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The Relation Between the Wind Sector in Brazil and The Global Crisis

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Abstract. This paper aims to present an overview of the evolution of the Brazilian Wind Sector in order to identify its relationship with the increasing external investments in Brazil [1],[2]. Since the global economic crisis of 2008, the Brazilian electricity market has been shown to be attractive due to its level of organization and regulation associated to model of power trading itself. To reach this standard, this electric sector has experienced a sequence of structural reforms that is summarised in this work so as to show the attractive scenario for external investments, especially in the increasing wind energy market.

Key words

Wind energy, external investment, economic crisis, regulated market.

1. Introduction

In recent years, the Brazilian Electric Power Sector has presented a significant growth in which the installed power exceeds the value of 138.9 GW that are assured by 4,322 generations companies including hydro, thermal, nuclear, solar and wind sources. Such diversity is a reflection of a series of reforms that contributed to its regulation, expansion and funding, in especial that one occurred in the 90´s and consolidated in 2003/2004 [3]. Whithin this context, the Brazilian Federal Laws 10.847/04 and 10.848/04 establish a new expansion policy and a new model for the electricity marketing. In addition, they indicate the diversification of the Brazilian energy matrix through government programs such as the Program to Foster Electric Power Alternative Source (known as PROINFA) [4]. Thus, by establishing contracts at the *Feed-in* tariff (FiT) and addressing the small hydroelectric, biomass thermoelectric and wind plants, the PROINFA is considered the starting point of the wind energy sector development in Brazil. Despite that, the great growth of this sector just came since 2009, when the Reserve Auction of Wind Energy, exclusively geared toward the contracting of energy from wind power generating centres, happened [5]. Meanwhile, Brazil is the seccond country in the BRICS group with the greatest level of direct external investment due to the global crisis of 2008[2].

In view of above, this work presents a reflection on the relationship between the expansion of the Brazilian Wind Sector and the increasing external investments as a result of the combination of the worldwide economic crisis, low risk electricity marketing, long term contracts and favourable regulation to energy producers.

2. Recent History of the Brazilian Electric Power Sector

A. The scenario just before the restructuration

During the 1970s, after the de-indexation of the US currency to value of gold as an inflation control mechanism, the central countries experienced an economic crisis. In such period, a worldwide inflation process took place and this affected mainly the peripheral commodity exporter countries, such as the OPEC members that limited the petrol production [6]. Even in a scenario of global pessimism, Brazil presented a growth in GDP which benefited the electricity industry and several power plants were constructed to meet the increasing demand. However, in the 80s, as the rest of commodities exporter countries, Brazil spent a period of economic instability and numerous frustrated attempts to control the inflation. Besides the increase in price of imported goods, this fact led to the raising of the commercial deficit which associated to the increase of international interest rates resulted in the boost in external debt. This scenario had a strong influence in the electricity sector funding since the tariff structure, based on the cost of service criterion was used to control the inflation. Moreover, the financial resource to the self-financing of the electricity sector was destined to the Provinces for different purposes. Thus, the scarce financial

resources to the sector expansion led to a high default rates by the electricity companies [7].

B. The restructuration in the 1990s

During the restructuration process of the Brazilian Electric Power Sector in the early 90s, it was taken into account the economic globalization towards attracting external companies and investors by means of the internationalization of production and consumer goods markets. Therefore, a new intitutional organization of this sector toghether with a new regulation were established and the role of the state was redefined [7].

In spite of the first liberalist steps have been taken with the Federal Law 8031/90 in 1990, which created the National Privatisation Program (known as PND), it was just in the middle of the 90s that the restructuration project of the electric power sector was implemented. The main purposes of this Law were to foster free market, enhance competition and diminish the government role in the electricity sector [3]. In order to reach such goals, the restructuration was based on the following basic principles:

1) The deverticalisation of electricity sector that consists of the segregation of the generation, transmission, distribution and comercialisation activities.
2) The privatisation of electricity companies which transfers the investment and administration to the private sector, leaving the Federal Government the tasks of regulating and concession.
3) The incentive to the competition in the generation and comercialisation process aiming to increase efficiency and reduce the price.
4) The free access to the transmission and distribution networks which defines the basis to the free market of electric energy.

Along with this restructuration, a new tariff methodology called "Price Cap" was established. Furthermore, the deverticalisation gave origin to new agents in electric sector such as the trading agent and the free consumer. In order to mediate the relations among the parts, the National Agency of Electrical Energy (ANEEL) was instituted by the Federal Law (FL) 9427/96. The main purpose of ANEEL is to guarantee that the restructuration actions are according to the policies and guidelines of the Federal Government. Additionally, the FL 9648/98 instituted the Wholesale Energy Market (MAE) and the Decree 2655/98 created the non-profit National System Operator (ONS). In 1999, at the end of the restructuration process, the System Expansion Planning Committee (CCPE) was conceived and, to give the President advice and support in formulating policies and guidelines, in 2000 the Energetic Policies National Council (CNPE) was regulated [7].

C. The Brazilian Electric Power Sector Crisis of 2001

In 2001, Brazil experienced the energy rationing which, in principle, was attributed to the low rainfall index. However, considering that such hydrological adversity would not be enough to cause such crisis, subsequent conclusions highlighted technical and operational weakness of the power system, as well as numerous problems of an unbalanced sector with many failures in coordination, planning, communication and regulation areas [3], such as:

1) *Lack of investment:* In the years before the crisis, the sector was in a period of transition to the private companies and presented the lowest rates of investment in the electricity industry, as can be seen in Fig. 1. Such scenario was linked to the fiscal balance plan that was signed with the International Monetary Fund (IMF), in which the slowdown of the public investment was agreed. Thus, the constructions were paralysed and hence the supply of electric power did not meet the growing demand. [6].

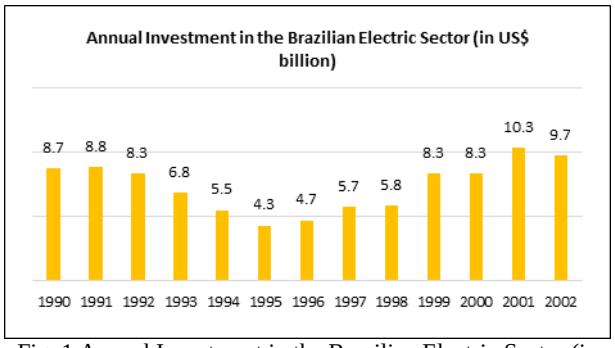

Fig. 1.Annual Investment in the Brazilian Electric Sector (in US$ billion)

2) *Coordination Failures:* Due to lack of an organization to well coordinate the water utilization for electric power production and the economic activity and, in the face of an imminent dry period the hydro power plants did not diminish the production. This resulted in a sharp decrease in hydroelectric power plant reservoir levels [3].
3) *High risk market:* The difficulties found by ANEEL in implementing a suitable regulatory environment with clear and stable rules, contributed to a low reliability of the market and thus to a decline in investment. In the 90s the energy purchasing agreements used to be firmed between the generating companies and power distribution companies and/or generating companies and free consumers. It was not uncommon to find the non-compliance with contractual obligations [3].
4) *Absence of a supply expansion plan:* One of the crucial reasons that led Brazil to the energy rationing was the lack of an expansion plan to guarantee the integrity of the power system, the construction of new power plants and transmission lines, the diversification of the energetic matrix and an alternative strategy to the hydrological adversity [3].

3. The Present Model of the Brazilian Electric Power Sector

After the energy rationing process in 2001, a new restructuration in the Brazilian Electric Power Sector started. In 2003 and 2004, new strategies were implemented so as to correct some points as well as to improve the restructuration of the 90s.

A. The Federal Laws 10847/04 and 10848/04

The Federal Laws 10847/04 e 10848/04, both promulgated in March 2004, are the basis of the "New Model" for the Brazilian Electric Power Sector. They instituted the Energy Research Company (EPE) and the new e o novo market of Commercialization of Electric Energy, respectively [6]. The FL 10848 establishes the hiring of electricity in the National Interconnected System in two modes, namely: the Free Market (ACL) and Regulated Market (ACR) [8],[9].

In the Free Market, the free classified consumers can negotiate the purchase of electricity through energy traders and / or directly from generators, through flexible bilateral agreements with short concession terms and prices above contracts in the regulated market. In addition, the generators can only sell their production in the Free Market, or both contracting environments [9].

On the other hand, in the Regulated Market, the agreements for electric energy trading occur through auctions supervised by ANEEL, between the producing agents and distribution companies, which are required to contract 100 % of forecast demand for its market. In this context, the generators compete under the criterion of offering the lowest price of MWh tariff, and the contracts are firmed with long delivery times [9]. The realization of electricity auctions in the regulated environment are defined by EPE which verifies the demand from the distributors and plans to expand the supply considering the main feature of the national grid generation (Hydrothermal System). The EPE lists the projects that can participate in the auction and sets the ceiling price of MWh [8]. The companies that are able to compete in these auctions are those existing (immediate energy) and/or works of future generation (new energy). The auctions are classified according to the beginning date of supply and further, according to the primary source of energy such as wind farms, biomass plants and small hydroelectric plants (SHP). In all cases the contracts have the duration of 5 to 30 years and early delivery with an original maturity 1-5 years, that is, through the auction, the generators have a guaranteed income throughout their time concession, which ensures reliability to the market and attracts private investment [4],[9].

Also in the Regulated Market, there are auctions for reserve energy contracting, in case of delay in any work previously contracted. In this situation, all costs are passed on to consumers, even for late onset supply by generators. The agreements signed in the two environments are recorded and accounted for Trade Chamber (CCEE), responsible for this market [4].

Besides restructuring the eletricity market, the focus of the "New Model" was the diversification of energy sources, since approximately 2/3 Brazilian production comes from hydroelectric, so as to ensure a safe electrical system along with a fair and attractive competition space to investors [1].

B. The Decree 5025/2004: PROINFA

In face of above, to promote the alternative energy sources, on March 30, 2004, the Program to Foster Electric Power Alternative Source (PROINFA) was established by Decree 5025 [10]. This program benefited projects based on wind, biomass and hydroelectric plants (SHP) and had as its main purpose, increase the share of electricity produced by enterprises of Autonomous Independent Producers. In this public-private partnership model, the contemplated producers entered into a purchase and sale contracts with Eletrobrás (mixed capital company and publicly traded under the controlling interest of the Brazilian Federal Government). This company in turn, assured the hiring of energy for a period of 20 years, with a power purchase tariff previously set by the Ministry of Mines and Energy (MME) and above the prices traded in the auctions [11]. The plants participating in the PROINFA were hired in public calls and, currently, the program has 131 participants plants in total, in which 60 are small hydroelectric plants, 52 are wind and 19 thermal biomass plant. Program costs are paid by all final consumers of the National Interconnected System (known as SIN), except for those classified as low income. This cost is divided into monthly quotas, collected by distribution and transmission companies and permissionaires and passed on to Eletrobrás to compensate the participating plants [12].

C. Brazilian Electric Power Sector Evolution

Faced with the reformulation of the electricity industry, the Brazilian electricity sector introduced himself as an outstanding area for capital investment. One of the reasons for that is the establishment of a reliable and market-friendly regulation to investors with guaranteed income for long term and the fact that additional costs are passed on to consumers and public subsidies. It can be confirmmed from Fig. 2 that shows the installed power evolution in Brazil and from Fig. 3 that presents the installed power by primary source.

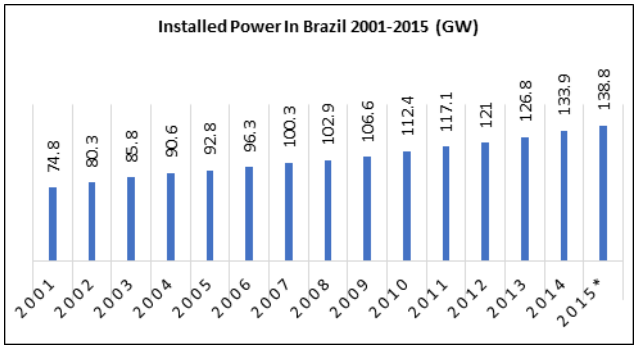

Fig. 2. Installed Power In Brazil 2001-2015 (GW). *September 2015. Source: ANEEL

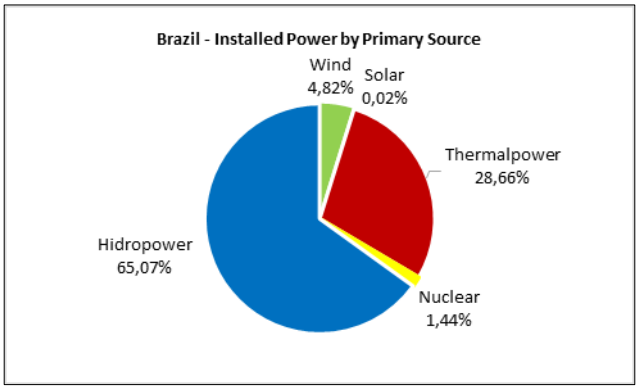

Fig. 3. Brazil - Installed Power by Primary in 2015. Source: ANEEL

Although more than 65 % of Brazil's electricity production comes from hydraulic, the primary source that is presenting the most crescent installed power is the wind, in spite of corresponding only 5 % of the total [1]. Thus, its rapid growth, tax incentives, lines of credit, frequent participation in energy auctions and wind potential to be explored are the main reasons that make wind power a financially attractive sector.

4. The Wind Sector in Brazil

The first wind turbine was installed in Brazil in 1992 and since then the wind sector went through a period of stagnation and insignificant growth, despite the program of incentive (PROEOLICA) in 2001, which failed [13]. The wind was unusual in Brazil so that by 2004, the National Interconnected System had only 0.029 GW from 11 wind farms (0.03% of the total). However, in the last 10 years, this scenario is changing. In 2015, wind farms have already reached a set of 274 plants in operation with a total power of approximately 6.65 GW. The production of wind power plants accounts for 4.8% of the installed capacity, which is more than 138.9 GW. This noticeable progress in a short period of time is closely linked to the Brazilian electric sector reform promoted in 2004 [1].

A. Incentives to the Brazilian wind sector

PROINFA can be considered the starting point for the development of the Brazilian wind sector. It was responsible, first, by the contraction of more than 1,400 MW of electricity.

At the time, the wind was the most expensive and least developed among the sources used in Brazil, so that the value set by the MME to the contract between Eletrobras and the wind power plants was 120.02 US $ / MWh [14]. Another item that PROINFA contemplated, was the financing of wind projects with funds from the National Bank for Economic and Social Development (BNDES), this in turn also designed their investments to plants that are not part of PROINFA, but these plants compete at power auctions [15]. Added to these, the possibility of selling carbon credits as a form of extra compensation to producers and other incentive that benefits the development of the wind industry is the tax exemption on the sale and import of wind turbine parts [13].

B. Idle wind potential

It is estimated that the Brazilian wind potential is 300 GW and, so far, only 6.7 GW of this is exploited. Much of this potential is in the coastal areas of the Northeast and South of Brazil [5]. That is a great attractive characteristic to large multinational companies to invest in yet unexplored sector.

C. Wind power auctions

The electricity commercialization model based on auctions is the trump card of the electricity industry to attract investment to the sector and line of credit opportunities facing the banks, especially BNDES. The auctions guarantee to the generators a long-term income and this fact facilitates the access to loans for project execution. Thus, through the auction, the electricity producer can have the power negotiated even before the plant be built. Initially, the PROINFA boosted the sector with its value paid to wind farms, however, these were signed at once with the participation in auctions. The first which included exclusively wind farms was the auction of reserve energy in 2009 [13]. Thus, such a model was essential for the progress of the wind industry, as the generation projects have long contracts of sale and purchase of electricity and frequent participation in auctions.

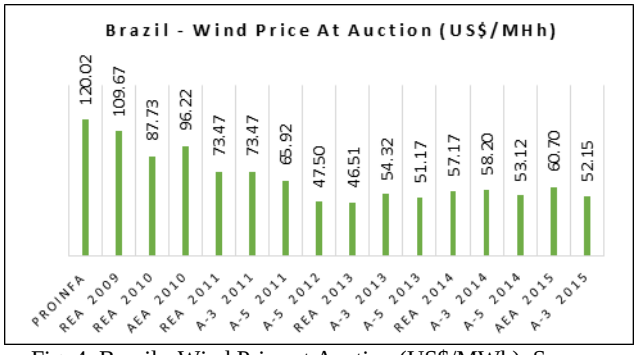

Fig. 4. Brazil - Wind Price at Auction (US$/MWh). Source: MME

By Fig. 3, it can be seen that the auction mechanism has contributed to the evolution of the sector and stabilization of wind energy prices, since by the year 2013, these experienced steady decline due to supply of new producers. This scenario was balanced from A-3 2013 auction, when the yield of the plants approached the international values.

5. Whind Energy Market in Brazil "There is No Crisis" [16]

Since when it started to be sold in auctions, wind energy had a significant jump, thus following the global trend of industry expansion, as it is pointed by the evolution of installed capacity in Brazil. Since 2009, wind power began to consolidate as the second most competitive source of the country [5]. By the year 2014, the figures put Brazil in the 11th position among countries with the largest installed capacity of wind energy in the world, according to information from the Global Wind Energy Council (GWEC), just ahead of Portugal and Denmark. When

observing the annual growth also in 2014, the country recorded the 4th place among the most put wind megawatts in operation, with 2,764, behind China, Germany and the United States [4].

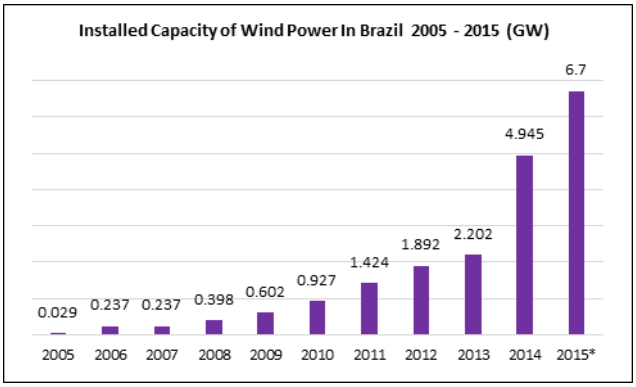

Fig. 5. Installed Capacity of Wind Power In Brazil 2005 - 2015 (GW). *by September 2015. Source: Aneel

However, not coincidentally, the significant development of the wind sector occurred soon after the international financial crisis in September 2008. This is because, with a shortage of capital and demand in developed countries, developing countries have become safe and promising barns for investments foreigners, in particular the countries of the BRICS (Brazil , Russia, India , China and South Africa) [5].

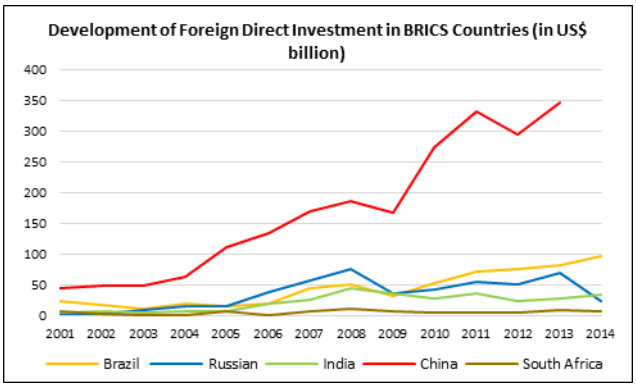

Fig. 6. Development of Foreign Direct Investment in BRICS Countries (in US$ billion). Source: World Bank Indicators

Amongst those who make up the BRICS, Brazil was the second country that, from 2009, received more foreign direct investment, behind China (Fig. 6) [2]. These investments can be applied to create new companies and / or incentives in existing companies.

In Brazil direct investment comes to supplement domestic savings, which are insufficient for the planned development projects [16]. Therefore, developments in the wind industry is intimately associated to foreign capital inflows, since at the same year, to meet the growing sector, there was the first auction of reserved power, with supply beginning period of five years. In Fig.5 it is shown that in 2014 there has been a " boom " of the installed power capacity, but this growth had already started after the global financial crisis.

Several factors influenced (discussed below) foreign direct investment and thus boosted wind and characterized the sector as shielded from the crisis.

A. Economic Government Policy

Government funding programs to energy projects as PROINFA, BNDES credit lines and exemption from taxes, make wind sector attractive and support to foreign investors to enter the area.

B. Economic Stability

Hiring energy through PROINFA, at fedd -in mechanism and models of electric energy auctions are revenue assurance for 20 years, signaling that the market of Brazil's electricity is low risk. Since wind power is often present at auctions in recent years and signed these prices, are close to those traded internationally. Such capital flow assurance facilitates obtaining loans for the sector.

C. Confortable Regulation

With a range of regulations that ensure a competitive market, high income, all costs passed on to consumers, among other benefits, the electricity industry is a sector, too protected. This security was paramount to the development of the energy sector, especially wind projects designed after the global financial crisis.

D. Growth projection for the sector

According to the Ten Year Energy Plan (PDE), prepared by the EPE, which aims to estimate the expansion of demand and energy supply for a period of 10 years, it is projected that by 2024, new power projects will add to the National Interconnected System (SIN), an amount of 73,569 MW and wind power will strongly participate in this market. That is because it is evaluated that only the increment provided by alternative sources will be 34,965 MW. Moreover, from 2015 until 2024, wind energy will get a 6.7 GW to 24 GW jump [18].

6. Conclusion

Based on the information and parameters analyzed in the article, it is prominent that the wind sector is booming, mainly because of the conditions encountered in the establishment of such technology in Brazil. Although the current scenario of the energy sector is recent, the renovation of this, in 2003/2004, with the establishment of a new market-based auctions and long-term concession, made the electricity sector an attractive environment for investors. This situation became explicit after the global financial crisis. Period in which the foreign investment raised the energy sector, particularly in the wind sector, which in 2009 recorded a significant growth of its installed capacity. All due to the financial security of the sector that was acquired thanks to the guaranteed remuneration, tax incentives and costs borne by consumers.

Nevertheless, it is worth mentioning the important role of PROINFA in the development of wind power, assuming the flagship paper of alternative sources at its beginning. However, the increase in installed capacity occurred essentially at auction mechanism.

Thus, it can be said that the Brazilian electric sector is like a gold mine, since the capital invested is certainly recovered because the trading environment is stable. Furthermore, the alternative energy sources are presented as more viable investments, as well as wind power, given the subsidies offered, the consumer market, potential to be explored and legal guarantees

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