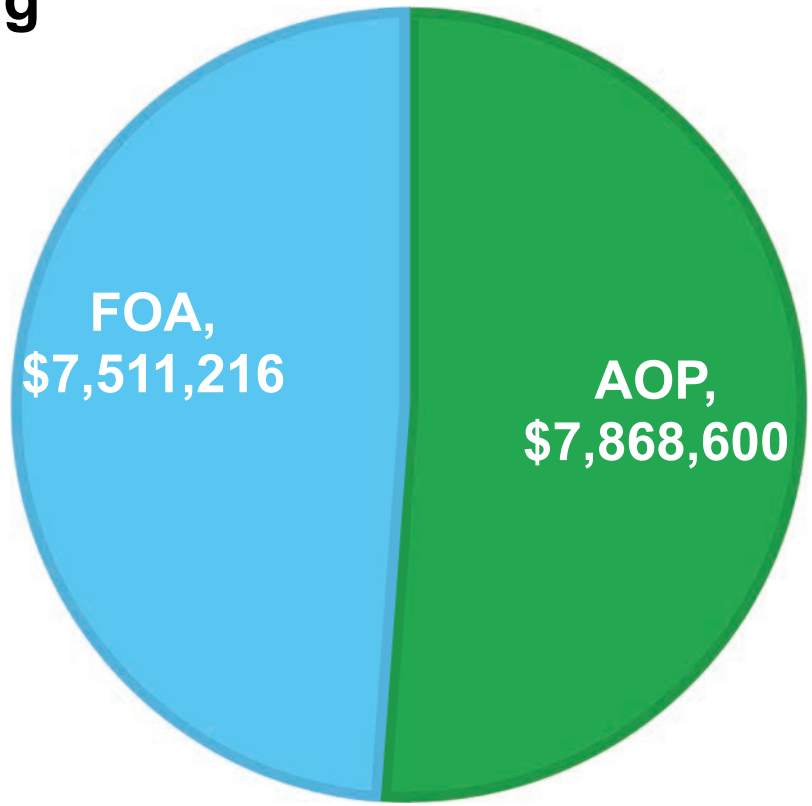
- Every year we accept proposals from our National Lab partners
  - Only National Labs can compete for this funding
  - These projects are called Annual Operating Plans (AOPs)

- Funding opportunities open to all:
  - **FY14 Carbon Fiber FOA**
  - **FY18 BioEnergy Engineering for Products Synthesis (BEEPS) FOA**
  - FY19 FOA: bio jet topic
  - FY20 FOA: biopower and bioproducts from waste

- Reminder: this session does not encompass *all* of BETO's bioproducts work. Some appears in the Biochemical Conversion and Catalytic Upgrading sessions. Some relevant analysis appears in the Analysis and Sustainability session.

Portfolio| Technology Area Strategy

In this PABP panel, we are reviewing
4 FOA projects and 5 AOP projects



Active Management | Technology Area Progress

- Many projects required a no-cost time extension (NCTE) due to the impacts of the global SARS-CoV2 pandemic

- All projects are actively managed by BETO technology managers
  - Quarterly reports and update meetings
    - Quarterly Financial reporting
  - Monitor progress toward milestones
  - Initial, Intermediate, and Final verifications for FOA projects

Let's get started!

To begin, we will start with our AOP portfolio

Start	End (ET)	Time	Project Title	Organization	PI
10:45 AM	11:15 AM	30	Renewable Carbon Fibers Consortium	NREL	Adam Bratis
11:15 AM	11:45 AM	30	Melt-stable engineered lignin thermoplastic: a printable resin	ORNL	Amit Naskar
11:45 AM	12:15 PM	30	Bio-Insecticides from Thermochemical Biomass Conversion	NREL	Nolan Wilson
12:15 PM	*12:30 PM*	*15*	*Break*	*All*	
12:30 PM	1:00 PM	30	Performance-Advantaged Bioproducts via Selective Biological and Catalytic Conversions	NREL	Gregg Beckham
1:00 PM	1:30 PM	30	Inverse biopolymer design through machine learning and molecular simulation	NREL	Nolan Wilson
1:30 PM	*1:40 PM*	*10*	*Break*	*All*	

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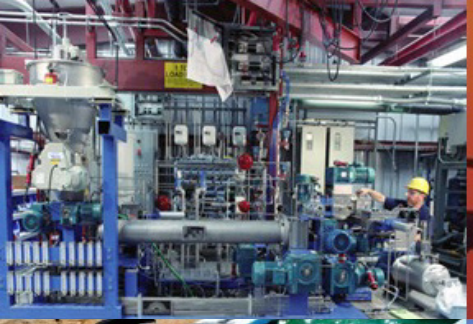




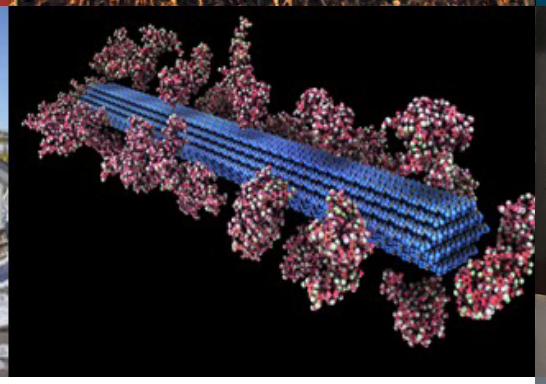


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FOA vs AOP Interlude

10 March 2021

Gayle Bentley

Technology manager

Approach | Funding Types

	FOA	AOP
Selection Method	Competitive	Lab Call
Open to the Public	✓	☒
National Lab Participant	Only as Subrecipient	✓
Go/No-Go Decision Points	✓	✓
Verifications	✓	☒
Award Modifications Method	Contracting Officer (CO)	AOP Tool Change Control

FOA = Funding Opportunity Announcement

AOP = Annual Operating Plan

Approach | BETO invests in both AOP and FOA projects to overcome barriers

- Every year we accept proposals from our National Lab partners
  - Only National Labs can compete for this funding
  - These projects are called Annual Operating Plans (AOPs)

- Funding opportunities open to all (related to PABP):
  - **FY14 Carbon Fiber FOA**
  - **FY18 BioEnergy Engineering for Products Synthesis (BEEPS) FOA**
  - FY19 FOA: bio jet topic
  - FY20 FOA: biopower and bioproducts from waste

- Reminder: this session does not encompass *all* of BETO's bioproducts work. Some appears in the Biochemical Conversion and Catalytic Upgrading sessions. Some relevant analysis appears in the Analysis and Sustainability session.

2018 BEEPs FOA

FOA Title: BioEnergy Engineering for Products Synthesis (BEEPS)

- FOA Released: 5/3/2018
- Selections: 9/30/2018
- FOA Number: DE-FOA-0001916
- Topic Area 3: Performance Advantaged Bioproducts
  - Subtopic A: Performance Advantaged Bioproduct **Identification**
  - Subtopic B: Performance Advantaged Bioproduct **Production**

All competitive projects reviewed in this panel were funded by the BEEPS FOA

Title	Organization	PI
Identifying Performance Advantaged Biobased Chemicals Utilizing Bioprivileged Molecules	Iowa State University	Brent Shanks
Cellulose-Chitin Composites for Performance Advantaged Barrier Packaging Bioproducts	Georgia Institute of Technology	Carson Meredith
Fermentative production of Tulipalin A: a next-generation, sustainable monomer that drastically improves the Performance of pMMA	Arzeda	Alex Zanghellini
Design and development of bio-advantaged vitrimers as closed-loop bioproducts	University of California, Berkeley	Jay Keasling

FOA Overview – Topic 3a

- Topic 3a: Performance Advantaged Bioproduct **Identification**
  - Iowa State University

It is difficult to identify promising performance advantaged biobased products because of limited available data linking chemical structure to functionality and performance for many biobased compounds. As such, applications of interest must focus on: a) identifying structures of novel biobased compounds, b) identifying performance attributes that could be addressed with biobased compounds, or c) addressing both issues simultaneously.

Metric	Unit	Minimum	Stretch
New / Novel Bio-based Products Identified	#	5	>5
Performance Advantage (Outperform Incumbent Product's Thermo / Mechanical Properties)	Variable	10%	20%

FOA Overview – Topic 3b

- Topic 3b: Performance Advantaged Bioproduct **Production**
  - Georgia Institute of Technology
  - Arzeda
  - University of California, Berkeley

The relationship between a bioproduct and a petroleum-derived product can be categorized one of three ways: bioproducts can be 1) direct replacements (i.e. the bio-derived product and the petroleum-derived product are chemically identical, also known as “drop-in” replacements); 2) functional replacements (i.e. the bio-derived product and petroleum-derived product are different chemically, but they have similar functions/properties), or 3) novel products (i.e. the bio-derived product does not resemble an existing petroleum-derived product in structure or function.) Performance advantaged biobased products are bioproducts that do not resemble an existing commercial petroleum-derived product with functions that offer a performance advantage over existing products.

Metric	Unit	Minimum	Stretch
Produce Novel Bio-based Product	#	1	>1
Performance Advantage (Outperform Incumbent Product’s Thermo / Mechanical Properties)	Variable	10%	20%

Technology Area Strategy – Portfolio

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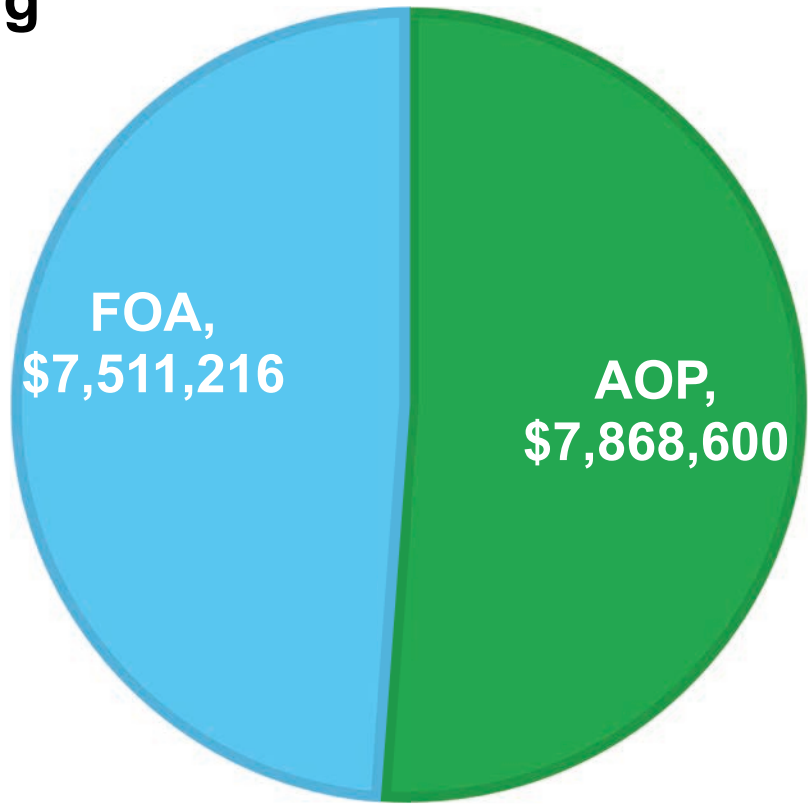
4 FOA projects and 5 AOP projects



Exciting progress to be showcased by our presenters!

Start	End (ET)	Time	Project Title	Organization	PI
1:45 PM	2:15 PM	30	Identifying Performance Advantaged Biobased Chemicals Utilizing Bioprivileged Molecules	Iowa State University	Brent Shanks
2:15 PM	2:45 PM	30	Cellulose-Chitin Composites for Performance Advantaged Barrier Packaging Bioproducts	Georgia Institute of Technology	Carson Meredith
2:45 PM	*3:15 PM*	*30*	*Lunch*	*All*	
3:15 PM	3:45 PM	30	Fermentative production of Tulipalin A: a next-generation, sustainable monomer that drastically improves the Performance of pMMA	Arzeda	Alex Zanghellini
3:45 PM	4:15 PM	30	Design and development of bio-advantaged vitrimers as closed-loop bioproducts	University of California, Berkeley	Jay Keasling
4:15 PM	4:30 PM	15	Comment Review Session	All Reviewers	

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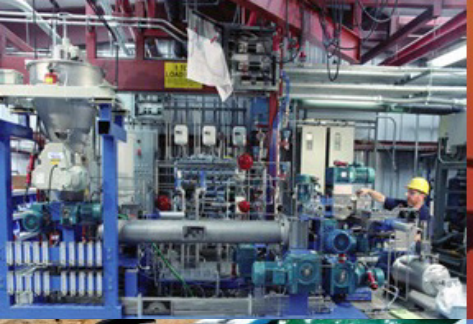




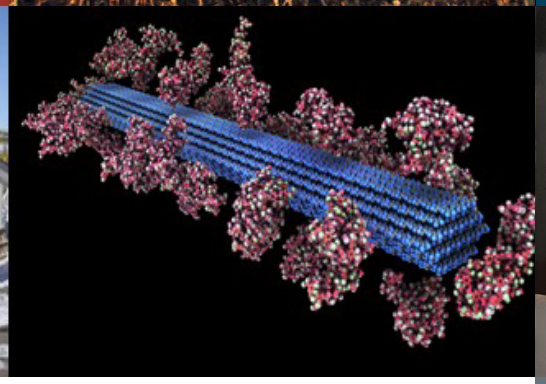


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Bioprocessing Separations Introduction

Gayle Bentley
Technology Manager
Peer Review 2021

Thursday March 11th, 2021

Outline

- Schedule walk-through
- Reviewer welcome
- Plastics overview
- BETO efforts

Agenda

Start Time ET	End Time ET	Min.	Title	Organization	Speaker
DAY 4 – Thursday, March 11, 2021					
11:30 AM	*11:50 AM*	*20*	*Gather, Tech Check, Networking Questions*		*All*
11:50 AM	12:00 PM	10	Separations - Overview	BETO	Gayle Bentley
12:00 PM	1:30 PM	90	Steering committee overview	ANL	Jennifer Dunn
1:30 PM	*1:45 PM*	*15*	*Break*		*All*
1:45 PM	3:15 PM	90	Lignin Rich Stream Fractionation and Purification	NREL	Eric Karp
			Volatile Products Recovery	ANL	Phil Laible
			Redox-Based Electrochemical Separations	ANL	Lauren Valentino
			2,3-Butanediol Separation	ORNL	Aimee Lu Church
			Counter Current Chromatography	NREL	Eric Karp
3:15 PM	*3:25 PM*	*10*	*Break*		*All*
3:25 PM	3:55 PM	30	Reviewer Debrief		All Reviewers

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Welcome to our Reviewers!

Name	Affiliation	Previous Peer Review Experience
Matt Tobin (Lead Reviewer)	Independent Consultant - Formerly Lygos, Amyris, and Codexis	2019 Panel
Peter Keeling	Purdue University	2019 Panel
Karen Draths	Michigan State University	New this year
Ray Miller	Independent Consultant – Formerly DuPont and PDO	2019 Panel
Bill Orts	USDA	New this year
Sharon Haynie	Independent Consultant, Formerly DuPont	New this year
Paul Bryan	Independent Consultant – Formerly BETO, Sandia, and Chevron	BETO longtimer

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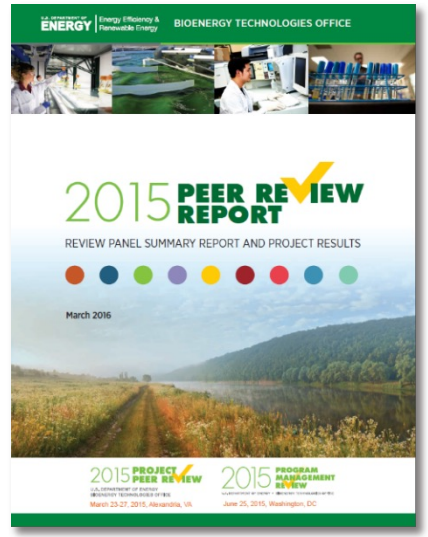
A Note About Consortia

- 2015 Peer Reviewers noted that work across the National Labs was occasionally duplicative and could be better coordinated
- Starting in 2017, launched several multi-lab consortia, including the Bioprocessing Separations Consortium and the Performance Advantaged Bioproducts Consortium
- 2017 Steering Committee Feedback:

> "The organization into consortia helps the national laboratories be **more efficient** in their research, **pooling expertise and avoiding** redundancy, while also **encouraging a broader perspective** on problem-solving across different processes and identification of common problems **(particularly for the Separations Consortium**). It also provides a **central point of contact for industry**, allowing companies to more easily find expertise across the national laboratories."



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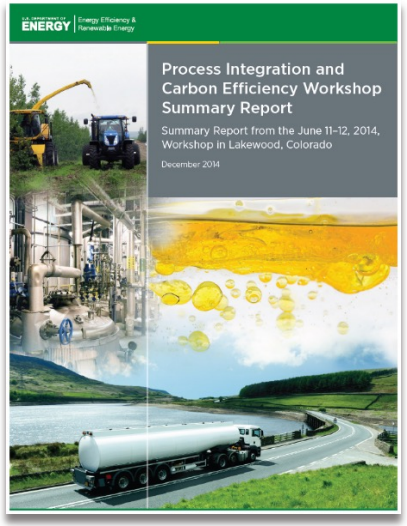
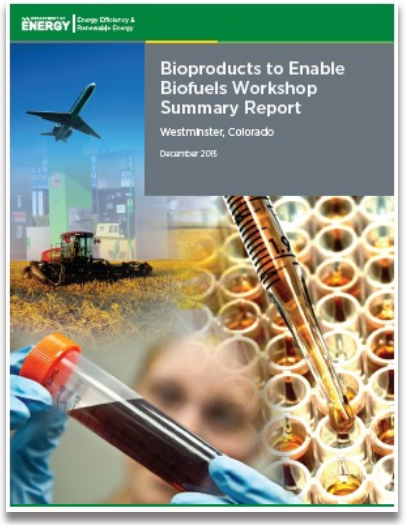
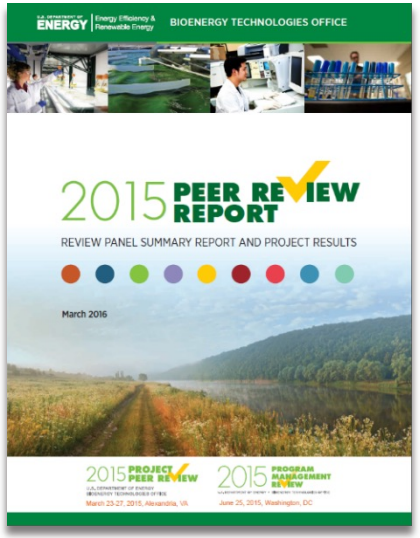
Context for a Separations Consortium

- 2015 Peer Reviewers, several workshops and FOAs have identified separations challenges







- Separations contribute up to 50% of processing costs
- Biofuels separations processes face a lot of unique challenges
- Cross-cutting area that spans all areas of conversion
- BETO funded a handful of disparate separations technologies, not necessarily affiliated with any critical challenges

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Bioprocessing Separations Consortium

- Launched Separations Consortium in FY17, ~$3.5M/year
  - Renewed in 2020

- Goals:
  - A separations consortium that addresses industrially relevant separations challenges in bioenergy
  - Research approach(es) grounded in technoeconomic analysis
  - High impact or broadly applicable separations techniques
  - Avoid developing separations processes that are not well suited for biofuel applications
  - Capitalize on shared expertise, resources, and passion across the Labs
- Challenges:
  - How do we determine what the most promising separations challenges are?

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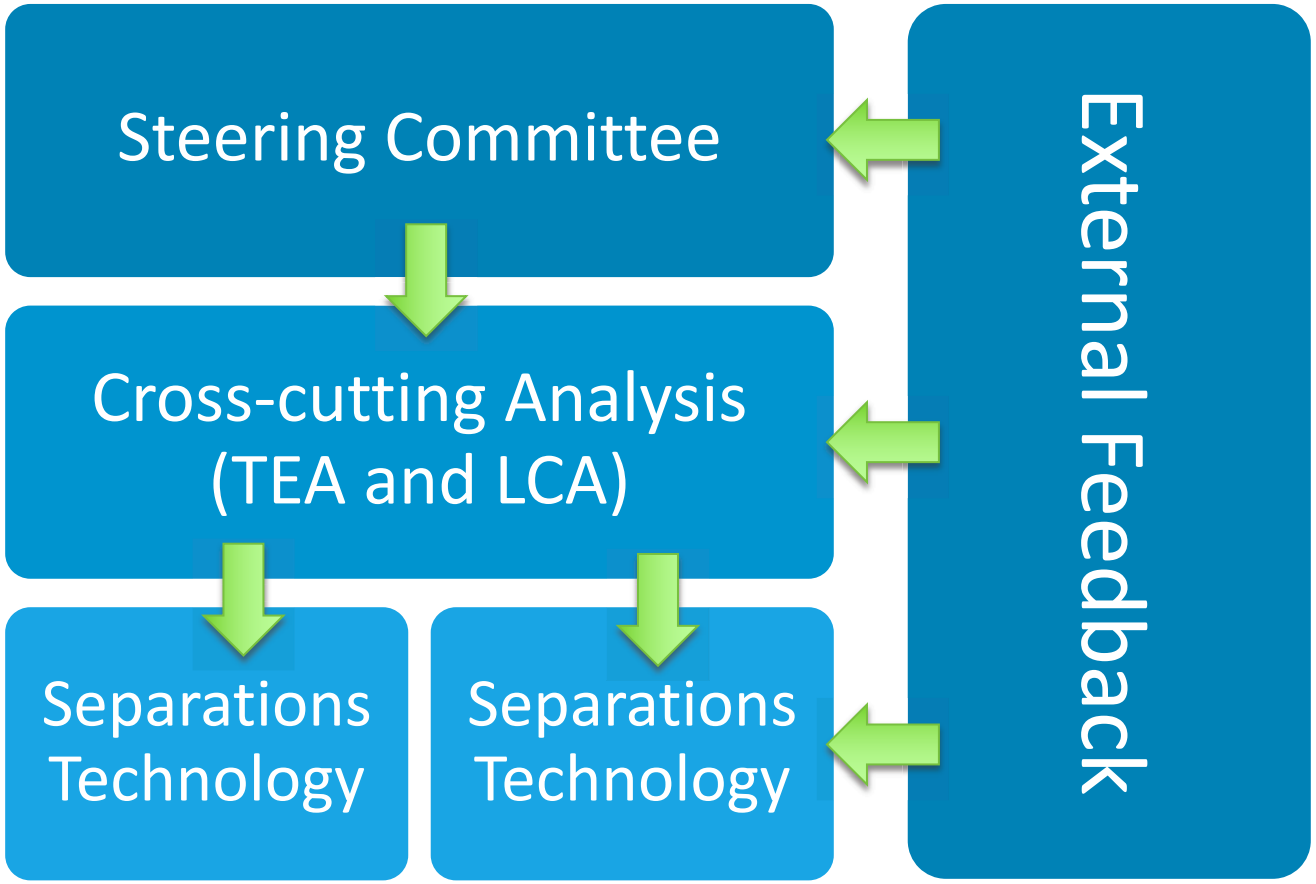
Consortium Structure



Consortium structure has evolved but the mission of the consortium remains constant: pursue separations technologies grounded in TEA and LCA while seeking frequent industry feedback

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Fast Forward to 2021

- **Consortium Structure has evolved**
  - Made difficult decisions about which technologies to focus on, where the Consortium could make the biggest impact
- **Focus on industry relationships**
  - Established an Industry Advisory Board with regular interactions
  - Launched a lab-directed funding opportunity
  - Developed an easy-to-use website to encourage partnerships
    - www.bioesep.org
- **Renewed in 2020 (2020-2022)**
  - New ideas based on industry feedback
  - Critical decisions about consortium structure and organization
  - Welcome feedback on future directions

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Goals and Targets | Separations Strategy

- BETO program goals broken down into BETO Level Barriers and challenges
- Feedstock Supply & Logistics R&D Barriers and Challenges
- Advanced Algal Systems R&D Barriers and Challenges
- Conversion R&D Barriers and Challenges
- Advanced Development and Optimization Barriers and Challenges
- Analysis and Crosscutting Sustainability Barriers and Challenges

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Goals and Targets | Separations Strategy

- BETO Program Barriers
  - Barrier Ot-B Cost of production: “As with petroleum refineries, product slates will need to include bioproducts to spread the costs of production across biofuels and higher-valued bioproducts to be competitive in commodity markets.”
- Conversion R&D Barriers and Challenges
  - **Ct-D. Advanced Bioprocess Development:** Increasing titer, rates, and yields of bioproducts through metabolic engineering and fermentation processing improvements is critical to lowering the costs of fuels and chemicals produced from biomass.
  - **Ct-O. Selective Separations of Organic Species:** “Separation of organic species in biomass processes for upgrading to final fuel and bioproduct molecules has high energy requirements. Desirable compounds are often closely related structurally to undesired intermediates… Low-cost purification technologies need to be developed to remove other organic contaminants and provide concentrated, clean intermediates from which biofuels and biobased chemicals can be manufactured.”

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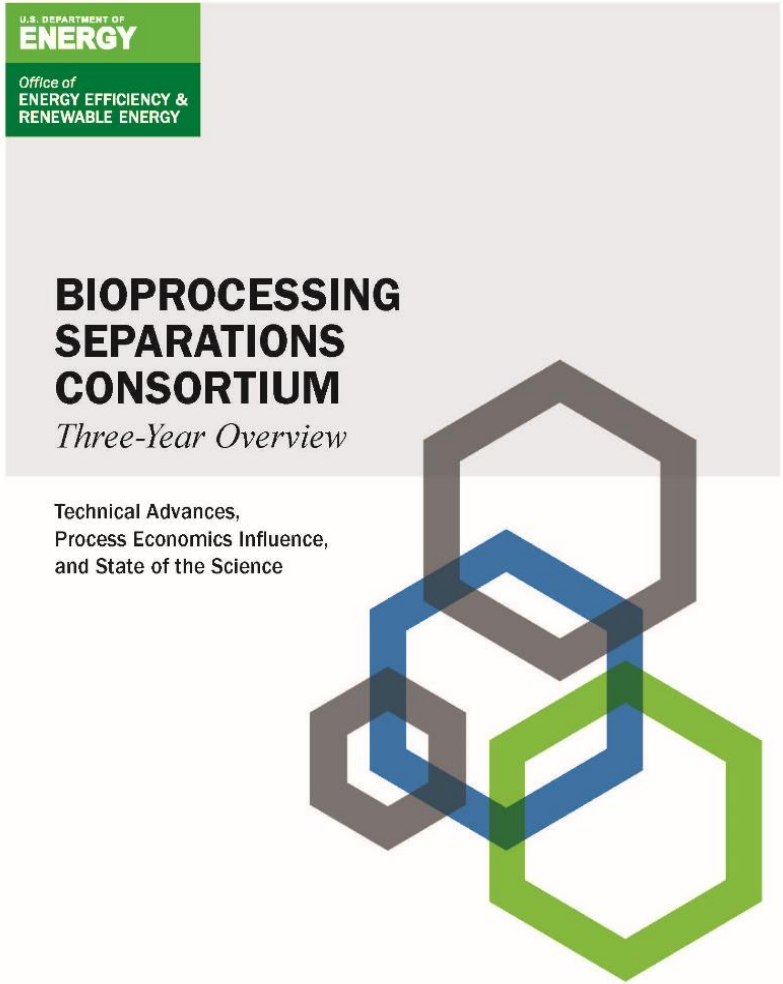
Engagement | Technology Area Strategy

Stakeholder feedback is regularly solicited to ensure BETO's Separations work is positioned for success



The Separations Consortium actively receives feedback from the Industry Advisory Board

Request for Information (RFI) run in 2020

Solicit feedback from industry and other stakeholders

- Technology barriers
- Tools and capabilities

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Let's get started!

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