

BIOFUELS AND THEIR IMPORTANCE FOR THE BRAZILIAN ENERGY TRANSITION



WHAT ARE THEY?

They are a category of fuels derived from organic raw materials, usually crops or agricultural products, which can be used to power vehicles, machinery and power plants, partially or totally replacing fossil fuels (MME, 2023).

LIQUID BIOFUELS

They represent a category of fuels derived from plant or animal sources that remain in a liquid state under standard temperature and pressure.

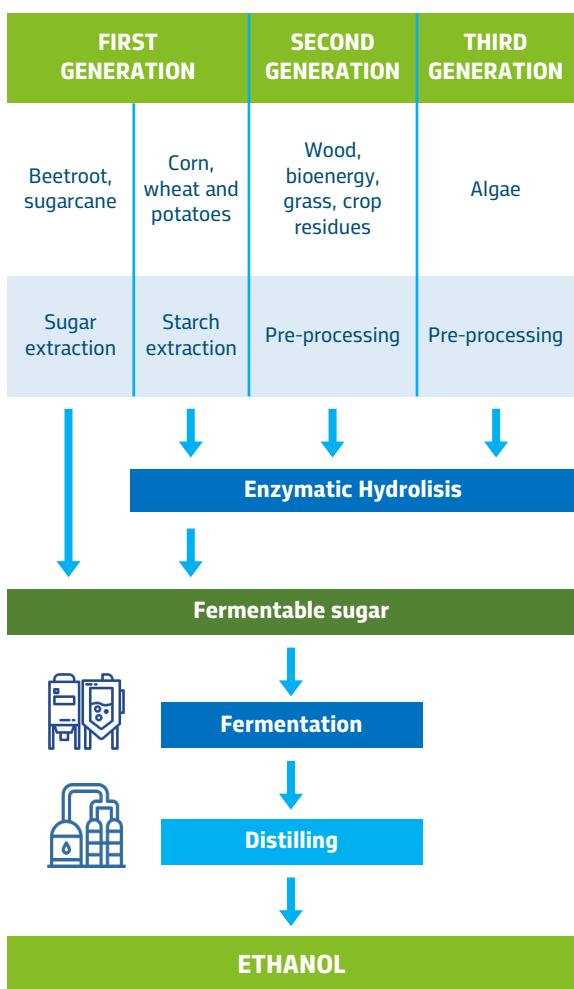
Ethanol is a chemical substance produced mainly by the fermentation of sugars. It is used in internal combustion engines with spark ignition (known as the Otto cycle) and is an alternative to gasoline (exhibit 1). Among the types of ethanol are anhydrous, hydrated and 2nd generation.

Anhydrous ethanol is a type of ethanol that has undergone a dehydration process, resulting in an extremely low water content, usually less than 1%. This process is carried out to make ethanol suitable for blending with gasoline.

Hydrous ethanol is a type of ethanol that holds a water content of around 5% to 7% of its weight. This category of ethanol is used directly as fuel in flex-fuel vehicles.

2^a-Generation ethanol is produced from the fermentation of sugars contained in the pomace and straw of sugarcane or other agroforestry residues, with a significant gain in productivity in the same planted area, compared to 1G ethanol.

Exhibit 1. Schematic pathways for the production of first, second and third-generation ethanol

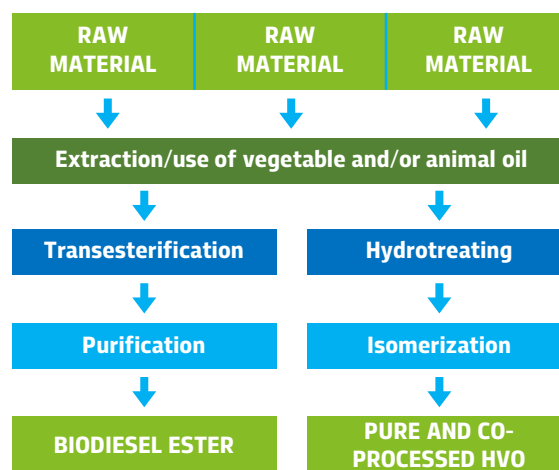


Source: UF-IFAS, 2023.



Biodiesel is a type of biofuel derived from renewable biomass, intended for use in internal combustion engines (diesel cycle) that use compression ignition or, in accordance with current regulations, can be used in the production of other forms of energy, with the capacity to replace, in part or completely, fuels derived from fossil resources (exhibit 2).

Exhibit 2. Schematic pathways to produce biofuels for the diesel cycle



Source: UF-IFAS, 2023.

There are different technological means to produce biofuels for diesel engines (biodiesel as provided by Act no. 9478/97):

Biodiesel ester is a biofuel produced from the transesterification and/or esterification of fatty materials and fats of vegetable or animal origin. It is a methyl ester that is transformed into biodiesel after undergoing purification processes.

HVO or Green Diesel is a 100% bio-based liquid fuel with the same characteristics as fossil diesel. It is fungible with fossil diesel and can be mixed in any proportion. Produced by hydrotreating biogenic material, it can use the same raw materials as biodiesel ester and other sources such as organic waste.

The **renewable portion of co-processed diesel (HVO)** is the result of an advanced production method that involves the simultaneous use of vegetable oils or animal fats and mineral oil fractions in a chemical co-reaction process. This process is carried out in oil refineries and uses hydrotreating units, adapted to include vegetable oils or animal fats in the process.

Another important type of biofuel is the **Sustainable Aviation Fuel (SAF)**. It is obtained from renewable sources, from various technological routes previously approved by ASTM, under sustainability standards.

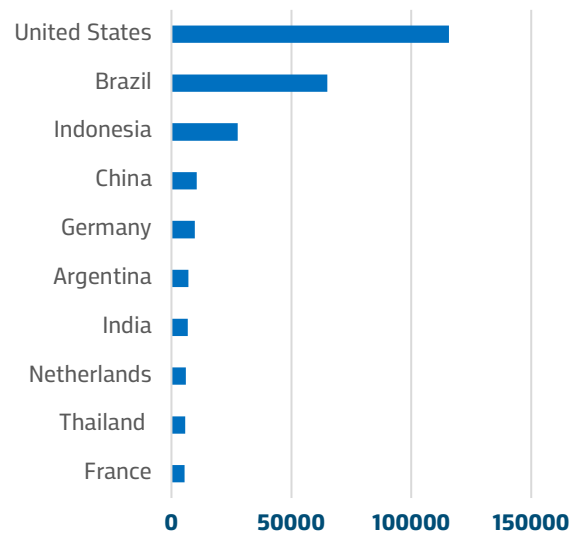
HVO and SAF are drop-in biofuels and can be incorporated directly into existing supply systems without the need for adaptations. Although they can be produced separately, both types of biofuels should be encouraged, as joint production leads to greater efficiency and consequently lower costs.

GLOBAL BIOFUELS LANDSCAPE

Global biofuel production has grown steadily over the last decade, exceeding 308,435 cubic meters per day (m³/d) by 2022 (IEA, 2022).

The United States is the world's largest producer of biofuels, responsible for 115,743 m³/d (38%), followed by Brazil with 65,026 m³/d (21.5%) and Indonesia with 27,664 m³/d (9.15%) (BP, 2023) (Chart 1).

Chart 1. Main biofuel-producing countries in 2022
Thousands of cubic meters (m³) per day



Source: BP Statistical Review, 2023.

IMPORTANCE OF BIOFUELS IN THE ENERGY TRANSITION

Biofuels are an important alternative to help decarbonize the transportation sector, due to its characteristics that enables a cleaner combustion and can emit up to 80% less greenhouse gases (GHG) than fossil fuels throughout their life cycle (ÚNICA, 2020).

According to the International Energy Agency (IEA, 2022), global demand for liquid biofuels is expected to increase in the following decades. In the optimistic scenario, called Net Zero Emissions (NZE), the agency estimates that this demand could reach 906,229 m³/d by 2030.

However, there are still challenges to be overcome in order to make the development and competitive diffusion of these technological options environmentally efficient, scalable and affordable compared to fossil fuels:



Regulatory stability to encourage long-term investment in expanding production.



Incentives for R&D projects aimed at developing competitive technological solutions.



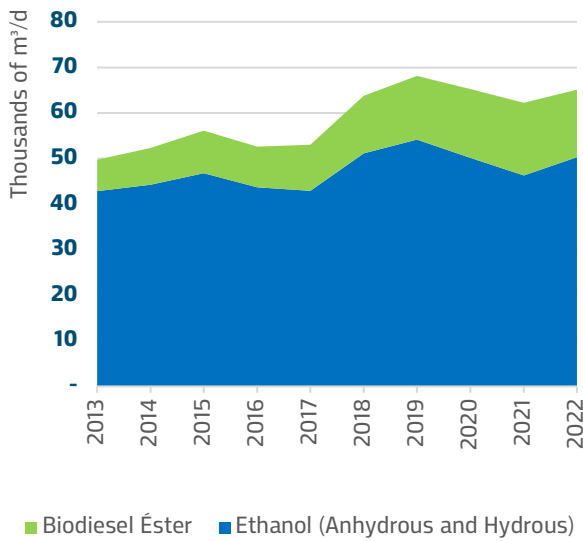
Sufficient availability of sustainable raw materials.

THE BIOFUELS INDUSTRY IN BRAZIL

Brazil has a long tradition of implementing public policies and working with the private sector to boost the development of biofuels.

Currently, the country has a consolidated biofuel industry with a wide variety of players operating along the production chain. The Brazilian production profile is concentrated on anhydrous and hydrous ethanol and biodiesel, with 360 and 59 production units, respectively (Chart 2).

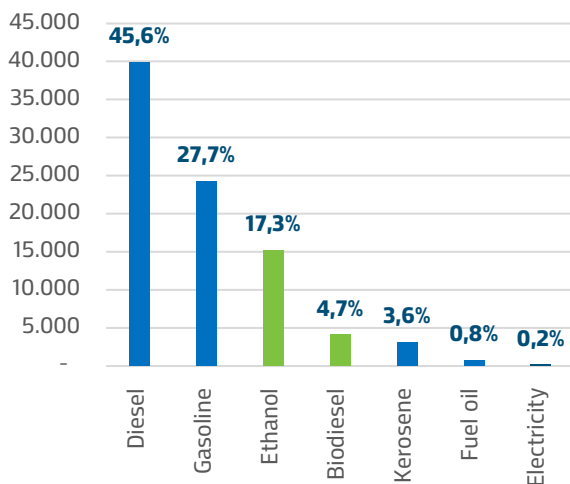
Chart 2. Evolution of ethanol and biodiesel production in Brazil (2013-2022)



Source: BP Statistical Review, 2023.

In 2022, ethanol and biodiesel accounted for 22% of the energy demand in the transportation sector (Chart 3).

Chart 3. Final energy consumption in the transportation sector (2022, thousand tons of oil equivalent)



Source: EPE.

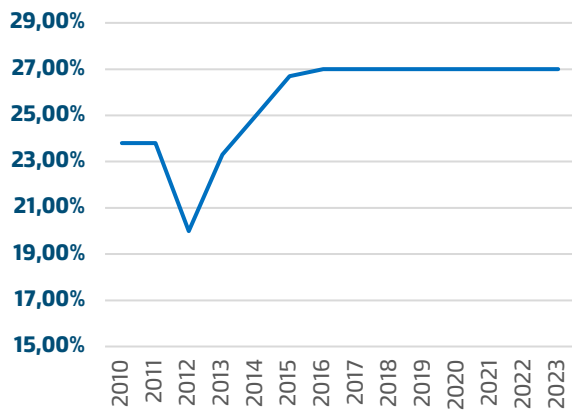
PILLARS OF BRAZIL'S BIOFUELS PUBLIC POLICY

Public policies to encourage the production and use of biofuels in Brazil can be segmented into three areas: compulsory mandate, RenovaBio and differentiated tax rates between fossil fuels and biofuels.

The **compulsory mandates** aims to encourage an increase in the share of biofuels in the transportation grid since the 20th century.

The blending of anhydrous ethanol into A gasoline has been carried out since the last century, evolving over time and, since 2015, stipulated at 27% (Chart 4)

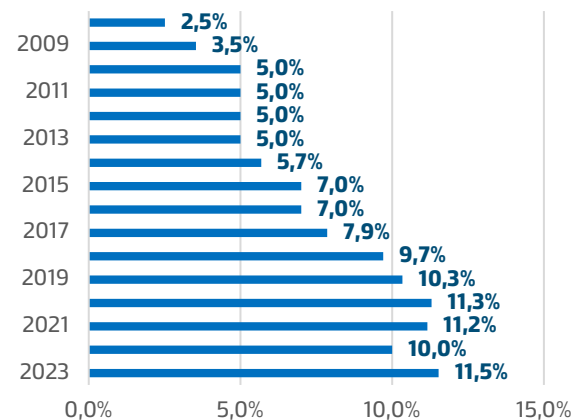
Chart 4. Average percentage of anhydrous ethanol in gasoline (2000-2023)



Source: Designed by IBP using ANP data.

In the case of diesel, the mandatory and gradual addition of biodiesel ester to diesel A began in 2008. Since then, the blending mandates have increased from 2% to the current 12% (Chart 5).

Chart 5. Average annual biodiesel blend (2008-2023)



Source: Designed by IBP using data from EPE and CNPE.
(*) 2023 Estimated amounts.

The definition of biodiesel established in Act 9478/97 is broader than the ANP regulation (focused only on the transesterification route).

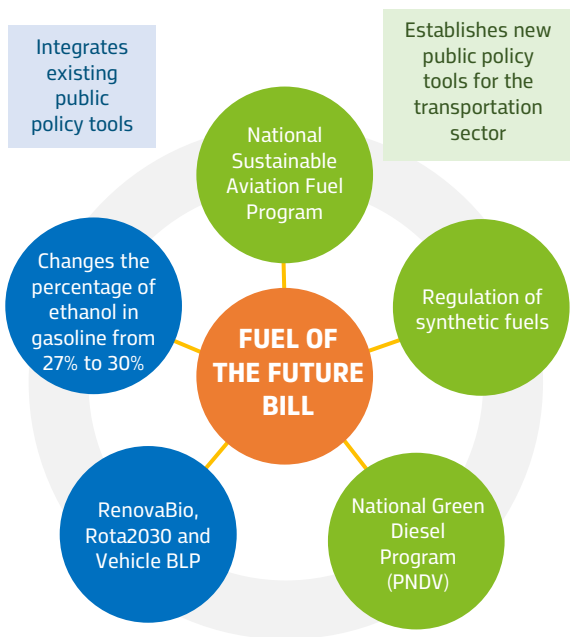
IBP is in favor of harmonizing the definitions of biodiesel, as set out in the legislation, which says *"biofuel derived from renewable biomass for use in internal combustion engines with compression ignition"*.

Therefore, a broader concept is ensured, and it is not exclusive to the transesterification route, as per RANP 45/2014 (Brasil, 1997; ANP, 2014)

THE FUEL OF THE FUTURE PROGRAM

As a result of discussions with society, the federal government recently sent to Congress the "Fuel for the Future" bill, PL 4516/23, with the aim of advancing the decarbonization agenda for the country's transport sector (Exhibit 3).

Exhibit 3. Pillars of the Fuel of the Future Bill




Source: designed by IBP.


"E-fuels" are a category of synthetic fuels produced by capturing carbon dioxide (CO₂) from the atmosphere and using renewable electrical energy to carry out the chemical synthesis, usually using hydrogen.


RenovaBio, established by Act 13576 of 2017, aims to expand the production of biofuels in line with Brazil's commitments to reduce GHG emissions under the Paris Agreement.


The Program's main tool is the definition of annual carbon emission reduction targets for the fuel sector. This is intended to stimulate the production and use of biofuels in the country's transportation sector (ANP, 2023).


Finally, the **different tax rate** between biofuels and fossil fuels provides a competitive tax differential between the products.

 The bill Gather RenovaBio, the Rota 2030 Program and the Brazilian Labeling Program, using the fuel's Life Cycle Assessment to estimate GHG emissions.

 It establishes the National Sustainable Aviation Fuel Program, encouraging the use of Sustainable Aviation Fuel (SAF), as well as other measures to decarbonize this sector (decarbonization mandate).

 It establishes the National Green Diesel Program (PNDV), which stipulates mandates for the gradual mixing of hydrotreated biodiesel, as a way of encouraging the investment necessary for its production and decarbonization of the road transportation sector.

 It proposes increasing the limits for blending anhydrous ethanol into gasoline, raising the minimum level to 22% and the maximum to 30%.

 It regulates the use of synthetic fuels, called "e-Fuels".

LEARN MORE ABOUT
BIOFUELS

