



Overview of alternative energy in Brazil

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Abstract. Brazil met in a deep financial and economic crisis. In this context, it is widely accepted that the strong industrial competitiveness is vital as an economic engine of growth and job creation. From this point of view, the development and use of new energy sources is needed. In this regard and given the characteristics of Brazil in size and ability to find great alternative energy sources, it is necessary to its use properly. This article offers the opportunity to examine all the crucial and fundamental components that the government has been offering for the growing use of new energy resources. This study shows the activities, growth and development of alternative energy sources since the year of energy crisis grid 2001 to the realization of projections for the next 5 years. The purpose of this study is to show the economic, financial and technological conditions necessary for the development of renewable energy and other domestic energy sources in order to reduce the dependence of small users with private Enterprise.

Key words

Energy, Resource, Renewable and Sustainability.

1. Introduction

In 2001 Brazil underwent an energy crisis that was linked to the lack of planning in the sector and the lack of investment in generation and distribution of energy. Within this lack of planning, the country had 90% of its Electric Energy Matrix of hydroelectric plants, which need rain to maintain the proper level of its reservoirs for power generation. However, there was in that year, a shortage of rain and the water level of the hydroelectric reservoirs were low [1]. Since then, due to the crisis, the government has tried to plan the electricity sector and encourage, by means of public policies, diversification of the Brazilian energy matrix. In this context, some government programs were created:

A. PROEÓLICA

The Wind Energy Emergency Program (PROEÓLICA) was created due to the energy crisis, in order to encourage the hiring of wind power generation projects in the country. This program was aimed the implementation of 1050 MW of electricity generation that comes from the strength of the winds by December 2003. However, this program was not successful and was replaced in 2002 by the Incentive Program for Alternative Sources of Electrical Energy, the PROINFA [2].

B. PROINFA

The Incentive Program for Alternative Sources of Electrical Energy (PROINFA), was released by Law No. 10,438, 2002 (regulated by Decree 4541 and 2002, then the Decree 5025 of 2004). With power purchase agreement for 20 years by Eletrobras and financing up to 80% of the project by BNDES, the program aimed at an early stage to develop 3,300 GW of electricity generation arising, also (1.1 GW for each source) of small hydroelectric plants (SHP), biomass and wind, requiring a service and equipment of national content of at least 60%. Reaching the goal of the first stage, the second stage of the program provides that such alternative sources must meet within 20 years, 10% of the national consumption of electricity, with an equipment nationalization index and minimum in service 90 % [3].

At the end of 2011 the program had not yet reached the goal of the first phase. A total of 119 projects was installed, composed of 41 wind farms, 59 SHP and 19 thermal biomass. Adding the installed capacity of 119 enterprises, it generates 2649.87 MW, comprising 963.99 MW in wind farms, 1152.54 MW in power plants and 533.34 MW in biomass plants [3].

C. Green property tax (IPTU VERDE)

Another development that deserves mention is the creation of green property tax, whereas from 2005 some cities began to encourage people to adopt some sustainable actions, such as the installation of photovoltaic panels to capture solar energy, by means of a percentage discount value of the Urban Building and Land tax (property tax). In some cases, the allowance may reach 100% [4].

D. Auctions

The auctions are the main form of energy contracting in Brazil. These works in a reverse manner, that is, it starts with a maximum price that goes down along the way. Who conducts the electricity auctions is the electric power trading chamber (CCEE), on behalf of the National Electric Energy Agency (ANEEL) [5].

In 2009 it was held the first exclusive competitive auction for energy, from wind sources [6]. Since then, several auctions, regarding renewable energy source, were carried out in order to meet the growing market in the regulated environment and increase the share of renewable sources in the Brazilian energy matrix.

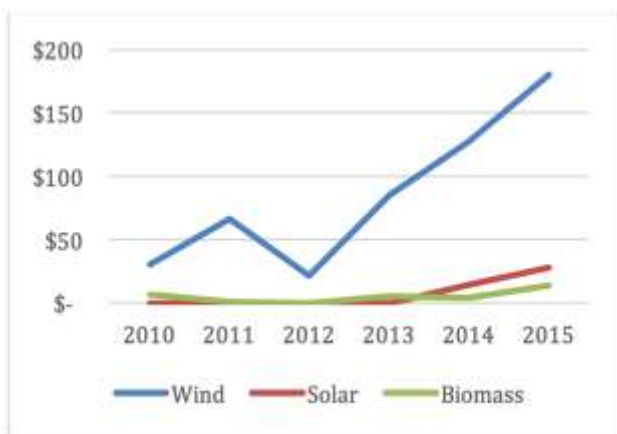


Fig. 1: Power Auction of Brazil in the last 5 years. Source: National Electric Energy Agency - ANEEL

E. Normative Resolution n° 482/2012

In 2012, the National Electric Energy Agency (ANEEL), through Normative Resolution No. 482/2012, created the Net metering, allowing consumers to install small generators (such as solar panels and wind micro turbines) in your consumption unit and when the amount of energy generated in a particular month is greater than the energy consumed in that period, the consumer is left with credits that can be used to reduce the invoice of the following month [7].

2. Currently

Currently, Brazil still has the hydropower plant as the main source of energy [8], but worth mentioning the growth of other renewable sources. It can be seen such an increase from the graph in Fig. 2 that shows the renewable

energy growth (excluding hydroelectric) in the last decade [9].

Within the new renewable energy stands out wind energy, where Brazil is already the world's 10th largest generator, surpassing countries such as Portugal and Sweden, according to the International Agency for Renewable Energy (IRENA) like is showing in Fig.3 [9].

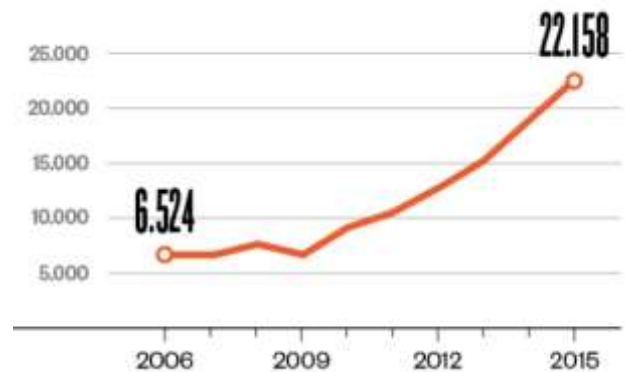


Fig. 2 Renewable energy in Brazil in the last decade (GW). Source: International Renewable Energy Agency (IRENA)

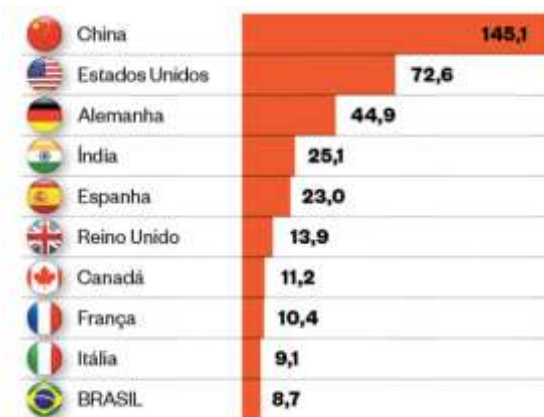


Fig. 3: Wind power in the World in 2015 (GW). Source: International Renewable Energy Agency (IRENA)

However, micro and mini generation in the country has still not become viable for the population. It is known that distributed generation benefits the consumer and the electricity sector [10], since it is in the center of consumption, which reduces the need for electrical transmission structure and prevents losses.

In this context, with the advent of regulatory review 482/2012 (ANEEL) – 687/2015-, [11] the most current action from the Brazilian government was the creation of the Development Program of Distributed Power Generation (ProGD), launched by the Ministry of Mines and Energy (MME), in December 2015, aiming to broaden and deepen the actions of stimulating the generation of energy, by the consumers themselves, based on renewable sources of energy, (especially solar photovoltaic).

The program foresees the elaboration of new horizons for the sale of energy generated by consumers-generators in

the free market. Also the ministries of Mines and Energy and Education study specific project generation systems installation distributed based on photovoltaic panels at universities and federal technical schools, extend to federal hospitals [12].

In addition, the ProGD brings some advances Net metering, established in **Normative Resolution 482**, ANEEL, making it more attractive to consumers the installation of photovoltaic solar panels and wind micro turbines to generate its own energy. These points are [12]:

- 1) *Deadline*: By the new rule, when the amount of energy generated in a given month is greater than the energy consumed in that period, the consumer will have a longer term to use the credits - 60 months, rather than the 36 months previously [12].
- 2) *Condominiums*: Another innovation of the standard concerns the possibility of installing net metering in condominiums. In this configuration, the generated energy can be distributed among the condominiums in percentages defined by the consumers themselves [12].
- 3) *Consortium bank*: The new resolution also created the "Shared Generation" figure, allowing various stakeholders to join a consortium or benchmark, install net metering systems and use the energy generated to reduce invoices from consortium members or cooperative members, as if it were a Single consumer [12].
- 4) *Remote Auto Consumption*: Another innovation is that the consumer can use the credits to write off the invoice of other properties whose that is under their ownership, even in other places, as long as they are in the service area of the same distributor. This type of use of credits was termed "remote Auto Consumption" [12].

The ProGD also has actions that seek tax incentives for distributed generation, such as [12]:

- 1) *Exemption from Tax on Circulation of Goods and Supply of Services (ICMS)*: One of the main contributing factors to the expansion of net metering is the exemption of the ICMS tax on the energy inserted by the consumer in the grid. In the new rule the consumer is only taxed with the ICMS only on the energy that is consumed and not on the one that is generated, that is, the consumer will be taxed only when it receives more energy from the distributor than the one that produces from the net metering. ICMS Agreement No. 16, dated April 22, 2015, of the National Council of Treasury Policy - CONFAZ, regulated this exemption [12].
- 2) *Reduction of import tax*: By December 31, 2016, the Import Tax rate on capital goods destined for the production of photovoltaic solar generation equipment was reduced from 14% to 2%. Provisionally, by December 31, 2015, the tax on imports of photovoltaic modules was reduced from 14% to 2% [12].

- 3) *Support from the National Bank for Development (BNDES)*: Law 13,203, of December 8, 2015, authorized The National Bank for Economic and Social Development (BNDES) to support resources of differentiated energy efficiency and net metering projects by renewable sources in schools and public hospitals [12].

3. Future perspectives

According to data from the National Electric System Operator (ONS), wind energy will take 9% of the Brazilian energy matrix in 2019. [15] With a highly favorable climate, especially in the north / northeast of the country - due to its geographical position as the Brazilian wind is predominantly located in these areas, thus highlighting Brazil in the capacity factor (CF) average compared to other countries-, [16] and public policies that encourage investment in this form generation, the trend is that wind energy occupies an increasingly relevant space in the Electric Energy Matrix for the next years. Such growth can be seen in fig. 4 and fig. 5.

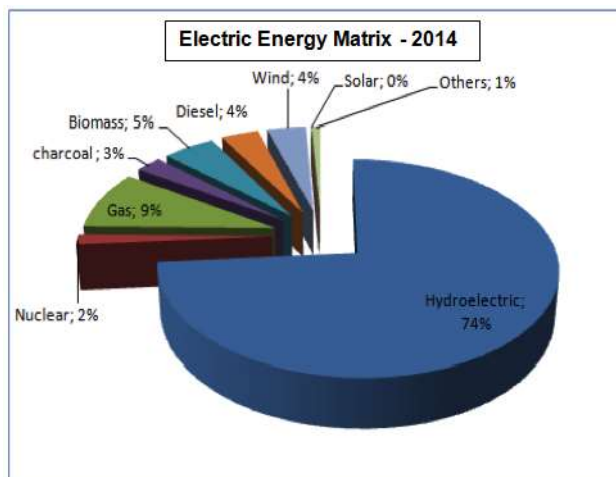


Fig. 4: Electric Energy Matrix in 2014 in Brazil. Source: National Electric System Operator - ONS

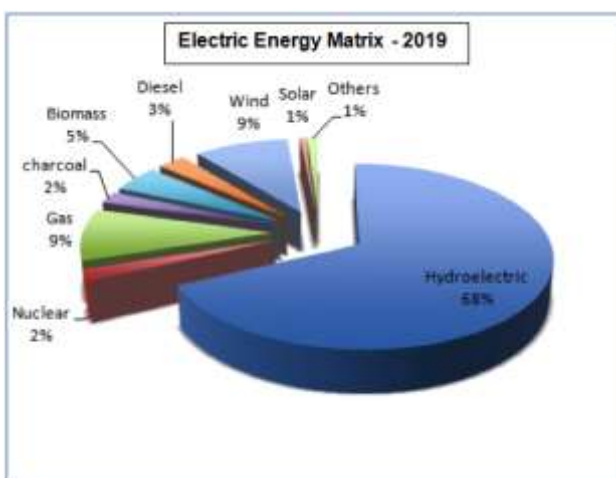


Fig. 5: Electric Energy Matrix in 2019 in Brazil. Source: National Electric System Operator - ONS

Table 1. Growth of Energy Sources in Brazil 2014-2019. Source: National Electric System Operator - ONS.

TYPE	2014	1019	Growth 2014-2019
	MW	MW	Mw
Hydroelectric	94,375.00	113,086.00	18,711.00
Nuclear	1,990.00	3,395.00	1,405.00
Gas	11,625.00	15,477.00	3,852.00
Charcoal	3,210.00	3,550.00	340.00
Biomass	6,428.00	7,969.00	1,541.00
Diesel	4,628.00	4,731.00	103.00
Wind	4,759.00	15,567.00	10,808.00
Solar	8.00	898.00	890.00
Others	1,021.00	1,649.00	628.00
Total	128,044.00	166,322.00	38,278.00

Even with the economic crisis introduced in Brazil since 2015, the prospects of renewable energy are for growing. [13] The Energy Research Company (EPE) estimates for the next 10 years a progressive increase in the use of renewable sources in the Brazilian Electric Energy Matrix, especially wind and solar energy. [14] This growth can be observed already for a projection to 2019 from the analysis of table 1.

According to the Energy Outlook (NEO) study by Bloomberg New Energy Finance (BNEF), Brazil is expected to attract U \$ 300 billion in investments to generate electricity, where approximately 70% will go to solar and wind projects. [18]

Another strong trend is the net metering, which gives a very large growth in the use of solar energy. With the release of ProGD in 2015, the Ministry of Mines and Energy estimates that by 2030, 23500MW (48 TWh produced) of clean and renewable energy will be generated from the net metering [12].

However, regulation is still an obstacle that must be faced by net metering, since the regulator should provide conditions that encourage favorable conditions for the growth of solar generation, but at the same time does not harm other consumers [10].

Another major challenge for the future of renewable energy in Brazil, mainly solar and wind is linked to its variable nature, leading the emergence of problems of stability and security of supply. So, it is the government's duty to seek solutions to these potential problems that may arise in the future as the creation of smart grids [17].

4. Conclusion

Brazil is a country with plenty of energy resources that in recent decades focused on harness the hydroelectric sources as a major alternative energy. This work shows the government's efforts to encourage the use of new energy alternatives. The new policy alternative energy sources in Brazil are constantly updating and improvement.

This gives an opportunity to formulate the development picture, rules and regulations on the technologies to be adopted or developed, power transaction, taxes and incentives. The installation of renewable energy and smart grid systems may require private investment in large scale. The global energy policy should be flexible, so that it is easily negotiated between the government and investors.

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