

The importance of shale for the American economy: is the net exporter profile here to stay?

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Abstract Shale is an important resource in face of the decreasing world oil supply. The American Oil Shale boom has given the country energy security by reducing oil imports. However, 2018 seems to have been the year of end of this revolution, with the bankruptcy of twenty-eight Exploration and Production (E&P) companies. Therefore, the objective of this article is to identify to what extent the production of shale oil and natural gas is promising for the American economy. The price interferes on every sector, mainly on those whose products need a high price to keep competitive. After reviewing the emergence of shale exploration in the United States, we compared the shale production costs and the price of oil to analyze the perspective for shale in the U.S.. It was found that there is concern about production efficiency and cost reduction by companies, but shale oil production is economically viable only when the production cost is lower than the value of the conventional oil barrel. However, the shale gas perspective is extremely favorable to the United States, as in its worst-case scenario it remains an exporter of the commodity. The development of technology to exploit gas in large quantities and at low cost was crucial. The response to the question: is the American exporting profile for oil and natural gas here to stay? The response is yes only to natural gas, given the exploration characteristics and the fragility in relation to international oil prices.

Keywords: United States, Shale Oil and Gas, Price, Cost, Energy Protagonism.

1 Introduction

In the past decades, the United States has seen changes in its energy matrix due to the growth of renewable energy. Oil, however, remains the main source of energy, leaving the country vulnerable to market instabilities. Shale production has emerged as an unconventional energy source which, even though it has high costs, has given autonomy to the United States over other oil exporters.

Carestiato (2014) argues that the low cost of capital and a favorable credit market in the United States in the 2000's was responsible for extensive firm entry and shale exploration technology development. However, 2018 seemed to be the end of the shale revolution, according to the Wall Street Journal, with the bankruptcy of 28 companies and unfavorable forecasts (O PETRÓLEO, 2019).

Given this scenario, the question arises: is the U.S. shale production able to survive and play a major role in the oil and natural gas market?

Oil is the main source of energy in the American energy matrix, most of it imported from the unstable Middle East. Strategically, while there are efforts to expand renewables, shale has been the main shifter in

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energy output. Shale role in the gas market cannot be understated. Shale allows the production of unconventional oil and gas supplies. Yet as in any industry, cost and relative prices matter, and we show how shale depends on Brent and WTI oil prices, particularly in a geopolitical analysis for 2009 to 2018. At the same time shale may influence prices as well. Given expected price trajectories for gas and oil prices, we show how shale market projections (2018 - 2050) reveal trends and their direct impact on the American economy.

The importance of this study on the American shale is due to its characteristics that can be associated with all mining companies, with high production costs and prices dictated by the international market. The results will be relevant in a context where the low global economic growth and the inflexibility of the companies in the industry will give rise to strategic models to be followed.

2 Shale Oil World Energy Context

Non-renewable sources, in particular fossil fuels - coal, natural gas and oil - are the world's leading energy source. Oil, in particular, responds to 31.9% of the total (EIA, 2018) of the energy matrix. In this scenario, the drilling of shale oil and gas wells emerged as both a new source and a more flexible method than the conventional one.

In 2018, driven by the extraction of oil and gas from shale, the United States was the world's largest oil producer with 11 million barrels per day (b/d), followed by Russia with 10.5 million b/d and Saudi Arabia with 10.2 million b/d (EIA, 2018). These countries have been boosting the supply of shale oil and gas worldwide: on the demand side, there is an increase of only 1.2% per year from 2018/2019, differently from what happened in the last 20 years, when it grew three times more; supply, in turn, is expected to record an excess of 2 million b/d by 2020.

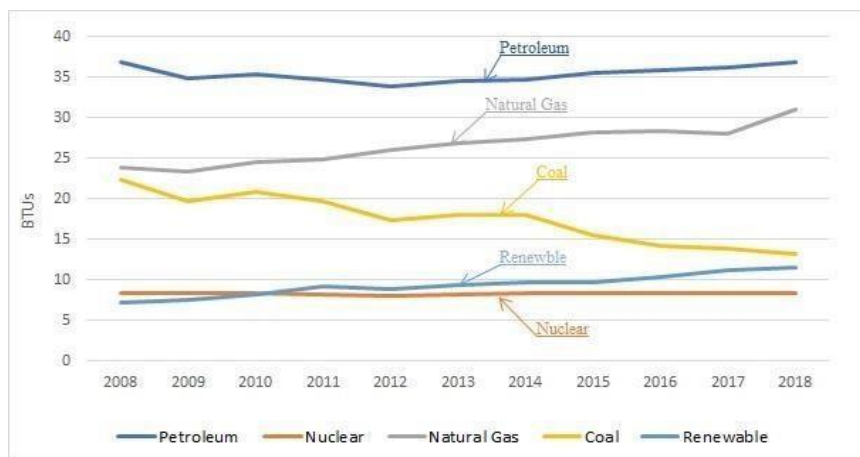


Fig. 1. United States energy matrix, 2008-2018 (Source: BP, 2019)

2.1 U.S. Oil Supply and Demand

Annual crude oil production in the United States grew significantly up to 2018, with approximately 11 million b/d in that year. This increase represents the highest average annual production level in the history of the United States (EIA, 2018). The growth of the last 10 years is attributable primarily to Shale Oil production, which represents 59% of the country's total crude oil production (EIA, 2018). Projections (EIA, 2019) indicate that production will continue to increase reaching the 13 million b/d mark by 2020.

In the opposite direction, the demand for oil in the North America has been affected by the development of cleaner energies, in an attempt to diversify the energy matrix. Figure 1 shows the participation of energy

sources in the U.S. energy matrix in the years 2008-2018. Coal has been decreasing, replaced by gas. Oil consumption may have not increased as much given gas expansion as well.

2.2 The rise of American Shale Oil

The exploitation of the shale has emerged in the American territory as an opportunity and solution in face of the strong historical dependence on oil imports, especially from the Middle East.

Supported with government programs, the intense use of shale oil and gas in the U.S. economy was only possible due to the process of technological innovation and public-private investments in exploration and production (E&P), in refining and in the logistics of production outflow. However, although the country has become a major oil exporter, it is still necessary to import (heavy) crude oil due to the profile and high demand from North American refineries (FOREMAN, 2018). Figure 2 presents the American Trade Balance for 2009-2018.

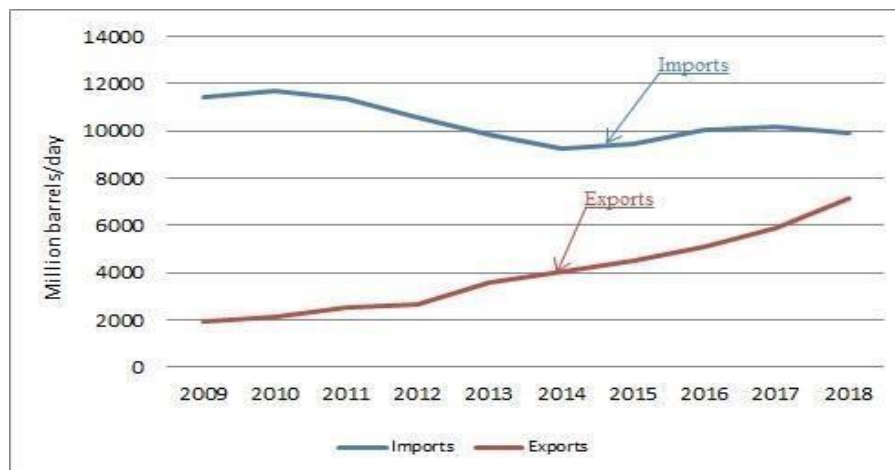


Fig. 2. United States oil trade balance, 2009-2018 (Source: EIA, 2019)

There is growing export over import, indicating the possibility of net exports in the near future. However, the difference between production costs and the price of oil in the market (Brent and West Texas Intermediate - WIT) may reverse the projection since the extraction of American shale oil is expensive in comparison with the reduced price of oil in the international market. The Brent oil is a reference for the European and Asian markets. Designates all oil extracted in the North Sea and traded on the London Stock Exchange. The WTI oil is a reference in the North American Market and is traded on the New York Stock Exchange. The WTI oil is more expensive than Brent oil, which reflects the quality of the product and the cost of refining and transportation (IPEA, 2005).

2.3 Reservoirs and Shale Oil & Gas Companies in U.S.

Bakken in North Dakota; the Permian and Eagle Ford in Texas were the main reservoirs supporting the American Shale Oil Boom, with 85% of American shale oil production since 2008 (CLEMENTE, 2019). These reservoirs are operated by several oil companies, in particular: EOG Resources, ExxonMobil and Chevron. The strategy adopted by these three main companies is directly related to production efficiency and cost reduction.

The Pittsburgh Business Times lists the five largest producers of shale gas in the United States in 2018, despite 45 companies active in the U.S. market. They are: EQT Corporation, Cabot Oil & Gas Corp.,

Chesapeake Energy Corp., Range Resources Corp. e Southwestern Energy Production Co.. The most remarkable common feature of these companies is the policy of low costs and efficient operations, followed by environmental responsibility and workers' safety.

3 Correlation between the International Oil Price (Brent oil and WTI oil) and the Production Costs of Shale Oil

The domestic production of American shale oil is strongly tied to the price of the commodity (Brent or WTI).

Several factors influence the value of a barrel of oil: supply controlled by the Organization of Petroleum Exporting Countries (OPEC), discoveries of new deposits, geopolitical conflicts, competition from oil against alternative energies and the price of the U.S. dollar, since the United States holds the historical position of largest importer of oil in the world.

The structure of production costs and oil prices are affected, mainly, due to two factors: spread of quality and location (HECHT, 2020). The spread is the difference between the purchase price and the sale price; quality concerns the properties of the oils produced, especially the sulfur content, which determines the processing required for their refining into by-products. The location spread, in turn, concerns the different locations of the Brent (Europe) and WTI (North American) oils and, therefore, the different storage costs in shopping centers (HECHT, 2020). As such, the WTI oil price is historically lower than the Brent oil price.

Figure 3 shows the historical series of Brent and WTI oil prices for 2009-2018.

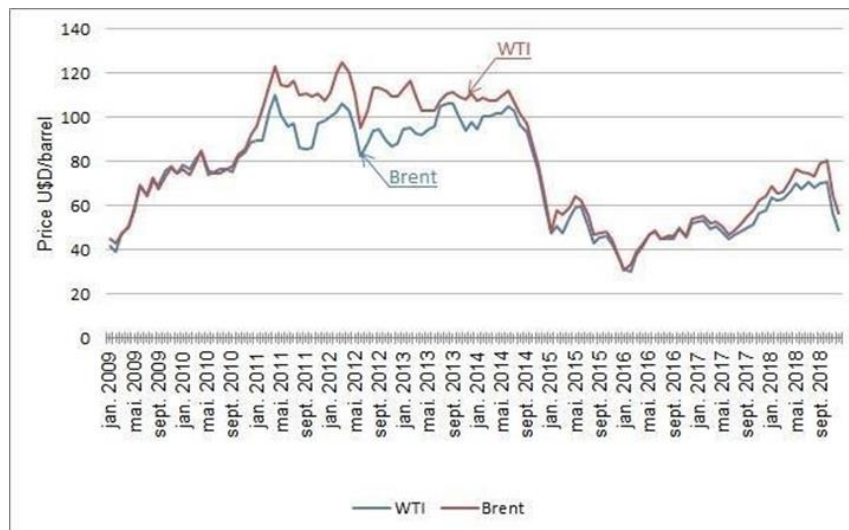


Fig. 3. Brent and WTI oil prices in US\$/Barrel, 2009-2018 (Source: Own elaboration based on IndexMundi data, 2019)

It is possible to see that Brent and WTI oil prices are strongly correlated, except for the years 2011-2014, when the WTI was positioned at a lower level. The world geopolitical situation of the time and institutional arrangements in the US is an important key to understand the price of approximately thirty dollars (OLIVEIRA, 2016), After 2014 US producers were allowed to export oil, balancing the WTI price market.

For the shale, the equilibrium price of each product is calculated according to the characteristics of each reservoir. The development of shale gas exploration resulting from the continuous technological advancement, directly impacted the reduction of costs and increased production.

Figure 4 presents the production projection of dry natural gas and natural gas at Henry Hub for 2019-2050.



Fig. 4. Production projection of dry natural gas and natural gas price at Henry Hub, 2019-2050 (Source: Own elaboration based on EIA data, 2019)

In figure 4 it is possible to notice that the Henry Hub price of natural gas starts growing from 2020, a decade characterized as one of higher growth rate. From 2035 on, both the price and the production of Dry Natural Gas will increase linearly at a similar rate.

4 Prospects for Shale Oil and Gas Production and Consumption

There are several factors that may alter the forecasts in the Annual Energy Outlook (AEO): global price of oil; economic growth; energy resources inventories and production technology; and last but not least, laws and regulations (EIA, 2018). Energy market projections are subject to external factors unpredictable to the National Energy Modeling System (NEMS). It is a system model used by the EIA to develop the AEO that considers only economic changes and changes in energy supply, demand, and price (EIA, 2019).

The projections for shale production are uncertain because there is little or no historical production series and extraction technologies and practices evolve rapidly (EIA, 2019). Next, in subsections 4.1 and 4.2, the projections for shale oil and gas production until 2050, respectively.

4.1 Shale Oil

The development of shale resources is the main responsible for the increase in production of American crude oil and natural gas plant liquids (NGPL) (EIA, 2019).

Figure 5 represents the composition of American crude oil in three projections considering the period from 2010 to 2050.

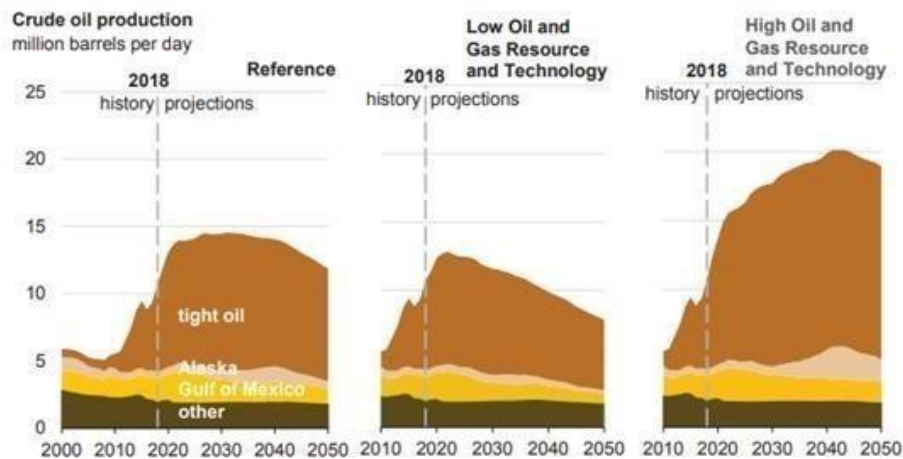


Fig. 5. Projection of crude oil production, 2010-2050 (Source: EIA, 2019)

The first projection, Reference, is based on the Environmental Management Suite (NEMS). In this case, shale oil is the head of crude oil production with approximately 68% of the total (EIA, 2019). Production is expected to reach 14 million b/d in 2040, when exploration will be carried out in areas of lower productivity and hence declining (EIA, 2019). The second projection (Low Oil and Gas Resource and Technology), when compared to the reference case, it considers a lower supply of resources, high costs and high prices; and a third projection (High Oil and Gas Resource and Technology), when compared to the reference case, it considers a higher supply of resources, lower costs and lower prices. Therefore, are forecasts based on possible changes in production as a function of resource supply and cost structure.

Shale oil will continue to be the main source of crude oil production in the three projections because there is, in spite of the decline of approximately 29% of daily production in the second case, an increase of approximately 43% in the third projection. That is, on average, the presence in shale oil will remain in both the American and world energy matrix. Figure 6 shows oil production and consumption for 2019-2050.

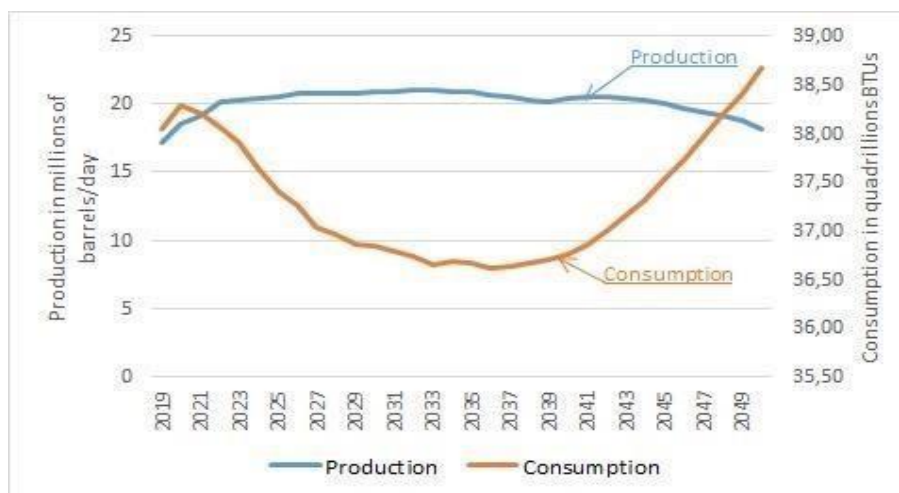


Fig. 6. Projection of crude oil production and NGPL, and consumed oil and other liquids, 2019- 2050 (Source: Own elaboration based on EIA data, 2019)

Figure 6 highlights that in the early 2020s, while crude oil and Natural Gas Plant Liquids (NGPL) production have their highest growth rate, consumption shows a sharp drop. However, it is possible to notice that it is resumed from 2041 on and gains a new peak at the end of the projection; on the other hand, production remains at a level approximately constant until 2045 when it starts to fall.

4.2 Shale Gas

The development of shale gas in recent years has placed it as the fastest growing fossil fuel in all scenarios (EIA, 2019). Figure 7 shows three projections for dry natural gas production for 2000-2050.

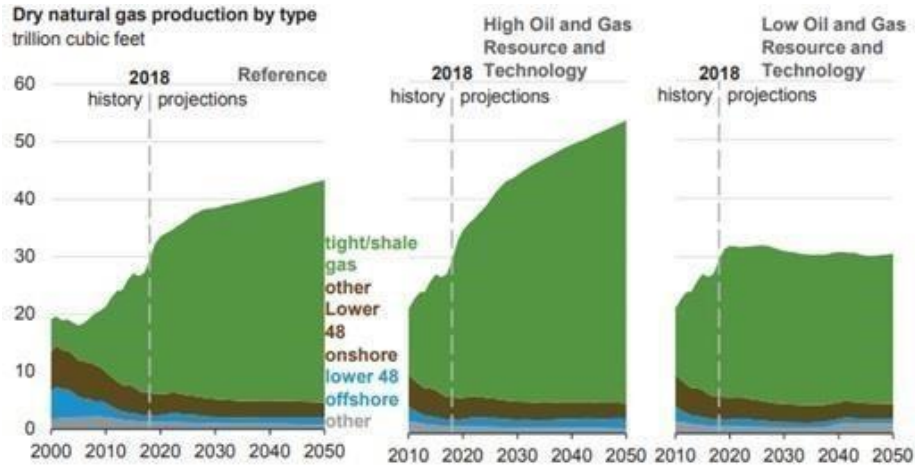


Fig. 7. Projection of dry natural gas production, 2000-2050 (Source: EIA, 2019)

Figure 7 shows in the second scenario (High Oil and Gas Resource and Technology) an accumulated production projection of 18% higher than the reference value is observed; however, in Low Oil and Gas Resource and Technology the decrease is 24% relative to this same value (EIA, 2019), but with a tendency to constant values. This indicates that gas at its worst will remain in the American energy matrix until 2050.

Figure 8 shows the production and consumption of natural gas for 2019-2050.

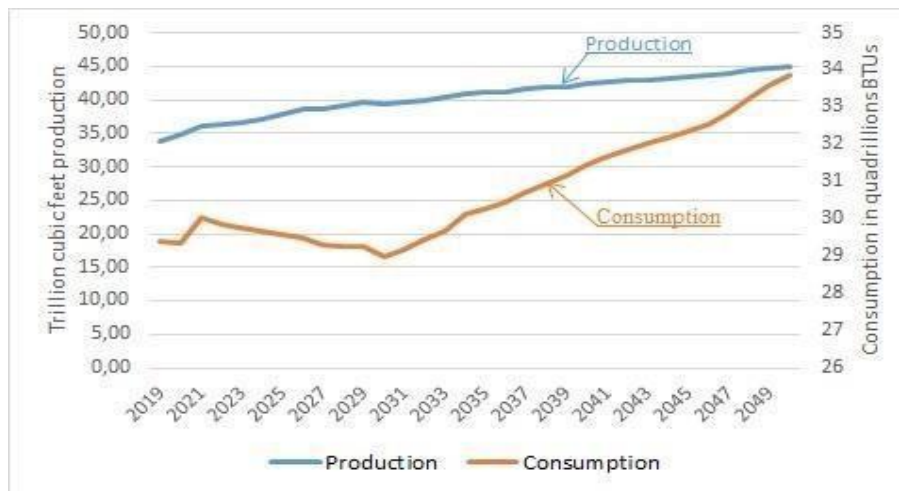


Fig. 8. Projection of dry natural gas production and natural gas consumption, 2019-2050 (Source: EIA, 2019.)

Figure 8 presents that the production of dry natural gas is presented in an approximately linear growth. Consumption, in turn, decreases between 2021 and 2030; however, in the following years it grows at the highest rate observed during the analyzed period. It persists until the end of the projection.

5 Conclusion

The strong American dependence on oil boosted international oil production for decades. Shale emerged as a rescue from market instabilities, providing the United States with some autonomy from oil imports.

The favorable projection of the U.S. Trade Balance regarding the production of shale oil and gas indicates that in the future they may become net exporters of oil; however, the high production cost of the shale compared to the price of a barrel on the international market, brings fragility to the sector.

As much as the concern with cost structure and increased efficiency is common to large shale oil/gas companies, geopolitical factors make it difficult to minimize market risks. Thus, shale production will only become viable when all factors are favorable.

The prospects for shale production highlight three scenarios: reference, positive and negative. For oil, the United States, on average, may remain an importer. For gas, the United States may become a net exporter. Thus, for associated oil-gas shale production, gas prices and market separation from the world will sustain shale production. On the other hand, oil only shale production do not face the same prospects.

The results show the strong fragility of the American shale, which should serve as a model for other companies in the mining sector, since high costs do not match low international prices for the commodity.

The dependence on prices is a characteristic of industry in general; therefore, the conclusions of this article can be used in the analysis of other areas, primarily those who have a high-dependence relation on high prices, such as the oil market does.

Answering the question about the possibility of the United States becoming a net exporter, it can be stated, based on these data, that the protagonism could be related to natural gas production, hardly to oil.

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