

HOW SUSTAINABLE ARE BIOFUELS?

Estimated read time:







KEY TAKEAWAYS

Under the right circumstances, biofuels can be considered a carbon neutral energy source.

Biofuels are produced from bio-matter, which has implications for their renewability and sustainability.

In the Caribbean region, there is potential for production and use of these fuels.

For over a century, fossil fuels have played a crucial role in fueling the economic, industrial and societal development across the globe. However, given the challenges of climate change, linked in part to the burning of fossil fuels,

diversifying the global energy mix to include cleaner alternatives such as renewables and nuclear energy has gained widespread acceptance as the way forward to limit global temperature increase to 1.5°C in accordance with the Paris Climate

agreement. Energy sources such as solar and wind provide a pathway to green energy and are rapidly increasing in scale and application. However, biofuels, another potential source of renewable energy, are often overlooked in the green energy discussion.

WHAT ARE BIOFUELS AND HOW ARE THEY PRODUCED?

Biofuels refer to "liquid, solid, or gaseous fuel produced by conversion of biomass such as bioethanol from sugar cane or corn, charcoal or woodchips, and biogas from anaerobic decomposition of wastes."¹ To produce the fuel, the feedstock is fermented or processed through chemical reactions to extract natural oils. Biofuels are categorised into generations based on the bio-matter used in the production process.

- First generation biofuels are made from sugar crops, starch crops, oilseed crops and animal fats.
- Second generation biofuels, or cellulosic biofuels are made from cellulose, which is available from non-food crops and waste biomass such as corn stover, corncobs, straw, wood and wood byproducts.
- Third generation biofuels use algae as a feedstock.



¹<https://www.sciencedirect.com/science/article/abs/pii/B9780128212646000005>

TYPE OF BIOFUELS	USE/APPLICATION
Ethanol	Transportation fuel that can mix with gasoline, example: E10 which is 10% ethanol and 90% gasoline or E15 which is 15% ethanol and 85% gasoline.
Biodiesel	Transportation fuel that can mix with petroleum or be used as pure biodiesel, example: 100% biodiesel or B20 which is 20% biodiesel and 80% petroleum.
Biomethane	Heating systems and electricity generation.
<i>National Geographic: Biofuels, from ethanol to biodiesel, facts and information (nationalgeographic.com)</i> <i>Office of Energy Efficiency and Renewable Energy: Biofuel Basics Department of Energy</i>	

Commonly known biofuels include ethanol and biodiesel which are mainly used in transportation. Each of the three generations of biofuels is produced from bio-matter, which has implications for the renewability and sustainability of biofuels as an energy source.

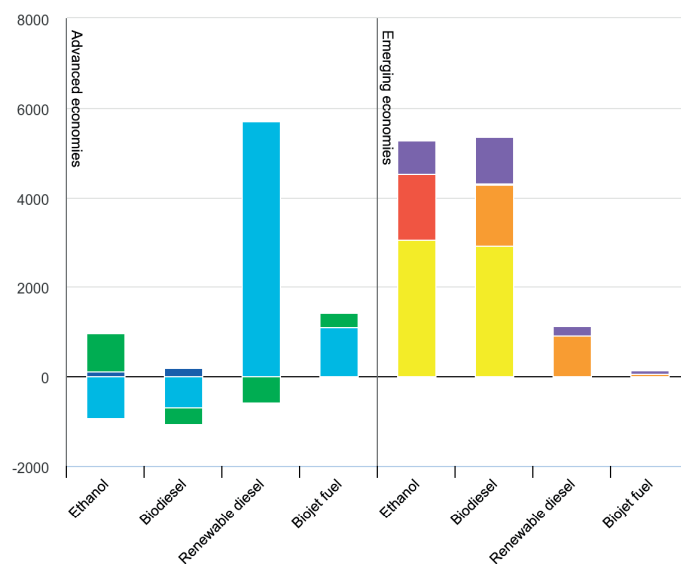
HOW SUSTAINABLE ARE BIOFUELS – THE PROS AND CONS

Biofuels are most widely used as transportation fuel, but are also used for heating systems and electricity generation. Globally, there have been varying levels of demand growth for this fuel. Statistics of biofuel production and consumption have shown that in 2021, about 17.5 billion gallons of biofuels were produced in the United States and about 16.8 billion gallons were consumed.²

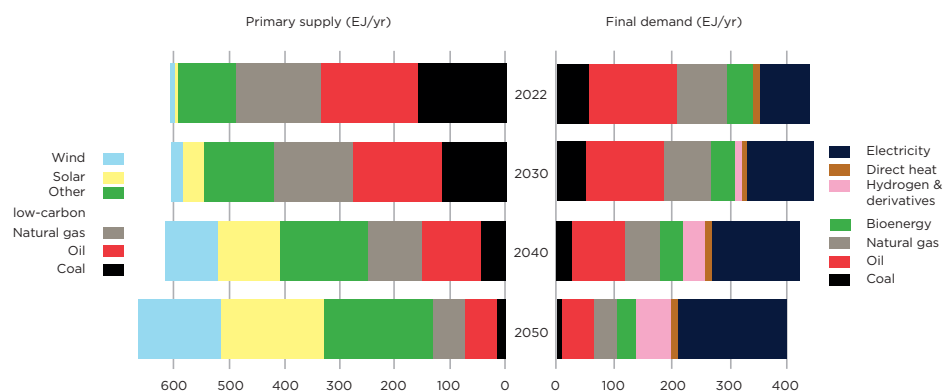
As of 2022, countries such as Brazil and Indonesia produced 254.02 TWh (terawatt-hours) and 108.22 TWh of biofuels, respectively.³

Moreover, since biofuels are derived from agriculture, the use of fossil fuels in the production stages is limited, resulting in lower greenhouse gas emissions. In fact, under the right circumstances, biofuels can be considered a carbon neutral energy source.

This means that “when done properly, they prevent the one-way release of carbon that is currently sequestered in fossil fuels.”⁴



IEA - Biofuel demand growth by fuel and region, 2022-2024



DNV - World Primary Energy Supply and Final Energy Demand

²www.eia.gov/energyexplained/biofuels/

³<https://ourworldindata.org/renewable-energy>

⁴<https://enpowered.com/are-biofuels-really-sustainable/>

ON THE GREEN AGENDA

THAT SAID, THERE ARE TRADEOFFS ASSOCIATED WITH USING AGRICULTURAL CROPS SUCH AS SUGAR CANE AND CORN AS FEEDSTOCK FOR ENERGY PRODUCTION:

Biomass sources may compete with food supply (feedstock barrier)



The production of biofuels is still expensive (financial barrier)

New technology or improvements in technologies for certain biofuels are still needed (technology barrier)

The production of a specific biofuel requires new or modified infrastructure (infrastructure barrier)

Existing laws and regulations are immature for biofuels (law and regulation barrier)



Existing storage and transportation systems are inappropriate for biofuels (storage and transportation barrier)

There is a lack of political will to promote biofuel market development (political barrier)

No quality standards exist for some biofuels (trade barrier)



There is a lack of knowledge on biofuels (knowledge barrier)⁵

To produce biofuels economically, significant land is needed. Preparing large parcels of land for crop production necessarily involves deforestation. Deforestation and change in land use contribute to increasing GHG emissions, soil degradation and spinoff impacts such as water stress, erosion and flooding.

When coupled with inefficient use of the land in the form of monocropping - the continuous growth of a singular crop on the same parcel of land - problems multiply. This agricultural technique has a series of drawbacks when it is used continuously. These include biodiversity loss due to the lack of crop variety, soil degradation, and food security concerns.

Most notably, growing crops for biofuel production requires the conversion of agricultural land that could otherwise be used for food production.

This poses a threat to food security and has associated socioeconomic impacts.

GIVEN THE ABOVE, TO PRODUCE BIOFUELS SUSTAINABLY, MODERN ADVANCEMENTS IN AGRICULTURAL TECHNIQUES WILL BE NEEDED.

One such technique is climate smart agriculture, which refers to the set of agricultural practices and techniques which simultaneously boost productivity, enhance resilience, and reduce GHG emissions.

BIOFUELS IN THE CARIBBEAN

In the Caribbean region, there is potential for production and use of biofuels. According to the International Renewable Energy Agency (IRENA) Sustainable

Bioenergy Potential in Caribbean Small Island Developing States, "Among all the crops with bioenergy potential, adoption was highest for sugarcane and palm, since they adapted well to soil and climate conditions in the region."⁶

There are, however, other viable options. In Haiti, the abundant *Jatropha* plant can offer a solution to the country's long history of energy shortages. If sustainably produced, oil from the *Jatropha* plant seeds can be used as a biofuel for electricity generation and in transportation. Meanwhile in Barbados, byproducts from rum distilleries and sargassum seaweed are being converted to biofuel.⁷

All things considered, biofuels can be a viable energy source, but sustainable agricultural practices and supportive policies will be needed if they are to become a staple in the global energy mix. ■

⁵<https://www.sciencedirect.com/science/article/abs/pii/B978012821264600005X>

⁶<https://www.irena.org/Publications/2024/Feb/Sustainable-bioenergy-potential-in-Caribbean-small-island-developing-states>

⁷<https://www.unsdn.org/rum-sargassum-biofuels-in-barbados>