



# Biofuels production and development in the United States

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Publications

*Feature article in IEA Bioenergy Task 39 Newsletter Issue #65, by Neha Shakelly, Oscar Rosales Calderon, Sharon Smolinski and Ling Tao – National Renewable Energy Laboratory (NREL).*

The article provides an overview of the state of biofuels in the U.S., policy and regulations, technology advancements, and environmental and social impacts.

**[Download the full article “Biofuels production and development in the United States”.](#)**

Below some of the highlights of the article.

- By utilizing renewable organic materials, biofuels can substantially lower the carbon footprint of the transportation sector, contributing significantly to mitigating climate change. Strategically, biofuels offer several benefits, including enhanced energy security and reduced geopolitical risks. By diversifying the sources of transportation fuels and reducing reliance on imported oil, the U.S. can strengthen its energy independence and resilience to supply disruptions and price fluctuations in the global oil market. Transitioning to biofuels can create new employment opportunities, particularly in rural areas where biofuel feedstocks are cultivated and processed, thereby fostering economic development and revitalizing rural communities. Moreover, biofuel production creates an extra market for farmers to sell agricultural commodities and biomass feedstocks, providing them with additional revenue sources and income stability.
- The U.S.' biofuel production capacity rose to 23.8 billion gallons per year (BGPY) in 2023, a growth of over 1.7 billion gallons compared to 2022. **Ethanol** production has reached 17.8 BGPY since 2023, while **biodiesel** production capacity stands at 2.1 BGPY and **renewable diesel** capacity is now 3.9 BGPY. The main investment wave for ethanol and biodiesel happened between 2005 and 2012. New investments focus more on renewable diesel (and other related biofuels), of which the production capacity in U.S. has significantly increased in the last three years, surpassing the biodiesel production capacity in 2022.

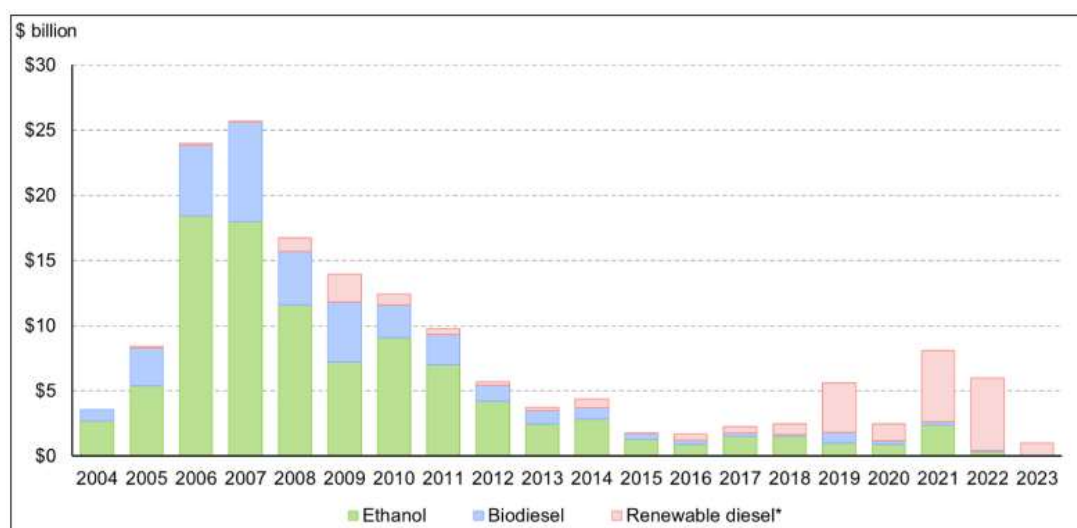


Figure3: Global investment in biofuels sector.

\*Renewable diesel includes production of co-products like sustainable aviation fuels, naphtha and renewable natural gas.

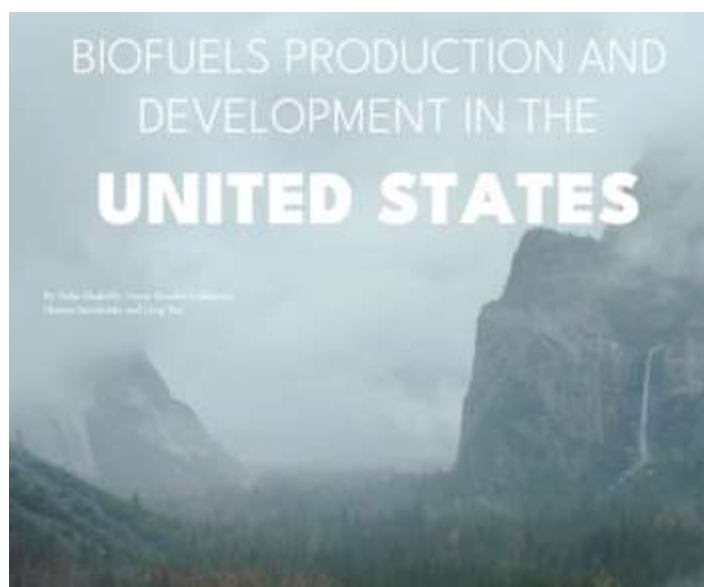
- **Sustainable aviation fuels (SAF):** As a consequence of support policies, such as the “SAF Grand Challenge”, and the steadfast commitment of private industries to reduce

their greenhouse gas (GHG) emissions, the utilization of SAF in the U.S. is on the rise. The targets are to expand current domestic SAF production to 3 BGPY by 2030, and then to 35 BGPY by 2050, while achieving life cycle GHG reduction of at least 50% relative to fossil Jet A.

- Multiple pathways for producing SAF have been approved by ASTM International. The hydroprocessed esters and fatty acids (HEFA) pathway is the most immediately accessible and the major commercially deployed method to produce SAF and RD. At the end of 2023, the total operational capacity of renewable fuel facilities using the HEFA technology in the U.S. was estimated in 3.9 BGPY. While most of these facilities focus on the production of RD, several RD facilities in operation can potentially be upgraded to produce SAF.
- The total announced total capacity for SAF production, including announced HEFA, alcohol-to-jet, Fischer-Tropsch, and power-to-liquid facilities, is expected to reach 2.0 BGPY by 2030, with the majority announced from HEFA.
- The U.S. EPA's RFS Program, first established in 2005, has been one of the main drivers for biofuels developments. It sets volumetric targets for biofuels which are regularly updated. This program supports multiple categories of biofuels, including cellulosic biofuel, biomass-based diesel, advanced biofuel, and renewable fuel, and establishes requirements for minimum lifecycle GHG emission reductions, as well as feedstocks and pathways. Renewable Identification Numbers (RINs) are generated by biofuel producers and traded in the market, tracking compliance with the program. These standards have contributed substantially to supporting the biofuels market in the states. The adoption of state-level clean fuel standards and SAF-specific tax credits remains limited but is increasing. California introduced the first state-level Low Carbon Fuel Standard (LCFS), which sets a threshold for transportation fuels' carbon intensity (CI) and gradually increases the required reductions. Deficits occur when fuels surpass the CI threshold, while credits are generated by fuels that meet the allowable CI limit.
- Feedstock Diversification: In the U.S., biofuel production currently uses a variety of feedstocks. Corn serves as the primary feedstock for ethanol production, creating E10, E15 and E85. Soybeans play a significant role as a feedstock for biodiesel production as B20 and B100. Research efforts are being made to expand the range of feedstocks used for biofuel production. This is important for making biofuels more sustainable and scalable. One area of exploration focuses on non-food biomass sources, like agricultural and forestry residues, dedicated energy crops, and municipal solid waste. This helps address concerns about food security and land use change in biofuel production.
- Looking forward:
  - Key aspects of U.S. policies supportive of biofuels include the increased adoption of state policies, the ability to combine federal and state tax credits, and the use of

performance-based incentives. Performance-based incentives are becoming common in U.S. policies. The adoption of performance-based incentives incentivizes the production and utilization of fuels with lower emissions, while also fostering innovation in feedstocks, pathways, and technologies to achieve even greater improvements in emissions reductions.

- The U.S. should prioritize certain areas of investment in biofuel research, development, and infrastructure to maximize the impact and sustainability of bioenergy technologies. These areas include advancements in feedstock development and utilization, focusing on high-yielding and sustainable options, as well as exploring innovative approaches for utilizing waste and non-food biomass resources. Improving conversion technologies and process efficiencies is also crucial for cost-effective and energy-efficient biofuel production. Finally, investment in infrastructure is critical to support the scaling up and commercialization of biofuel technologies, including expanding production facilities, upgrading distribution networks, and increasing the availability of biofuel refueling stations.



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