IEA-Advanced Motor Fuels ANNUAL REPORT 2024

Brazil

Technology Collaboration Programme
by IEA

Brazil

Drivers and Policies

Brazil has a long history with bioethanol dating back to the 1970s. Initial bioethanol efforts were associated with energy security issues related to the first oil crisis. As a result, the country has stimulated the production of ethanol and, since 2003, the use of hydrous ethanol in dedicated or fuel-flexible vehicles (FFVs). Today, the allowed blend level of ethanol is 27% in regular gasoline (MAPA 2015), and blend limits range between 18% and 27.5% (Brazil 2014). The Fuels of the Future Law (14993/2024), enacted by Brazilian President Luís Inácio Lula da Silva on October 9, 2024, allows for new biofuels mandatory blends for ethanol and biodiesel only after CNPE (Brazilian Energy Policy Council) approval. Since 2005, Brazil has also imposed minimum levels of biodiesel in diesel fuel, according to the Brazilian Program of Production and Use of Biodiesel (PNPB). The environmental agenda has supported the agricultural sector[1] and, in particular, the biofuels value chain, especially ethanol and biodiesel, and now biogas and advanced fuels, including sustainable aviation fuels (SAF) and hydrotreated vegetable oil (HVO). Note that Brazilian federal states apply differentiated consumption tax rates for gasoline (in general, higher rates) and hydrous ethanol (in a majority of the states, lower rates). Another public policy that promotes the production and consumption of biofuels is the National Biofuel Policy, known as RenovaBio (Brazil 2017), which has been operational since March 2020.

The official document driving Brazil's national policy framework for renewable energy is its Nationally Determined Contribution (NDC) (UNFCCC 2022) toward achieving the objective of the United Nations framework convention on climate change.

Under the fourth revision of its NDC concerning the Paris Agreement, Brazil committed to reducing its domestic greenhouse gas (GHG) emissions to between 59% and 67% below 2005 levels by 2035, which is consistent with an emission level of 1.05 to 0.85 gigatons CO_2 equivalent ($GtCO_2e$). The new commitment increases the emission reduction target set in the first NDC, consolidating a trajectory of increased ambition, as determined by the Paris Agreement. Between 2025 and 2030, the absolute emission reduction was 9% and, for the period from 2030 to 2035, the new NDC increases its goal to a reduction ranging from 13% to 29% (MMA 2024). Brazil is also committing to the long-term objective of becoming carbon neutral by 2050. Such measures continue to include all sectors of the economy, such as agriculture and energy, with transport in the latter sector. Brazil also intends to adopt further measures consistent and aligned with the 1.5°C temperature goal, especially in the energy sector (IEA 2023).[2]

Brazilian Policy Framework

The main policy instruments behind the evolutions that will subsidize the future growth of biofuels in Brazil include the following:

- The *Brazilian Alcohol Program (PROALCOOL)*, created during the 1970s by the Brazilian government, aimed to increase the level of ethanol blending in gasoline to 25% (E25) and introduce hydrous ethanol (E100 [approximately 95% ethanol and 5% water]) for use in dedicated vehicles. The program was successful until the 1990s, when falling oil prices reduced ethanol's competitiveness. However, in 2003, a new oil crisis boosted the manufacture of flex-fuel cars, which can use both alcohol and gasoline (EPE 2023). Since then, Proálcool has contributed significantly to Brazil's economy and sustainability, generating energy savings equivalent to more than 2.5 billion barrels of oil and resulting in savings of about $205 billion in gasoline imports (Brasil 2024d; Fapesp 2016).

[1] The agriculture sector represents 22.0% of Brazil's gross domestic product (GDP) in 2024 preliminary results until Sept. 2024 (CEPEA 2025)

[2] Additional measures include the following:
- Expanding the use of renewable energy sources other than hydropower in the total energy mix.
- Expanding the use of non-fossil fuel energy sources domestically.
- Achieving 10% efficiency gains in the electricity sector by 2030.

In addition, in the transportation sector, Brazil intends to further promote efficiency measures and improve infrastructure for transport and public transportation in urban areas.

- The *Brazilian Program for Production and Use of Biodiesel (PNPB)* was created by Law No. 11,097/2005, on January 13, 2005 (Brazil 2005), to further stimulate energy, economic, and social objectives and foster feedstock production among small farmers.
- *Flex fuel technology* was established in 2003 to enable consumers to choose between E27 and E100.
- *Biofuel addition on petroleum products* — Since 2015, all automotive gasoline sold at retail contains, by mandate, a blend of 27% anhydrous ethanol, or E27.[3] The government also mandated that biodiesel be added to fossil diesel. According to the chronogram stipulated by CNPE, there was a gradual increase in the mandatory blend of biodiesel in diesel fuel. In April 2023, the established mix was set at 12% and, since March 2024, 14%.[4]
- *National Biofuel Policy (RenovaBio)* (Law 13,576/2017) (Brazil 2017) — A state policy recognizing the strategic role of all types of biofuels in the national energy matrix, both for energy security and for the mitigation of GHG emissions. The policy includes the additional objective of reducing dependence on mineral diesel.
- *Law 14,993/2024* (Brazil 2024b), sanctioned by Brazilian President Luís Inácio Lula da Silva on October 9, 2024 — This law, based on discussions under the Fuels of the Future Program, aims to further increase the use of sustainable and low-carbon fuels to decarbonize the Brazilian transport energy matrix. Allows the increase of ethanol mixed in gasoline from the current 27.5% to 35% and the increase of biodiesel mixed in diesel from the current 14% to 25%.
- *Federal and state tax differentiation* between renewables and fossil fuels[5] establishes credit lines to support rural sugarcane producers and their cooperatives to select business plans and promote projects that consider the development, production, and commercialization of new industrial technologies for sugarcane biomass (E2G [second-generation ethanol], gasification, and more).[6]
- *Law 14,948/2024* (Brazil 2024c) establishes the regulatory framework for the production of low-carbon hydrogen. The law also creates incentive mechanisms for the sector, provides for the National Policy for Low Carbon Hydrogen; creates the Low Carbon Emission Hydrogen Development Program (PHBC), and establishes a voluntary certification.
- *Consolidation of the National Hydrogen Program (PNH2)* — The Brazilian government organized and published a strategy for developing the country's hydrogen economy (Brazil 2023b), which would harmonize with other sources of its energy matrix.[7]
- *Brazil's membership* in the International Maritime Organization (IMO) and International Civil Aviation (ICAO)/Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).[8]
- *A pledged commitment to efficiency programs*, such as INOVAR-Auto, INOVA-E, and other governmental initiatives dedicated to improving efficiency and innovation.
- *Federal government approval* of the framework of the Rota 2030 program (Law 13,755/2018) in December 2018 to foster efficiency and safety in vehicles produced in Brazil (Brazil 2018).
- Provisional Measure 1,205 (December 30, 2023) enacted June 27, 2024, the *Green Mobility and Innovation Program (MOVER)*, offer a broader approach for mobility than Rota 2030. MOVER's goals include a well-to-wheel perspective, which will measure energetic efficiency and an objective for car manufacturers to use at least 50% recyclable components to achieve tax differentiation. After 2027, vehicles commercialized in Brazil will be evaluated using a "cradle to

[3] Gasoline premium contains 25% anhydrous ethanol, according to MAPA Ordinance N. 75 (MAPA 2015). However, it accounts for a very small fraction of fuel sales.

[4] Blend definition in accordance with CNPE Resolutions (MME 2023a).

[5] Regarding federal taxes, gasoline and ethanol are subject to the following levies: the Contribution to the Social Integration Program and the Civil Service Asset Formation Program (PIS/Pasep), the Contribution to Social Security Financing (Cofins), and the Contribution for Intervention in the Economic Domain (Cide). The current PIS/Pasep and Cofins rates are R$ 792.50/m³ for gasoline A (pure gasoline, without ethanol), R$ 241.81/m³ for hydrous ethanol, and R$ 130.90/m³ for anhydrous ethanol. The current Cide rate is R$ 100/m³ for gasoline, while for both anhydrous and hydrous ethanol, it has been set at zero since 2004. As for the state tax, the ICMS follows a single-phase taxation system for gasoline and anhydrous ethanol sales, applying fixed and uniform rates nationwide. The current rate for these two products is R$ 1.47/l. For hydrous ethanol, however, the ICMS is applied under a different system, with ad valorem rates that vary by state. At present, the lowest ICMS rate is 11.33% in the state of Mato Grosso do Sul, while the highest rate is 22% in the state of Maranhão. (EPE 2025)

[6] CPNE did all of this through CNPE Resolution number 07, April 20, 2021.

[7] The Triennial Plan for H_2 2024–2026 was approved in December 2023 by the Executive Committee of the PNH2 (Brazil's National Hydrogen Program).

[8] CORSIA is a global market-based measure designed to offset international aviation CO_2 emissions in order to stabilize the levels of such emissions (ICAO 2023).

grave" life-cycle model. MOVER also includes a financial bonus for automakers that take into account some sustainable indicators.

- *Decree number 11,902* (January 30, 2024), which restructures the Social Biofuel Seal (Brazil 2024a) and creates significant investments — Starting in 2024 with Brazilian real (BRL) 740 million, in 2026, BRL 1.6 billion will be allocated to strengthen biodiesel production and support family farming. Compared to year 2022, the number of registered families is estimated to grow by 120% this year. The Social Biofuel Seal is a fundamental instrument that has already guaranteed the participation of more than 54,000 family farmers in the biodiesel production chain (Brazil 2024e). This policy aims to strengthen family farming, especially in the North, Northeast, and semi-arid regions of Brazil. It also encourages the production of new crops, such as *macaúba*, and palm tree, which is abundant in northeastern Brazil (Brazil 2024a).
- *Brazilian Sustainable Taxonomy* — At the end of 2023, the Brazilian government launched a public consultation about the Brazilian Sustainable Taxonomy, a document that consists of a classification system that defines — in a clear, objective, and scientifically based manner — activities, assets, and/or project categories that contribute to climate, environmental, and/or social objectives through specific criteria (Brazil 2023a).
- PPI Program — Created by Law No. 13,334 of 2016, the Investment Partnerships Program (PPI) aims to modernize and increase the logistical efficiency of Brazil, covering all modes of transport (air, road, rail, waterway, and pipeline).
- Energy Efficiency Programs (PEE) (Programas de Eficiência Energética [PEE], linked to Law No. 9,991/2000) — These programs require public electricity distribution concessionaires and permit holders to annually invest in R&D of the electricity sector and in energy efficiency programs for end use.
- Brazilian Emissions Trading System **(**Sistema Brasileiro de Comércio de Emissões [SBCE], instituted by Law No. 15,042, December 11, 2024) — The SBCE regulates the carbon market in Brazil, establishing an emissions trading system to reduce greenhouse gases and stimulate low-carbon technological innovations.
- Energy Transition Acceleration Program (Paten [Programa de Aceleração da Transição Energética], instituted by Law No. 15,103, January 22, 2025) — Paten facilitates access to credit for sustainable projects, promoting clean technologies and expanding Brazil's renewable energy matrix.
- PLANTE National Energy Transition Plan (Plano Nacional de Transição Energética) — Part of the PLANTE is a long-term action plan to achieve the goals of the National Energy Transition Policy, aiming for a more sustainable energy matrix and neutrality in greenhouse gas emissions.
- National Integrated Plan for Natural Gas and Biomethane Infrastructure (Plano Nacional Integrado das Infraestruturas de Gás Natural e Biometano), instituted by Decree 12,153/2024. This plan aims to integrate and develop natural gas and biomethane infrastructure in Brazil, promoting a more sustainable energy matrix.

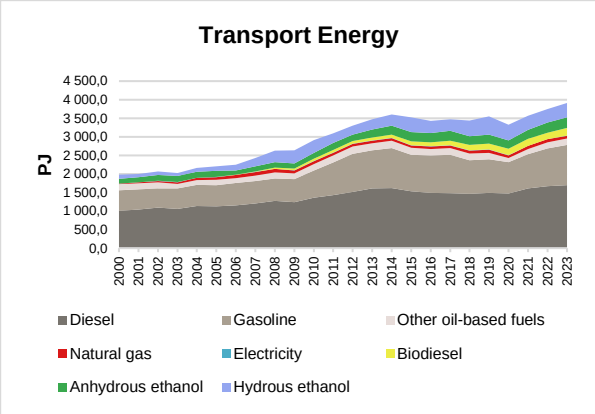
Advanced Motor Fuels Statistics

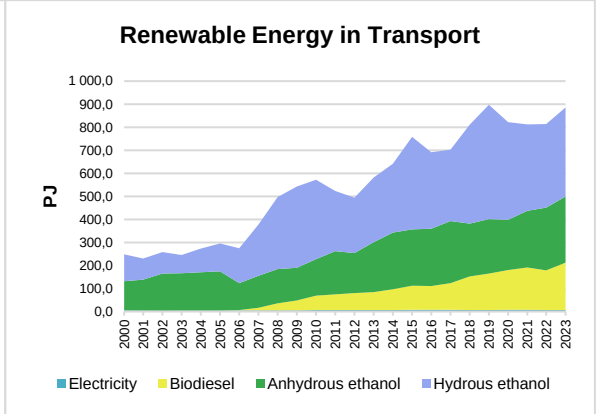
Transport

Figures 1 and 2 provide an overview of the energy used for transport in Brazil, categorized by different fuels/energy carriers. Note that Brazilian statistics define biogasoline (E27) as anhydrous bioethanol blended with gasoline and that hydrous ethanol is used in dedicated or FFVs. Bioethanol represented 38% (by energy) of combined gasoline and ethanol use in 2023 in Otto cycle engines.

Transport fuel consumption in Brazil has stabilized over the past five years, and the use of biofuels has grown steadily over the past 20 years. In particular, the use of hydrous ethanol in FFVs has substantially increased. The consumption of anhydrous ethanol has grown with gasoline consumption, as evidenced in Figure 1. Biodiesel was introduced in 2005 and has also steadily grown as a substitute for fossil diesel consumption, mainly for heavy-duty transport. On average, biodiesel represented 10.8% (by energy) of diesel consumption in 2023, as Figure 2 shows.

Also as shown in Figure 1, electricity represents a share of 0.2% of total transport energy use in 2023, maintaining the share of previous years. This is mostly in rail — Brazil has no report of electricity used in road vehicles.





Figures 1 and 2. Evolution of Transport Fuels in Brazil, 2000–2023 (Source: EPE 2024a).

Table 1 displays the growth of the Brazilian fleet from 2013 to 2023.

Table 1. Growth of the Brazilian Fleet, 2013–2023

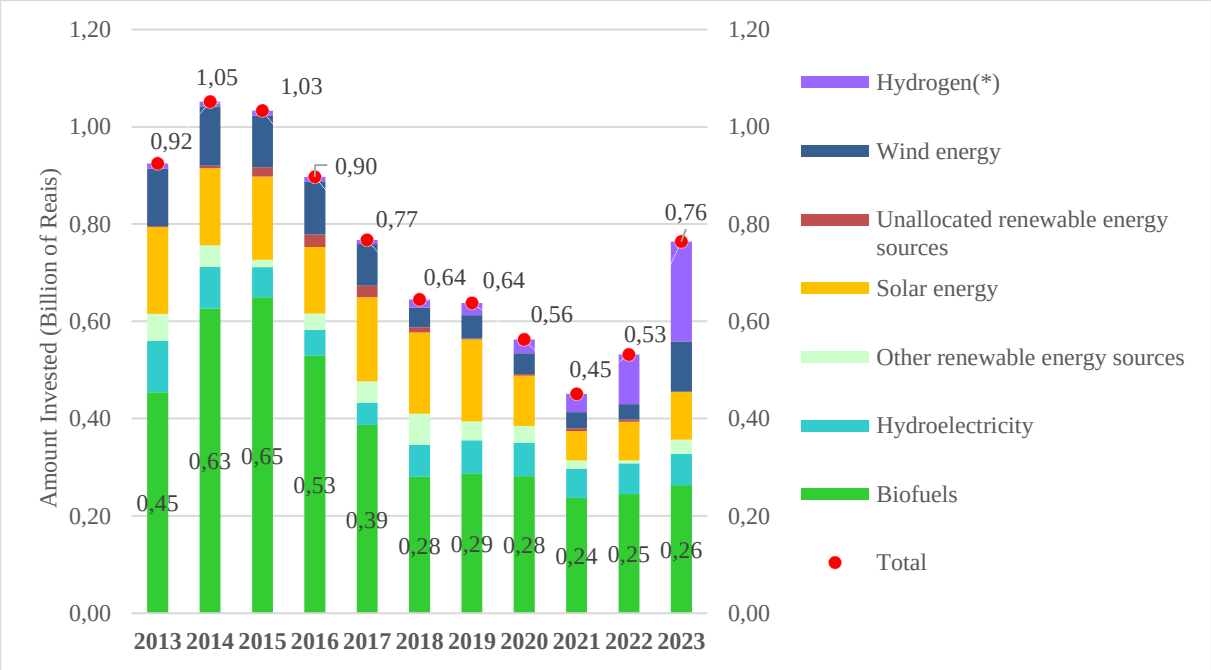
Stock of Vehicles	Unit	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Motor spirit cars	10^6	11,7	11,0	10,3	9,6	8,9	8,2	7,6	7,1	6,5	6,0	5,5
Diesel oil cars	10^6	1,7	1,8	1,9	2,0	2,1	2,2	2,3	2,3	2,4	2,5	2,7
Electricity cars	10^6	0,000	0,000	0,000	0,000	0,000	0,000	0,001	0,001	0,004	0,012	0,0
Other type of cars (hybrid)	10^6	0,001	0,002	0,003	0,004	0,007	0,010	0,021	0,038	0,057	0,085	0,1
Flex fuel cars	10^6	20,7	23,2	24,9	26,0	27,1	28,4	29,7	30,2	30,7	31,0	30,9

Source: EPE 2024e.

Research and Demonstration Focus

Brazil has several government-backed mechanisms providing support for biofuels research, development, and demonstration (RD&D) plants. Public and publicly oriented support totaled more than BRL 250 million (USD 50 million) in 2023,[9] which includes support in the form of loans, equity participation, and grants and is also available via the PAISS programme for ethanol and other biofuel production (including cellulosic ethanol) and drop-in biofuels (including aviation fuels). Note that, within the scope of the Fuels of the Future (Law 14,993/2024, Brazil 2024b), the government created and launched lines of financing and incentive mechanisms for biofuels. Furthermore, Law 14,948/2024, (Brazil 2024c) established the National Low Carbon Hydrogen Policy, having as one of its principles the promotion of R&D for the use of low carbon hydrogen. Figure 3 illustrates the annual distribution of public investments in renewable energy, including research, development, and innovation (RD&I), by source.

[9] The average 2023 USD to BRL exchange rate was 4.99 (BCB 2025).



*Hydrogen investments may include non-renewable hydrogen research.

Figure 3. Public Investments in Renewable Energy RD&I, 2013–2023 (Source: EPE 2024f).

Figure 4 displays the total amount of public financing specific to the sugar-energy sector. In 2023, total disbursements of the Brazilian Bank for Economic and Social Development (BNDES) in the agricultural area for the cultivation of sugarcane totaled USD 180 million (or roughly BRL 900 million) (BNDES 2024).[10]

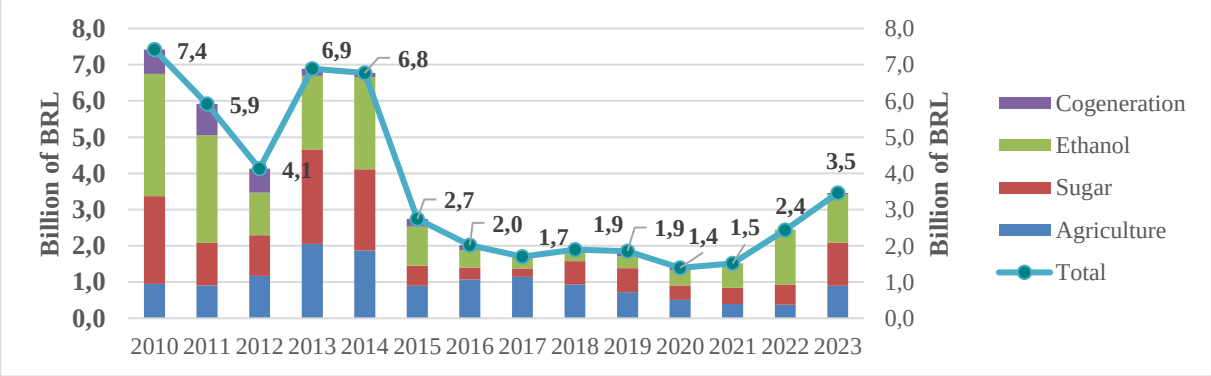


Figure 4. Public Funding for Sugar-energy Sector (Source: Constructed by EPE from data provided by BNDES [2025].

Outlook

Figure 5 consolidates the demand for fuel ethanol and other (non-energy) uses, which grows at an annual rate of 3.8%, in a ten-year period, reaching an estimated 45.7 billion liters in 2034, with the major increase coming from the demand for hydrous ethanol fuel. By 2034, the Brazilian fleet should achieve 45.4 million vehicles, according to the EPE (EPE 2024b).

[10] At the average 2023 USD to BRL exchange rate (BCB 2025).

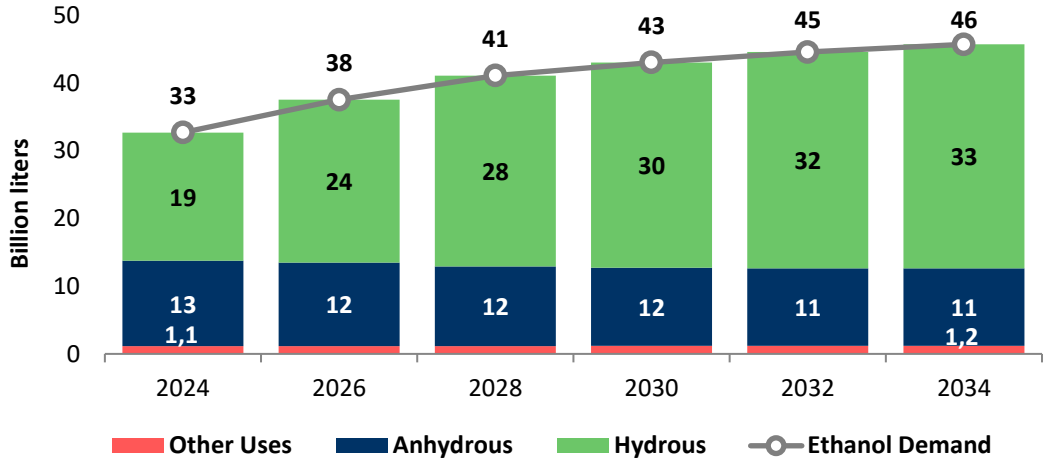


Figure 5. Forecast of Total Ethanol Demand, 2024–2034 (Source: EPE 2024b).

When added to imports, 0.5 billion liters, the total value of ethanol amounts (split into sugarcane and corn) to 48.0 billion liters. Figure 6 shows the forecast for total ethanol supply.

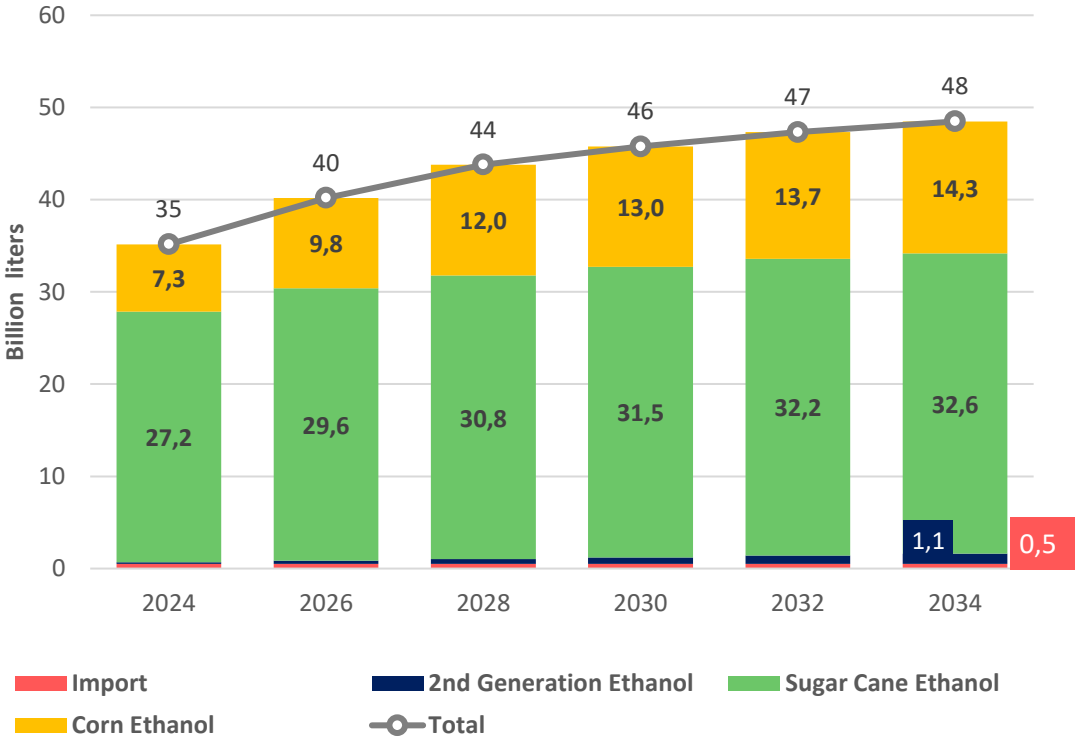


Figure 6. Forecast of Total Ethanol Supply, 2024–2034 (Source: EPE 2024b).

The biodiesel demand projections of this study were obtained based on the forecast of the regional consumption of oil diesel type-B (EPE 2024e) and the evolution of biodiesel blend, which follows CNPE stipulated chronogram according to Law No. 13,263/2016, will maintain 15% levels from 2025 onwards (Figure 7). Although there is no blend obligation for the maritime sector, voluntary tests with 24% blend on maritime fuels have been made.

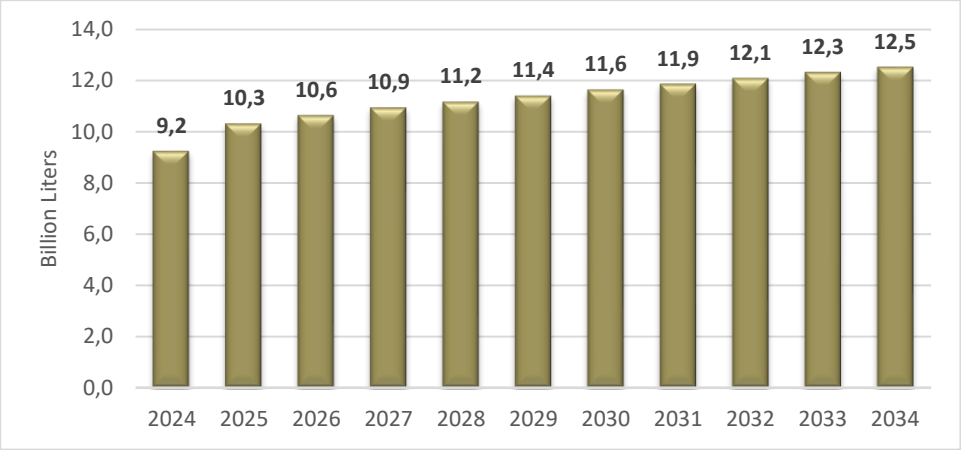


Figure 7. Forecast of Total Biodiesel Demand, 2024–2034 (Source: Based on EPE 2024e)

Projections for ethanol and sugar production presented in this study indicate a high amount of residues from this sector that can be used for biogas production. The methodology applied to this item considered both the vinasse and filter cake as part of the biogas production, which will be destined for biodigestion. In this case, the technical potential of biogas from residual sugarcane biomass through monodigestion reaches 6.4 billion Nm³ in 2034, representing 3.6 billion Nm³ of biomethane (Figure 8).

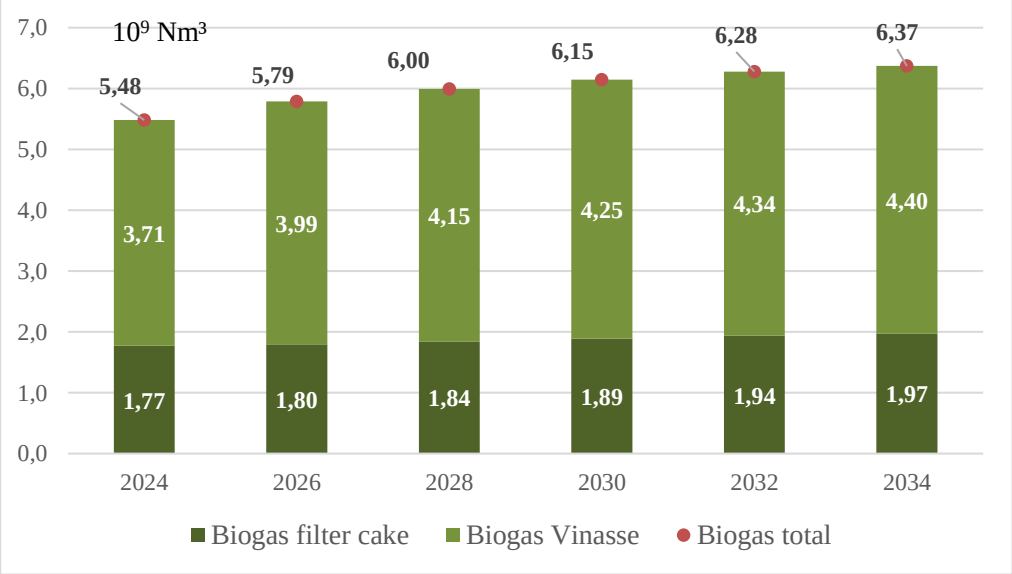


Figure 8. Biogas Potential with Sugarcane Residual Biomass, 2024–2034. Source: EPE 2024b.

Recent Developments

Currently, Raízen has one operational E2G plant in Guariba (SP), two plants in commissioning phases, and two more under construction (Raízen 2024). The company plans to complete these projects by the 2025/2026 harvest, increasing its total production capacity to 440 million liters per year (Forbes 2024). Raízen has shifted its strategy and will no longer produce E2G at its Piracicaba plant, which will now be dedicated to tests and future developments (Globo 2025). Additionally, Raízen secured a R$ 1 billion financing from BNDES for the construction of a new E2G plant in Andradina (SP), with a capacity of 82 million liters per year (BNDES 2025).

With regard to biogas, its participation in the internal supply of energy is still timid (0.15%), but it has shown accelerated growth: 17.7% per year over the last five years (EPE 2024a). Recently, the Louis Dreyfus Company (LDC) began constructing the world's largest biogas plant using citrus residues in Bebedouro (SP), which will contribute to biogas production in Brazil (LDC 2025).

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