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Energy market and global competitiveness strategies

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Abstract

The energy market and competitiveness make up a challenging and constantly changing scenario on the international stage. The emergence of natural reserves can contribute to a more advantageous positioning for a given nation to the detriment of another. New exploration technologies and discoveries of Shale gas reserves on North American soil indicate that the U.S. will significantly increase its production of natural gas. The Brazilian government, until then, attributed to Pre-salt a large part of its strategies regarding energy security and the expansion of its competitiveness. This study has the objective of examining the Brazilian energy strategy in the face of the international competitive scenario. The study is justified by the opportunity to understand the intricacies of Petrobras' strategic activities and to raise subsidies that contribute to the decision-making process of Petrobras in the petrochemical segment; as well as the possibility of a critical assessment of consolidated guidelines and possible conflicts in the scope of strategic actions in the organization. The study found an imminent need by the Brazilian government to promote new sources of natural gas as an alternative to achieving competitive production standards in the petrochemical market.

Keywords: *Energy Sector; Strategy; Petrochemical Sector.*

1. Introductory aspects

The energy sector, in turn, comprises a set of bodies that seek to promote the strategic use of different sources of energy from available energy, economic and technological resources. In this sense, it consists of an open system that establishes relationships between its subsystems: electric, coal, oil, gas, and others. In this perspective, oil and natural gas represent resources of influence in contemporary geopolitical relations, since they started to occupy the largest part of the energy matrix of industrial society. The economic and geopolitical role of these resources is configured through the high competitiveness of the petrochemical industry, endowed with a high degree of internationalization of its activities. The dynamics of the international market in the petrochemical industry are composed of transnational organizations, large financial groups, as well as state-owned companies and regulatory bodies. In this scenario, the competitiveness of this segment is strongly associated with factors such as degree of organizational verticalization, high investments in technology, large economies of scale, availability and guaranteed supply of raw materials and significant investments in product distribution logistics [3], environment where the administration of energy information is a strategic tool in the positioning of companies in the petrochemical segment.

The report by Chatham House, an independent political leadership institute in international affairs, published in 2010 and entitled Shale gas revolution: hype and reality, drew the attention of the world energy market towards the prognosis of rapid changes in the planet's economic and geopolitical relations from the perspectives of Shale gas exploration in the U.S.A. [22]. Shale gas comprises shale gas trapped within low permeability shale rocks [24]. To the extent that Shale gas has natural gas as a derivative, its application is largely linked to the generation of electric energy in industrial structures, in order to replace more polluting fuels such as fuel oils, firewood and coal [14]. It is considered a source of

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fossil and non-renewable energy, however, cleaner than oil derivatives and coal as part of the gases that form its composition are eliminated because it does not have energy capacity or does not leave residues in the conductors. It is the source of fossil energy that releases the least amount of carbon dioxide (CO^2) per unit of energy generated (MIT, 2011). In this sense, there are reasons to approach, in a way, this resource as a source of "clean" energy [22]. However, its environmental impacts are not yet widely known and are linked to the possibility of contamination of aquifers, which are water sheets close to the surface and which often serve drinking water for populations [22].

The chaining of this whole process was due to recent discoveries of Shale gas in the United States, specifically in Louisiana, Texas, North Dakota, Oklahoma and Kansas, and by the development of two new technologies that have enabled access to large reserves gas and oil, which until then were technically and economically unviable, and the lower costs of numerous energy-intensive industries [23]. The two main technologies for the exploration of Shale gas are horizontal drilling and hydraulic fracturing (fracking). The first operates by injecting a mixture of water, sand and chemicals into rocky structures that contain micropores filled with gas and oil in order to release the hydrocarbons trapped in these structures [5]. The second technology improved the arrival at the thinnest layers of these rocks located at low depths, as well as making it possible to drill numerous wells from a single reference point [5].

These exploration technologies associated with the discoveries of Shale gas reserves indicate that the USA will become the world's largest producer of oil and gas, overtaking Saudi Arabia in 2020, which added to the increase in domestic production, would leave the country free from imports of these resources in a decade [7]. This context is the result of investments by the American government since the 1970s in an attempt to improve technologies capable of identifying and exploiting the reserves of this energy resource. The interpretation of the reflexes of this new panorama is still uncertain and making statements about its developments is a great challenge, since the results of North American Shale gas with international prices of different types of gas are still relatively modest. However, the U.S. is not the only one to hold reserves of this resource and the trend of global competitive stiffening becomes a matter of time.

The Brazilian petrochemical sector is making high investments in the pre-salt. Pre-salt comprises a layer corresponding to a strip that extends over 800 kilometers between the states of Espírito Santo and Santa Catarina, below the seabed, and encompasses the sedimentary basins of Espírito Santo, Campos and Santos [18]. The oil and gas located in this layer reaches a depth that exceeds 7 thousand meters, below an extensive layer of salt that, according to geologists, preserve the quality of the oil [9]. New technologies were also present in the Pre-salt. When the depth of operations in the Campos sea reached hundreds of meters, it was necessary to abandon the fixed platforms embedded in the seabed and resort to floating structures [6]. Estimates indicate that the layer, in total, can hold something close to 100 billion boe (barrels of oil equivalent) in reserves, which would position Brazil among the ten largest producers in the world of oil and gas and until 2020, as producer of half of its internal consumption [9]. This whole context raises new competitive possibilities for Brazilian oil and gas.

This study has the objective of examining the Brazilian energy strategy in the face of the international competitive scenario. The study is justified by the opportunity to understand the intricacies of Petrobras' strategic activities and to raise subsidies that contribute to the decision-making process of Petrobras in the petrochemical segment; as well as the possibility of a critical assessment of consolidated guidelines and possible conflicts in the scope of strategic actions in the organization.

2. Methodological aspects

The research is characterized as qualitative and quantitative in terms of addressing the problem. It is qualitative, as it seeks to focus on subjectivity, working with the universe of meanings, motives, aspirations, values and attitudes that cannot always be quantified [15]. It is quantitative, how much it provides a comparative analysis of gas prices and costs for industries in Brazil and the U.S. Regarding the objectives, the investigation is descriptive and exploratory. It is descriptive as it covers the challenges of the Brazilian petrochemical sector in the face of North American Shale gas. It is exploratory at the moment when it constitutes a preliminary approach with the probable reflexes from the discovery of Shale gas and the new technologies used in the exploration of this resource. This methodological strategy divided this study into three parts: data collection, treatment and analysis of results. Data collection covered the period between 2017 and 2018. The collection started with a bibliographic survey with books, magazines and specialized periodicals. Then, a documentary survey was carried out using reports made available on national and international websites of governmental institutions in the energy sector and independent bodies that develop advanced research in this segment. Then, these data were treated with the intention of comparing them to the average unit price of natural gas, derived from Shale gas, practiced in the USA and enabling the calculation of the additional costs that Brazilian industries are paying if compared to the prices of North American industries. American. The results analysis examined the new international energy context based on Shale gas that imposed new competition standards in the Brazilian petrochemical

sector. This analysis was composed of two parts: In the first, Brazilian natural gas and natural gas derived from North American Shale gas were analyzed by comparing their prices, costs and additional expenses. In the second part of the study, the position of the Brazilian government was strategically analyzed based on a bibliographic and documentary survey.

3. Approach to the strategic environment

The strategy comprises a set of integrated principles that deal with the environment of organizational analysis and decision making [25]. The strategy can also be understood basically as a set of decision-making rules for the behavioral guidance of an organization, standards by which the company's present and future performance are measured [25]. The simple maintenance of the company's position can be considered a stagnation, since the market trends point to evolution in all organizational aspects. In this sense, an alternative is to seek extensions of the strategy that leverage the system of existing activities in order to create services or specifications that rivals consider impossible to combat on an individual basis [19].

Given this approach, an important strategic extension in modern theoretical currents is the Resource-Based View - RBV or resource-based view. The fundamental principle of RBV is that the competitive advantage of an organization is directly related to the use and development of certain strategic resources available to the organization, which can be tangible and intangible resources [19].

The theory of the resource-based view seeks to clarify that the fact that organizations with superior performance and a competitive advantage achieved is not explained by having a better product-market position or being in a more favorable sector, but because they appropriate resources that generate sustainable competitive advantage [25]. Differing from the classic view of strategic positioning, it is noted that the fundamental strategic point in RBV is not only to guarantee unique resources, but also to develop them in an innovative way is sustainable, prioritizing the maintenance of the advantage that a given resource offers to the organization.

The strategic approach at Petrobras is an interesting case to study due to its hybrid (public-private) nature that brings relative ideological conflict in its objectives, The government agencies classified as mixed economy meets three basic requirements: a) they are wholly or majority owned by the State, that is, at least 50% plus one share with voting rights (common share) of the company belong to the State; b) they are oriented towards the satisfaction of public purposes and interests, internalizing costs generally neglected by private companies to meet social demands; c) perform activities of an economic or commercial nature, guided by the profitability of investments and with a view to obtaining profit [17].

The conflict or cooperation will depend precisely on the three factors listed above. Thus, in situations of abundance of resources, in those where there is convergence about the distribution of public goods and when there is little distinction as to the influence of the actors on the channels of access to political power, there would be incentives for cooperation. In the opposite situations, that is, when there is a scarcity of resources and when certain groups enjoy privileges in accessing political power, the actors tend to take risks to pursue their interests, potentiating internal conflict [17].

The strategy at Petrobras is divided into four strategic actions: pricing, investments, management in research and development - R&D and operational production performance. As for pricing, it is noteworthy that the price policies adopted by each country, as well as institutional and political risks, have significant importance on investments in the industry, because the pricing action is an element of direct influence on an organization's self-financing, as your profitability and cost coverage rates are directly linked to the sale of your products or services. In the case of biofuels such as ethanol, the pricing and production factor cannot be studied in isolation due to the competitive relationship and the convergence of ethanol with gasoline. These products are competing to the extent that they compete for the same domestic automotive vehicle supply market, mainly with the insertion of flex-fuel engines in the Brazilian market and are convergent because federal laws require the addition of ethanol in gasoline, which since 1° of May 2013 is 25%, according to the ordinance of the Ministry of Agriculture, Livestock and Supply - MALS, No. 105 of February 28, 2013.

Thus, the pricing action of a product such as ethanol, which is inserted in a highly competitive market, is one of the factors that can lead to a better understanding of the strategic actions taken by Petrobras. The improvement of the organizational structure with the adoption of cost management techniques, production processes with continuous improvement and analysis of the value chain, together with the elaboration of pricing methods, are important to determine the company's limitations and opportunities in the face of demand of products [20]. Therefore, the pricing action on a given product corresponds to the ability of an organization to know how to dimension various aspects related to this product, such as degree of market competitiveness, cost of production and value of the product or brand to be marketed, being a highly important tool. for insertion or maintenance of a particular product on the market. In

price formation methods, the appropriate levels of sales prices are established in comparison to the prices charged by competing companies. The positioning in relation to cost and value, that is, cost leadership or product differentiation, are highlighted in adverse environments, where the business strategy is defined by the pricing process and policies adopted in the sector [20].

As for investments, the accumulated capital is an essential financing tool, mainly in the segment in which Petrobras is inserted, where the high risk indexes reduce the organization's access to external sources of financing, thus the economic viability of the projects is directly linked with the income stream. The economic viability of a project is correlated with expectations about the evolution of prices and costs of the company, which refers to the operational pricing actions of the organization [20]. In this sense, in sectors with a high degree of internationalization, companies' decisions regarding the allocation of their resources are influenced by the risk and profitability differential that exists between the different regions and countries of the globe.

Regarding advances in research and development management, R&D management stands out as an effective growth action in a sector. The literature on management in R&D does not propose models of innovation. However, all of this literature is based on the premise that there is a strong cause relationship between management and innovation, the former being a determinant of the latter. The authors supported by this tradition have focused mainly on what is called management practices in evolutionary management models in R&D. The main characteristics of the latest models adopted in R&D management are: first generation technology management - objective of advancing knowledge, strong autonomy for researchers, little or no focus on project selection , indefinite time horizons and ease in obtaining resources; second generation technology management - market-driven strategy, focused projects, improved methods of project evaluation, quality of projects in micro project management; third generation technology management - strategically balanced project portfolio, link with corporate strategy, partnerships, business integration process and strategic management of business R&D [12].

4. Results analysis

Conceptual interpretations of competitiveness encounter challenges in the literature as even traditional authors such as Porter, Mintzberg, Collis, Hamel and Prahalad do not offer a clear definition [11]. Porter, when he was a member of the U.S. government's Presidential Industrial Competitiveness Commission, went so far as to state that it would have been clear to him during the Commission's period that there was no widely accepted definition of competitiveness [20]. The relevance of the competitiveness theme in the current world economic order of rapid global changes is the result of two important facts. The first is the depth of changes in the world market, especially with regard to technological and organizational changes [3]. The second fact is the fundamental role played by transnational companies in these global transformations, insofar as these are the main actors for carrying out the changes, including the strategic reaction they face in the face of global restructuring [3].

Competitiveness is understood from different perspectives, in line with the current macroeconomic context, driven by variables such as exchange and interest rates, deficits and government policies, low expenditure on labor force, natural resources, and, above all, differences in administrative practices [13], [19]. Competitiveness can also be derived from the generation or valuable innovations of the market, building barriers to imitation or learning and changing faster than competitors, not only as a product of market power, but is derived from the combination of organizational resources [10]. Competitiveness acquires increasing relevance considering that the new global geopolitics will be outlined based on the geopolitics of countries that maintain and expand the conditions of competitiveness of their economies, including in the face of changes in the world energy matrix [3]. The energy sector, considering the perspective of competitiveness and the determinants of national advantage, is essential to guarantee the conditions of factors of production and for constituting itself as an industry that supports numerous other industrial sectors in all national economies [19]. There is a need to consider, not only the importance of the competitive advantages of organizations in the energy sector, but the critical importance of this segment for reaching and maintaining environmental competitive conditions in the various national economies [3].

The role of the energy sector has always assumed the condition of a strategic vector in global geopolitics and the competitive standards used in the exploitation of resources projected in the national energy matrices have always promoted reflexes in power relations [3]. In this market panorama, the petrochemical sector, which comprises the transformation of petroleum refining by-products, mainly natural gas, into consumer and industrial goods, is increasingly gaining prominence in the global debate. The competitiveness in this segment is so intense, that the possibility was raised of commercial information from Petrobras, passed on to the National Agency of Petroleum, Natural Gas and Biofuels - ANP, having been intercepted by the American government [16].

In short, understanding the dynamics of global changes represents the possibility of bringing together conditions to treat energy information as a strategic tool. Among the factors of change are: the interaction between markets, the improvement of the information collection process, the advances in productive and technological processes, the development of information technology, as well as the formation of economic market blocks, the development emerging countries, scarcity of resources, ecological problems [3], and the discovery of significant natural reserves.

The discussion of results consists of an analysis of the prices and costs of natural gas in Brazil and a strategic analysis of the position of the Brazilian government. Both inserted in the competitive landscape resulting from the U.S. Shale gas. Regarding the analysis of prices and costs of natural gas in Brazil from the competitive context arising from North American Shale gas, it is emphasized initially that the prices of Brazilian natural gas to the final consumer come from the sum of production costs (or price molecule), transport and distribution, added to taxes. That price must be such that it pays: the costs of exploration and production, the carrier for the cost of transport and the distributor for the costs of distribution and marketing [5]. This composition is observed through the following equation:

PNG = § + **ß** + ***∂***+ £

Being:

PNG = Price of Natural Gas

§ = price of the molecule

ß = transport tariff

∂ = distributor margin

£ = taxes

The international natural gas market has undergone a series of changes since the 2000s, where the two main ones were the increase in the world trade in liquefied gas and the recent advances in the production of Shale gas in the U.S. [22]. The latter, the focus of attention of the Brazilian petrochemical sector in terms of maintaining competitive prices for national industries. Industrial consumption of natural gas in Brazil is 354,700,512 MMBtu/year [1]. If this consumption is multiplied by the average unit price of gas for industries in Brazil, US $ 17.15 / MMBtu, obtained in this study through the weighted average of the ten largest distributors of this resource in the country, a cost of gas is recorded for these industries of US $ 6,083,113,780 per year. If this consumption is multiplied by the unit price identified in each Brazilian state surveyed in this study, only with the intention of analyzing national consumption from the different prices available in Brazil, it appears that none of the Brazilian states has a competitive price in relation to the price practiced for North American industries. The state of Paraná has the highest annual cost with US $ 6,852,813,891 per year and the state of Rio Grande do Norte has the lowest annual cost with US $ 4,972,901,178 per year.

The average unit cost of gas for the North American industry supplied by the Henry Hub distribution center in Louisiana is US $ 3.42 per MMBtu [7]. Value, well below the average Brazilian cost of US $ 17.15 per year. If the annual Brazilian consumption profile, that is, 354,700,512 MMBtu per year, is considered for calculation purposes, the cost of gas for U.S. industries would be US $ 1,213,075,751 annually. In this perspective, it is highlighted that the average annual costs of gas for Brazilian industries (US $ 6,083,113,780 per year) are 501.46% higher than the average annual costs with this input for North American industries.

The observation of the additional expense of the Brazilian industry in relation to the North American industry allows an analysis of losses when using the supply from national distributors. These additional expenses, calculated from the average gas prices for the Brazilian and US industries, amount to US $ 4,870,038,029 per year, that is, the calculation reveals the disadvantageous competitive condition in which Brazil will remain if it does not position itself quickly and strategically in the face of US Shale gas Even if all Brazilian gas consumption was met by the lowest unit price distributor, Potigás in ~~do~~ Rio Grande do Norte, the additional annual expenses for Brazilian industries would still be high, in the order of US $ 3,759,825,427.

The maintenance of high natural gas prices in Brazil has become yet another factor restricting industrial competitiveness as part of the industrial segments, which depend on natural gas, face major obstacles to maintain their activities and the other chooses sources alternatives to natural gas. As for the strategic analysis of the Brazilian government's position in relation to the North American Shale gas, which is part of this study and used a bibliographic

and documentary survey, it identified three fundamental objectives established in Petrobras' 2012 for Gas and Energy Business Plan [17]. The first is the greater flexibility of the gas supply with the construction and expansion of liquefied natural gas - LNG terminals. The second is the guarantee of energy security through thermoelectric plants – UTE. And finally, the implantation of fertilizer factories with the intention of promoting the expansion of the Brazilian agricultural frontier.

The first of the objectives, the flexibilization in the gas supply, registered modest advances as the alternative of importing Bolivian gas reduces Petrobras' efforts to invest in the flexibilization of the supply of this input. The threat of increased consumption of natural gas imported from Bolivia has been gradually increasing, which according to Petrobras [17], occurs due to the increased demand by the industrial market and the need for extra dispatch for some thermoelectric plants.

The implantation of the fertilizer factories is also Petrobras' objective as the production of nitrogen fertilizers is inserted in the natural gas value chain and are widely used in agriculture and industry [17]. The demand of the Brazilian fertilizer market, according to Petrobras [17], is greater than the national production and the segment is expanding both in Brazil and in the world. In this sense, this organizational objective is not subject to major market threats. The third objective, energy security, faces the threat of American Shale gas, which has highly competitive prices. This resource can also be found in Brazil, which has a reserve of 6.4 trillion cubic meters [7]. However, production in the country will only be viable in 2023 if investments begin to be made in 2013 [2].

In this environment of Petrobras' objectives, a contractual factor also brings contributory concerns to the environment of their implementation, it is the Brazilian model adopted in 2010 to explore the Pre-salt, which replaced the concession regime with the shared production regime. Under the concession regime, oil companies own the oil produced, remunerating the State through royalties and a bonus on signing the contract. In the new model, the shared production regime, the State is the owner of the production, receives mineral royalties and the bonus on signing the contract [4]. There are concerns that the interest of private ventures will be less with the new model, as profit would be a central element and uncertainties about the conditions for obtaining a return on investment would hinder the decision of investors in the segment.

The threats from the discovery of Shale gas reserves in the USA and the increase in gas imports from Bolivia put pressure on the need for the Brazilian government to invest in new sources of gas supply. Petrobras' strategic positioning needs to recognize that, in addition to being an oil organization, the company also has gas as its core activity and should include in its strategic plans the search for new sources of natural gas supply. In this perspective, the strategic analysis of possibilities for sources of natural gas supply can guide a repositioning of the Brazilian petrochemical sector with the intention of making it more agile in promoting better price conditions and security of gas supply based on a versatile logistical arrangement and safe. Sources of natural gas supply are linked to natural gas imports from Bolivia, LNG imports from Trinidad and Tobago, Nigeria and Qatar, increased offshore production and prospects for onshore production. The import of Bolivian gas has brought uncertainty since 2004, when the nationalization of the oil and gas industry occurred, and the flow of investments in the country was significantly reduced [5]. However, it still figures as an alternative source of supply to the Brazilian market. International LNG prices do not recommend it as strategic to a possible expansion of thermoelectric generation in Brazil based on its importation, in addition to being the source with the greatest restrictions in the short term.

Offshore production refers to the prospecting, drilling and exploration of oil and natural gas by companies installed on the seabed through fixed or floating structures, which already occurs through Petrobras' floating platforms [17]. Onshore production comprises the same activities of prospecting, drilling and exploitation of these resources by enterprises deployed on land, which should be directed to the Brazilian Shale gas reserves [17]. Onshore production is indicated by the lower costs in relation to offshore exploration and can still contribute strategically to the expansion of the Brazilian thermoelectric park using natural gas, as the absence of a transport infrastructure verified in certain producing regions could favor the use of this resource for the generation of thermoelectricity, since the thermoelectric plants can be implemented in areas close to the consumption centers. Thermoelectric plants that use natural gas as a source have low environmental impacts and are more economically viable than conventional thermoelectric plants [21].

The exploration of these new sources should consider the interests of private enterprises more carefully in order to reduce uncertainties about the return on investments made in the Brazilian petrochemical sector. Then, the Brazilian government needs to examine the other components in the formation of the price of natural gas, in addition to the molecule, because through severe structural changes in the transport tariff, in the margin of the distributor and in taxes the Brazilian gas will reach competitive conditions.

5. Conclusion

The study concluded that there is an imminent need for Petrobras to promote new sources of natural gas supply in order to meet its demands in competitive market standards. This indicator was revealed through the analysis of the measurement of the additional expenses, with natural gas, of the Brazilian industry in relation to the North American industry, verified in this study, which demonstrated a disadvantageous competitive condition for Brazil in the order of US $ 4,870,038,029 per year. The study also found that the average annual gas costs for Brazilian industries are 501.46% higher than the average annual costs with this input for North American industries. In this sense, the hitherto comfortable condition attributed to the Brazilian oil sector due to the pre-salt layer, should be reviewed in order to build mechanisms capable of fostering a competitive commercial structure.

The energy market and competitiveness make up a challenging and constantly changing scenario on the international stage. The emergence of natural reserves can contribute to a more advantageous positioning for a given nation to the detriment of another. The possibility of analyzing the Brazilian energy landscape in the face of the competitive challenges imposed by the discoveries of Shale gas reserves in the USA and by the new technologies developed for the exploitation of this resource provided this investigation with a great opportunity to question to what extent the country's energy positioning from of the pre-salt should be redefined in the face of North American Shale gas. The natural gas derived from the U.S. Shale gas offers a price well below the world average and the North American model is difficult to practice in other countries due to competition with other sources of natural gas in the new markets. The strategic analysis of Petrobras' posture also indicated the need for the company's posture. The study basically identified two points of threats to the company's objectives: the increase in imports of Bolivian natural gas and the impacts arising from North American Shale gas. Shale gas, most notably, brought great concerns to the competitive environment of the Brazilian petrochemical sector and the possibility of a response from the Pre-salt finds contractual obstacles to exploration and coping with the new commercial model imposed by the production of Shale gas in the U.S. In this sense, the research confirms the hypothesis that if the country does not redefine its strategies in the short term it will register significant losses in the competitiveness of its petrochemical sector and new sources of gas supply must be planned and implemented. The search for new sources of supply will allow, through greater logistical flexibility, the formation of more competitive prices. In view of this strategic redefinition environment, it is recommended to strengthen investments in Onshore production, which has the opportune possibility of contributing to the expansion of the Brazilian thermoelectric park using natural gas.

Compliance with ethical standards

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