Benefits of Biofuel Production and Use in California

California

California is the second-highest energy-consuming state in the nation and a leading promoter of energy efficiency and renewable energy. The Bioenergy Technologies Office (BETO) enables the development of novel technologies that can be used to establish California as a leader in the bioeconomy.

California is a leader in sustainable transportation, having required reductions in the carbon intensity of transportation fuels since 2011. Biofuels can play a key role in meeting state goals for reducing greenhouse gas emissions and foreign petroleum demand.

Economy

California's transportation sector consumed the equivalent of **$82 billion** worth of petroleum in 2013 (more than any other state)—51% of its crude oil supply came from foreign sources. Expanding the production of domestic biofuels can keep those dollars at home to stimulate economic development and add to California's **360,000+ jobs** in green goods and services.

Energy

Biofuels support California's use of **low-carbon** transportation fuel options—the state is home to almost half of the nation's plug-in electric vehicles.

Drop-in biofuels offer a potential non-petroleum transportation fuel option for current **commercial aviation infrastructure** and the U.S. **military**.

Environment

In 2011, petroleum use in California's transportation sector released **198 million metric tonnes** of carbon dioxide. On a life-cycle basis, advanced biofuels can **reduce greenhouse gas emissions by ≥ 50%** compared to petroleum—helping to reduce environmental impacts.

Feedstocks

California can use **cellulosic agricultural residues** to produce advanced biofuels and high-value products from its existing **nine million acres** of farmland without increasing water usage. **Algae** and **urban wastes** are among the other sustainable biomass resources suitable for use in California.

Strategic policies and investments help *bridge the gap* between promising research and large-scale production of advanced biofuels.

California's **Alternative and Renewable Fuel and Vehicle Technology Program** provides grants for innovative fuel and transportation technologies. Biofuels support state energy and climate goals.

Since 2005, the U.S. Department of Energy (DOE) has awarded more than **$408 million** to university, national laboratory, and industrial partners in California to research, develop, and deploy sustainable bio-based fuels and products.

In February 2015, **Kiverdi, Inc.** of Berkeley, California, was awarded up to **$2 million** to lead a project to genetically engineer bacteria for the production of drop-in biofuels from biomass-derived syngas.

California's three national laboratories play a key role in biofuels research.

Lawrence Berkeley National Laboratory (LBNL)

LBNL leads the Joint BioEnergy Institute (JBEI), a DOE research and development (R&D) consortium for advanced biofuels.

Advanced Biofuels Process Demonstration Unit for testing and developing emerging biofuels technologies in a process demonstration production environment.

Sandia National Laboratories (SNL) (Livermore, CA)

SNL is a key partner in JBEI, developing technologies to generate renewable biofuels from algae and sustainable non-food sources, such as municipal solid waste.

SNL has a world-leading combustion research facility equipped with next-generation diagnostics and computational tools.

Lawrence Livermore National Laboratory (LLNL)

LLNL contributes to JBEI as well as other advanced bioengineering research to produce biofuels more efficiently.

For more information, visit: bioenergy.energy.gov
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U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

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DOE has supported **research and development at universities**. This research improves the productivity of bioenergy feedstocks and maximizes the benefits of biofuels and bioproducts while minimizing negative impacts. DOE seeks to promote promising biofuel and biotechnologies research with the greatest chance of impact on commercial biofuel and bioproducts production.

BETO Office Projects in California

Operated by:	Amyris	California Polytechnic State University	Solazyme	University of California, Riverside	University of California, Riverside	Vertimass
Location:	NABC* facilities	Delhi wastewater treatment plant	San Francisco	Riverside	Riverside	Irvine
Stage:	R&D, multiple stages	R&D	Pilot	R&D	R&D	R&D
Primary product:	Biodiesel	Biodiesel precursors	Renewable oils (fuel, food, and products)	Efficiency feedback software	Pretreatment for clean fuel precursors	Blend-stock for jet fuel, biodiesel, and gasoline
Feedstock:	Multiple	Algae	Algae	N/A	N/A	Ethanol

* National Advanced Biofuels Consortium

Why California?

Robust agricultural industry can provide plentiful, locally sourced cellulosic feedstocks.

State policies recognize the social, economic, and environmental benefits of biofuels.

Developing in-state resources reduces dependence on imported petroleum products.

Bio-based jet fuel reduces the high petroleum dependence of the state's airports and military bases.

Existing non-cellulosic ethanol facilities can be upgraded to utilize non-food-based feedstocks and contribute to advanced biofuels production.*

* California ranks 14th (168 million gallons/year) among 25 ethanol producing states in the U.S.

For more information on the economic and national security benefits of biofuels for California, visit:
eia.gov/state/analysis.cfm?sid=CA
acore.org/files/pdfs/states/California.pdf (based on 2011 survey by the Bureau of Labor Statistics)
navy.mil/submit/display.asp?story_id=83417
For more information on the environmental benefits and diversity of Californian biomass resources, visit:
eia.gov/environment/emissions/state/state_emissions.cfm
eere.energy.gov/bioenergy/pdfs/billion_ton_update.pdf, maps.nrel.gov/biofuels-atlas
epa.gov/otaq/fuels/renewablefuels/documents/420f12078.pdf

For more information on Californian clean energy initiatives and DOE partnerships, visit:
energy.ca.gov/drive/
energy.gov/eere/bioenergy/past-solicitations
energy.gov/eere/bioenergy/articles/energy-department-announces-10-million-develop-innovative-bioenergy
For more information on biofuels research at California's national laboratories, visit:
genomicscience.energy.gov/centers/jbei.shtml
sandia.gov/research/research_foundations/bioscience/biofuels.html
llnl.gov/news/lawrence-livermore-scientists-discover-bacterial-resistance-improve-biofuel-production
U.S. ethanol production: eia.gov/state/seds/sep_prod/pdf/P4.pdf, eia.gov/petroleum/ethanolcapacity/