



Natural Gas Consumption Overview In Brazil

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ABSTRACT: *Currently there are several assets of the gas industries in Brazil and major pipeline networks in the northeast are connected to the southeast grid. The process of evaluating the effects of the interconnection of pipeline networks in Brazil get more importance due to the changes currently underway in Brazil. Such changes include the recent disclosure of Petrobras efforts in gas natural assets divestments according to your Business and Management Plan. Natural gas in Brazil has use in several markets of the economy. Meeting the demand of these markets in a very large country is a challenge. This challenge could serve as a motivation for further studies about natural gas supply-demand mismatch in Brazil. This study will evaluate the behavior of natural gas demand in Brazil in the last 10 years and discuss hypotheses that explain the causes and effects of the difficulties in supplying Brazilian consumers of natural gas.*

Keywords – Gas Natural Pipeline, Supply, Demand, Consumption.

I. INTRODUCTION

Natural gas is a gaseous mixture rich in light hydrocarbons, especially methane, found in geological deposits or escaping from these. In addition, natural gas is an odorless, colorless and lighter fluid than air. The main international publications point out that natural gas adds flexibility in power supply and is the energy source with the highest growth potential on the world scenario until 2035 [1]. In addition, natural gas will become, by 2030, the main fuel of the energy matrix of the 34 member countries of the Organization for Economic Cooperation and Development - OECD [2]. Relevant technological innovations in the natural gas industry that have emerged in the last decade, such as technological advances in the natural gas liquefaction process and non-conventional gas production, also known as shale gas, have made it possible to expand the gas supply to the world market.

Over the last decade, the trend in the share of natural gas in the Brazilian energy matrix has been growing, in line with that observed in other emerging and developing countries. A key aspect that points to the potential increase in the use of natural gas in Brazil is related to the fact that the combustion of natural gas reaches higher temperatures than its alternative competitors. This allows the industry to carry out more production batches spending less time. This important feature of energy efficiency enhances the strategic use of natural gas to increase the competitiveness of domestic industry.

Brazilian legislation addresses the definition of natural gas through Law n° 9.478/1997 (Law of Oil) and Law n° 11.909/2009 (Law of Gas). As defined in these laws, natural gas means “any hydrocarbon remaining in the gaseous state under normal atmospheric conditions, extracted directly from oil or gas reservoirs, including wet, dry, waste gases and rare gases”.

Additionally, the Law n° 11.097/2005 and Law n° 12.490/2011 added the definition of biofuels, filling an important regulatory gap that hindered the use of these renewable substances derived from biomass.

The national market structure of natural gas is centralized in Petrobras, the largest oil company in Brazil. This company is vertical and monopolistic in the transport segment. Petrobras also sells competing products with its own natural gas and has significant participation in the capital of the main natural gas distribution companies in Brazil. In this context, the price of natural gas in Brazil has no direct relationship to the costs of production and this discourages the possibility of competition in the sector. One of the causes of these problems is related to the fact that the Gas Law does not begin to implement an unbundling process in the transport segment.

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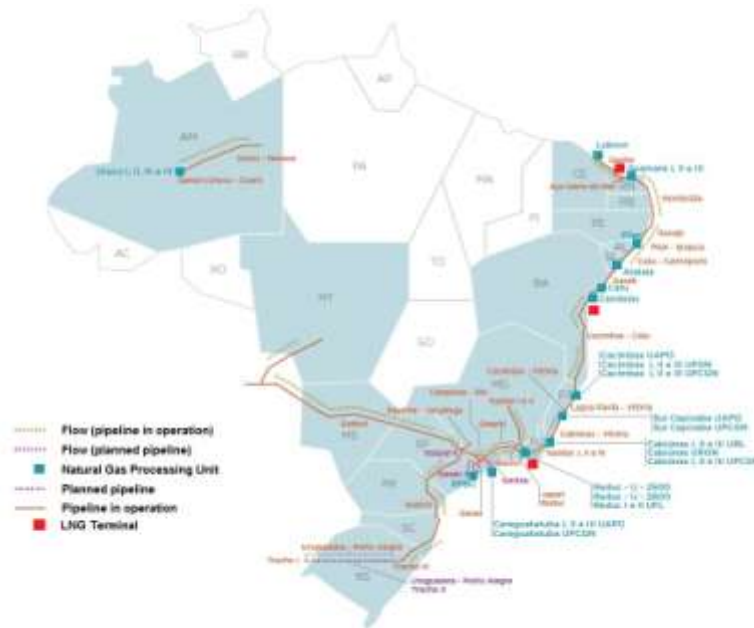


Fig. 1 – Natural gas transport pipeline, processing unit and LNG infrastructures in Brazil [3]

II. LITERATURE REVIEW

In the last decade, the non-renewable energy used in Brazil has a stable behavior in the supply of oil and oil products, unlike the supply trends of natural gas and coal. While natural gas has growth trend, coal/coke showed a slight decrease, (as shown in fig. 2). In 2015, the share of natural gas in Brazil's domestic energy supply was 34.871 million toe (tons of oil equivalent), ie about 12.2% of the national energy matrix.

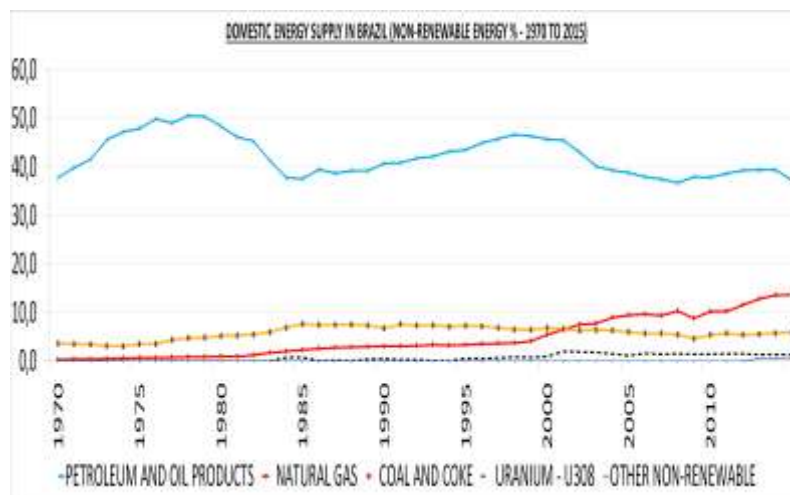


Fig. 2 – Non-renewable domestic energy supply in Brazil (%) 1970 - 2015 [4]

There is expectation in the coming years of growth in the use of natural gas in Brazil due to the confirmation of proven reserves of natural gas from the pre-salt oil province. Gas production in this area will contribute positively to the quest for national energy self-sufficiency. The planned exploration of pre-salt area can leverage the socioeconomic development of Brazil.

In the period of 2005 and 2015, the use of renewable energy in Brazil showed a stable trend in the supply of energy via domestic and imported hydraulic (hydroelectric) sources, unlike supply trends for sugarcane and firewood/charcoal. While the supply of sugarcane by-products increased, the supply of firewood / charcoal presented a retraction (as shown in fig. 3).

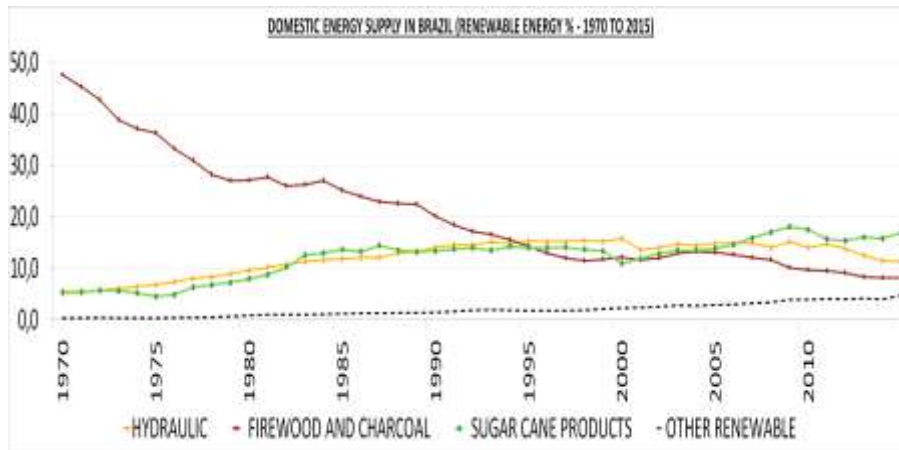


Fig. 3 – Renewable domestic energy supply in Brazil (%) 1970 - 2015 [4]

A preliminary analysis of the National Energy Balance (BEN) published annually by EPE indicates that natural gas is currently the energy source with the highest growth rate in Brazil, in contrast to coal and firewood / charcoal that are in a declining trend [5]. This growth trend will allow natural gas, in the short term, to move from third to second position in the Brazilian energy matrix, surpassing the source of energy derived from sugarcane products and remaining behind only the source from petroleum and its derivatives. It should be noted that for the first time, since 1970, the share of natural gas in the national energy matrix was higher than the amount of energy from the hydraulic source. This fact demonstrates that the generation of electric energy in Brazil, decades ago limited to hydroelectric plants, and has been increasingly carried out by gas-fired thermal power plants.

The growth trend in the share of natural gas mentioned above can be explained by the sharp increase in natural gas supply in Brazil, whether domestic or imported. This can be seen through the linear trend behavior shown in Figure 4.

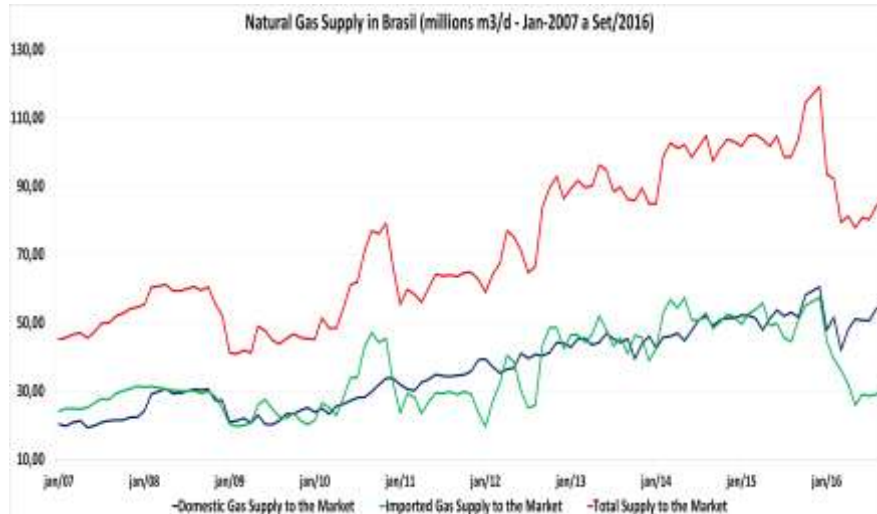


Fig. 4 – Natural gas supply in Brazil (millions of m^3/d – Jan/2007 to Set/2016) [5]

It is worth pointing out that the growth behavior of natural gas use in Brazil in the period illustrated above has continued to rise, even though a global crisis started at the end of 2008. Important to note that since January 2016 the natural gas supply fell sharply due demand reduction. Another highlight was the establishment of the regulatory framework for the natural gas sector in Brazil, through the Law nº 11.909/2009. The publication of these Laws along with the publication of various federal and state regulations on this subject are increasingly bringing security to agents in this industry. In order to increase efforts to consolidate regulations and planning in the natural gas sector, the Ministry of Mines and Energy (MME) published at the end of 2013 the Decennial Expansion Plan for the Transport Pipeline Network (PEMAT 2022), signaling to market agents the prospects for gas supply and demand in the 2013-2022 cycle.

Another relevant consideration is that offshore production of natural gas continues higher than onshore production. In addition, the predominant type of domestic gas produced in Brazil is still the associated type,

although the share of non-associated gas is growing. Moreover, in relation to imports, it is important to highlight the flexibility and guarantee of supply made possible through the import of LNG, which is also growing.

Figure 5 shows the growth trend of national natural gas reinjection and consumption in the exploration and production sector in Brazil, together with the reduction of its share of burning and loss. It is worth mentioning that part of the natural gas consumption in the exploration and production sector is used in electricity generation in Production Units. The reduction of the natural gas burning by the Brazilian companies operating in the exploration and production sector is a requirement of the National Agency of Petroleum, Natural Gas and Biofuels (ANP). The great amount of natural gas reinjected in the production wells in the last year draws attention and has as an explanation the growing difficulty of transferring the natural gas to the consumer centers. New production units also began operations before the completion of pipeline construction.

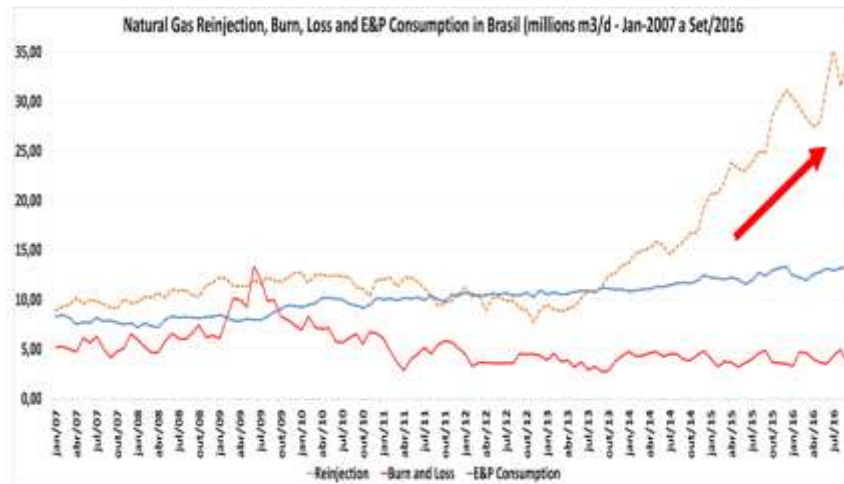


Fig. 5 – Natural gas use in exploration & production sector (millions m³/d – Jan/2007 to Set/2016) [5]

Over the next few years, it is planned to build several natural gas production, processing and transportation infrastructures in Brazil, such as the construction of LNG terminals and the construction of gas pipelines to transfer natural gas produced in the pre-salt area. These infrastructures will contribute to increase the supply of natural gas to the market. A large part of this natural gas will be used to meet the future needs of the electric power generation segment, according to the EPE projections in PEMAT for the annual increase in electricity consumption in Brazil for the period 2013-2022, which is around 4.7% per year.

Figure 6 shows the growth trends in gas consumption in Brazilian refineries and gas-fired thermal power plants (TPP) from January 2007 to September 2016. The increase in these consumptions in recent years has reduced the amount of natural gas offered exclusively to state natural gas distributors. Important to note that since January 2015 the natural gas for Petrobras TPP fell sharply due demand reduction and increase of hydroelectric sources use.

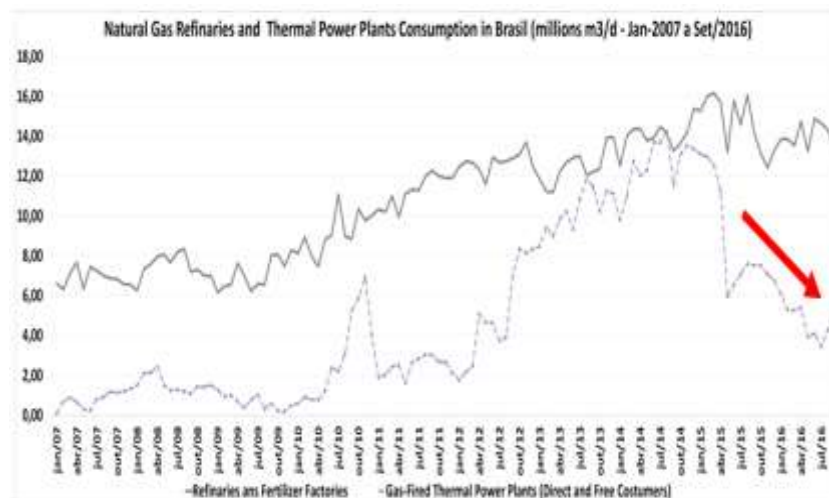


Fig. 6 – Natural gas use in refineries and TPP in Brazil (millions m³/d – Jan/2007 to Set/2016) [5]

The fact that a large part of natural gas in Brazil will be used to meet the future needs of the electric power generation segment can already be verified in the present. The consumption of gas for electricity generation exceeded became the segment that consumes the most natural gas in Brazil and the only segment that shows a tendency to grow, unlike the other sectors of the economy, as can be observed in Figure 7.

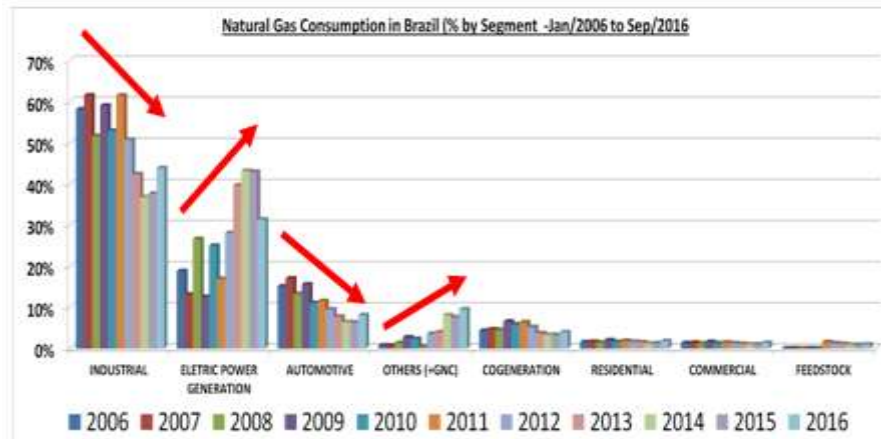


Fig. 7 – Natural gas consumption in Brazil by segment (%) 2006 – 2016 [6]

III. CONCLUSIONS AND SUGGESTIONS

This study evaluate the behavior of natural gas demand in Brazil in the last 10 years and discuss hypotheses that explain the causes and effects of the difficulties in supplying Brazilian consumers of natural gas. It is possible to conclude that despite the increase in the extension and interconnection of the transmission pipeline network in recent years, some Brazilian states still do not consume natural gas. The study points out that even with the decline in natural gas demand for today's consumers, gas reinjection is increasing. As a hypothesis to be verified, it is recommended the elaboration of mathematical models to evaluate if there is a limitation of the simultaneous supply of industrial and electric power generation consumers. Since whenever there is increase / decrease in demand in one of the sectors, there is an increase / decrease in the demand of the other.

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