ENERGY DEMAND OF LIGHT-DUTY VEHICLE: 2018-2030

Empresa de Pesquisa Energética

NUMBER 01 RIO DE JANEIRO, OCTOBER 2018

Natural Gas and Biofuels Department/ Biofuels Studies Division
URL: http://www.epe.gov.br |**E-mail:** biocombustíveis@epe.gov.br
Central office: Av. Rio Branco, nº 1 - 11º Andar - CEP 20.090-003 - Rio de Janeiro/RJ

ENERGY DEMAND FOR LIGHT-DUTY VEHICLES

The projected demand for light-duty vehicles based on Otto cycle (automotive gasoline type and ethanol) and hybrid/electric light-duty vehicles for the 2018-2030 study cycle was obtained through an accounting model developed by EPE. For this, besides the economic scenario, several aspects were considered, among them, related to the licensing of light-duty vehicles, the domestic supply of ethanol, the domestic price of gasoline type A and consumer preference between gasoline type C (gasoline type A plus anhydrous ethanol) and hydrous ethanol in flex fuel vehicle supplies. Note that the present study considered the impacts arising from the establishment of the National Biofuels Policy (RenovaBio), through Law No. 13,576, promulgated in December 2017 (BRAZIL, 2017). This important public policy aims to recognize the strategic role of biofuels in the national energy matrix, focusing on security of fuel supply and the mitigation of greenhouse gas emissions (EPE, 2018a).

Technical Team

Executive Coordination
Giovani Vitória Machado

Technical Coordination
Angela Oliveira da Costa

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

I. LICENSING AND FLEET OF LIGHT-DUTY VEHICLES

In 2017, 2.2 million new light-duty vehicles were licensed in Brazil (ANFAVEA, 2018), with flex fuel share being equivalent to 89% of this total. The projection of licensing of light-duty vehicles in the country is consistent with the reference economic scenario, presented in the Economics Booklet (EPE, 2018c), which considers economic growth, encompassing the gradual recovery of the Brazilian economy and the trajectory of household indebtedness. In this context, it is projected an increase of the national fleet of cars and commercial light-duty vehicles, which grows at an average annual rate of 3.1%, and should reach 54 million units for the Otto cycle by the end of the period.

It is noteworthy that the entry of a large number of new vehicles is an important factor in changing the profile of the fleet, either in terms of reducing the average age, or in terms of the share of fuel used.

The evolution of the licensing profile of the various categories was defined as a result of the technological advances obtained, the growth of the economy, the incentives granted through government programs and policies, as well as the uniqueness of the national fuel market, which offers hydrous ethanol in all its filling stations.

In 2017, with the end of the Inovar-Auto Program[1], a new initiative was developed for the automotive industry: the Rota 2030. This program was launched through Provisional Measure established on July 5, 2018 (CONGRESSO NACIONAL, 2018). The following points stand out: the goal of increasing energy efficiency by 11% untill 2022, with a reduction in average fuel consumption; IPI tax

[1] INOVAR-AUTO (Incentive Program for Technological Innovation and Density of the Automotive Vehicle Production Chain) aimed to support the technological development, innovation, safety, environmental protection, energy efficiency and the quality of vehicles and auto parts, pursuant to Decree No. 7,819 of October 3, 2012 (BRASIL, 2012). This program ended in December 2017.

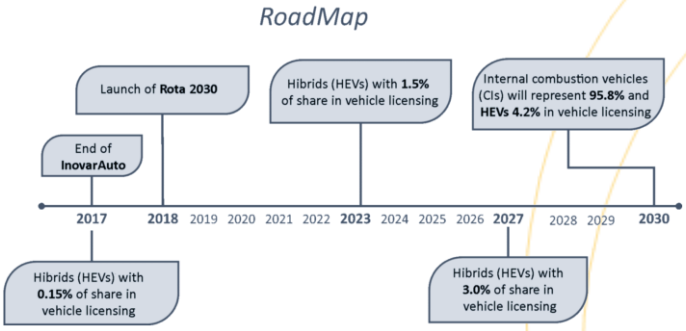
reduction for hybrid and electric vehicles, plus extra discount for motor hybrid flex; labeling with consumption information and safety items. There will also be tax incentives of up to R$ 1.5 billion per year, if companies invest at least R$ 5 billion in research in Brazil. Rota 2030 is expected to last 15 years.

By the end of the period, the Company adopts a car sales profile, mainly internal combustion and flex fuel. EPE treats vehicles called micro-hybrids and mini-hybrids as incremental innovations of conventional vehicles,[2]therefore classifying them in the category of internal combustion. The flex-fuel vehicles, which accounted for 74% of the fleet in 2017, will represent about 90% by 2030. Considering the persistence of technical-economic viability difficulties and the degree of government incentives, it is assumed that hybrid vehicles (not plug in) will continue to gradually expand their participation in the Brazilian market, reaching 4.2% of licenses in 2030. The insertion of hybrids plug in and electrical will not have statistical significance until 2030.

It is estimated, based on the particularity of the Brazilian market, that the national development of hybrid technology with flex fuel motorization will occur, what will impact the licensing profile of new light-duty vehicles. Thus, it was assumed that the hybrids will be imported gasoline type vehicles by 2020 and that, from 2021, they will be produced by national automakers with technology flex fuel.

Figure 1 below illustrates the roadmap with the milestones for hybrid entry in Brazil

Figure 1 – *Road map* of hybrid vehicles



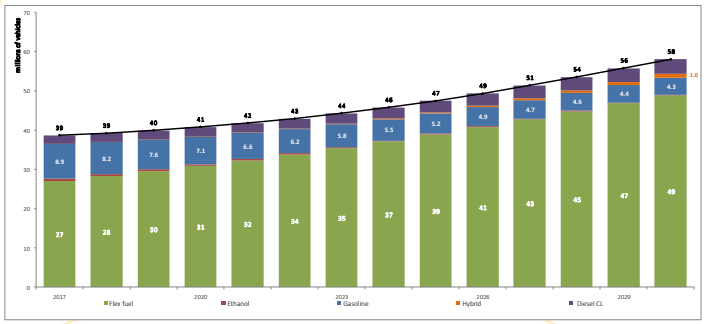
Source: EPE

For Otto-cycle demand projection, in addition to the assumptions related to licensing and fleet profile, the following aspects were also considered:

- Evolution of vehicle efficiency: a gain of 1.0% per year in the average efficiency of new vehicles entering the country was admitted. It is expected that with the implementation of Rota 2030, the stimulus for the introduction in the national market of technologies already available internationally, such as the *stop start*, the use of lighter materials and improvements in the propulsion system;
- Choose between hydrous ethanol and gasoline type C: the variable preference of flex-fuel consumer is a function of the evolution of the relative price of these fuels, which, in turn, results from the comparison between the projection of total fuel demand for the Otto cycle national fleet (measured in volume of gasoline-equivalent) and the projection of the domestic supply of fuel ethanol;
- It has been assumed that the mandatory anhydrous content added to gasoline type A will be maintained at 27% over the entire study period (MAPA, 2015).
- Cars will be the predominant light-duty vehicles in licensing, although there is a growing share of light-duty commercials (including SUVs).

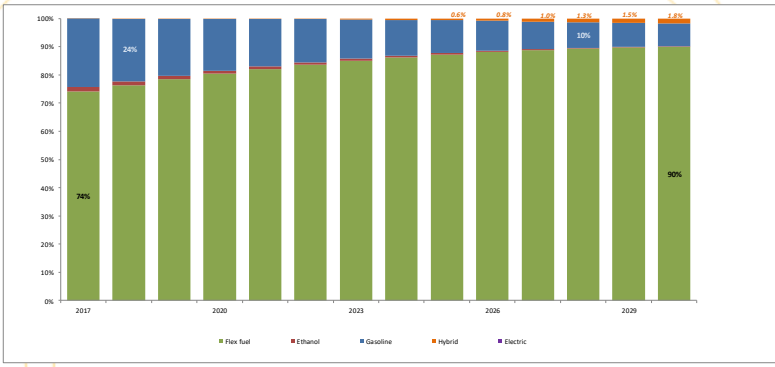
The following graphs illustrate the total light-duty vehicle fleet and the Otto-cycle fleet profile, projected until 2030.

Chart 1 – Light-duty vehicle fleet 2017–2030



EPE, 2018

Chart 2 – Share in the Otto-cycle fleet



EPE, 2018

Over the 2030 horizon, the increase in income is considered per capita population (EPE, 2018c) and the urbanization rate of cities, associated with the low level of motorization observed in Brazil

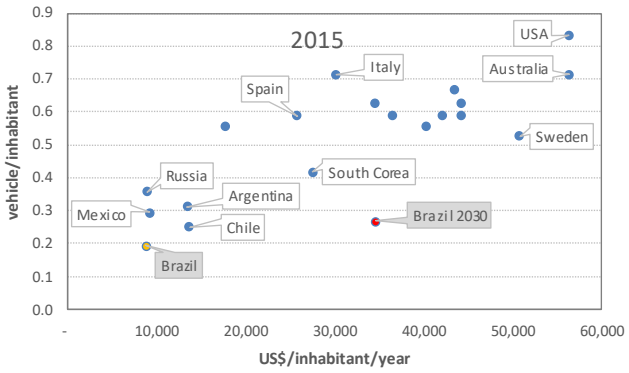
[2] For more details, see MACHADO, COSTA e STELLING (2018).

and still poor public transport, will be reflected in the increase in individual vehicle ownership.

The national fleet of light-duty vehicles, added to that of buses and trucks, should correspond, in 2030, to about 60 million vehicles. As a result, the level of motorization evolves from 5.1 inhabitant/vehicle in 2017 to 3.7 inhabitant/vehicle in 2030 (or 0.19 and 0.27 vehicles/inhabitants respectively), similar to that observed in countries such as Argentina, Chile and Mexico in 2015, as illustrated by Chart 3.

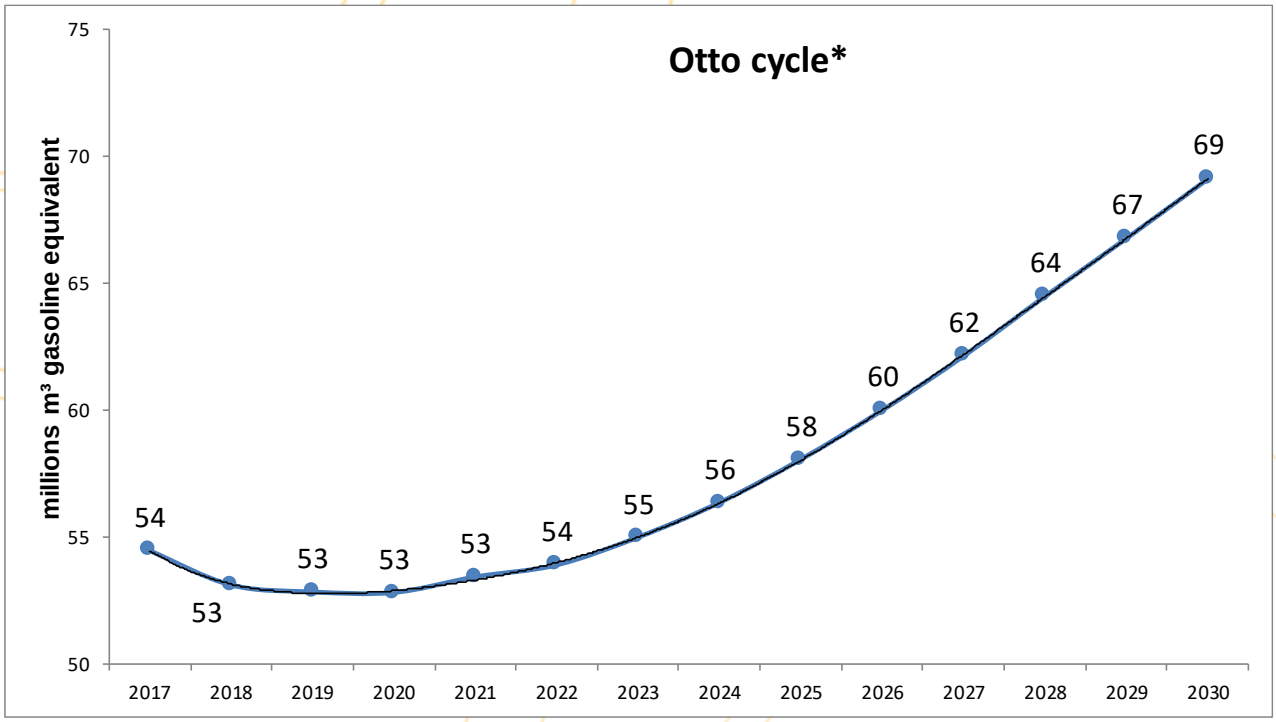
Thus, from 2017 to 2030, for the light-duty vehicle licensing trajectory described, it is estimated that the global demand for Otto cycle fuels (million m^3 of gasoline type equivalent) will grow by 1.9% per year, as shown by the Chart 4.

Chart 3 – Evolution of motorization rate



Source: ANFAVEA, 2018 EPE, 2018c, WORLD BANK, 2018

Chart 4 – Otto cycle global demand*



Source: EPE
Note: *Excludes CNG

II. AUTOMOTIVE GASOLINE

From the projection of the total domestic supply of fuel ethanol, corresponding to the Average Growth Scenario presented in EPE (2018d), it was estimated the share of flex-fuel vehicle demand which will be met by hydrous ethanol and that one which will be met by gasoline type C (gasoline type A + anhydrous ethanol).

The demand for gasoline type A, in the period evaluated, is intended to meet both the dedicated gasoline type fleet and the portion of the flex-fuel fleet, which consumes this fuel. In 2017, this demand was 32.2 million m^3 (EPE, 2018b). It is estimated that by 2030 the volume of this fuel will be 33.7 million m^3. The rate between 2017 and 2030 will be 0.3% per year.

In relation to the national demand for gasoline type C, with the mandatory addition of anhydrous ethanol, an analogous rate to that observed for gasoline type A, 0.3% p.a., is projected to increase from 44.3 billion liters in 2017 to 46.1 billion liters at the end of the period. To fully meet the growing demand for fuels from the Otto cycle vehicle fleet, there is also a growth in demand for hydrous ethanol at

much higher rates, as will be shown below. Table 2 consolidates projections of C and A gasoline type demand.

Table 1 Demand projections for gasoline type C and A

	one thousand m³/year			Variation Period (% p.a.)		
Year	2017	2025	2030	2017–2025	2025–2030	2017 - 2030
Gasoline type C	44,301	38,658	46,123	-1.69	3.59	0.31
Gasoline type A	32,229	28,220	33,670	-1.65	3.59	0.34

Source: EPE

III. ETHANOL

This item deals with liquid biofuels for the supply of Otto-cycle motor vehicles: fuel ethanol, hydrous and anhydrous.

The projection of fuel ethanol demand was prepared in conjunction with that of gasoline through the fuel demand model for light-duty vehicle developed by EPE. The behavior of gasoline and ethanol demand is determined based on projections of internal fuel ethanol supply and total fuel demand for the Otto cycle national fleet. The demand for anhydrous is calculated from the demand for gasoline type C and the anhydrous content, pre-established by the legislation. Thus, the portion of the energy demand to be met by hydrous ethanol is determined and, consequently, the supply preference of flex-fuel vehicle users.

In 2017, national demand for hydrous ethanol reached 14.5 billion liters (EPE, 2018b). For the period from 2017 to 2030, it is estimated a growth of 6.5% per year, and its volume in 2030 should reach 32.8 billion liters.

For anhydrous ethanol, consumption was 12.1 billion liters in 2017 (EPE, 2018b). By 2030, anhydrous ethanol demand is projected to reach 12.5 billion liters, falling at a rate of 0.2% per year. 2017–2030

Table 2 consolidates projections of anhydrous and hydrous ethanol demand.

Table 2 Projections of hydrous and anhydrous ethanol demand.

	one thousand m³/year			Variation Period (% p.a.)		
Year	2017	2025	2030	2017–2025	2025–2030	2017 - 2030
Anhydrous Ethanol	12,072	10,438	12,453	-1.80	3.59	0.24
Hydrous ethanol	14,514	27,684	32,824	8.41	3.46	6.48

Source: EPE

IV. BOX

Box 1 – Increasing Otto Cycle Demand

Considering a superior light-duty vehicle licensing trajectory, associated with the superior economic scenario (EPE 2018c), the national light-duty vehicle fleet is projected to grow 3.7% per year, reaching 59 million units for the Otto cycle in 2030. Demand for the Otto cycle in Brazil, in this scenario, will increase at a rate of 2.6% per year between 2017 and 2030. In this case, demand for gasoline type A would reach 39.9 million m^3 by 2030, which corresponds to an increase of 1.7% p.a. over the study horizon. Considering the maintenance of the mandatory anhydrous content at 27%, this same rate would be observed for gasoline type C, which would rise from 44.3 billion liters in 2017 to 54.7 billion liters at the end of the period.

In this scenario, demand projections for C and A gasoline type and hydrous ethanol would evolve as follows:

Table 3 – Demand projections of gasoline type C and A for higher licensing path

	one thousand m^3/year			Variation Period (% p.a.)		
Year	2017	2025	2030	2017–2025	2025–2030	2017 - 2030
Gasoline type C	44,301	42,133	54,758	-0.6	5.4	1.6
Gasoline type A	32,229	30,757	39,973	-0.6	5.4	1.7
Hydrated	14,514	26,698	30,377	7.9	2.6	5.8

Source: EPE * Excludes CNG and Diesel

References

1) ANFAVEA - Associação Nacional dos Fabricantes de Veículos Automotores. **Anuário Estatístico 2018**. São Paulo, 2018. Disponível em: http://www. anfavea.com.br. Accessed in: 13 May 2018.
2) BRAZIL – Decree No. 7,819, of October 3, 2012. Provides for the Incentive Program for Innovation of the Automotive Vehicle Production Chain – INOVAR-AUTO. Diário Oficial da União, Brasília, DF, 03 Dec. 2012. Available at: http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/Decreto/D7819.htm . Accessed in: 13 Aug 2017.
3) _____. Law No. 13,576, of Tuesday, December 26, 2017. Provides for the National Biofuels Policy (RenovaBio) and makes other arrangements. Diário Oficial da União, Brasília, DF, December, 27 2017. Available at: www.planalto.gov.br. Accessed in: 28 Dec 2018
4) NATIONAL CONGRESS. Provisional Measure No. 843, of 2018. Establishes mandatory requirements for the commercialization of vehicles in Brazil, establishes the Rota 2030 – Mobility and Logistics Program and provides for the tax regime of non-produced autoparts. Disponível em https://www.congressonacional.leg.br. Accessed in Aug 13. 2018.
5) EPE - Empresa de Pesquisa Energética. Análise de Conjuntura dos Biocombustíveis: ano 2017. Rio de Janeiro, 2018a. Disponível em http://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-167/Analise_de_Conjuntura_dos_Biocombustiveis-Ano_2017.pdf . Accessed in 13 Jul. 2018.
6) _____. Balanço Energético Nacional 2018. Ano Base 2017. Rio de Janeiro, 2018b. Available at: http://www.epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/BEN-Series-Historicas-Completas Acesso em: 13 Jun 2018.
7) _____. Caderno de Economia. Ano I. Número 1. Rio de Janeiro, 2018c. Available at: http://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-280/Caderno%20de%20Economia_vf.pdf. Accessed in: 13 Apr 2018.
8) _____. Cenários de Oferta de Etanol e Demanda do Ciclo Otto. Rio de Janeiro, 2018d. Available at: http://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-255/topico-392/EPE-DPG-SGB-Bios-NT-01-2017-r0_Cenarios_de_Oferta_de_Etanol.pdf. Accessed in: 13 Aug 2018.
9) MACHADO, Giovani V.; COSTA, Angela O. da; STELLING, Patrícia F. B. (2018). A Estrada à Frente: Oportunidades e Desafios para a Eletromobilidade no Brasil. Apresentado em Rio Oil&Gas Expo & Conference 2018, Rio de Janeiro: Organização IBP (IBP1714_18).
10) MAPA - Ministério da Agricultura, Pecuária e Abastecimento. Ordinance No. 75, of March 5, 2015. Fixa o percentual obrigatório de adição de etanol anidro combustível à gasolina. **Diário Oficial da União**, Brasília, DF, 06 mar. 2015 Disponível em: http://sistemasweb.agricultura.gov.br/sislegis/action/detalhaAto.do?method=consultarLegislacaoFederal Acesso em: 13 Jun 2018.

11) THE WORLD BANK – World Bank Open Data. Available at https://data.worldbank.org/. Accessed in Aug 13. 2018.