

OPINIÃO

Past, Present, and Future of the U.S. natural gas market: Lessons for Brazil

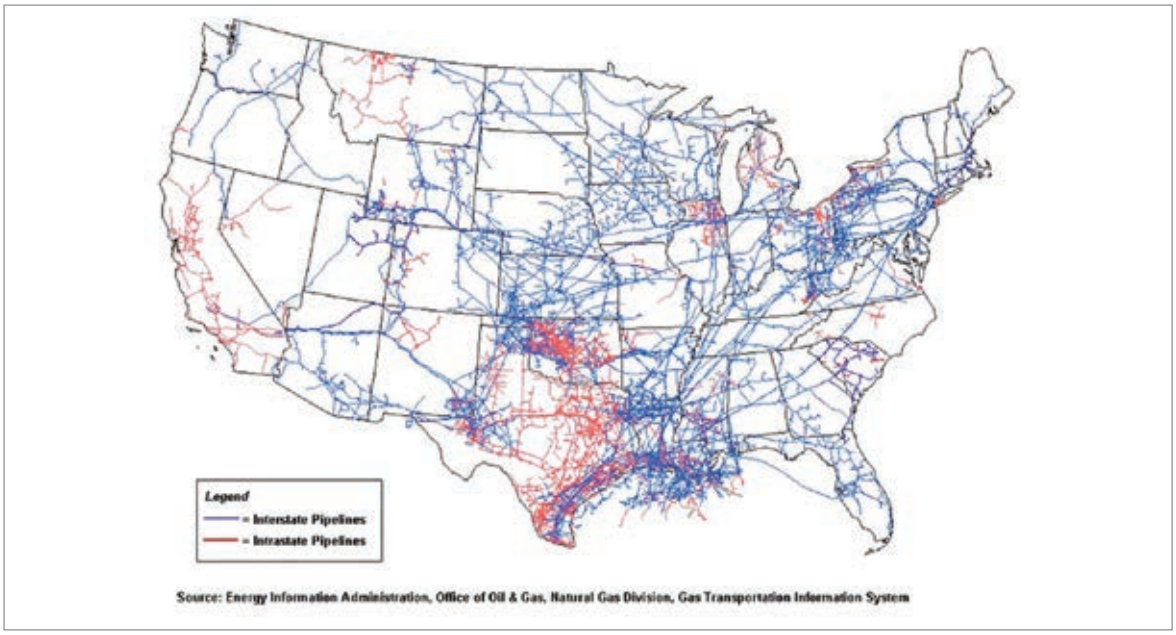
*Por Alexandre Scarcioffolo e Xiaoli L. Etienne**

Natural gas has been one of the fastest-growing energy sectors in the United States over the past decade. Between 2008 and 2017, total domestic production grew more than 30%, overtaking coal as the largest fuel source for electricity generation. Growth in domestic production and consumption of natural gas is expected to continue over the next few decades, cementing it as the second largest energy sector after crude oil and an integral component of the US economy. Since February 2016, the US has also begun exporting liquefied natural gas (LNG) from the lower 48 states, with its LNG export capacity continuing expanding at a rate that is poised to make the country the third largest exporter globally behind Australia and Qatar by the end of 2019[1]. Although natural gas only accounts for 13% of Brazil's energy consumption, there is great potential to develop the natural gas industry as the nation is equipped with over 367 billion cubic meters in proven reserves[2], the second largest in South America. Lessons from the United States, can provide valuable insights for Brazil to grow its natural gas industry.

Overall, three structural transformations played a key role in the rise of the US natural gas sector. **The first is continuous pipeline capacity expansion**. Currently, more than 210 natural gas pipeline systems criss-cross the US, with more than 490,000 kilometers of interstate and intrastate pipeline (Figure 1). The system is also connected to the Canadian and Mexican grid, facilitating imports and exports of gas across countries. Still, there exist opportunities for capacity expansion due to the geographical separation between production and consumption regions, as well as the ever-increasing production related to the low-permeability gas formations.

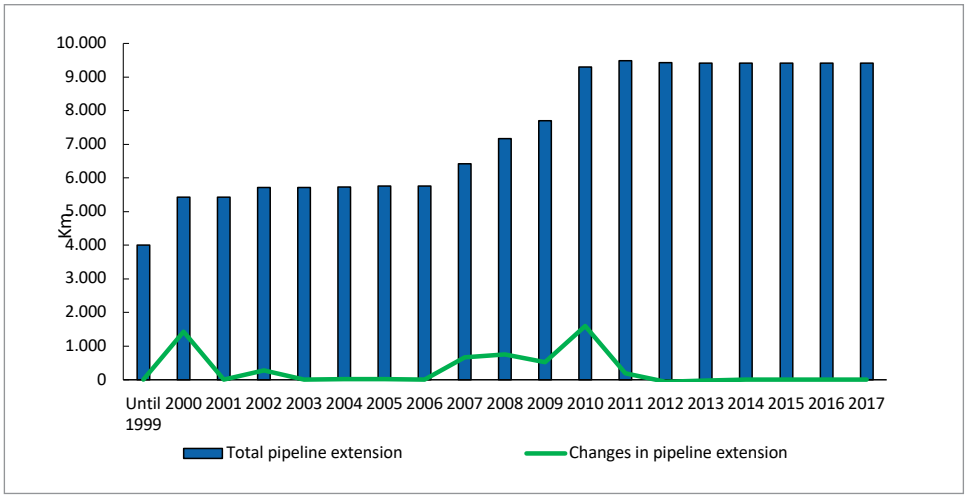
1 See https://www.eia.gov/todayinenergy/detail.php?id=37732, accessed on January 9, 2019.
2 See http://www.anp.gov.br/images/Palestras/State_art_pre-salt_Brazil_AAPG_2018.pdf, accessed on January 7, 2019.

Figure 1. Natural Gas Pipeline System in the U.S.



The natural gas industry in Brazil had been left behind due to the emphasis on oil production and the absence of a reliable transportation system. With the discovery of gas formations closer to more developed regions (Bacia de Campos, Rio de Janeiro) and two global oil shocks, the gas sector finally took root in 1980. However, the large fixed cost required for pipeline construction created barriers to entry, hindering the development of an extensive national transportation system. Currently, Brazil's pipeline grid extends only 9,409 kilometers (Figure 2),[3] partially covering the Brazilian territory, clustering in the coast, Amazonas, and the Bolivia-Brazil pipeline (GASBOL). Although various plans exist to expand the pipeline network, grid extensions have stagnated for the past decade. The lack of investment in connecting the production regions to consumers across the country greatly impedes Brazil's ability to advance its natural gas industry.

Figure 2. Brazilian Pipeline Extension Evolution



Source: Empresa de Pesquisa Energetica. Prepared by the authors

[3] Boletim Mensal de Acompanhamento da Indústria de Gás Natural, MME (January/2018)

The second pillar that strengthened the natural gas industry in the US is continual market deregulation. Since the 1800s, state-by-state regulations in the US acted to restrain abusive local prices. However, these regulations were unable to control prices out of their jurisdiction, which led the Supreme Court to require the Federal Power Commission (FPC, later the Federal Energy Regulation Commission, or FERC) to impose price control on the interstate production and distribution of natural gas. Although diverse price control methods (e.g., company-to-company, historical cost area-rate, price ceilings) were later implemented, they were ineffective and led to shortages throughout the US from 1969 to 1978.

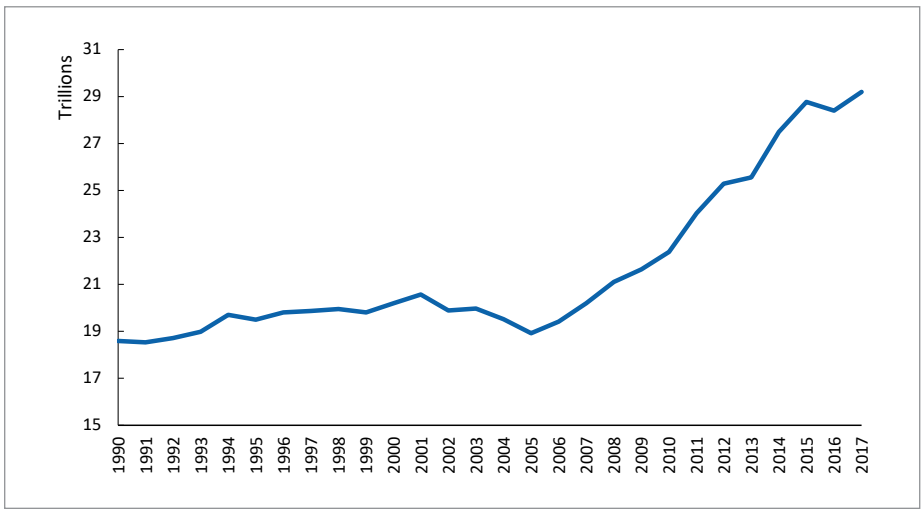
In 1978, Congress enacted the Natural Gas Policy Act of 1978 to bring back the demand-supply equilibrium. Through various orders, the FERC started restructuring the natural gas market. It first unbundled gas from transportation, allowing private customers to ship their own gas into the pipeline. The Natural Gas Wellhead Decontrol Act of 1989 further deregulated wellhead prices and integrated intra- and inter-state markets where any consumer could contract at the wellhead in a deregulated market. The deregulation process incentivized the creation of various natural gas spot markets, most of which are located at the intersection of major pipeline systems and within major producing regions. The natural gas market also expanded to futures trading at the New York Mercantile Exchange (NYMEX) in the early 1990s. The trading of natural gas in the spot and futures markets made the industry more attractive, enabling producers and consumers to both anticipate future prices and manage adverse price risks.

Oil and natural gas sectors were strictly regulated in pre-1995 Brazil, with Petrobras acting as a monopolist in the production and distribution at the federal level. Hence, the expansion of the oil and gas sector depended primarily on Petrobras' investment activities. Changes were made to break this monopolist structure and create a flexible and competitive market. The "Oil Law" and the "Gas Law" were passed in 1995 and 2009, respectively, allowing private companies to explore and produce oil and gas in the country. Private producers have access to the pipeline network, and private companies can invest through concessions in pipeline construction. Although regulators have made big steps to establish an integrated horizontal-structured natural gas industry, those changes did not completely break the monopolistic structure and the market remains largely in the hands of Petrobras.

The third pillar of the US natural gas market was the development of the nation's shale resources during the mid-2000s due to technological advancements in the sector. Market competition has driven firms to continually search for ways to advance their exploration technologies, one of which is the combined use of horizontal drilling and hydraulic fracturing techniques. Since the mid-2000s, these technologies have made the extraction of natural gas from low permeable shale plays profitable. Spurred by the shale boom, natural gas production in the US has increased over 30% over the past decade (Figure 3).[4] The EIA projects that shale production to account for 69% of total domestic natural gas production by 2040Additionally, due to its lower carbon dioxide emissions and low projected prices, natural gas is projected to account for over 33% of the total domestic energy consumption by 2030, just behind the 36% of petroleum products.

[4] See https://www.csis.org/features/us-natural-gas-global-economy, accessed December 5, 2018

Figure 3. U.S. Natural Gas Marketed Production



Source: Energy Information Administration. Prepared by the authors

Brazil currently forbids the exploration of shale reserves. Given the success in the U.S., removing this restriction could allow Brazil to absorb and adapt the existing shale exploration techniques from the U.S., thereby increasing natural gas production and lowering prices. For the pre-Salt reserves, technology advancements currently rely primarily upon Petrobras, who has worked with universities, suppliers, and research centers to enhance production efficiency in deep-water operation.[5] However, the development of pre-salt exploration was hindered by several factors, including low crude oil prices, the 2014 "Car Wash" scandal that brought down Petrobras stock values,[6] the high level of economic uncertainty in the country, and the 2010 "Pre-Salt Law" that requires at least 30% of the reserves for Petrobras operation in private investment. Fortunately, economic uncertainty has subdued in recent years, and the "Pre-Salt Law" was modified in 2016 which removed the mandatory 30% reserve requirement. As a result, pre-salt auction rounds were successful so far, of which 93% of the auctioned exploration blocks were contracted by major oil firms and private parties. For instance, auctions across 2018 generated a total of R$ 18 billion for the Union, in which the fifth sharing agreement auction, the last round of actions in 2018, had produced an impressive goodwill of 170.58%.[7] Additionally, thanks to the cutting-edge technologies developed by operators, technical teams, scholars, and researchers under the Petrobras-private partnership, the time to construct offshore wells are now 2.5 times faster.[8]

Finally, focusing solely on the production and distribution side might not suffice to develop a competitive natural gas market. To achieve this goal, the US has created various incentives to encourage the use of natural gas across the country, including the Clean Power Plan that discourages the use of coal in

5 See http://www.petrobras.com.br/en/our-activities/performance-areas/oil-and-gas-exploration-and-production/pre-salt/, accessed January 09, 2019

6 See https://www.bbc.com/news/world-latin-america-35810578, accessed January 09, 2019.

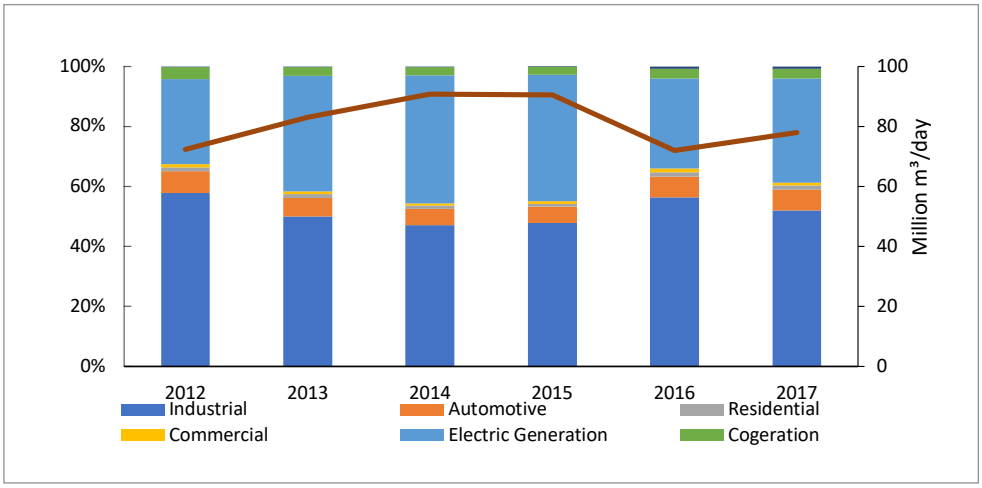
7 See https://g1.globo.com/economia/noticia/2018/09/28/veja-os-resultados-da-5a-rodada-de-partilha-de-producao-da-anp.ghtml, accessed February 19, 2019.

8 See http://www.petrobras.com.br/en/our-activities/performance-areas/oil-and-gas-exploration-and-production/pre-salt/, accessed January 09, 2019

electricity generation, as well as tax credits and other financial incentives for using natural gas in vehicles and business operations. Currently, gas-powered buses represent more than 20% of the total national fleet in the US, and about 32% of the electricity generation comes from natural gas. EIA projects that starting in the early 2020s, the industrial sector will become the largest consumer of natural gas in the US, through increased use of natural gas as feedstock in the chemical industries, and as lease and plant fuel for industrial heat and power, as well as for liquefied natural gas production.[9] In Brazil, natural gas currently only accounts for 13% of the national energy matrix, far below the global average of 26%. Demand for natural gas is centralized in two sectors—industrial and electric generation—with remaining sectors such as automotive, residential, and commercial representing only a small fraction (Figure 4). The government should design policies/incentives to foster an environment propitious to increase demand for gas by other sectors, as well as the continuing use of gas for power generation and industrial production.

All in all, the lessons from the US natural gas market suggest that Brazil should first and foremost intensify the deregulation process to boost private participation. In doing so, we would expect more investment in distribution infrastructure as well as in production and exploration, breaking the monopolistic power from Petrobras. Moreover, changes in the regulation to allow exploration of low-permeability gas and oil would be beneficial to the industry, decreasing prices and imports of natural gas to generate a more reliable national energy mix. From the demand side, the Brazilian government must foster an environment that incentivizes the consumption of natural gas by other players in the industry, as well as the continuing use by the existing key sectors. By increasing production and the participation of the private sector under a competitive market as well as implementing policies that foster consumption of natural gas by diverse players, Brazil has the potential to no longer be the "eternal country of the future," at least when it comes to energy security.

Figure 4. Daily average demand for natural gas by sector in Brazil, 2012-2017



Source: ANP. Prepared by the authors

[9] See https://www.eia.gov/outlooks/aeo/pdf/aeo2019.pdf, accessed February 22, 2019



Alexandre Scarcioffolo
is a Ph.D. student at West Virginia University, United States.



Xiaoli L. Etienne
is an Assistant Professor at West Virginia University, United States.

* Este texto é de inteira responsabilidade do autor e não reflete necessariamente a linha programática e ideológica da FGV.