U.S. DEPARTMENT OF
ENERGY

Office of
ENERGY EFFICIENCY &
RENEWABLE ENERGY

Biofuel Innovation: Clean Energy Solutions, Ready Today

To combat climate change, the United States intends to build a 100% clean energy economy and reach net-zero emissions by 2050. The United States can employ innovative biofuel solutions today to help drive the country toward a cleaner energy future.

Innovations in biofuels research are leveraged today in transportation technologies and infrastructure. The clean energy future is enabled by the U.S. Department of Energy (DOE) Bioenergy Technologies Office (BETO) investment of $255 million enacted in Fiscal Year 2021 for biofuels research and development (R&D). With over 300 active R&D projects, BETO initiatives encourage cost-competitive, efficient, and sustainably produced biofuels.

Biofuels can be blended with or completely replace a range of fossil fuels significantly reducing greenhouse gas (GHG) emissions over a 30-year time horizon. One example of this is fuels from energy crops which have significant potential to reduce GHG emissions relative to conventional fuels because feedstocks can be produced using marginal land.[1] These cleaner fuels can power transportation technologies in use today. Furthermore, the pipelines, fueling stations, and other infrastructure that support these technologies can work with biofuels allowing for an easier transition and immediate impact.

A National Renewable Energy Laboratory (NREL) researcher prepares samples in the Analytical Characterization Lab in the Integrated Biorefinery Research Facility (IBRF).
Photo courtesy of Dennis Schroeder, NREL 60925.

Biofuels Support Existing Vehicle Fleets

In the United States, cars and trucks use approximately 54.4 million gallons of diesel fuel annually.[2] A diesel car or truck purchased today will likely be on the road for the next 12 years.[3] Innovative biofuel R&D funded and supported by BETO can reduce life cycle GHG emissions for these existing diesel cars and trucks.

For example, DOE has funded the development and scale-up of T2C-Energy's TRIFTS® process that can take either landfill gas or biogas from an anaerobic digester and turn it into cost effective, carbon neutral/ negative renewable diesel. T2C-Energy is currently designing their 1,000,000 gasoline gallon equivalent/year demonstration facility which will utilize over 1,300 standard cubic feet per minute of landfill gas.

Sustainable Aviation Fuels Available Today

According to the International Energy Agency, the aviation sector will account for about 15% of global oil demand growth through 2030 and currently consumes more than 26 billion gallons of jet fuel annually.[4] Airlines make a significant investment every time they purchase a new plane, and the more than 7,500 aircraft currently in service will continue flying for decades. Couple this with the difficulty of electrifying long-range flights.

BETO, along with industry partners like LanzaTech and Virgin Airlines, are researching methods to foster biofuel use for aviation by helping lower cost and increase accessibility. BETO funds DOE national laboratories to conduct applied R&D to reduce cost and risk associated with innovative pathways to sustainable aviation fuels. Some of the R&D efforts include developing catalysts and biocatalysts and upgrading biomass-derived intermediates.

Lower Marine Emissions through Biofuels

Global marine fuel consumption is approximately 87 billion gallons of mostly heavy fuel oil and is expected to double in the next 20 years.[5] Although marine fuels account for just 7% of transportation fuel demand, it accounts for 90% of the transport sector sulfur oxide emissions.[6]

A Cleaner Future Now with Biofuels

Bioenergy is a critical part of a holistic approach to address a clean energy future with solutions that work today. Whether land, air, or marine transport, BETO supports research to enable U.S. industry to drive down costs for consumers, and lower emissions for everyone.

1 epa.gov/environmental-economics/economics-biofuels
2 go.usa.gov/xzekh
3 autonews.com/article/20161122/RETAIL05/161129973/average-age-of-vehicles-on-road-hits-11-6-years
4 eia.gov/state/seds/data.php?incfile=/state/seds/sep_fuel/html/fuel_jf.html&sid=US
5 nrel.gov/docs/fy19osti/74678.pdf
6 afpm.org/newsroom/blog/us-marine-fuel-makes-shipping-cleaner

BETO supports R&D into cost-competitive, efficient, and sustainably produced biofuels for the auto, airline, and shipping industries.
Photos courtesy of iStock (left to right) 1307086567, 499098808, and 591986620.

Along with lowering maritime GHG emissions, biofuels can eliminate sulfur oxide emissions, helping maritime shippers comply with IMO 2020, the rule limiting sulfur in ship fuel oil.[7] Previously, BETO commissioned a multi-laboratory effort to outline the opportunities and challenges associated with using biofuels on marine vessels. This effort resulted in BETO's *2019 R&D State of Technology* report and serves as a basis for BETO's efforts to address marine biofuel feasibility and define opportunities.[8]

Biofuels Support Existing Fuel Infrastructure

U.S. fueling infrastructure contains more than 100,000 vehicle gas stations that are served by well-established regional refineries, and fuel storage and distribution networks.[9] These systems have been in place for decades and have withstood times of crisis during natural disasters, trade disruptions, and even a global pandemic.

Biofuels are compatible with this massive fueling infrastructure. BETO endeavors to strengthen this infrastructure by working with industry to encourage co-location of bioenergy processing facilities and the reuse of equipment and utilities to lower upfront capital costs and reduce long-term operating costs.[10] Recent analysis suggests that refinery integration could lead to a $.50/gasoline gallon equivalent reduction in the cost of biofuel production.[11]

BETO has supported several collaborative projects between the national laboratories and industry to develop data to help close several gaps and risks associated with refinery integration. One of these projects involved NREL, Petrobras, and other partners to successfully co-process pine-based raw bio-oil with petroleum-based fuel to optimize feed options.[12] Concerning existing infrastructure and biofuels, DOE has provided a handbook for dispensing E85 and other ethanol-gasoline blends from existing gas stations.[13] ■

About the Bioenergy Technologies Office

BETO supports research, development, and demonstration to enable the sustainable use of domestic biomass and waste resources for the production of biofuels and bioproducts. BETO's overall goals are designed to:

- Lower costs and reduce technology risks for production of biofuels and bioproducts
- Improve environmental benefits of bioenergy production
- Reduce greenhouse gas emissions from the transportation, industrial, and agricultural sectors to address the climate crisis
- Support the scale-up of sustainable, low-carbon biofuel production technologies
- Create economic opportunities and good-paying jobs in agriculture and manufacturing sectors.

Meeting these goals requires significant and rapid advances in technology development and innovation across the entire biomass-to-bioenergy supply chain.

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BIOENERGY TECHNOLOGIES OFFICE

For more information, visit:
energy.gov/eere/bioenergy

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8 energy.gov/sites/prod/files/2020/07/f76/beto-2019-state-of-technology-july-2020-r1.pdf
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