

Bioenergy Technologies Office

2017 Program Management Review

Bioenergy Technologies Office Response

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BETO Director

Arlington, Virginia

July 13, 2017

- I. Welcome and Thank you
- II. The Bioeconomy
- III. BETO Impact
- IV. Trajectory to Cost Competitiveness
- V. FY17 Budget Request
- VI. BETO Partners

Thank you again to the Steering Committee Members:

Peer Review Steering Committee

<i>Name</i>	<i>Affiliation</i>
Michael Lakeman*	Boeing
Steven Costa	U.S. Department of Transportation
Robert Graham	Ensyn
John May	Hamilton Clark
Shelie Miller	University of Michigan
Dawn Mullally	American Lung Association
Robert (Bob) Rummer	University of Kansas
Bob Wooley	Biomass <i>ad infinitum</i> , LLC.

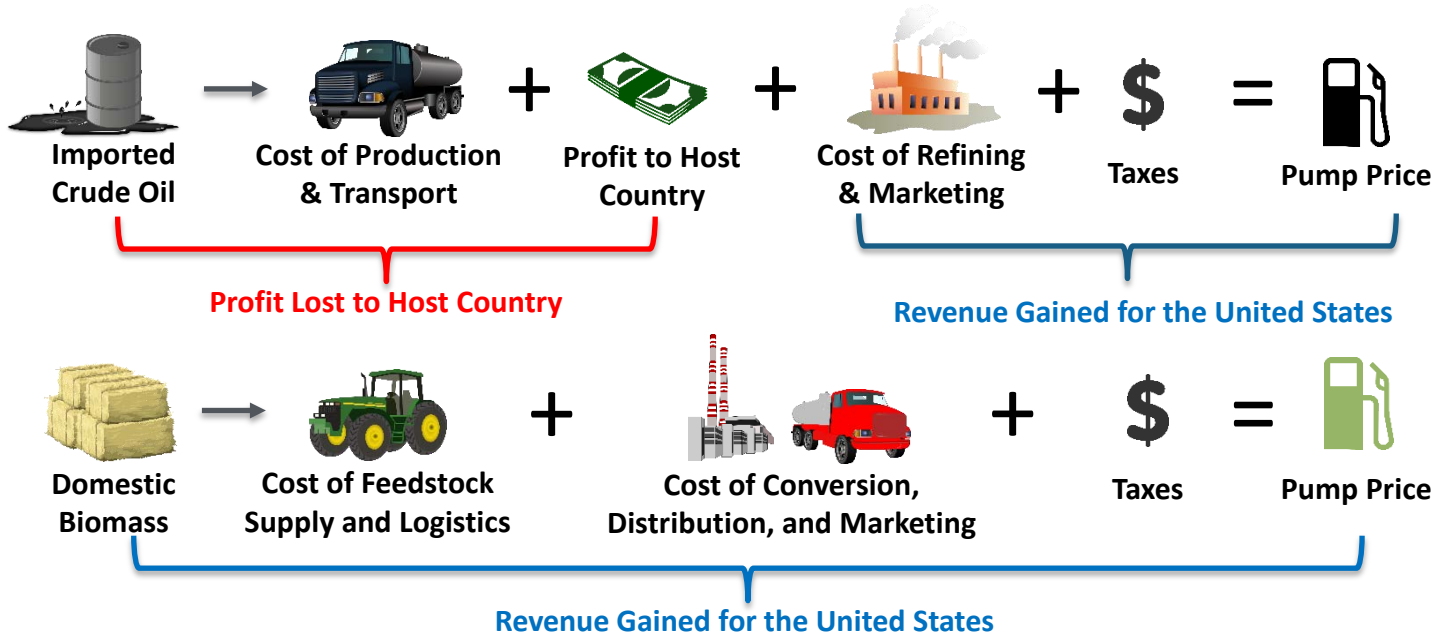
As well as the Lead Reviewers:

Peer Review Lead Reviewers

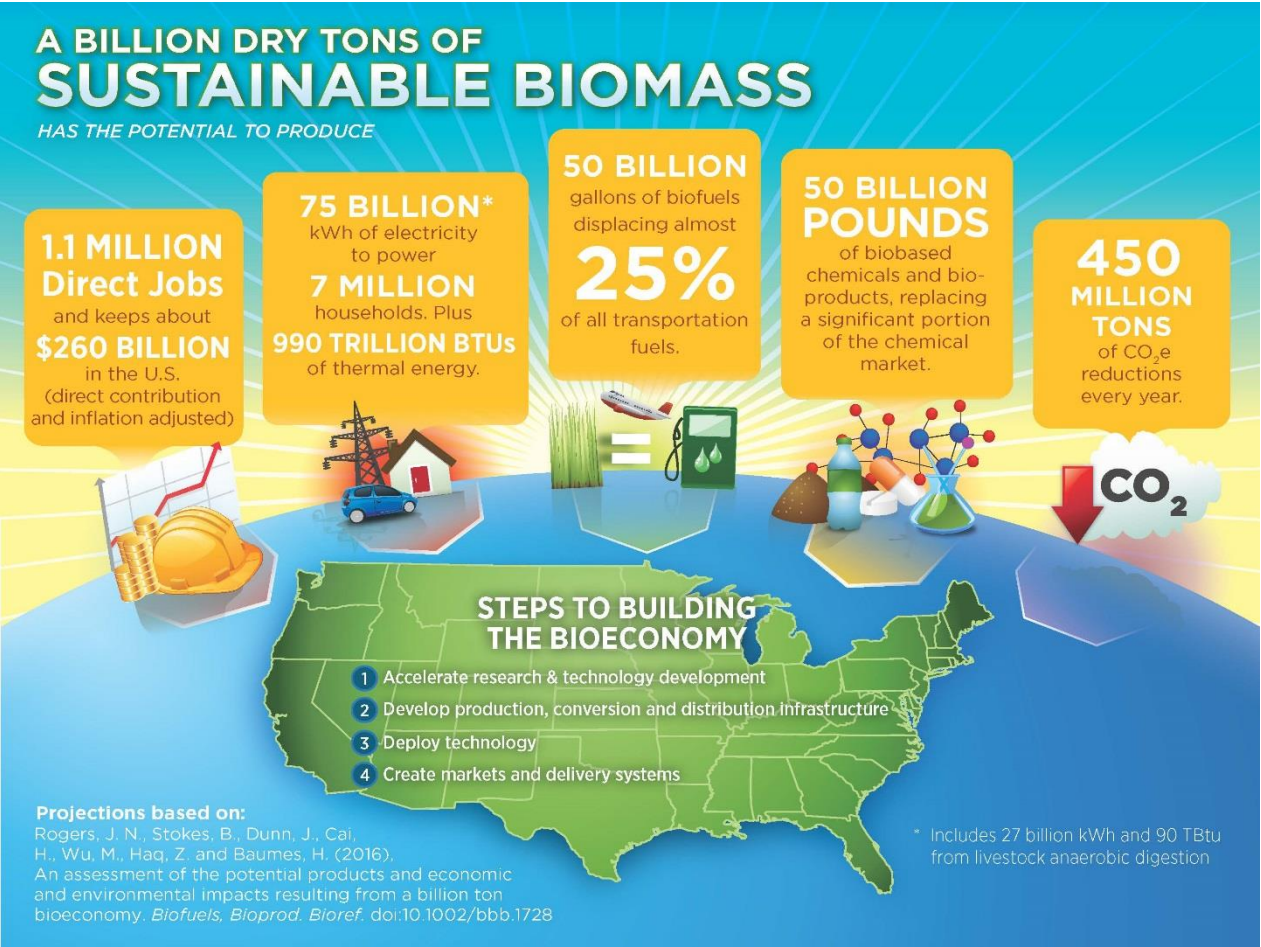
<i>Name</i>	<i>Affiliation</i>
Steve Searcy	Texas A&M University
Gerson Santos Leon	Abengoa
Eric Jarvis	Nexajoule
Candace Wheeler	General Motors (Retired)
Suzanne Lantz	DuPont
Shawn Freitas	Thermochem Recovery International
F. Michael McCurdy	Leidos
Luca Zullo	VerdeNero, LLC.

Benefits of a Robust Domestic Bioeconomy

- **Job Creation and Balance of Trade** – Displacing oil imports offers a massive opportunity for domestic jobs creation, with virtually no consequent job destruction
- **Energy Security** – Domestic production decreases vulnerability to short-term economic disruption due to war, civil unrest, OPEC action, speculation, etc
- **Environmental Benefits** – Sustainable biomass production can reduce harmful emissions versus petroleum-based fuels on a life-cycle basis



Fuel from domestic biomass versus imported crude oil helps grow the US economy



The **bioeconomy** is a global industrial transition of sustainably utilizing renewable aquatic and terrestrial biomass resources in energy, intermediate, and final products for economic, environmental, social, and national security benefits.

1 billion tons of biomass could be sustainably produced in the United States.

Since 2009 ...



Lab Patents

246



Lab Publications

916



Lab Licenses

32



Biofuel Production
3,837,918* Gallons
of Cellulosic Liquid
Biofuel

More than 285K jobs
from biofuels in 2014**



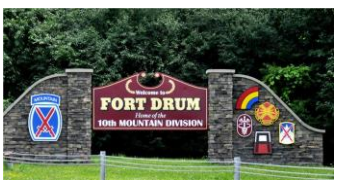
1.1 million potential
direct jobs by 2030**

* 2016 Renewable Fuel Standard Data
** Rogers et al. 2016, Ethanol-Economic-Impact-for-2015, & RFS-Premier-Energy-Program-2016

BETO Technology in the Market

BETO Technology in the Market | R&D + Industry Partnership | Impact

Self-propelled woody crop harvester



State University of New York
College of Environmental Science and Forestry



- Case New Holland commercialized their system, which doubled output while cutting costs by 33%
- Fort Drum Army base in NY is run by a 60-megawatt biomass power plant, partially fueled by woody biomass harvested with this technology



Coca-Cola PlantBottle



Fuel Blend Stock



- Virent produces bio-intermediates for fuels and products
- Tesoro acquired Virent and plans to scale-up
- Coca-Cola and Virent plan to produce 100% PlantBottles by 2020 (35 billion bottles)

BETO Technology Approaching the Market

BETO Technology Approaching the Market

R&D + Industry Partnership

Impact



- LanzaTech licensed microbial strains to produce alcohol
- Neat fuel meets alcohol-to-jet specs and 50% Jet A blend meets ASTM specs
- Demonstration fuel will be used in future flight test with Virgin Atlantic to support goal of adding to ASTM D7566, Annex 5



← Stabilized Pyrolysis Oil

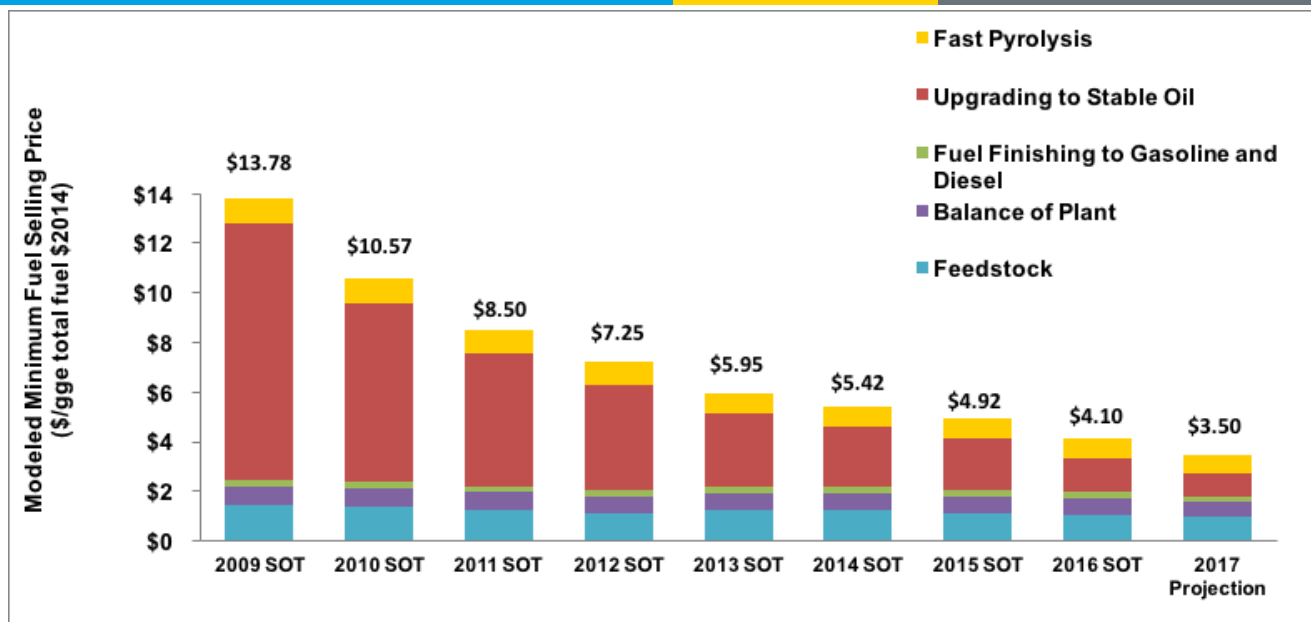
Petrobras Refinery



SOUTHWEST RESEARCH INSTITUTE®

- Ensyn produces renewable bio-oil to be co-processed with petroleum sources or to sell for heating
- Processing utilizes existing 6 million BBL/day US FCC capacity
- Co-processed diesel and gasoline were approved as EPA registered fuels and under LCFS by CARB

Trajectory to Cost-Competitive Gasoline & Diesel Blendstock Fuel



- Biomass derived liquid transportation fuels have the potential to be competitive—without subsidies—with their fossil derived equivalents
- The pathway presented here (the conversion of biomass into infrastructure-compatible hydrocarbon fuels via fast pyrolysis) represents a goal case targeting performance potentially available between now and 2017
- Based on this design case, a total potential cost reduction of 75% can be achieved between 2009 and 2017 with continued funding of R&D activities
- In FY17/18, BETO will initiate analysis on R&D needed to enable price competitive biofuels (\$2/gge)

BETO R&D plays a crucial role reducing the costs of biofuels without subsidies.

FY18 Budget Request

Program Area	FY 2016 Enacted*	FY 2017 Enacted*	FY 2018 Request*	FY 2018 House Marks*
Conversion Technologies	85,500	90,230	34,600	-
Advanced Development and Optimization (Formally DMT)	75,100	54,041	6,000	-
Analysis and Sustainability	11,000	10,729	5,000	-
Advanced Algal Systems	0	30,000	5,000	-
Feedstocks Supply and Logistics	46,500	20,000	6,000	27,000
NREL Site-Wide Facility Support	6,900	0	0	0
Total, Bioenergy Technologies	225,000	205,000	56,500	90,000

*Dollars in thousands

Bioenergy Technologies (\$56.6 million) Priorities:

- ***Advanced Algal Systems***: Multi-lab consortium to develop promising algae strains to improve algae strain productivity and yield
- ***Feedstocks and Supply Logistics***: Improve the quality and consistency of bioenergy feedstocks with a specific emphasis on Feedstock-Conversion Interface R&D to improve downstream conversion efficiency.
- ***Conversion***: Synthetic biology of engineered organisms and development of novel catalysts to improve yields and selectivity of renewable chemicals and drop-in biofuels
- ***Advanced Development and Optimization***: Co-Optimization of Fuels and Engines to develop bio-based fuels/additives that enable 15-20% fuel economy gain when blended with petroleum and used in high-efficiency engines
- ***Strategic Analysis and Sustainability***: Pathways to achieve target of \$2/gge; sustainability research into strategies for increasing bioenergy production without detriment to food security, air, land, and water

THANK YOU again to all the Lead Reviewers and Steering Committee, as well as AetherQuest and BCS staff.