

BIOENERGY SERIES – THE EVOLUTION OF THE BRAZILIAN ETHANOL INDUSTRY

In the first three articles in our bioenergy series, we focused on biomass: the sustainability credentials of biomass; biomass and BECCS; and the impact of RED III on forest biomass. In our latest piece, we look at the evolution of ethanol as a biofuel in Brazil.

Brazil is the world's largest producer of sugarcane ethanol for fuel and the second-largest producer of fuel ethanol overall.¹ Its corn ethanol industry has also been expanding rapidly, with production reaching 6 billion litres in 2023, representing an 800% surge over the last five years.²

It is also a significant developer of second generation ethanol, from sugarcane waste or "bagasse." This gives it the advantage of being able to produce significantly more ethanol from the same land and, as technology advances, producers are also able to extract more and more energy from the bagasse. Second generation ethanol, known as an advanced biofuel, is particularly in demand because it meets growing sustainability related regulatory requirements.

This all sounds promising – but it is not to say that the Brazilian ethanol industry is without its challenges. Its great advantages have been the strength of its domestic sugarcane and ethanol production, the availability of a strong internal market and its flexibility. It has also been helped by legislation and regulation. As both the domestic and international ethanol markets change, these advantages continue to prove useful.

Motor fuel market

Historically, most of Brazil's production has been absorbed by the domestic fuel market where it is sold as either pure ethanol fuel (E100; hydrous ethanol) or blended with gasoline (E27; anhydrous ethanol). Brazil has been a pioneer in using ethanol as motor fuel in what are known as flex fuel engines.

Legislation has played a significant part in this: the mixing of ethanol with gasoline is required by law. Brazil has also used the advantage of flexibility here: Brazilian drivers can choose between sugarcane ethanol and gasoline when they fill their cars up. They can opt for the more efficient fuel based on sustainability and/or price.

The ethanol industry in Brazil has been assisted by the National Biofuels Policy, known as RenovaBio, which came into effect in December 2017 under Law No. 13.576/2017. RenovaBio is a key tool in reducing greenhouse gas emissions to help Brazil fulfil its commitments under the Paris Agreement.

However, given that internal combustion engine cars are the key users of ethanol, the growing popularity of electric vehicles globally has posed a significant threat. The Brazilian car market (the seventh largest in the world) may be unusual – but it is not immune to the challenges faced by other markets. As of April 2024, Brazil was the largest export market for Chinese electric vehicles (including battery and plug in hybrids).³ Historically, the vast majority of cars purchased in Brazil have been domestically produced and the Brazilian government is keen to ensure that this continues: in May 2023, it unveiled a series of measures designed to protect and promote the domestic car industry, including tax breaks and incentives for the use of domestic components.

In the Brazilian domestic market, global car manufacturers have developed biofuel versions of hybrid cars, known as "flex hybrids". These vehicles have internal combustion engines and electric motors for propulsion. Plug in versions

¹ [Brazil: share of global ethanol fuel production 2023 | Statista](#)

² [The flourishing ethanol industry in Brazil | Brazilian Farmers](#)

³ [Brazil is buying lots of Chinese EVs. Will that continue? - Atlantic Council](#)

are also under development and in an illustration of the market's flexibility, Brazilian ethanol producer Raízen has joined forces with Chinese carmaker BYD to build a network of 600 charging stations in eight Brazilian cities.⁴

International aviation market

In a sign of their flexibility and ability to make the most of opportunities presented by developing regulation, Brazilian ethanol producers are now also focusing on new markets, in particular sustainable aviation fuels (SAF).

In 2022, the International Civil Aviation Organisation (ICAO) adopted a goal to achieve net-zero carbon dioxide emissions from international aviation by 2050.⁵ One significant way to achieve this, which is projected to contribute to a 65% reduction in emissions, is by use of SAF.⁶

The European Union's ReFuelEU Aviation Regulation imposes a blending mandate on aviation fuel suppliers, to ensure all aviation fuel supplied to aircraft operators in the EU includes a minimum volume of 2% SAF from 2025, increasing in five year intervals to reach 70% in 2050.⁷ Similarly, in the UK, under the SAF Mandate set to be introduced from 2025, 2% of jet fuel supplied in the UK must be SAF. This will be increased annually to reach 22% in 2040.⁸

Following the ICAO's announcement, global SAF production tripled from 2021 to 2022 and tripled again from 2022 to 2023, reaching 600 million litres and representing 0.2% of global jet fuel use.⁹

Brazilian producers have embraced this opportunity. In August 2023, Raízen SA announced that it was the first ethanol producer in the world to have obtained ISCC CORSIA Plus certification¹⁰. This confirms that the ethanol produced at Raízen's Costa Pinto bioenergy plant complies with international requirements for the production of SAF.¹¹ These requirements include confirmation that no deforestation took place in production and that production involved low carbon emissions. Brazilian corn ethanol producer FS followed suit in March 2024. bp, Bunge Bioenergia and mills linked to Copersucar SA have also obtained CORSIA certification.

It is reported that Brazil will start exporting ethanol based feedstock for SAF this year, with domestic SAF production expected to begin by 2027.¹² (Currently, there is only one alcohol-to-jet plant in the world, in the US, but experts predict that 20-30% of global SAF demand will be serviced by ethanol based SAF by the end of the decade.)

Advanced biofuels

Brazil's existing infrastructure and capabilities are also making it an attractive prospect for new projects: bp is now exploring the use of a massive biofuel base in Brazil to develop key projects, including next generation ethanol, SAF, e-fuels and biogas. Raízen is currently developing the world's largest cellulosic ethanol programme (a second generation ethanol).¹³ In June 2024, Copersucar and Geo bio gas&carbon signed a memorandum of understanding to develop technology for converting biogas into SAF. The aim is to make large-scale SAF production feasible in Brazil by combining Copersucar's scale and Geo's biogas/biomethane production technology. The companies have said that the SAF produced will be a product with high added value and a low carbon footprint.¹⁴

HFW comment

The great strengths of the Brazilian ethanol industry – Brazil's domestic sugarcane and ethanol production, the availability of a healthy internal market and its flexibility, together with the ability to embrace the opportunities created by legislation and regulation, look set to continue to be significant as both the domestic Brazilian and international ethanol markets develop.

⁴ [Raízen, China's BYD to build EV charging station network in Brazil | Reuters](#)

⁵ [Long term global aspirational goal \(LTAG\) for international aviation \(icao.int\)](#)

⁶ [Net zero 2050: sustainable aviation fuels \(iata.org\)](#)

⁷ [RefuelEU aviation initiative: Council adopts new law to decarbonise the aviation sector - Consilium \(europa.eu\)](#)

⁸ [Aviation fuel plan - GOV.UK \(www.gov.uk\)](#)

⁹ [Net zero 2050: sustainable aviation fuels \(iata.org\)](#)

¹⁰ ISCC is International Sustainability and Carbon Certification and CORSIA is Carbon Offsetting and Reduction Scheme for International Aviation

¹¹ [Raízen | Raízen is First Ethanol Producer to Receive Global Certification for SAF Production \(raizen.com.br\)](#)

¹² [Brazil expected to start ethanol shipments for SAF industry this year | Agribusiness | valorinternational \(globo.com\)](#)

¹³ [BP plans foray into 2G ethanol, sustainable jet fuel with Brazil base \(msn.com\)](#)

¹⁴ [Copersucar signs MoU to advance biogas-to-SAF production in Brazil \(bioenergy-news.com\)](#)

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