U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

2021 PROJECT PEER REVIEW

U.S. DEPARTMENT OF ENERGY
BIOENERGY TECHNOLOGIES OFFICE

Valerie Reed

Acting Director

8 March 2021








- March 8, 2021

Outline

I. Welcome to BETO Peer Review

II. Overview of BETO Mission

III. BETO areas of activity

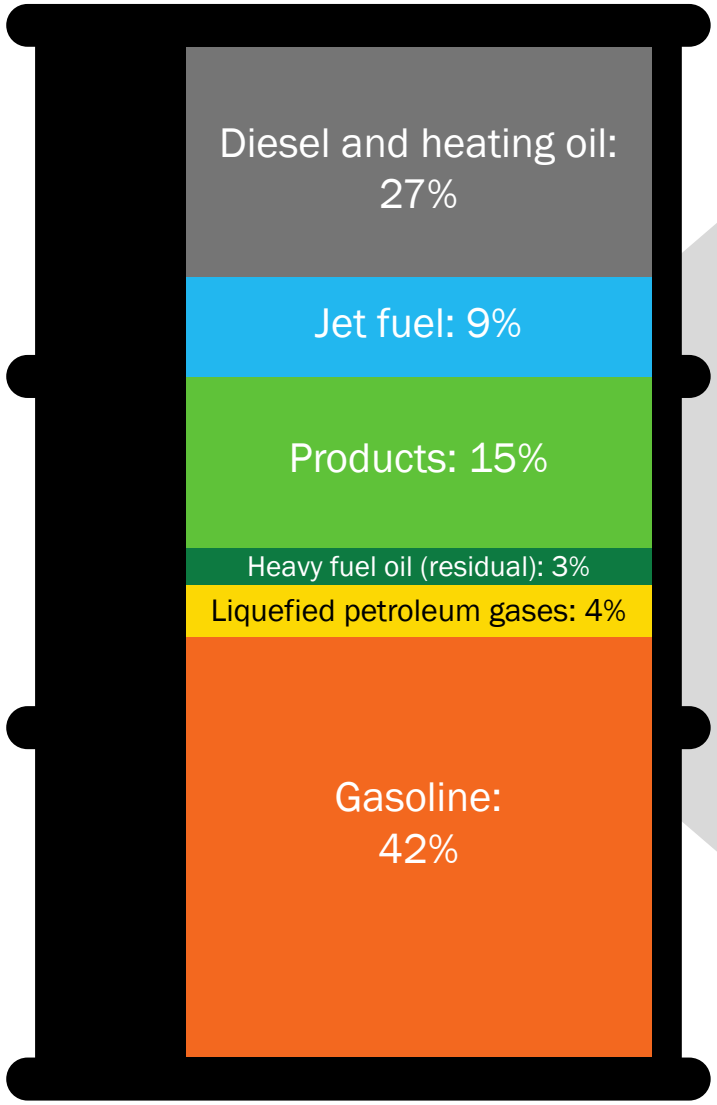
IV. Highlights

Welcome!

March 8–12, March 15–16, and March 22–26
Held Virtually for 2021

A special thanks to our Reviewers, Presenters, and Attendees!

Our Economy Is Built on Carbon



Photos by iStock

BETO Mission, Vision, and Strategic Goals

Vision

A thriving and sustainable bioeconomy fueled by innovative technologies

Mission

Developing transformative and revolutionary sustainable bioenergy and coproduct technologies for a prosperous nation

Strategic Goals

Develop industrially relevant technologies to enable domestically produced biofuels, biopower, and coproducts

BETO Critical Program Areas

Production and Harvesting

Feedstock Technologies

Lower cost, improve quality, and increase types of renewable carbon feedstock intermediates available for conversion.

Advanced Algal Systems

Increase algae productivity through algal strain improvement and efficient cultivation.

Conversion and Refining

Conversion Technologies

Reduce costs of deconstructing feedstock into intermediate products (such as sugars, intermediate chemicals, bio-oils, or gaseous mixtures)

Upgrading intermediates into liquid biofuels, bioproducts, and biopower

Distribution and End Use

Systems Development and Integration

Systems research to combine tech components, unit operations, or subsystems developed by R&D programs into integrated processes.

Integrated processes tested (pre-pilot to demo scale) to identify further R&D needs or verify readiness for scale-up and commercialization.

Crosscutting

Data, Modeling, and Analysis

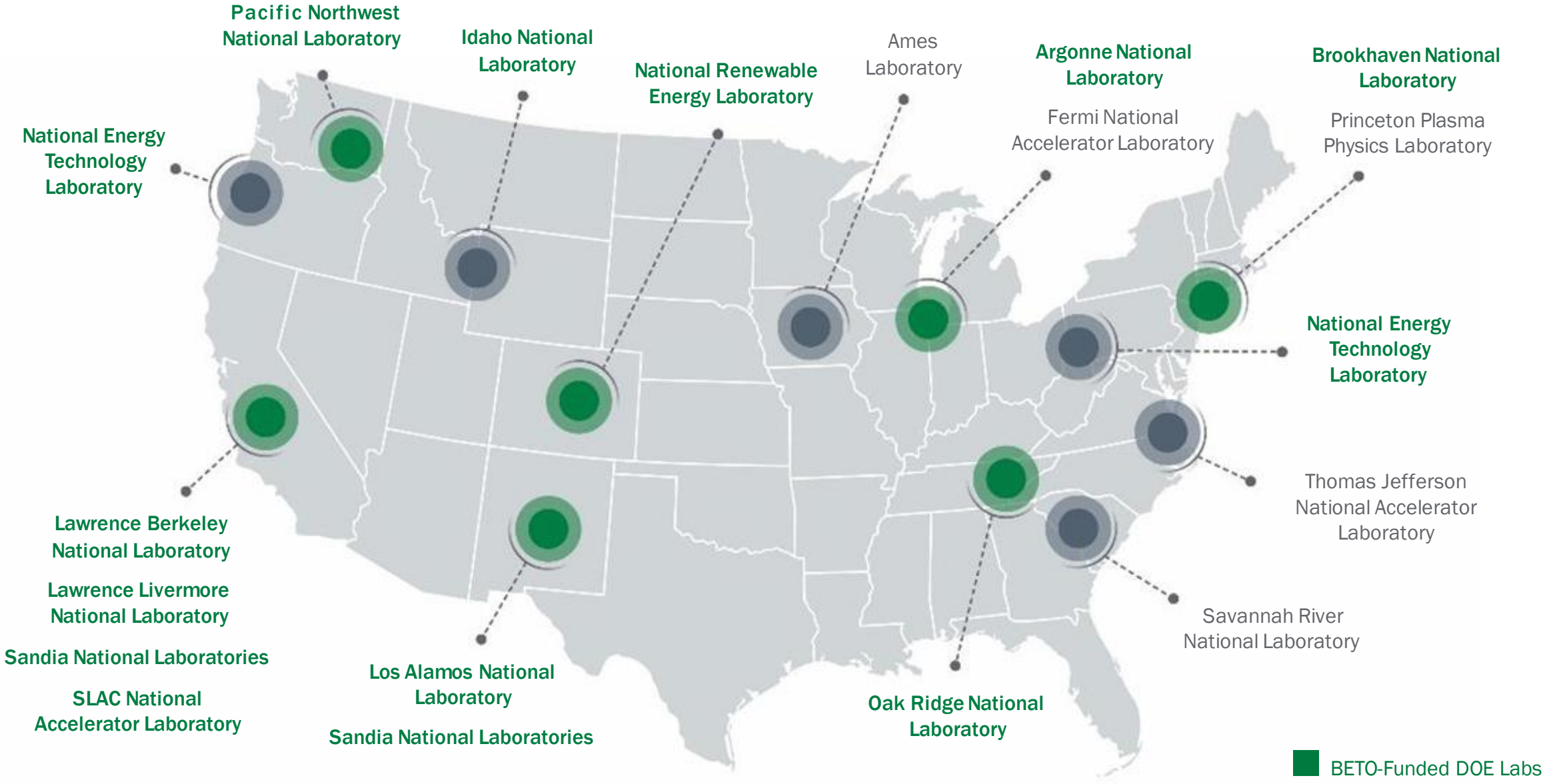
Track technology progress and identify opportunities and challenges related to economic/environmental impact of advanced bioenergy systems.

FY 2019-FY 2021 BETO Budget

Program Area	FY 2019*	FY 2020*	FY 2021*
Advanced Algal Systems (AAS)	32,000	40,000	40,000
Feedstock Supply and Logistics (FSL)	30,500	40,000	40,000
Conversion Technologies	96,000	110,000	110,000
Systems Development and Integration (SDI). Formerly Advanced Development and Optimization	57,500	60,000	55,500
Strategic Analysis and Sustainability	10,000	9,500	9,500
Total, Bioenergy Technologies	226,000	259,500	255,000

*Dollars in thousands

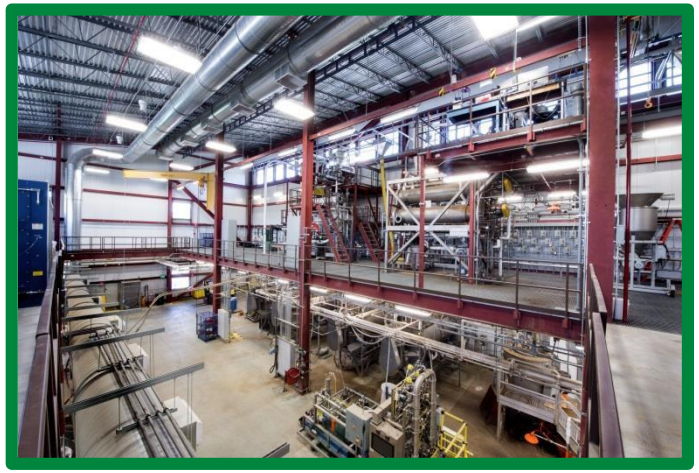
DOE National Laboratories



National Laboratories Process Development Units

Advanced Biofuels PDU
LBNL

Biomass Feedstock PDU
INL



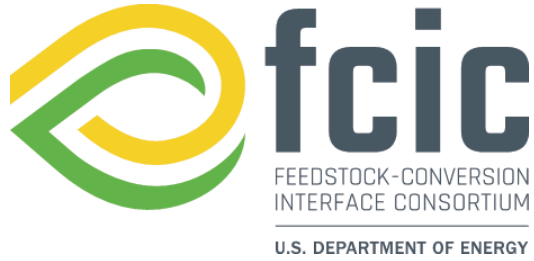
Integrated Biorefinery PDU
NREL

Coupled Pyrolyzer - DCR
NREL

Hydrothermal & Hydrotreating PDU
PNNL

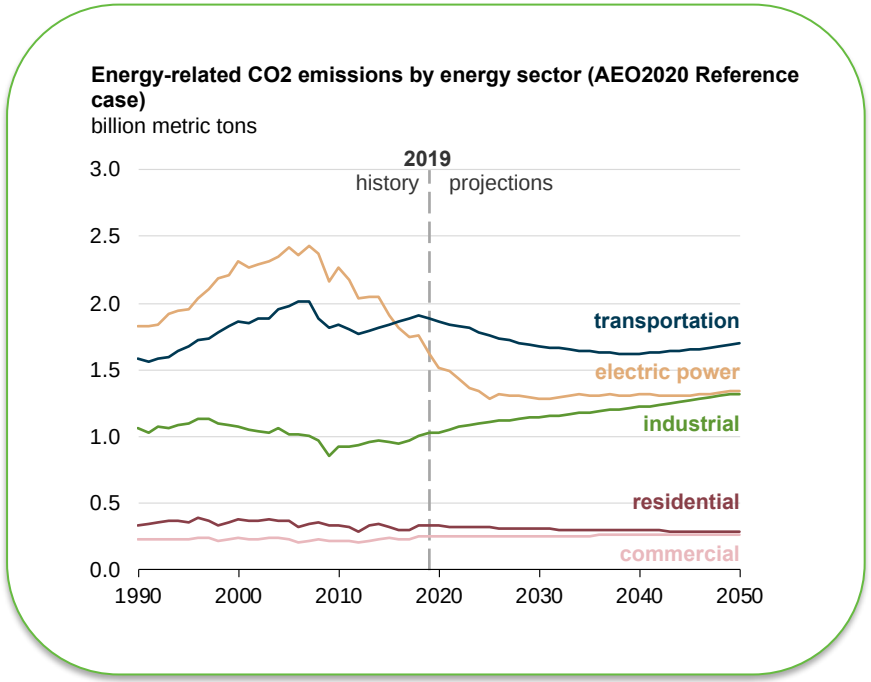
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

BETO Consortia: The Spirit of National Laboratory Collaboration



Bioenergy consortia overview: energy.gov/eere/bioenergy/bioenergy-consortia

From Challenge to Opportunity



THE CHALLENGE

More than $215 million is spent **every day** on foreign oil **imports ($43/barrel/day in 2016*)**. Dependence on **foreign oil** can leave us vulnerable to disruptions in supplies and contributes significantly to our trade deficit.

Transportation accounts for 67% of petroleum consumption.

*Annual Energy Outlook 2017 with projections to 2050
eia.gov/outlooks/aeo/pdf/0383(2017).pdf

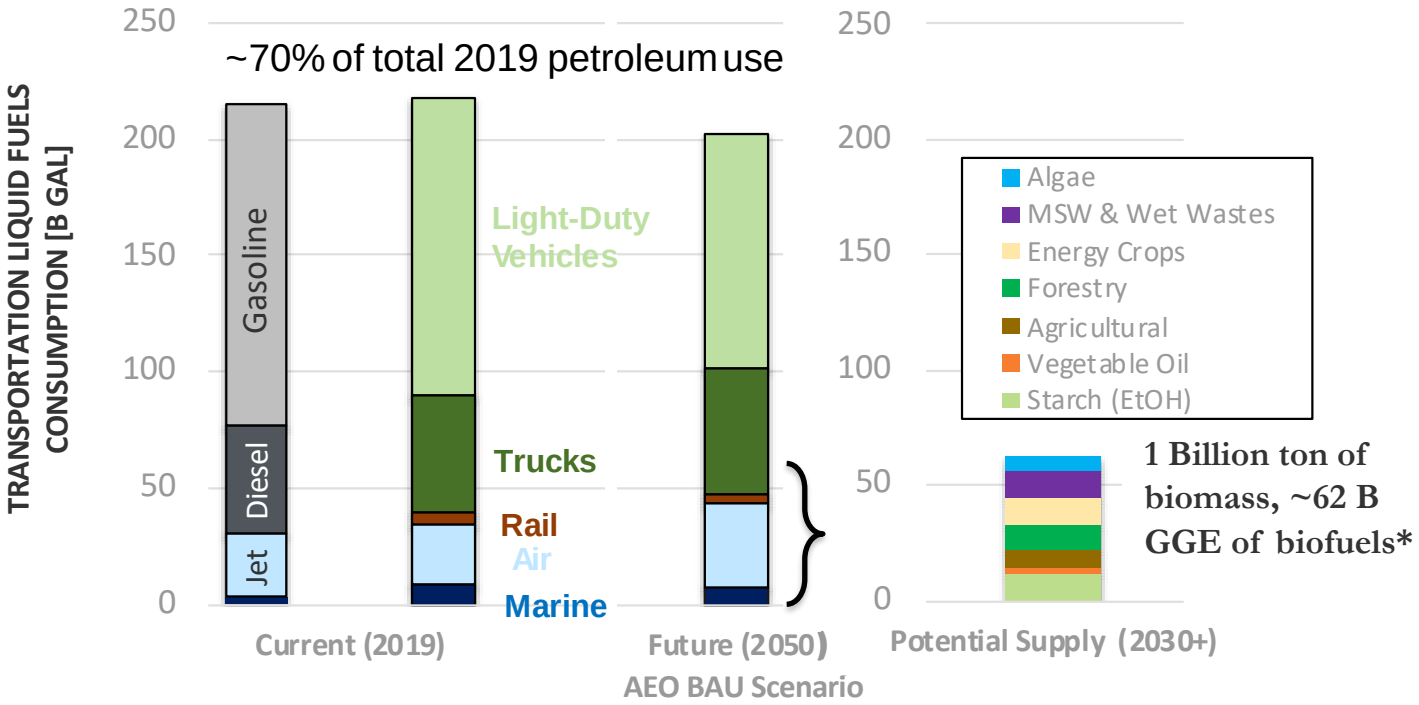
THE OPPORTUNITY

More than **1 billion tons of biomass** could be domestically converted into biofuels and products.

Biomass could displace up to **25%** of U.S. petroleum use annually by 2030, **keeping revenues in the United States**, adding **jobs,** and reducing annual CO_2 emissions**.

** Rogers et al. 2016, An assessment of the potential products and economic and environmental impacts resulting from a billion ton bioeconomy.
onlinelibrary.wiley.com/doi/10.1002/bbb.1728/full

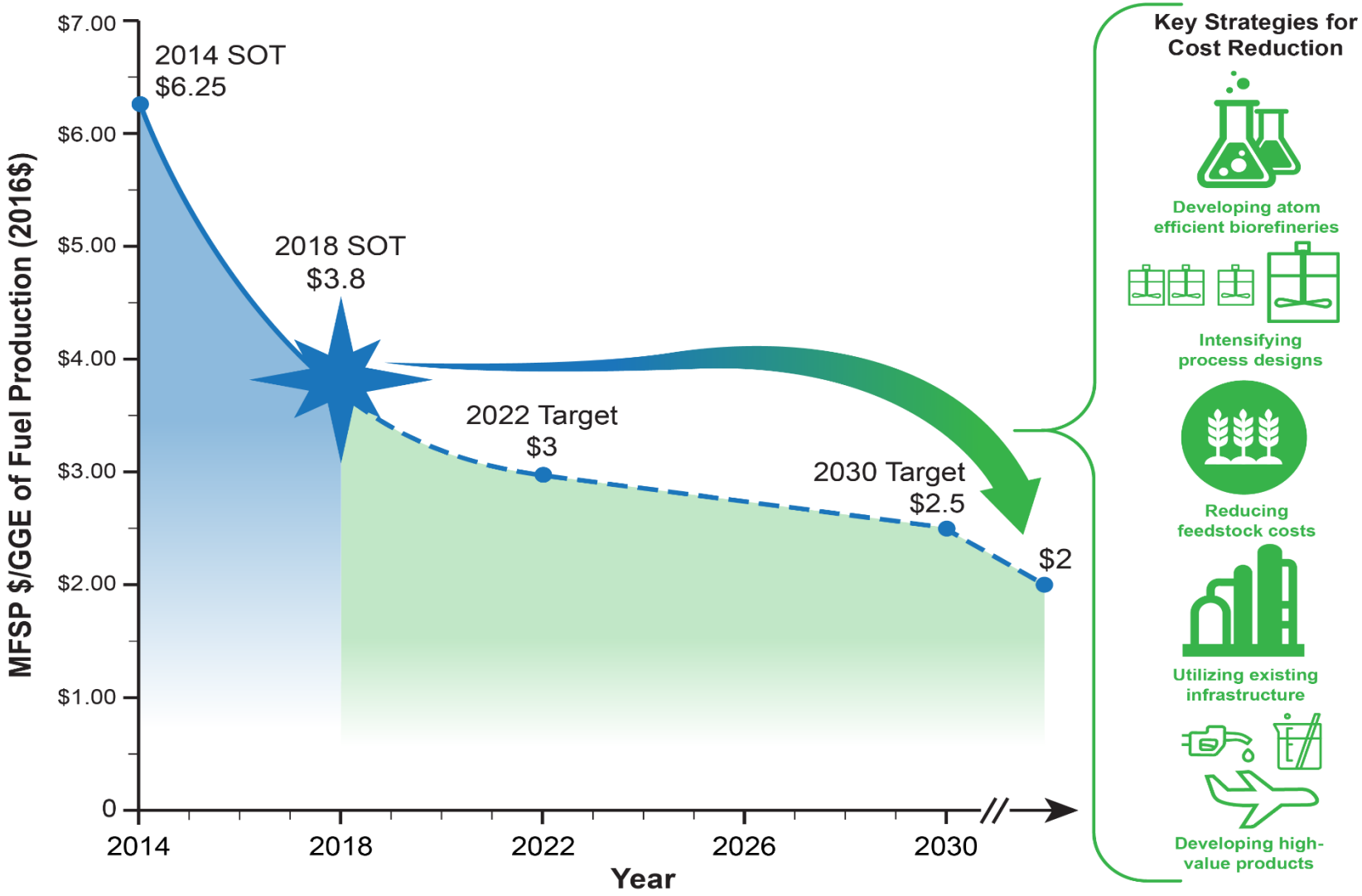
Total Available Biomass Key Consideration



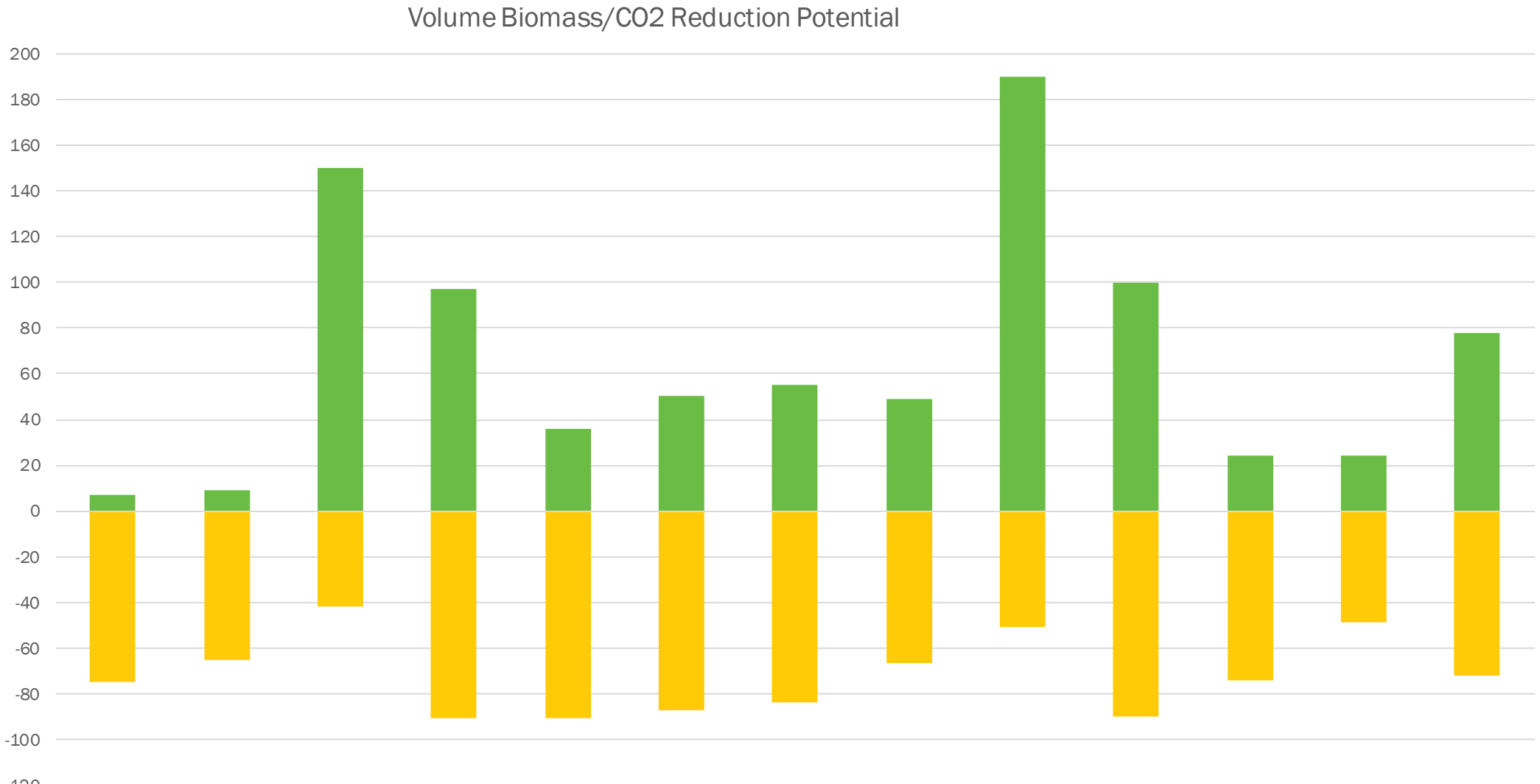
- Biomass can fully **supply future Aviation/ Maritime/Rail** (requires 75% of all feedstocks)
- Biggest market pull is in **sustainable aviation fuels** (SAF)
- DOE has **3 large scale SAF Demo projects (Fulcrum, Red Rocks, Lanzatech)**
- Provides market for **current ethanol** (~17B gal, ~40% of corn production)
- Supports decarbonization of chemicals via **bioproducts**, and decarbonization of agriculture through healthy forests and sustainable agriculture
- **CO_2-to-fuels** remains to be explored

Opportunities to Reach BETO Price Goals

BETO's goal for $2.50/Gasoline Gallon Equivalent (GGE) of a drop-in hydrocarbon biofuel by 2030

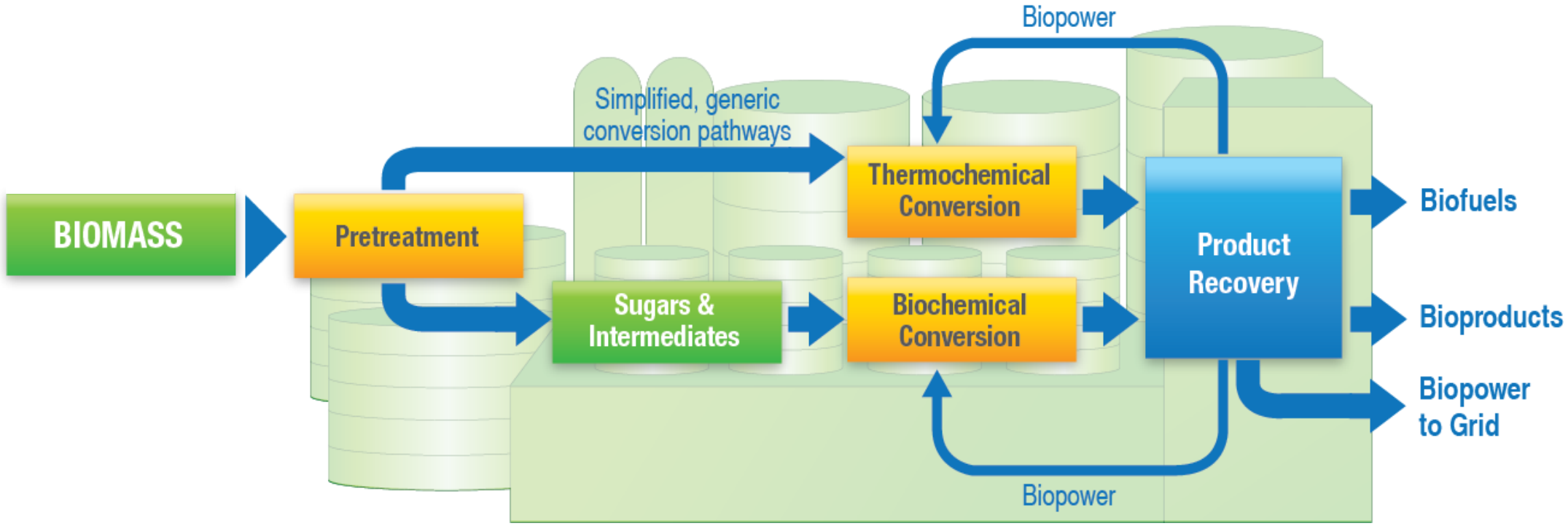


SAF CO2 Reduction Potential



	Fats Oils Grease	Seed Oils	Corn Grain	Forest Res	Wood Waste	Woody Energy Crops	MSW	Ag Residues/Isobutanol	Herbaceous Energy Crops	Ag Residues/Ethanol	Algae/ BDO	Algae/HTL	Wet Wastes
Quantity million dry tons/year	7	9	150	97	36	50	55	49	190	100	24	24	78
% GHG Reduction	-75	-65	-42	-91	-91	-87	-84	-67	-51	-90	-74	-49	-72

Feedstocks to Fuels, Bioenergy, and Bioproducts



Key Challenges			
Feedstock	**Pretreatment**	**Conversion**	**Product**
• Reliable supply • Consistent quality • Affordable delivery	• Biomass feeding, sizing and moisture • Solids handling • Material of construction	• Products yields • Material of construction • Catalysts • Fermentation organisms	• Separations • Catalytic upgrading • Recycle loops

Recent BETO Highlights

Conversion

NREL demonstrated:

- Recovery/valorization potential of a total of 81% of lignin
- Recovery of a solid lignin carbon stream and a dimers stream

Algae

- BETO improved summer algae productivity to 27.1 g/m^2/day in FY19, exceeding the FY19 target of 15.9 g/m^2/day by 70%

Co-Optimization of Fuels & Engines

- The Co-Optimization of Fuels & Engines initiative identified biofuel-derived blendstock candidates that offer environmental benefits and boost energy efficiency

- LanzaTech developed their Alcohol to Jet (ATJ) technology with Pacific Northwest National Laboratory
- Flew Virgin Atlantic's Boeing 747 aircraft from Orlando, FL to Gatwick Airport, United Kingdom with fuel blend made from industrial waste gases

Thank you!