



Empresa de Pesquisa Energética

ETHANOL SUPPLY SCENARIOS AND OTTO CYCLE DEMAND 2020-2030

EXECUTIVE SUMMARY

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Oil Products and Biofuels Department / Division of Oil, Gas and Biofuel Studies

URL: <http://www.epe.gov.br> | E-mail: biocombustiveis@epe.gov.br

Head Office: Av. Rio Branco, nº 1 - 11º Andar – Zip Code: 20.090-003 – City/State: Rio de Janeiro/RJ



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 2020 up to 2030. This study makes assumptions regarding ethanol from lignocellulose, corn ethanol and energy cane. In addition, the document included the bioelectricity from sugarcane exported to the National Interconnected System and the potential of biogas production, as well as an evaluation of the sugar-energy sector contribution for greenhouse gases emissions (GHG) reduction in the Energy Sector and an assessment of associated investments.

The enactment of the National Biofuels Policy Act (RenovaBio) in December 2017 provides huge opportunities for production expansion and biofuels use in the national energy matrix, with a focus on regular fuel supply and forecast of the country's fuel market share of these sources of energy. RenovaBio also aims to cooperate to meet Brazilian commitments to the Paris Agreement under the United Nations Framework Convention on Climate Change, aiming to enhance its role in mitigating GHG.

Technical Staff

Executive Coordination
Angela Oliveira da Costa

Technical Coordination.
Angela Oliveira da Costa
Rafael Barros Araujo.....

Technical Team
Angela Oliveira da Costa
Marina D. Besteti Ribeiro
Rachel Martins Henriques
Rafael Barros Araujo

ETHANOL SUPPLY

This study provides three scenarios for ethanol supply, **High Growth, Medium Growth and Low Growth**, which are distinguished by the effectiveness of RenovaBio, reflected by the biofuel production increase, the revenues from the carbon credit trade (CBIO) and the effectiveness of the stakeholders' responses. 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, the construction of two new units and expansion of the milling capacity of 16 existing ones (9 Mtc). Also, for all three scenarios, E2G generation will be integrated with the E1G and produce 1.0 billion liters by 2030. In the same year, Brazil will export 2.1 billion liters of ethanol and consume 1.2 billion liters

of it for non-fuel use. Sugarcane yield will reach 140 kg TRS (Total Recoverable Sugar) / tons of sugarcane by 2030, considering that part of the sugarcane industry will seek for good agricultural practices and technologies.

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 9, 16 and 20 new plants, with a variation of the installed capacity of nominal milling of 38, 112 and 196 million tons, in the low, medium and high growth scenarios, respectively. For corn ethanol, the study considers flex and dedicated plants, forecasting production of 4.1 billion liters for the low and medium growth scenarios and 5.4 billion for the high growth scenario. Sugar production in the period of 2018-2030 will grow at a rate of 3.8% per year, reaching 44.8 million tons in 2030 for the low and medium scenarios and 48.4 million tonnes for the high growth scenario, at the end of the period.

The study estimates that the insertion of “energy cane” will occur gradually, and should be used preferentially to ethanol production. In 2030, it will represent 190,000 hectares in all the scenarios. The table below summarizes the results of area, productivity, processed cane, total ATR and ethanol supply for the year 2030.

Table 1: Supply scenarios results for 2030

GROWTH SCENARIOS	AREA (MHA)	YIELD (TC/HA)	SUGARCANE (MTC)	TRS (Mt)	ETHANOL SUPPLY (BILLION LITRES)
Low	9.6	81.7	784	110	43.0
Medium	10.1	84.3	851	119	48.8
High	10.5	88.3	922	130	54.4

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 53.4 million units in 2030, a rate of 3.1% p.a., leading the demand for Otto cycle fuels, reaching 67.2 billion liters of gasoline equivalent. At the end of the period, flex fuel vehicles will represent 90% of the national fleet.

Table 2: Demand scenarios results for 2030

GROWTH SCENARIOS	FUEL ETHANOL (BILLION LITRES)	A GASOLINE (BILLION LITRES)	HYDROUS ETHANOL MARKET SHARE ON FLEX FUEL (%)
Low	39.7	35.7	37
Medium	45.1	32.1	45
High	51.2	28.1	53

To evaluate the A gasoline balance, the analysis considered historical data on domestic production, presented in the Brazilian Energy Balance (BEN2019) and the production forecast, according to The Ten-Year Energy Expansion Plan 2020-2029 (PDE2029). Considering this, imports of this fuel would be necessary for the medium and low growth scenarios over the entire horizon, whereas, for the high growth scenario, only in the period from 2025 to 2027 the gasoline balance would be positive, not requiring net fuel imports. In 2030, A gasoline imports would reach 9.3 billion, 5.7 billion and 1.7 billion liters for the low, medium and high growth scenarios, respectively.

OTHER RESULTS

The study also showed that, in 2030, the sugarcane bioelectricity is expected to inject 4.2 GWm, 4.5 GWm and 4.9 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 6.6 MMNm³, 7.5 MMNm³ and 8.2 MMNm³ in 2030, for low, medium and high growth scenarios, respectively. In contrast, avoided GHG emissions from use of fuel ethanol and bioelectricity will reach 62.5, 67.2 and 70.0 MtCO₂ 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 27.3 billion, 44.7 billion and 69.0 billion reais for growth scenarios low, medium and high, respectively.

The document considers that the ethanol supply trajectory by 2030 will be defined by the execution of the RenovaBio and the degree of effectiveness 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.