DEVELOPMENT OF THE NATURAL GAS MARKET IN THE ISOLATED SYSTEMS OF BRAZIL: Lessons from the State of Amazonas to Maranhao

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# Overview

The past two decades have been emblematic of the discovery of natural gas reservoirs within the Solimoes and Parnaiba Basins, situated in the Amazonas and Maranhao regions, respectively. These geographical locales are distant from the main transport grid, thereby necessitating substantive effort to cultivate a sustainable market for this energy resource. In the instance of Amazonas, notwithstanding its geographical isolation, concerted efforts under Petrobras' guidance facilitated the construction of a pipeline that bridged production centre with consumer markets, concurrently fostering enhanced efficacy for the local distribution apparatus.

Contrarily, Maranhao's predicament unfolded with heightened intricacy. Confronted with complete isolation from extant transportation networks, the immediate avenue to monetize on the reserves lay in electricity generation, facilitated by the access to the transmission networks of the power grid (National Interconnected System -SIN). Undeniably, Eneva's economic strategy was underpinned by the exigency to recover basin investments. However, a strategic imperative emerges to diversify the scale of natural gas applications, if the aspiration entails fostering a robust state-based market, thereby mutually advantageous outcomes for consumers and the producing entity.

The numerous discussions that position natural gas as the new catalyst for Brazil's reindustrialization necessitates an expansive vantage, extending beyond the assessment of Pre-Salt reserves, to encompass an evaluation of extant consumption potentials within these regions and the requisite investments to interconnect them with the national transport network. This becomes especially relevant when considering the depletion likelihood of producing fields over the long term, necessitating an immediate supply response from regions with greater capacity to provide.

Within this context, the central inquiries of this research are as follows: To what extent can demand diversification for natural gas be viable in Maranhao? What distinctives and parallels characterize the exploration and maturation of the natural gas sector in Maranhao and Amazonas, both marked by their detachment from the national transportation infrastructure? What insights can be gleaned from the experience of the Amazonas state? Is it plausible to replicate the model employed for infrastructure construction in Amazonas? In pursuit of resolving these queries, the objective of this research is to analyse the latent potential for developing a natural gas market in Maranhao, with the benchmark being the comparable situation in Amazonas.

**Methods**

For estimating energy consumption, an attempt was made to consider all possible sources of supply in the state of Maranhao. First, the sales of petroleum derivatives and ethanol by source and sector were taken as the basis, available on the website of the Energy Information System - SIE Brazil of the Ministry of Mines and Energy (MME) from 1980 to 2021. Second, for the composition of charcoal and firewood consumption, production data from 1986 to 2021 per municipality were considered using the SIDRA IBGE. Third, imports of metallurgical coal and petroleum coke by municipality from 1996 were obtained from MDIC's ComexStat. Fourth, the available natural gas production data from the ANP website. Finally, the renewable sources of electricity generation published in EPE's BEN closed the picture of what we considered as the main energy sources in the state's matrix.

The next step was to find the conversion factor between the provided units, cubic meters, and tons in terms of energy equivalence, transforming all units into gigajoules. This choice of unit was made to facilitate conversion for natural gas consumption units in the inter-energetic substitution scenario. Furthermore, to standardize the fuel sales series for the missing years, the annual geometric growth rate was calculated for each source.

To estimate the demand for natural gas in the transportation sector, only the demand for the taxi and ride-sharing segment was considered. For this purpose, the simulation considered the number of people employed in the Transportation, Storage, and Courier Services sector, based on the proportion that approximately 22% of those employed in the sector were directly linked to passenger transportation services by taxi or app (IPEA, 2022). Since the policies at the state level, according to Gasmar, are being designed for São Luís, a comparison was made between the simulation for the state and for the capital.

To assess the potential impact of substituting oil products with natural gas, we had to consider two key variables: the pricing of fuel oil, diesel, and gasoline by Petrobras, and the prices of natural gas as stipulated in contracts between Eneva and the National System Operator (ONS). In the former scenario, our data was sourced from monthly reports issued by municipalities, with a specific focus on prices in Sao Luis, Maranhao. We meticulously factored in both national and state taxes during our analysis. In the latter situation, we derived the natural gas price from contracts associated with the Parnaiba Complex 1, 2, and 3. This intricate process involved considering the overall value of these contracts and factoring in the impact of inflation to ascertain the price per cm as of the year 2021. Following this intricate calculation, our subsequent simulations considered additional elements, such as taxes, transportation expenses, and distribution fees, to arrive at the final price point.

# Results

From the estimate of the potential natural gas demand in Maranhao's industrial and electricity sectors, using 2021 consumption data as a foundation, the demand for these sectors stands at 2.1 million cm per day, signifying a quarter of the state's production capacity. This value would be feasible within workable thresholds if the entire production wasn't exclusively allocated to the SIN.

Within the industrial sector, the segments with the highest energy demand are Non-Ferrous Metals/Other, Extractive Industry, and Paper and Pulp. The combined demand of these three segments accounts for 94.2% of the final industrial demand in Maranhao. This implies that any inter-energy substitution policy should focus on these sectors. Another interesting fact is that out of the 1.2 MMcm/day demand from these sectors, 1 MMcm/day is for the substitution of fuel oil, 126.9 thousand cm/day is for diesel, and the rest is for LPG and other energy sources. Economically, replacing fuel oil, diesel and LPG would result in an annual savings of US$ 211.4 million, without accounting for conversion costs of the facilities to accommodate natural gas.

In the case of the Chemistry, Pig Iron and Steel, and Other Industries segments, the potential demand would be around 61.7 thousand cm/day, with 97.8% resulting from diesel substitution. This would generate an annual savings of US$ 12.9 million. The demand is higher in the electricity sector, where the potential demand is 804.5 thousand cm/day, considering the substitution of fuel oil and diesel, with 99.2% associated with the substitution of fuel oil.

Regarding to the transportation sector, specifically for the taxi and ride-sharing segments, the potential demand for natural gas is around 93 thousand cm/day, with 58 thousand cm/day in Sao Luis. It's known that a significant portion of these vehicles is concentrated in Sao Luis. One of the main challenges is the establishment of a network of compressed natural gas (CNG) refuelling stations to meet this demand. Additionally, the identification of beneficiaries of a policy encouraging the conversion of vehicles to CNG is important. Taxi drivers are easier to identify through their association, while ride-sharing drivers often use vehicles owned by others, making the conversion less feasible due to a lack of ownership.

A notable development occurred during discussions with Eneva, marking the first instance in a decade. The prospect of a pioneering initiative materialized—a scheme entailing the supply of small-scale liquefied natural gas (LNG) to Vale in Sao Luis and Suzano in Imperatriz, Maranhao. The ongoing construction of a liquefaction facility in Santo Antonio dos Lopes, with an investment of US$ 193 million (adjusted for 2022), is expected to have a processing capacity of 600 thousand cm per day of natural gas. A key aspect of the agreements is the allocation of 250 thousand cm per day to Vale and 150 thousand cm daily to Suzano. The remaining capacity of 200 thousand cm per day could be utilized to drive projects focused on integrating natural gas into the transportation sector, starting with taxis and ride-sharing services, aligning with Gasmar's goals.

Scheduled to commence operations in the first half of 2024, the impending launch of the liquefaction facility has spurred action in Sao Luis. A regasification terminal will be established at the Port of Itaqui, followed by a six-kilometer distribution pipeline connecting the terminal to Vale's pelletization complex. Vale has committed approximately US$ 5,8 million for the adaptation of its infrastructure to accommodate natural gas over the four-year contract. A similar scenario unfolds with Suzano, as a regasification plant will strategically be located near the company's manufacturing facility in Imperatriz, along with a corresponding distribution network.

Gasmar will oversee the operational management of both distribution systems. Notable is the regulatory shift introduced by the New Gas Market regulations, allowing for innovative transportation methods beyond traditional pipelines. Unlike the previous requirement for a major consumer to justify the construction of a transportation conduit, current dynamics enable the pursuit of commercial ventures, even on a smaller scale. The ability to use road-based transportation for LNG exemplifies the evolving landscape of market dynamics.

**Conclusions**

Given the prevailing circumstances, two essential prerequisites emerge as imperative. Firstly, a substantial augmentation in production within the Parnaiba Basin becomes imperative, accompanied by a concerted endeavor to extend market reach beyond the confines of power generation. Secondly, the prominence of Gasmar takes on a pivotal role as a catalytic agent in shaping public policy. This is underscored by Gasmar's operational approach, which notably diverges from the conventional role of a state distribution company. Evidently, a lack of clearly defined policies for the short, medium, and long terms is evident, alongside a dearth of substantial interaction between the company and the society it serves. After a decade in this market, it is now opportune to devise a proactive and viable policy to democratize the utilization of natural gas within the state.