



Empresa de Pesquisa Energética

# ETHANOL SUPPLY SCENARIOS AND OTTO CYCLE DEMAND

## 2022-2031

### EXECUTIVE SUMMARY

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## INTRODUCTION

The Ethanol Supply Scenarios and Otto Cycle Demand analysis aims to contribute for identifying opportunities and risks to the fuel demand of Otto cycle light vehicles in Brazil. In this aspect, the present document discusses **three ethanol supply scenarios** and its consequences for the fuel demand in light vehicles and the **national balance of “A” gasoline** from 2022 up to 2031. This document, that considers the impact of Covid-19 pandemic in the scenarios, also includes the bioelectricity from sugarcane exported to the National Interconnected System, the potential of biogas production and an evaluation of the investments associated to each scenario. Also is presented the sugar-energy sector contribution for greenhouse gases emissions (GHG) reduction in the Energy Sector.

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## ETHANOL SUPPLY

This study provides three scenarios for ethanol supply denominated **High Growth, Medium Growth and Low Growth**, which differ in the degree of economic attractiveness of ethanol production and hydrous ethanol competitiveness in front to gasoline. Thus, the effectiveness of RenovaBio was reflected in the biofuels increase in production by revenues from Credit Decarbonization (CBIO) sales. The Combustível do Futuro Program proposes a discussion on advances in renewable fuels in Brazil, also considering the evolutions in engine technologies and in the decarbonization processes in the transport sector. Another issue concerns over the scope of government actions, whether direct or indirect, such as the tax differentiation between hydrous ethanol and C gasoline (CIDE, ICMS, PIS / COFINS) and the provision of specific financing lines for this industry, which will induce its growth to a greater or lesser degree. Common assumptions for all scenarios are: an effective installed capacity of 750 Mtc sugarcane milling in 2020 and the construction of four new units, with construction authorization by ANP in June/2021. In the same year, Brazil will

export 2.3 billion liters of ethanol and consume 1.2 billion liters of it for non-fuel use. Sugarcane yield average will reach 140 kg TRS (Total Recoverable Sugar) / tons of sugarcane in the period.

Specifically for each scenario, this study estimates that the price of CBIO will contribute, somehow, to the expansion of ethanol production. Thus, it is estimated that the expansion of production capacity for conventional sugarcane ethanol will add 4, 9 and 14 new plants, with a variation of the installed capacity of nominal milling of 3, 28 and 73 million tons, in the low, medium and high growth scenarios, respectively, related to 2020. E2G generation will be integrated with the E1G and produce 500, 400 and 200 million liters by 2031, in the low, medium and high growth scenarios, respectively. For corn ethanol, the study considers flex and dedicated plants, forecasting production of 8.1 billion liters for the low and medium growth scenarios and 10.6 billion for the high growth scenario in 2031.

Sugar production in the period of 2020-2031 will grow at a rate of 0.7% per year, reaching 44.9 million tons in 2031 for the low

and medium scenarios and 47.8 million tonnes for the high growth scenario, at the end of the period.

The table 1 summarizes the results of area, productivity, processed cane, total ATR and ethanol supply for the year 2031.

**Table 1: Supply scenarios results for 2031**

GROWTH SCENARIOS	AREA (MHA)	YIELD (TC/HA)	SUGARCANE (MTC)	TRS (MT)	ETHANOL SUPPLY (BILLION LITRES)
Low	9.2	79.8	731	103	42.7
Medium	9.3	83.0	770	109	46.4
High	9.4	86.4	810	114	50.9

## FUEL DEMAND OF OTTO CYCLE LIGHT VEHICLE

In addition to the economic scenario, the global fuel demand for Otto cycle light vehicles fleet considers a few other aspects, such as the registration of new light vehicles, the price of C gasoline at pump and the consumer preference between C gasoline and hydrous ethanol in flex fuel vehicles supply.

Other assumptions include: the non-entry of pure electric or diesel cars in the period; the 27% mandatory anhydrous ethanol content in C gasoline in the period; the vehicle efficiency gains at 1% p.a.; and the alignment of the producer's price of gasoline with international prices. As a result, the national fleet of light vehicles (cars and light commercial vehicles) reaches the mark of 47.9 million units in 2031, a rate of 2.2% p.a., leading the demand for Otto cycle fuels, reaching 60.4 billion liters of gasoline equivalent. At the end of the period, flex fuel vehicles will represent 89% of the national fleet.

**Table 2: Demand scenarios results for 2031**

GROWTH SCENARIOS	FUEL ETHANOL (BILLION LITRES)	A GASOLINE (BILLION LITRES)	HYDROUS MARKET SHARE ON FLEX FUEL (%)	ETHANOL SHARE ON FLEX FUEL (%)
Low	39.3	29.7	42	
Medium	43.0	27.3	48	
High	47.4	24.4	55	

To evaluate the A gasoline balance, the analysis considered historical data on domestic production, presented in the Brazilian Energy Balance (BEN2021) and the production forecast, according to The Ten-Year Energy Expansion Plan 2022-2031 (PDE2031). This exercise showed that, for all

scenarios, volumes of gasoline A imports will be necessary in 2022. For the medium growth scenario, fossil fuel imports also occur in 2023. In the low-growth scenario, however, there is a gasoline deficit in 2023, 2030 and 2031, when it reaches 1.7 billion liters, lower than the historical maximum (4.9 billion liters in 2020). For the high scenario, there will be no import for the period.

## OTHER RESULTS

The study also showed that, in 2031, the sugarcane bioelectricity is expected to inject 3.9 GWm, 4.1 GWm and 4.3 GWm in low, medium and high growth scenarios, respectively. Also considers that if all vinasse and filter cake would be used exclusively for the production of biogas, the volumes produced would reach 11.5, 12.3 and 12.9 Billion Nm<sup>3</sup> in 2031, for low, medium and high growth scenarios, respectively. In contrast, avoided GHG emissions from use of fuel ethanol (EG1) and bioelectricity will reach 62.1, 65.1 and 66.5 MtCO<sub>2</sub> in 2031 for the low, medium and high growth scenarios, respectively.

The estimated investments for the expansion of existing sugar-energy units (brownfield), new units (greenfield), second generation ethanol and corn ethanol (flex and full), are 11.5 billion, 19.4 billion and 37.9 billion reais for growth scenarios low, medium and high, respectively.

The document considers that the ethanol supply trajectory by 2031 will be defined by the effectiveness public policies, such as RenovaBio, and the degree of the stakeholders' actions towards the production factors' improvement. Further development studies are relevant to determine the magnitude and the performance of the public policies aimed at supplying the Otto cycle fuel market. Moreover, it contributes to Brazil meets international commitments under the Paris Agreement, contributing to the country's energy planning in the medium and long term.