



## ENERGY TRANSITION AND PUBLIC POLICIES IN RENEWABLE ENERGY IN BRAZIL

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### ABSTRACT

To understand the use of biomass as a source of energy in Brazil it is important to know about the challenges and the public energy policies that engender the theme. Brazil has one of the most sustainable energy matrixes of the world. This accomplishment was the resulting efforts toward the intensification of the use of renewable sources every decade. The objective of this paper is to give an overview of the programs and projects related to the energy transition and renewable energy in Brazil. The paper will present those programs and the main axes of it. To understand these energy policies since 2000's and the results achieved is important to know the challenges that the policy maker face nowadays in a world which climate changes agenda is the one of the points to be considered.

**Keywords:** Biomass, Technological uses, Biofuels, Public policies.

### Introduction

Brazil is a reference as a country that has one of the most sustainable energy matrixes of the world. According to the Energy Research Company [1], in 2022, 48,4% of the energy matrix are due to renewable sources despite the 15% of the world. In fact, the investment on renewable energy is one of the remarkable points of the Brazilian energy policies.

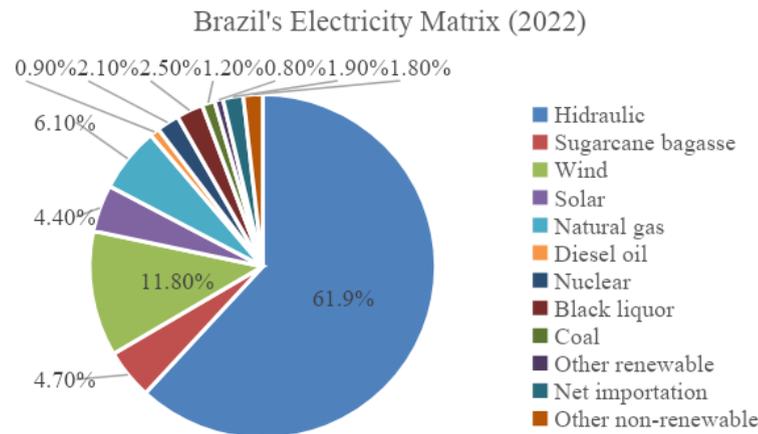
When considering the electric matrix, the hydropower source predominates in the mix. It represents 61,9% of the total, wind at second place with 11,8% and sugarcane bagasse in third, with 4,7%. And that is a result of an energy policy of the 60's which brings the idea of the construction of large-scale hydropower plants using the countries' hydro potential.

Biomass, nevertheless, has entered in the discussion, specifically when considering electricity purposes, through the public policy Incentive Program for Alternative Electric Energy Sources – PROINFA, in 2002. The Law n° 10.438/2002 was the largest program in the world to encourage alternative sources of electricity [2]. Also, considering the energy transition and the Paris Agreement, RenovaBio was implemented to expand biofuels considering annual decarbonization targets [3].

In this sense, the main objective of the present work is to present public policies in Brazil regarding energy transition themes, as incentives of renewable energy and biofuels.

#### A. Biomass in the Brazilian energy balance

Brazil is an overseas country. The geographic extension allows to explore different types of energy sources. The electricity matrix is composed by renewable sources (87,9%) and non-renewable sources (12,1%), as seen in **Figure 1**. Compared to other countries, in the world this composition is about (26,6%) of renewable and (73,4%) non-renewable.[1] Most of the renewable sources of energy used in Brazil comes from hydro sources (62%) and (8%) from biomass. The majority source used as biomass come from: sugar cane residues; firewood; black liquor and agricultural residues. [4]



**Figura 1** Brazil's electricity matrix, in 2022  
Source: EPE (2022).

In spite of the huge geographic extension, the share of biomass is almost the same as in 2020. The sugar cane residues dominate the process of generating energy from biomass.<sup>1</sup> This concentration in one important biomass fuel is directly related to the fact that the production of it is outstanding in Brazil compared to the other biomass biofuels. [5]

Other factors must be considered to understand the concentration in one biomass fuel. It is important to analyze the technological factors, human capital, logistic, engineering factors. As a large country, logistic factors and technological ones may tend to build a production chain based on certain biomass fuels that can be transported easily from one point to other in the country. On the other hand certain biomass fuel can be very sophisticated and the lack of human beings specialized on those biofuels the production will face high costs of production and transportation. [6]

The internal offer of energy in Brazil, in 2019, was 12,9 extra joules (EJ) toe<sup>2</sup>. As we can see the internal offer comes from of renewable sources (45,5%). Biomass (31,9%); Hydric (11,6%); Windpower (1,6%) and Solar (0,2%). This confirms the tendency of Brazil to continue its improvement toward the use and production of biomass biofuels. [6] According to the Ten-year expansion energy plan, 2031 [6], it is expected 2,1 GW on renewable thermal units, where sugarcane bagasse (666 W), black liquor (363 MW), chips and residues (297 MW) and biogas from MSW (33 MW).

Considering the implementation of bioenergy, it has been taking place at three distinct levels. First level include at low powers ranging from 1to 3 to a few dozens of kW (typical of small communities). The second level, reaches up to some MWs, which is typical of communities with hundreds of inhabitants, saw-mills, furniture factories and rice treatment plants. The last level, include power over 5–10 MW, typical of sugar and alcohol plants, cellulose and paper factories and biomass thermal power plants as well. [6]

All these energy expansion plans are in line with some public policies that have been implemented through the years, and which are presented in the following sections.

## B. Public policies on energy: biofuels and other sources

### PROINFA

<sup>1</sup> Bioenergy is a form of renewable energy generated when we burn biomass fuel. Biomass fuels come from organic material such as harvest residues, purpose-grown crops and organic waste from our homes, businesses and farms. Biomass can be converted to energy in different ways: Direct combustion (burning) to produce heat. Thermochemical conversion to produce solid, gaseous, and liquid fuels. Chemical conversion to produce liquid fuels.

<sup>2</sup> Tonnes of oil equivalente.



PROINFA is a program to incentivate the use of alternative sources of energy that was launched in 2004 and regulated by the Decree 5.025/2004 [2]. The goal is that, in the short term, guarantee that the demand on electrical energy was offered from PROINFA until 3.300 MW (biomass, wind and small hydro plants). [7]

The acquisition of this energy based in a feed-in tariff plan in a period of 20 years. It is estimated that this program will attend the 10% of the electrical demand of Brazil. On the other hand, the long term of PROINFA it includes a financial support from BNDES, the Brazilian bank of development and also an obligation that the equipments used to expand the offer must has a 90% index of nacionalization. It means that the engeneering equipments must be built by Brazilian enterprises. [7]

The total investment in PROINFA projects is estimated to range about 3.6 billion dollars. PROINFA's first selection process for biomass projects resulted in the selection of projects comprising 685 MW and the second selection process reached 1.080 MW. A total power of 1.100 kW for biomass generation projects must be authorized. [7]

The first phase brought an outstanding auction of energy sold. As we can see in Table 1, biomass didn't reach the 1.100 MW auction of energy in this phase although it was reached in the 2nd phase which the projects are in the long term.

**Table 1 – Results from 1<sup>st</sup> Phase.**

Source	Expectation	Final contribution
Biomass	1.100 MW	685 MW <sup>1</sup>
CHP plants	1.100 MW	1.191 MW
Windpower	1.100 MW	1.422 MW
<b>TOTAL</b>	<b>3.300 MW</b>	<b>3.299 MW</b>

Source: E.S. Lora, R.V. Andrade (2009)

PROINFA reached its goals in spite of some critics about the tariffs and its value. Some critics are also due to the difficulty of equipments nationalization and services used by the energy generators that were part of the program. Also, financing problems with the National Development Bank (BNDES) [8]. The wind sector was the main benefited of the program, as seen in Table 1, and also when considered job creation. A methodology applied considering direct and indirect job through the years of 2010 and 2020, it was estimated 195 thousand new employees operating in wind farms [9].

## **RENOVABIO**

RenovaBio is a Brazilian energy policy instituted by Law 13.576/2017. It recognizes the strategic role of the biofuels (ethanol, biodiesel, biomethane, biokerosene for aviation and others) in the Brazilian energy matrix with regard to its contribution to energy security, the predictability of market and the mitigation of greenhouse gas emissions (GHG) in the fuel sector.

Renovabio, the Brazilian National Biofuel Policy (RenovaBio), meets of Brazil's Nationally Determined Contributions (NDCs) under the Paris Agreement. Its goal is to reduce emissions of greenhouse gases besides the carbon intensity of the Brazilian transportation matrix by expanding the use of biofuels and creating a carbon credit market to offset those emissions of greenhouse gases.

RenovaBio is composed of 3 strategic axes toward the targets of national decarbonization for the next 10 years. In the first one, Government must establish annual national decarbonization targets. Those targets are unfolded into mandatory individual targets for fuel distributors, proportional to their shares in the fossil fuel market.

The second axis, incorporates biofuel producers voluntarily certifying their production and receive, as a result, energy-environmental sufficiency scores. These notes are multiplied by the volume of biofuel traded, resulting in the decarbonization credit (CBIO) that a producer can commercialize, which is the third axis.[3] The policy aims to reduce the carbon intensity of the transport fuel matrix by 10% and avoid 620 million tons of CO<sub>2eq</sub> emissions from 2018 until 2030.



In other words, one C BIO is equivalent to one ton of CO<sub>2eq</sub> avoided into the atmosphere.[8]<sup>3</sup>Therefore, the more efficient and sustainable the individual production, the more C BIOs can be issued. Actually, RenovaBio recognizes that different biofuels contribute differently to GHG emissions reduction, and those produced with lower carbon intensity (relative to liquid fossil fuel) will generate more C BIO per volume unit.

According to NovaCana [10], data from October 2022 points that certified plants in the Program have emitted 1,8 million decarbonization credits (C BIOs). It represents an increase of 130% considering the first half of the month. In 2022, the total number of registered C BIOs was 25,6 million traded on the Brazilian stock Exchange (B3).

## Conclusion

The importance of energy regulatory milestones for the country is through the results obtained in the development and expansion of the sector. The introduction of Proinfa, as well as Renovabio, represented, and also represent, important measures adopted by the State into account of the goals set by the Paris Agreement for the Energy Sector, i.e. Reduction of Emission GHGs, flexibility and diversification of the electrical and energy system.

Brazil, although holding a prominent role globally by the mostly renewable energy and electrical matrix, has even greater renewable resources not yet explored. Still, policies that can be restructured and adjusted.

The present work sought to present an overview of the most representative public policies in the Brazilian energy sector. And, as a conclusion, it is possible to verify the potentiality of the country given the main results of expansion measures.

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<sup>3</sup> The calculator “RenovaCalc”, a tool based on the life cycle analysis, measures the carbon intensity of biofuels (in g CO<sub>2</sub> eq./MJ) and compares it to its fossil fuel equivalent, generating the “Energy & Environment Efficiency Score”.



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