

U.S. DEPARTMENT OF
ENERGY

Office of
ENERGY EFFICIENCY &
RENEWABLE ENERGY

2021 **PROJECT
PEER REVIEW**

U.S. DEPARTMENT OF ENERGY
BIOENERGY TECHNOLOGIES OFFICE

Co-Optimization of Fuels and Engines (Co-Optima) Session Overview

Alicia Lindauer, Technology Manager

March 15-16, 2021



Housekeeping and Logistics

- Presenters and Reviewers should use their **webcam** when speaking.
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Agenda Overview

Monday

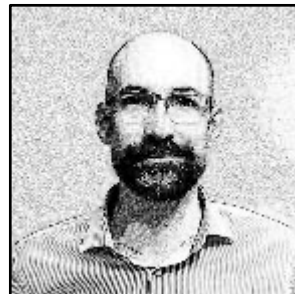
Co-Optima
National
Laboratory
Consortium

Tuesday

FY18 FOA
Projects:
Bioblendstocks
to Optimize
MCCI Engines

Co-Optima Reviewers

Name	Affiliation
Cory Phillips*	Phillips 66
Karl Albrecht	Archer-Daniels-Midland Company
Aron Butler	U.S. EPA Office of Transportation and Air Quality
Bhupendra Khandelwal	University of Alabama
Nikita Pavlenko	The International Council on Clean Transportation
Reuben Sarkar	American Center for Mobility
Luca Zullo	Synergy BurCell Technologies and VerdeNero LLC



Co-Optima Overview

Co-Optimized
Solution



Engine R&D

Fuel R&D

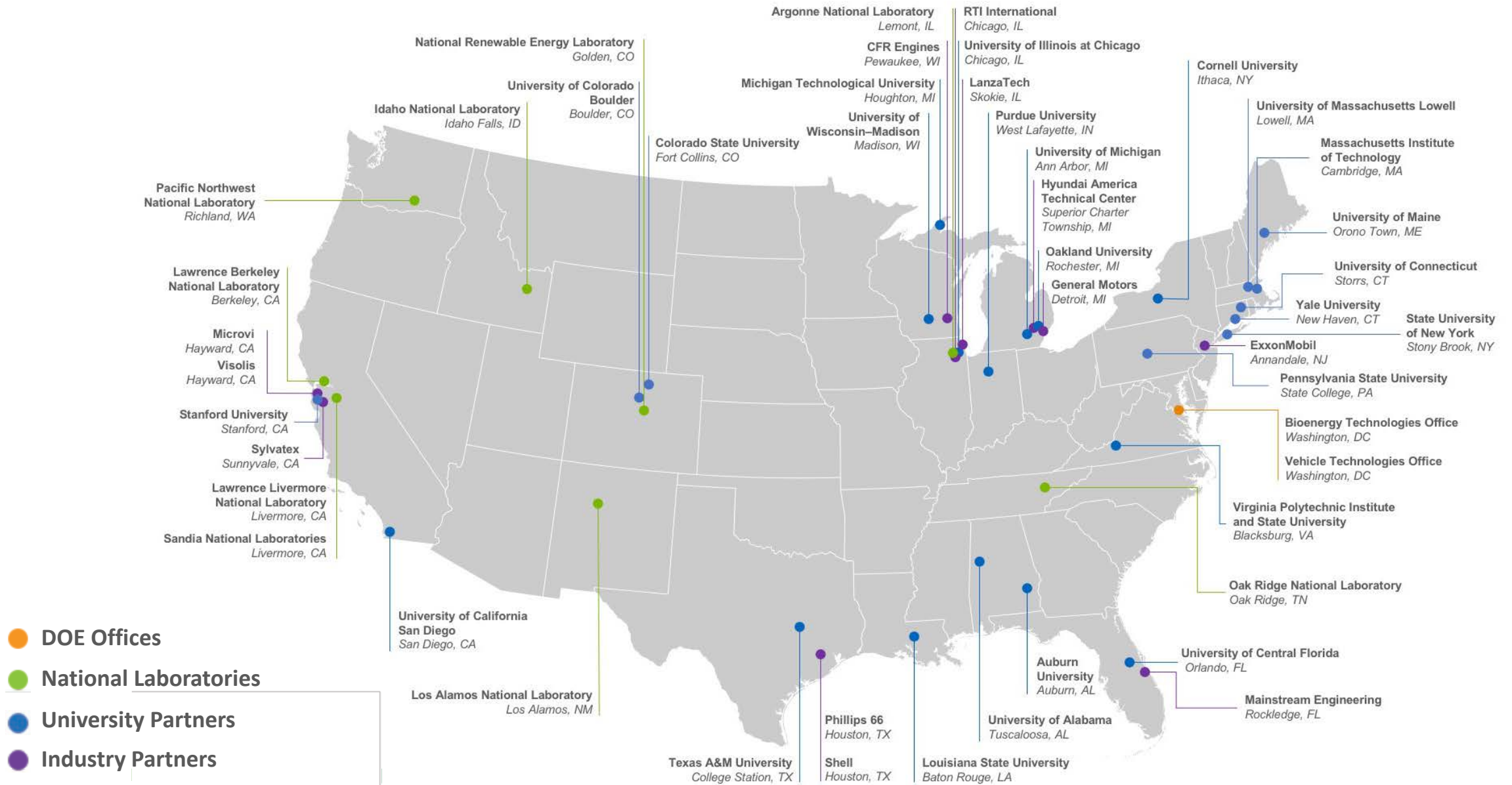


*Co-Optima: Better fuels
and better vehicles
sooner*



Objective: Advance the underlying science needed to develop fuel and engine technologies that will work in tandem to achieve significant efficiency and emissions benefits

Co-Optima Partners



Program Goals

Cross-Cutting Goals

- Increase market opportunities for biofuels
- Reduce transportation sector GHG emissions through efficiency gains and fuel change
- Provide economic options to fuel providers to accommodate changing demands and drivers

Light Duty

- 10% fuel economy gain over 2015 baseline beyond improvements from engine efficiency increases alone (35% total fuel economy gain)

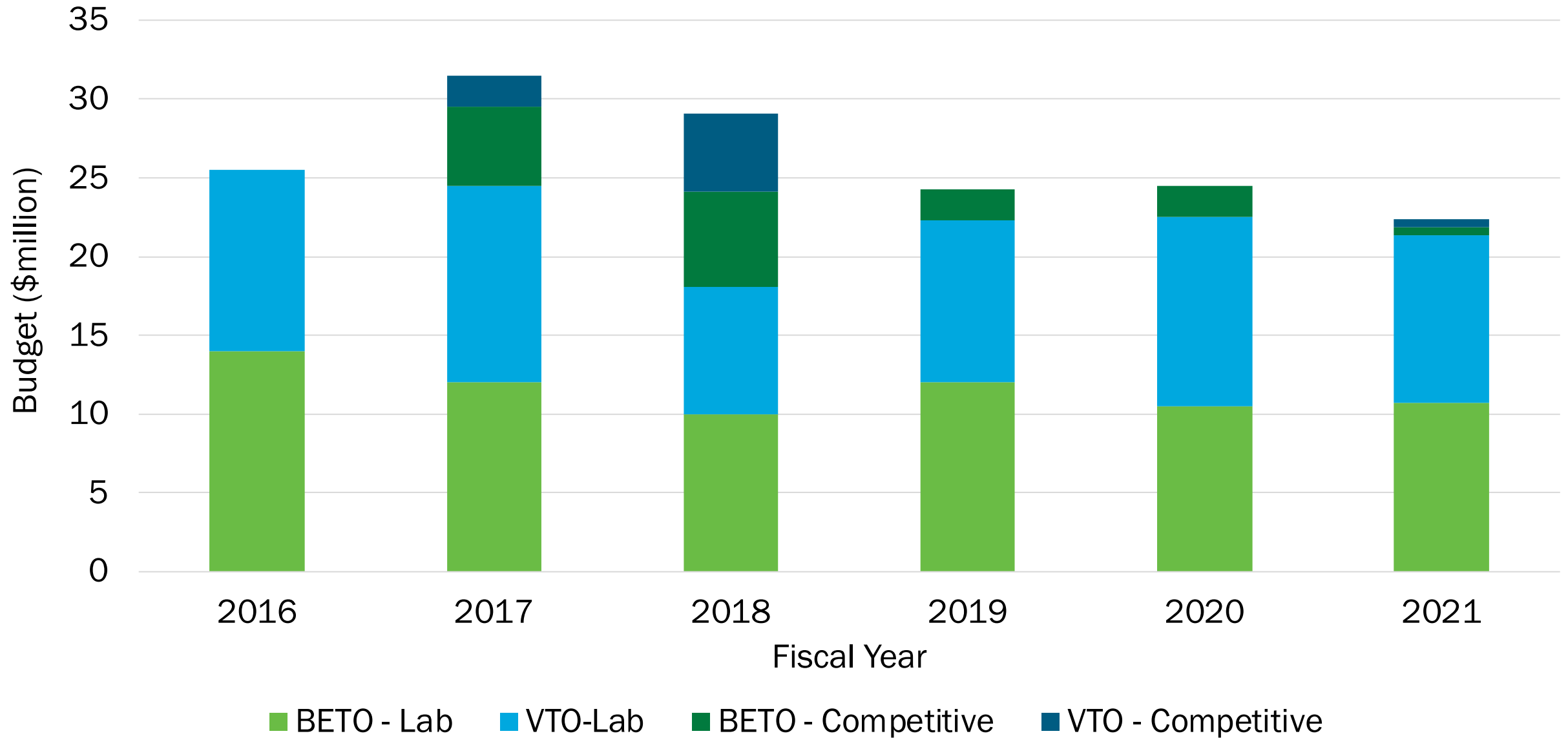
Medium- and Heavy-Duty

- Reduce engine-out criteria emissions
- Up to 4% fuel economy gain

Co-Optima Organization



Co-Optima Funding



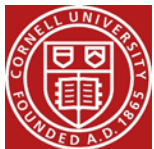
2016 FOA – University Partner Call

Objectives:

- Cost-effectively expand and improve analytical capability and test methodology available to the Co-Optima national lab project
- Tap into pool of expertise at institutions of higher education to improve understanding of fuel properties that can enable or enhance advanced combustion regime engine operation

Awardees:

- **Cornell University** with University of California-San Diego
- **Louisiana State University** with Texas A&M University and the University of Connecticut
- **Massachusetts Institute of Technology** and University of Central Florida
- **University of Alabama**
- **University of Central Florida**
- **University of Illinois-Chicago** with Oakland University
- **University of Michigan**
- **Yale University** with Penn State University



More Information: <https://cooptima.org/about/partners/>

2018 FOA: Bioblendstocks to Optimize MCCI Engines

Objectives:

- Develop and demonstrate single and multicomponent bioblendstocks for medium-duty/heavy-duty mixing-controlled compression ignition (MCCI) engines
- Bioblendstocks will improve at least two of 4 properties: energy density, sooting propensity, cetane number, and cold weather behavior.

Projects Awarded:

- **Auburn University**, Cornell University, University of Alabama, Microvi Biotech, and Virginia Tech: [Bioproduction and Evaluation of Renewable Butyl Acetate as a Desirable Bioblendstock for Diesel Fuel](#)
- **Colorado State University**, University of Colorado Boulder, and Yale University: [Poly\(oxymethylene\) Ethers \(POM-E\) as a High-Cetane, Low-Sooting Biofuel Blendstock for Use in MCCI Engines](#)
- **Stony Brook University** and RTI International: [Naphthenic Biofuel-Diesel Blend for Optimizing MCCI Combustion](#)
- **University of Massachusetts Lowell**, University of Maine, and Mainstream Engineering: [“Renewable Fuel Additives from Woody Biomass](#)
- **University of Michigan** and Penn State University: [Tailored Bioblendstocks with Low Environmental Impact to Optimize MCCI Engines](#)
- **University of Wisconsin-Madison**: [Mono-Ether and Alcohol Bioblendstocks to Reduce the Fuel Penalty of MCCI Engine Aftertreatment](#)



Colorado State University



Stony Brook University



University of
Massachusetts
Lowell



2020 and 2021 Co-Optima Directed Funding Opportunity (DFO)

Objectives:

- Solicit industry-led projects that leverage national laboratory capabilities to overcome key technical challenges.
- Address specific technical challenges that Co-Optima researchers can help address to move biofuels closer to market for advanced, high-efficiency engines.

DFO Details

- \$200K-\$300K per award
- 12-18 month duration
- 20% cost share required
- \$2M FY20, BETO
- \$1M FY21, BETO and VTO

DFO capabilities matrix

<https://cooptima.org/capabilities/>

7 Projects Selected in 2020

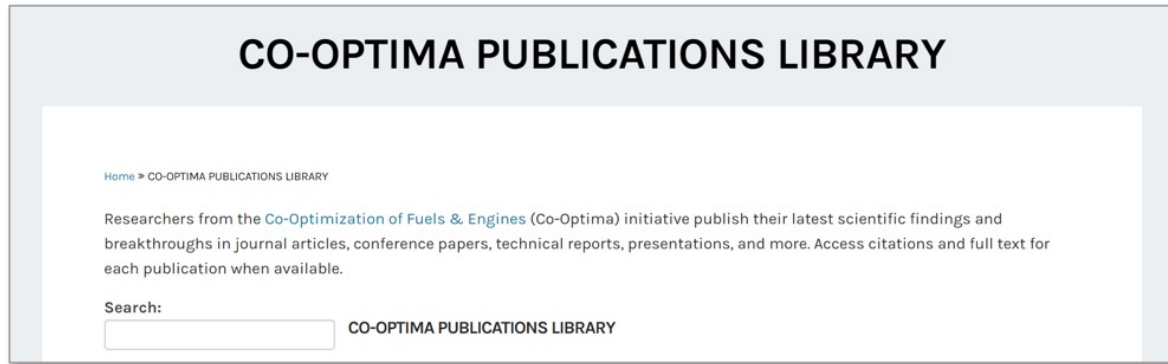
- CFR Engines with ANL
- ExxonMobil Research and Engineering Company with ANL
- General Motors with ORNL and NREL
- LanzaTech with PNNL
- Shell with NREL
- Sylvatex with ANL
- Visolis with PNNL

4 Projects Expected to be Awarded in 2021

More Information

Searchable Co-Optima Publications Library

<https://www.energy.gov/eere/bioenergy/co-optima-publications-library-0>



Co-Optima Capstone Webinar Series kicks off March 25, 2021

<https://www.energy.gov/eere/bioenergy/co-optima-capstone-webinars>

Co-Optima Year in Review

<https://www.energy.gov/eere/bioenergy/co-optima-publications-library-0>



Vehicle Technologies Office Annual Merit Review (AMR)

- The 2021 Vehicle Technologies Office AMR will be held **June 21-25, 2021**.
- The Co-Optima VTO portfolio will be presented on **June 24**.
- More information and registration links:
<https://www.energy.gov/eere/vehicles/vehicle-technologies-annual-merit-review>

Co-Optima Session Agenda - Day 1 of 2

Monday, March 15, 2021: National Laboratory Consortium

Start Time EST	End Time EST	Presentation	Organization	Presenter
12:15 PM	12:30 PM	Co-Optima Session Intro	BETO	Alicia Lindauer
12:30 PM	1:00 PM	Co-Optima Initiative Overview	Co-Optima Consortium	Daniel Gaspar
1:00 PM	1:30 PM	Structure-Property-Processing Relationships for Bioblendstock Identification	Co-Optima Consortium	Vanessa Dagle
1:30 PM	2:00 PM	High-Performance Bioblendstock Generation	Co-Optima Consortium	Derek Vardon
2:00 PM	2:15 PM	Break		
2:15 PM	2:45 PM	Techno-economic and Environmental Life-Cycle Assessment	Co-Optima Consortium	Troy Hawkins
2:45 PM	3:15 PM	Evaluating the Potential for Impact at Scale	Co-Optima Consortium	Avantika Singh
3:15 PM	4:00 PM	Reviewer Debrief		

Co-Optima Session Agenda- Day 2/2

Tuesday, March 16, 2021: FOA Projects

Start Time EST	End Time EST	Presentation	Organization	Presenter
12:25 PM	12:30 PM	Co-Optima Daily Intro	BETO	Alicia Lindauer
12:30 PM	1:00 PM	Naphthenic Biofuel-Diesel Blend for Optimizing Mixing Controlled Compression Ignition Combustion	SUNY-Stony Brook	Dimitris Assanis
1:00 PM	1:30 PM	Renewable Fuel Additives from Woody Biomass	University of Massachusetts Lowell	Hunter Mack
1:30 PM	2:00 PM	Tailored Bioblendstocks With Low Environmental Impact To Optimize MCCI Engines	University of Michigan	André Boehman
2:00 PM	2:15 PM	Break		
2:15 PM	2:45 PM	Mono-Ether and Alcohol Bioblendstocks to Reduce the Fuel Penalty of Mixing Controlled Compression Ignition Engine Aftertreatment	University of Wisconsin-Madison	Dave Rothamer
2:45 PM	3:15 PM	Poly(oxymethylene) Ethers as a High Cetane, Low Sooting Biofuel Blendstock for Use in Medium to Heavy Duty Mixing Controlled Compression Ignition Engines	Colorado State University	Bret Windom
3:15 PM	3:45 PM	Bioproduction and Evaluation of Renewable Butyl Acetate as a Desirable Bioblendstock for Diesel Fuel	Auburn University	Yi Wang
3:45 PM	4:30 PM	Reviewer Debrief		

Co-Optimization of Fuels and Engines (Co-Optima) Session – Day 2

Alicia Lindauer, Technology Manager

March 16, 2021



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2018 FOA: Bioblendstocks to Optimize MCCI engines

Objective: Develop and demonstrate single and multi-component bioblendstocks for MD/HD mixing controlled compression ignition (MCCI) engines

- Opportunity for lower-octane components; counterbalance increased high octane demand
- Multidisciplinary industry and/or university teams
- Bioblendstock to be blended into diesel fuel at a minimum of 5% by volume
- Excludes commercially-available blendstocks from conventional feedstocks– e.g., FAME biodiesel

Outcomes

- Improve at least 2 of the following properties of the finished fuel without significantly impairing others:
 - energy density
 - sooting propensity
 - cetane number
 - cold weather behavior (cloudpoint, pourpoint)
- Show route to large scale cost effectiveness

Chemical families identified in Tier 1 screening that can provide desired properties to optimize MCCI engines

