



INFERENCES ABOUT A PETROLEUM DEMAND DROP ON THE MARKET THROUGH LITERATURE GROUNDED THEORY

INFERÊNCIAS SOBRE UMA POSSÍVEL REDUÇÃO NA DEMANDA DE PETRÓLEO NO MERCADO ATRAVÉS DA TEORIA FUNDAMENTADA EM DADOS

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ABSTRACT

The objective of this study was to understand the pathway that economies and companies could get prepared in case of drop on Oil & Gas demand. The study has made use of Literature Grounded Theory (LGT) to perform a Systematic Literature Review. Through this study it was possible to observe that Oil & Gas Cycle will last for many decades, and that companies that today actuate on this market could find opportunities to continue energy market by investing in Hydrogen, Carbon Capture and Geothermal Energy, as examples. Companies and Countries that today own the production control of Oil& Gas, or that work on services for this business, must capitalize to invest on this transition.

Keywords: Petroleum. Economy. Energy.

RESUMO

Esse estudo objetivou entender de que forma as empresas e economias do mundo poderiam se organizar no caso de uma possível redução na demanda por Petróleo e Gás. O estudo utilizou-se da Teoria Fundamentada em Dados (LGT) para realizar uma revisão da literatura. Através do estudo foi possível observar que o ciclo do Petróleo ainda vai durar muitas décadas, e que empresas que hoje atuam nessa área podem encontrar oportunidades para continuar participando do mercado de energia ao investirem em conhecimentos associados a Hidrogênio, Captura de Carbono e Energia Geotérmica, como exemplos, além de Empresas e Países que hoje detêm o controle da produção de Petróleo, ou que executam serviços nessa área, precisam se capitalizar para investir na mudança.

Palavras-chaves: Petróleo. Economia. Energia

1 INTRODUCTION

As the negative impacts of greenhouse gas emissions become clearer to society, actions to reduce these emissions are being taken, a phenomenon we know as the energy transition. Among the main causes of greenhouse gas emissions is the burning of fossil fuels, including coal and oil with their derivatives for energy production, heating, and transportation (Fatima Rizvi *et al.*, 2020).

Oil is currently the commodity with the greatest impact on the economy, having already been the central reason for global conflicts (Strasser, 2017), however, as the world works to reduce oil consumption and the exploitation of this resource becomes more complex, it is unclear how the world will reorganize and what opportunities might arise for the economy (Aleksandrov *et al.*, 2023).

Several economies around the world are largely supported by oil and gas production (Strasser, 2017), even without a clear horizon for the end of oil, like what is happening with coal to this day, these economies and various actors in the oil industry need to be prepared for this change, as a reduction in demand could affect the market.

2. THEORETICAL FOUNDATION

2.1 Petroleum and Society

The world has about 1,666.3 billion proven oil reserves, and 80% of global energy comes from oil, gas, and coal. 90% of global transportation depends on oil, as well as approximately 32% of energy production. Therefore, oil is an important element in energy production, and consequently for economic and social development in the world (Alam *et al.*, 2018).

The petroleum, due to its need for very specific geological conditions for its development, is not distributed uniformly around the world. This makes it necessary to transport it through pipelines, ships, railways, among others, contributing to a complex and large logistical chain. (Strasser, 2017).

Although most producing countries that already had complex political and social conditions used oil to exacerbate crises, and in some cases generate armed conflicts (Strasser, 2017), the largest oil producers in the world are Venezuela, Saudi Arabia, Canada, Iran, Iraq, and Russia (Alam *et al.*, 2018).

Conflicts in the name of oil produce cultural compromises between geopolitics, psychology, and minimize respect, ultimately leading to armed conflicts and disputes driven by the quest for petroleum resources as a crucial source of energy and wealth (De Moura *et al.*, 2023).

Each region of the world produces oil with different physical and chemical properties, such as density and sulfur content, which gives each type of oil a different pricing, such as West Texas Intermediate (WTI) and Brent crude oil (BRENT). This is because the refining process will be different, and consequently, the production of its derivatives such as gasoline, diesel, naphtha, kerosene, liquefied petroleum gas, lubricants, asphalt, fertilizers, and others (Alam *et al.*, 2018).

Some regions of the world, such as the area around the Arctic, are extremely dependent on the extractive economy of mineral resources, such as oil and gas, as well as fishing. One of the solutions for these populations is the development of the so-called Arctic route, which opens new paths (Moura *et al.*, 2024) for the transportation of goods. Digitalization has been a way to identify unsafe points that could affect navigation safety in this region (Ilinskiy; Bianco, 2021).

In the case of the European energy transition plan, the focus is not only economic but also places social and social well-being as priorities (Ginevicius *et al.*, 2021). Latin America, especially Chile, Colombia, Brazil, and Mexico, are economies extremely dependent on mineral exploitation, and changes in the prices of these commodities significantly affect financial results (Candelo-Viáfara; Oviedo-Gómez, 2020), similar to what happens in the case of Nigeria (Musa *et al.*, 2022).

2.2 Corporate Responsibility and Sustainability

The definition of corporate responsibility is not necessarily a simple task, as it is unclear where the level of responsibility of organizations ends, and the responsibilities of governments begin. Over the years, in different countries, this definition has taken on different perspectives, but in general, global companies have been self-regulating and learning from accidents to become more productive and meet the expectations of markets where their investors are present (Strasser, 2017).

Corporate social and environmental responsibility is based on four dimensions: it needs to be economically profitable, comply with the law, be ethical, and provide social support. A company can demonstrate its commitment through environmental reporting, implementation of circular economy principles, social actions, waste reduction, and reduction of pollutant and greenhouse gas emissions, as examples (Suska, 2021).

The impact of reducing fossil fuel use is not solely on reducing carbon dioxide emissions, but also includes a considerable reduction in water consumption (Tidwell; Moreland, 2016). Additionally,

there is the aspect of reducing environmental pollution through pollutants such as nitrous oxide and volatile organic compounds (Holliman; Schade, 2021). Companies in the energy sector have performed better than mining companies in terms of environmental or even social criteria (Kurowski; Huk, 2021).

In addition to the aspect of reducing carbon dioxide emissions, there is also the opportunity for the capture, storage, and use of carbon dioxide. This technology has been expanding and improving, but currently faces technical and economic challenges to achieve efficiency results in capture and the expected cost. Among the applications for captured carbon are its use for oil recovery, chemical applications, storage, among others, including fuel production (Yusuf; Almomani; Qiblawey, 2023).

The European Green Deal aims to achieve net-zero greenhouse gas emissions by 2050. To accomplish this, it relies on the transition to renewable energy sources, efficiencies, and more advanced technological developments. This transition plan should be implemented in a way that does not affect the economic development of the member countries, and it should also assess the impact of the transition on each sector (Ginevicius et al., 2021).

One of the aspects to be considered as oil and gas wells become economically unviable is what to do with these assets. Wells in an abandoned state, that is, without use for oil operators, need to be properly plugged to prevent methane leakage, which can significantly affect greenhouse gas emissions, as it has four times more potential to cause a greenhouse effect than carbon dioxide, in addition to other risks. An important characteristic of oil wells is that they connect the surface with the subsurface where the porous rocks containing oil, gas, and other stored fluids are located (Kang et al., 2021).

To obtain credit in the market for investment in green or sustainability projects, Norway and Sweden have issued Green Bonds that allow investors to find yield opportunities while contributing to the development of sustainable solutions and technologies. These investments have been successful and are fueling projects in the areas of Energy, Green Building, Transportation, and Circular Economy (Torvanger; Maltais; Marginean, 2021).

2.3 Price and Demand

The demand for energy has been continuously growing, directly associated with economic growth. The main countries driving this demand are the United States, China, and India. Despite the increase in environmental awareness and the emergence of new energy production technologies, the consumption of fossil fuels has also been growing (Manowska, 2020). This growth was already expected to be 28% between 2015 and 2040, in both renewable and non-renewable energies, with a lower growth rate in non-renewables (Fatima Rizvi et al., 2020).

During the COVID-19 period, the world experienced two phases: an initial phase of a price war between Saudi Arabia and Russia, which raised the price of oil, at a time when a short pandemic cycle was expected, and a period of reduction in global production, and consequently a drop in demand for oil and its derivatives. Oil prices experienced significant daily fluctuations, even reaching negative values in the case of WTI (De Blasis; Petroni, 2021).

Some countries already have confirmed targets for reducing fossil fuel consumption for electricity production, such as Germany, which aims to reduce this number to 20%. One of the solutions to reduce the energy deficit is the search for energy efficiencies, which can have an impact of 4% in reducing consumption. Unlike oil, the demand for gas is expected to rise (Manowska, 2020) due to its interchangeability with biogas, which is gaining ground, and with hydrogen (Fatima Rizvi et al., 2020).

2.4 Oil and Gas Future

The search for oil has been directed towards regions with increasingly complex geologies and greater depths of water and even drilling (Strasser, 2017). Governments around the world have also been concerned about the risks of supply shortages and exposure to a volatile market controlled mainly by a few countries, in addition to environmental issues, which converges in investment in renewable energies (Che Derasid et al., 2021).

It is not simple to infer this new market where the future composition of different energy sources, given the complexity of the presence of various variables, such as the availability and price of these different sources over time, and the elasticity in the substitution of non-renewables by renewables, in addition to solutions for reducing carbon in the atmosphere and the availability of fossil fuels in the market (Li; Narajabad; Temzelides, 2016).

One of the ways to increase the elasticity of energy production and demand is Electrification, a path chosen by the European Union, which allows the use of different energy sources in electricity production, and this can be used according to demand needs (Ginevicius et al., 2021).

There is an expectation of a decrease in the use of coal for energy production, being replaced by other less polluting sources, as well as the use of taxation mechanisms related to the emissions of each energy source, which can activate the storage of other fossil sources for use at more advantageous times. The composition of each of these elements can be modeled for specific scenarios (Li; Narajabad; Temzelides, 2016).

As an alternative to the creation of taxes, which also fosters the carbon market, there is the creation of a surcharge on the most basic and carbon-intensive raw material, right at the beginning of the production chain, but not in the form of taxes, but in the form of a commitment to the cost of capturing and storing this liability. Thus, companies that generated the emission, in the extraction of raw material, become responsible for its final destination or storage for a period of time, which would affect the supply chain from the origin (Thess et al., 2020).

Companies operating in maritime transport in Europe are already working on a project to reorganize themselves with the potential reduction in demand for services in the oil market, which is not limited to operating in other markets, but also digitalization and increasing presence in other regions (Philipp et al., 2020).

3.METODOLOGY

3.1 Literature Grounded Theory (LGT)

One of the research methodologies is the literature review, which can yield more effective results if conducted through the Systematic Literature Review (SLR) (Kitchenham & Charters, 2007). The SLR is a procedure with systematized stages of bibliographic and documentary research, which allows classifying contributions and summarizing results, leading to more accurate and repeatable conclusions about the research question (Denyer & Tranfield, 2009). According to Cardoso Ermel (2020), the application of the SLR is not limited and can be implemented in various fields of knowledge, as it is a methodology for systematic analysis and synthesis of literature composed of the stages:

1. Formulation of the Research Question,
2. Formulation of the Review Scope,
3. Definition of the Work Team,
4. Definition of Search Strategies,
5. Protocol Development,
6. Risk of Bias Assessment,
7. Eligibility Search,
8. Quality Assessment,
9. Coding,
10. Research Reliability Assessment,
11. Literature Analysis (optional),
12. Literature Synthesis (optional),
13. Research Presentation,
14. Research Update (optional)

A systematic review requires an appropriate tool for formulating questions of interest. In this case, the PICOC (Population, Intervention, Comparison, Outcome, and Context) tool contributes to the use of the most suitable research strategy, as shown in Table 1 (Cardoso Ermel, 2020).

Table 1 | PICOC tool

Word	Meaning	Application in the systematic review
P	Population	Area, application, group, industry.
I	Intervention	Methodology, tool, procedure.
C	Comparison	Methodology, tool, procedure.
O	Outcomes	Compare with the Intervention. It should answer the research question
C	Context	In what situations does the Intervention influence the Results

Source: Adapted from Cardoso Ermel (2020).

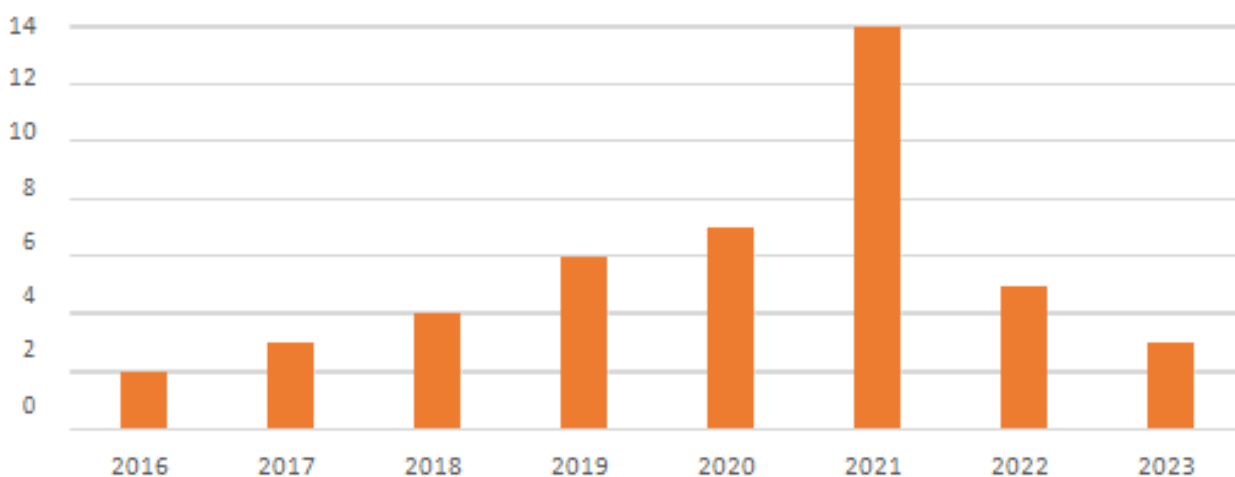
3.2 Application of LGT in trend analysis for the Petroleum Economy

Using the PICOC tool, it was determined that for the specific study question, the database adopted would be the Scopus database, accessed via Café do CAPES with the search for the terms “Oil & Gas” and “Economy”, focused on understanding how the Petroleum Economy developed, its impact on society and different industries, and finally how the post-petroleum economy will develop.

659 documents were found in the search. After filtering with the choice of the year 2015, the year of the Paris Agreement, as the initial year, 334 documents remained. Then, the documents were filtered in Portuguese, English, and Spanish, resulting in 301 documents. Of these, 230 were selected for being journal or conference articles, with 72 being open access to the public.

The 72 documents were reviewed, and 44 were considered relevant for being related to the study question, and these were coded into: Historical, Demand, Future, Pricing, Sustainability, and Logistics. The peak of publications was in 2021, with a slight growth trend as there is much room for research in this area according to Graph 1.

Graph 1 | Relevant publications for research by year in the Scopus database.



Source: Prepared by the Author (2023)

4. RESULTS AND DISCUSSION

The scientific production associated with the economy of oil and gas has received more publications since the Paris Agreement in 2015, reaching a peak of publications in 2021, probably associated with the moment of energy transition in the world. Governments and organizations are already working on actions for decarbonization and transition to more sustainable socio-environmental practices, driven by demands from consumers, investors, and even legal requirements, which is having a considerable impact on communities and more broadly on economies more based on oil, as is happening in Europe (Ginevicius et al., 2021).

The cost for this change is not low, and credit capture mechanisms for the creation or implementation of new technologies are being created, either through credit titles or even through taxation (Yusuf; Almomani; Qiblawey, 2023). The demand for energy only tends to grow, so for the future, it is important to have a model that relates emissions, energy cost, available sources and their quantities, among other factors, to define the level of actions of each government such as energy stock, investment in compensation mechanisms, or even forms of taxation to balance the market (Torvanger; Maltais; Marginean, 2021).

The oil market will still be present for decades, but the pace of investment in new projects should reduce, with governments and companies being obliged to diversify their portfolios from now on, especially since the use of petroleum and gas derivatives is not limited to fuel combustion (Fatima Rizvi et al., 2020).

The market for CO₂ injection into depleted wells, geothermal energy exploration, and the hydrogen economy are clear opportunities. In other words, according to Ginevicius et al. (2021), actions aligned with the energy transition are already underway, considering not only the positive impact that will be generated by the change with decarbonization but also the impact of these changes on the market.

Yusuf et al. (2023) explain that this journey will have a high cost and that there are various ways to charge this cost, with taxation being one of these ways. Torvanger et al. (2021) also believe that taxation is one of the paths, but emphasize that governments will work with variables such as stock or investment incentives, but in the end, the market will reach a balance. Fatima Rizvi et al. (2020) explain that companies and governments have already started the work of diversifying investment portfolios, which should already mitigate the impact on the market as a whole..

5. FINAL CONSIDERATIONS

The objective of this work was to understand how companies could organize themselves in a post-oil environment based on literature related to the Petroleum and Gas Economy.

The study revealed that there is no clear horizon for when the inversion should happen, but it should be a slow process. The current reality shows a significant increase in investment in renewable energies, but this increase is associated with a growth in global energy demand, as regions that today do not have access to basic living conditions and technology are developing. Market self-regulation alone will not have an effect due to the relative costs of investing in new green technologies, requiring state support. Hydrogen, carbon capture and storage in the subsurface, geothermal energy, and offshore wind energy seem to be natural paths for companies that currently have the know-how of the oil world, but for this, it is a sine qua non condition that they start investing to occupy these spaces.

Countries that have greater political-economic prominence focused on oil tend to lose this prominence precisely because of the volatility they generate in the financial market, and countries with greater potential for green energy production tend to develop rapidly.

The use of specific and well-adjusted models between fuel stock, availability and storage capacity of renewable energy, greenhouse gas emissions, demand, prices, and taxation tend to be the best for economic balance, and exploring the application of oil companies' skills in alternative businesses should be the current path for future development.

This research was based on a literature review using the Scopus database. There is an opportunity to expand this work and research in other databases to analyze recent changes in legal, market, or regulatory requirements regarding decarbonization and their impacts on the market, and a more detailed assessment of the impact on each of the subsectors of the oil sector.

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