

This report was prepared from the 2018 OECD/IEA World Energy Balances, combined with data and information provided by the IEA Bioenergy Executive Committee and Task members. All individual country reports were reviewed by the national delegates to the IEA Bioenergy Executive Committee, who have approved the content. General background on the approach and definitions can be found in the central introductory report¹ for all country reports.

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NATIONAL POLICY FRAMEWORK IN BRAZIL

The official document that is driving the national policy framework of renewable energy today is the Federative Republic of Brazil **nationally determined contribution** (NDC)² towards achieving the objective of the United Nations framework convention on climate change. This document, announced in December 2015 in the Paris Conference (COP 21), gives the broad perspective of the Brazilian energy trends for the next years and provides orientation for the main energy planning document, the PDE (Ten Year's Energy Plan, also known as Plan for Energy Expansion), elaborated by EPE (Energy Research Agency) and published every year by the Ministry of Mines and Energy.

Also, all policies, measures and actions to implement Brazil's NDC are carried out under the National Policy on Climate Change (Law 12,187/2009), the Law on the Protection of Native Forests (Law 12,651/2012, hereinafter referred as Forest Code), the Law on the National System of Conservation Units (Law 9,985/2000), related legislation, instruments and planning processes. The Government of Brazil is committed to implementing its NDC with full respect to human rights, in particular rights of vulnerable communities, indigenous populations, traditional communities and workers in sectors affected by relevant policies and plans, while promoting gender-responsive measures.

Brazil is a developing country with several challenges regarding poverty eradication, education, public health, employment, housing, infrastructure and energy access. In spite of these challenges, Brazil's current actions in the global effort against climate change represent one of the largest undertakings by any single country to date, having reduced its emissions by 43,9% (GWP-100; IPCC SAR) in 2015 in relation to 2005 levels.³

¹ Available at <https://www.ieabioenergy.com/iea-publications/country-reports/2018-country-reports/>

² Available at: http://www.planalto.gov.br/ccivil_03/_ato2015-2018/2017/decreto/D9073.htm

³ Source: MCTIC. Estimativas anuais de emissões de gases de efeito estufa no Brasil. Fourth edition (2017). Available at <http://sirene.mcti.gov.br/publicacoes>, accessed on 30 August 2018.

Brazil is nevertheless willing to further enhance its contribution towards achieving the objective of the Convention, in the context of sustainable development. Brazil's NDC represents a progression in relation to its current undertakings, in both the type and levels of ambition, while recognizing that emissions will grow to meet social and development needs.

Brazil already is a large producer and consumer of bioenergy. Brazil has reduced the deforestation rate in the Brazilian Amazonia by 82% between 2004 and 2014. Brazil's energy mix consists of 43% (in 2017) of renewables (80% of renewables in its electricity supply, in 2017). This already qualifies Brazil as a low carbon economy.

Brazil intends to adopt further measures that are consistent with the 2°C temperature goal, in particular:

i) increasing the share of sustainable bioenergy in the Brazilian energy mix to approximately 18% by 2030, by expanding biofuel consumption, increasing ethanol supply, including by increasing the share of advanced biofuels (second generation), and increasing the share of biodiesel in the diesel mix;

ii) in land use change and forests:

- strengthening and enforcing the implementation of the Forest Code, at federal, state and municipal levels;
- strengthening policies and measures with a view to achieve, in the Brazilian Amazonia, zero illegal deforestation by 2030 and compensating for greenhouse gas emissions from legal suppression of vegetation by 2030;
- restoring and reforesting 12 million hectares of forests by 2030, for multiple purposes;
- enhancing sustainable native forest management systems, through georeferencing and tracking systems applicable to native forest management, with a view to curbing illegal and unsustainable practices;

iii) in the energy sector, achieving 45% of renewables in the energy mix by 2030, including:

- expanding the use of renewable energy sources other than hydropower in the total energy mix to between 28% and 33% by 2030;
- expanding the use of non-fossil fuel energy sources domestically, increasing the share of renewables (other than hydropower) in the power supply to at least 23% by 2030, including by raising the share of wind, biomass and solar;
- achieving 10% efficiency gains in the electricity sector by 2030.

In addition, Brazil also intends to:

iv) in the agriculture sector, strengthen the Low Carbon Emission Agriculture Program (ABC) as the main strategy for sustainable agriculture development, including by restoring an additional 15 million hectares of degraded pasturelands by 2030 and enhancing 5 million hectares of integrated cropland-livestock-forestry systems (ICLFS) by 2030;

v) in the industry sector, promote new standards of clean technology and further enhance energy efficiency measures and low carbon infrastructure;

vi) in the transportation sector, further promote efficiency measures, and improve infrastructure for transport and public transportation in urban areas.

Table 1: Brazil's 2026 energy targets

Sector	2026 (Mtoe)	Δ 2016-2026 (%)
Logwood	16,546	-7%
Charcoal	3,877	10%
Sugarcane bagasse	37,373	29%
Ethanol	20,371	47%
Biodiesel	5,901	87%
Electricity	63,760	44%
Total energy consumption*	308,364	20%

Source: Plan for Energy Expansion 2026, table 47 (page 255) and table 45 (page 253)

*Including all other sources as Oil and Natural Gas

Table 2: Projected renewable electricity capacities in Brazil in 2026

Sector	2026 (GW)	2016 (GW)	Δ 2016-2026 (%)
Hydro**	103.5	89.7	+15%
Small hydro	8.1	5.8	+40%
Biomass	16.9	12.9	+31%
Wind	28.5	10.02	+184%
Solar	9.7	0,021	+46090%

Source: Plan for Energy Expansion 2026, according table 14, page 102.

**Without the share of the Itaipu HPP belonging to Paraguay, whose surplus energy is exported to the Brazilian market.

A detailed description of all fiscal and non-fiscal supports for bioenergy development is available at: <http://www.iea.org/policiesandmeasures/renewableenergy/?country=Brazil>

TOTAL PRIMARY ENERGY SUPPLY (TPES) AND THE CONTRIBUTION OF BIOENERGY

The total primary energy supply of Brazil in 2016 amounted to 11,912 petajoule (PJ). Fossil energy represents 55%, and renewable energy a substantial share of around 43%. Fossil energy includes 4,578 PJ oil products, 1,250 PJ natural gas and 667 PJ coal products. Nuclear energy represents a small share of 1.2% of total primary energy supply or 173 PJ. Renewable energy sources have a share of 42.8% or 5,094 PJ – 30.0% bioenergy and 12.8% other renewable energy sources. 147 PJ of electricity is imported, which represents 1.2% of Brazilian TPES.

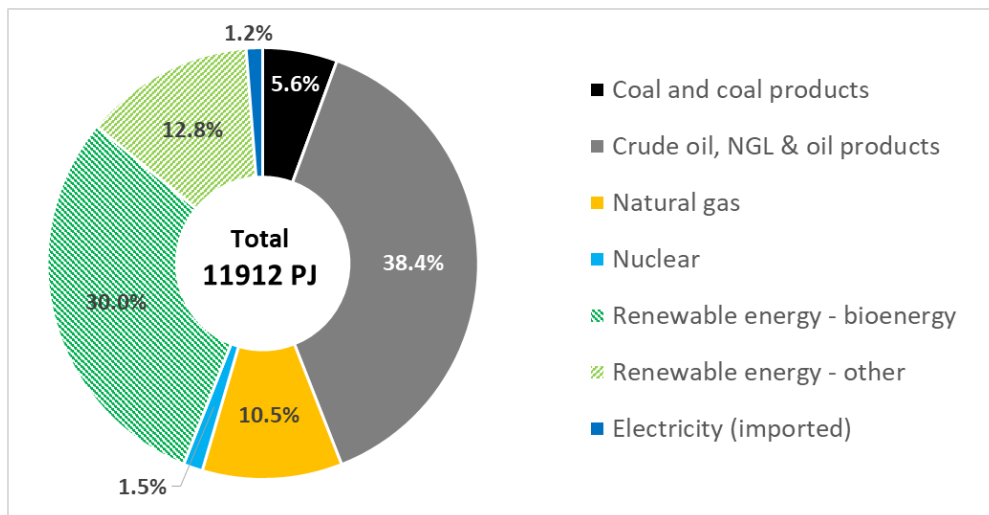


Figure 1: Total primary energy supply in Brazil in 2016 (Source: World Energy Balances © OECD/IEA 2018)

Compared to 5 years earlier (2011) the share of coal and nuclear remained fairly stable, while oil reduced from 40.3% to 38.4% and the share of natural gas increased from 8.5% to 10.5%. The role of bioenergy increased from 28.9% to 30%. Other renewable energy (non-bioenergy) reduced from 13.9% to 12.8%. This is particularly linked to a reduction in hydro-energy (while other renewable energy like wind increased, but at much smaller level than hydro).

Renewable energy sources in Brazil are dominated by bioenergy (3,570 PJ), followed by hydropower (1,371 PJ). There are some small shares of wind energy (121 PJ) and solar energy (32 PJ).

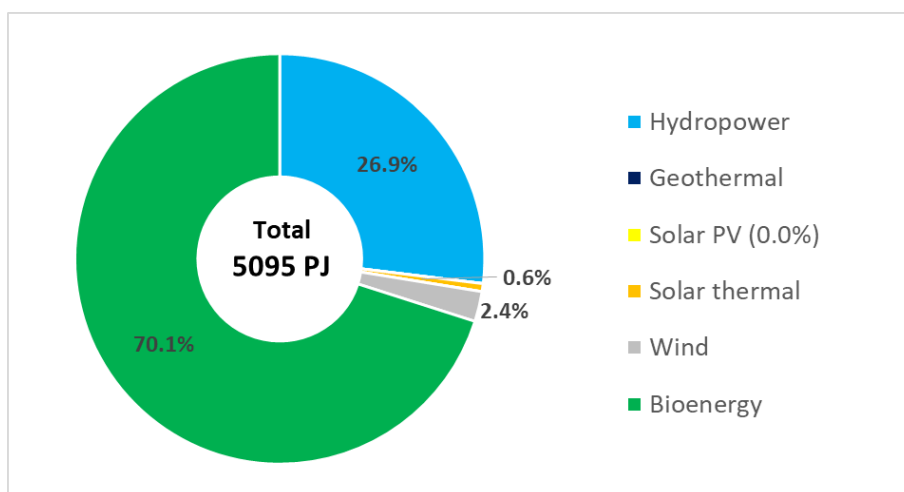


Figure 2: Total primary energy supply of Renewable Energy Sources in Brazil in 2016 (Source: World Energy Balances © OECD/IEA 2018)

Most bioenergy (80%) in Brazil is from solid biomass (2,868 PJ). Most of this is bagasse, consumed in the sugar and ethanol industry. Only about 265 PJ of solid biomass is consumed by the residential sector. The other 20% are liquid biofuels. Mind that in the Brazilian statistics biogasoline is defined as anhydrous bioethanol blended with gasoline at blending levels of around 20%; 'other liquid biofuels' contains hydrous ethanol which is used in dedicated or flex-fuel vehicles. So in total bioethanol represents 583 PJ or 17% of bioenergy. The role of biodiesel is smaller (3.1% or 111 PJ) and biogas has a limited role (8 PJ).

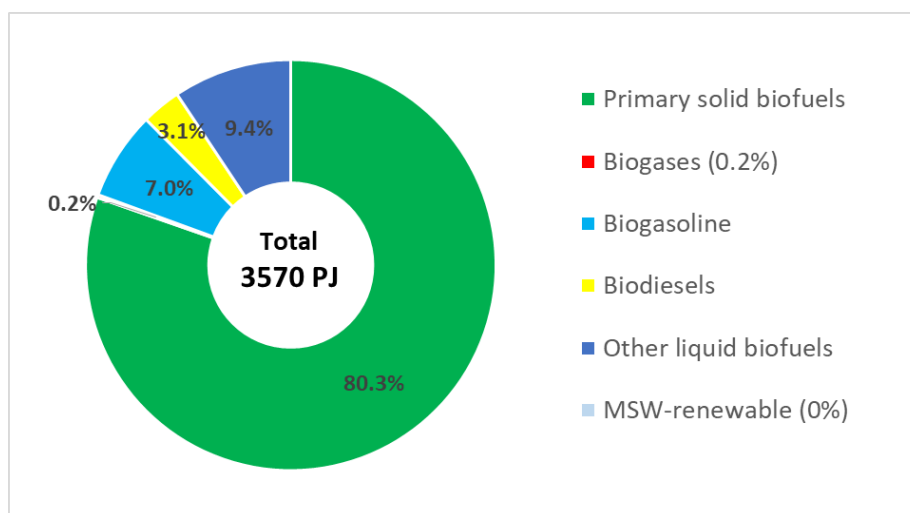


Figure 3: Total primary energy supply from bioenergy in Brazil in 2016 (Source: World Energy Balances © OECD/IEA 2018)

The share of bioenergy in TPES in Brazil is around 27-30% in the past 10 years, with an important role both for solid biomass and liquid biofuels. From 1990 to 2010 overall TPES in Brazil almost doubled from 5.9 to 11.1 exajoule (EJ). In the period 1990-2000 bioenergy consumption was fairly constant, which meant that the share in overall TPES went down from 34% to 25%. This has picked up again between 2000 and 2010, when bioenergy increased by 75% (which represents an average growth rate of 6% per year). There was a particular high increase in liquid biofuels between 2005 and 2010 which doubled in 5 years. After 2010 the levels of solid biomass and liquid biofuels stabilized. While the use of solid biomass remained fairly stable afterwards, there is again a growth in liquid biofuels since 2012. Biogas is also growing in the past years, but these levels are still very small.

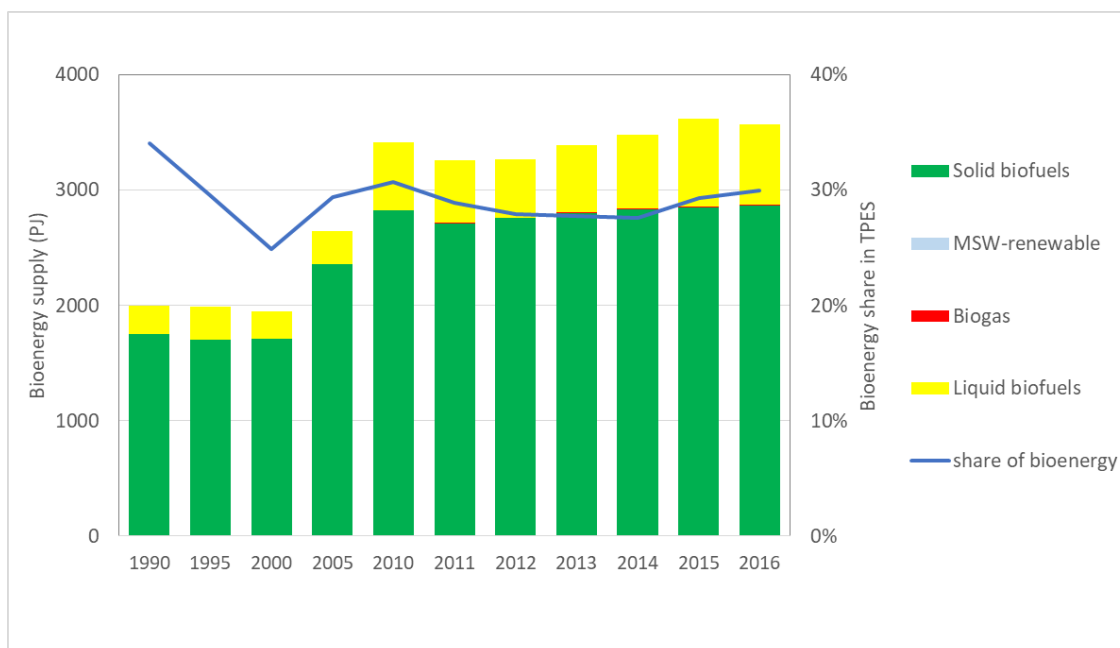


Figure 4: Development of total primary energy supply from bioenergy in Brazil 1990 – 2016 (Source: World Energy Balances © OECD/IEA 2018)

Table 3 expresses the 2016 TPES figures per capita, considering Brazil's population of 207.7 million people. Compared to the other 22 member countries of IEA Bioenergy (expressed per capita), Brazil ranks in the top 3 for liquid biofuels, and 6th for solid biofuels. Mind that in relation to its overall primary energy supply (% of TPES) the role of bioenergy in Brazil is highest of all IEA Bioenergy member countries. Biogas and renewable MSW for energy are underdeveloped in Brazil compared to the other countries.

Table 3: Total primary energy supply per capita in Brazil in 2016

	GJ/capita
Total energy	57.4
Bioenergy	17.2
Solid biofuels	13.8
Renewable MSW	0.0
Biogas	0.04
Liquid biofuels	3.3

Role of bioenergy in different sectors

Brazil has a very high share of renewable electricity, reaching 80% of total electricity production in 2016. Most is hydropower (66% of total electricity production), the rest of renewable electricity is divided between bioenergy (8.7%) and other renewable energy sources (5.8%).

The share of biofuels for transport is very high, with around 20% in 2016, which is higher than any other member country of IEA Bioenergy. The role of renewable electricity in the Brazilian transport system is very modest.

Biomass represents half of fuel/heat consumption, and this is similar for the overall share of biomass for heating in the different sectors (industry/residential). Heat output generated and sold by CHP and heat plants is not significant.

Table 4: Role of bioenergy and renewable energy in electricity production, transport energy consumption and fuel/heat consumption in 2016

Sector	Share of bioenergy	Share of renewable energy	Overall production/ consumption
Electricity production	8.7%	80% (66% hydro)	579 TWh (2,084 PJ)
Transport energy (final consumption)	19.9%	20.1%	3,474 PJ
Overall fuel and heat consumption⁴	48.5%	48.5%	3,512 PJ

Source: 2018 World Energy Balances © OECD/IEA

The following figure shows the development of energy and bioenergy consumption in Brazil from 1970 to 2016. The total energy supply has increased steadily.

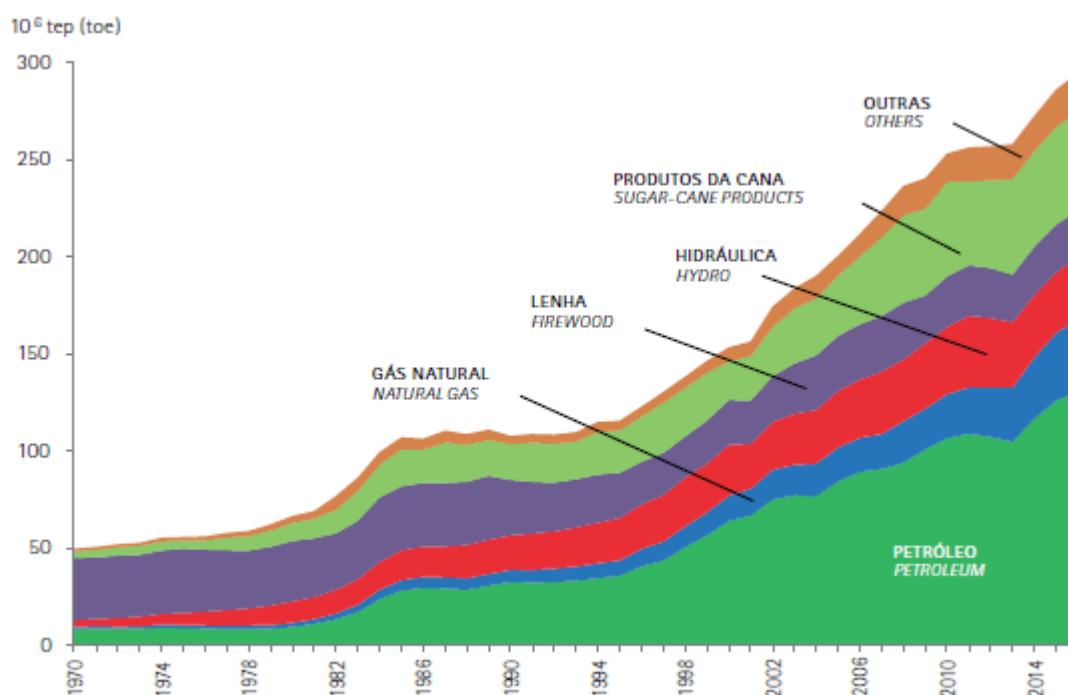


Figure 5: Evolution of domestic energy supply in Brazil from 1970-2016. Source: Brazilian Energy Balance EPE/MME (2017), page 23. Available at: https://ben.epe.gov.br/downloads/Relatorio_Final_BEN_2017.pdf

⁴ This includes final consumption of fuels and heat in industry, the residential sector, commercial and public services and agriculture/forestry. Transport fuels are excluded. Energy used for transformation and for own use of energy producing industries is also excluded.

RESEARCH FOCUS RELATED TO BIOENERGY

Currently, one of the main actions in Brazil in research related to bioenergy is second-generation ethanol (E2G). The E2G has the potential to promote large expansion of ethanol production in Brazil, in synergy with traditional ethanol from the sugarcane, without the need to increase cultivated area, increasing competitiveness of this fuel. Another possibility is to use elements such as sugarcane straw, or even other fibres, such as sugarcane bagasse, wood chips or rice straw, for example.

Currently, private agents and the Brazilian government, under the RenovaBio Program, are engaged in the promotion of second-generation biofuels in Brazil.

According to the Plan for Energy Expansion (PDE)⁵, Brazil has two commercial second generation ethanol plants (Granbio and Raízen) and one experimental ("Centro de Tecnologia Canavieira" CTC), with nominal production capacity of 82, 42 and 3 million litres per year, respectively.

Source: <http://www.mme.gov.br/web/guest/secretarias/petroleo-gas-natural-e-combustiveis-renovaveis/programas/renovabio/principal>

RECENT MAJOR BIOENERGY DEVELOPMENTS

RenovaBio is a State policy that aims to draw up a joint strategy to recognize the strategic role of all types of biofuels in the Brazilian energy matrix, both for energy security and for mitigation of reduction of greenhouse gas emissions.

The objectives of the RenovaBio Program are:

- Provide an important contribution to the fulfilment of Brazil's **Nationally Determined Contribution** under the Paris Agreement
- Promote the adequate expansion of biofuels in the energy matrix, with emphasis on the regularity of the fuel supply
- Ensure predictability for the fuel market by inducing gains in energy efficiency and reduction of greenhouse gas emissions in the production, commercialization and use of biofuels.

⁵ Plan for Energy Expansion (Chapter 8, page 195), available at: <http://www.epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/plano-decenal-de-expansao-de-energia-pde>

LINKS TO SOURCES OF INFORMATION

Ministry of mining and energy: <http://www.mme.gov.br/>

Energy research agency (Empresa de Pesquisa Energética): <http://epe.gov.br/>

Brazilian Nationally Determined Contribution (NDC), Accessed on 30 august 2018:

http://www.itamaraty.gov.br/images/ed_desenvsust/BRAZIL-iNDC-english.pdf or

<http://www4.unfccc.int/submissions/INDC/Published%20Documents/Brazil/1/BRAZIL%20iNDC%20english%20FINAL.pdf>

Decree nº 9.073/2017 (June 5, 2017), available at: http://www.planalto.gov.br/ccivil_03/_ato2015-2018/2017/decreto/D9073.htm

Brazilian Energy Balance: <http://www.epe.gov.br/en/publications/publications/brazilian-energy-balance> and <http://www.epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/balanco-energetico-nacional-ben>

Brazilian Plan for Energy Expansion: <http://www.epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/plano-decenal-de-expansao-de-energia-pde>

Resenha Energética Brasileira (Brazilian Energy Review):

<http://www.mme.gov.br/documents/10584/3580498/02+->

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