

Examining the Determinants of Contemporary and Future Demand and Supply Dynamics of the
Global oil Industry: Implications for Ghana as an Oil Exporter.

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ABSTRACT

Oil-dependent African nations like Ghana face uncertainty in oil's future trajectory due to shifting demand and supply determinants influenced by global dynamics: financial crises, pandemics (e.g., COVID-19), pro-environmental agendas, and geopolitics (e.g., the Russia-Ukraine conflict). Understanding current global oil trends and its outlook is vital. This study addresses how oil-exporting countries like Ghana, reliant on oil revenue, should position themselves for the future. Through expert interviews and thematic analysis, the study reveals that pro-environmental shifts, geopolitics, renewable energy focus, and energy efficiency affect supply. Robust economies, COVID-19, energy generation, and environmental concerns impact demand. Renewable energy will grow in significance in Ghana's energy mix. Ghana's oil revenue is expected to remain substantial, with global dynamics posing limited threats. Recommendations include expediting oil exploration, diversifying policies, and transitioning to renewables to secure long-term sustainability.

Keywords: Determinants, Contemporary, Demand, Supply, Implications.

1: OVERVIEW

1.1. Background

1.1.1. The Global Oil Industry

The global oil industry traces its origins back to the 1850s when Benjamin Silliman Jr. analyzed the properties of Rock oil as an illuminator, prompting investment and the rise of the petroleum business in the USA. John D. Rockefeller's Standard Oil Company played a significant role in the oil industry's development in the USA (Yergin, 1991). Oil serves as energy and a feedstock for fuels, aviation, shipping, and petrochemicals. It has driven wealth creation and even influenced wars. Notably, although little mentioned, the Nigerian civil war's escalation stemmed from oil-related disputes. Oil also played major roles in WW II and the USA invasions of Iraq. The dynamics of supply and demand impact global oil prices (Statista, 2021).

The COVID-19 pandemic disrupted oil demand and supply in 2020. While transportation demand fell due to lockdowns, oil-generated electricity demand rose. Reports indicate a gradual return to pre-pandemic oil supply and demand levels recently. In August 2021, global petroleum and liquid fuel consumption reached 98.4 million barrels per day, up from the previous year. Predictions indicate an average consumption of 97.4 million b/d in 2021 and 101.0 million b/d in 2022 (Energy Information Administration, 2021).

1.1.2. Facts About the Global Oil Industry

World oil reserves surged from 1 billion barrels in 1990 to nearly 1.7 billion barrels in 2011 (*see figure 2 in appendix*). Over three decades, global oil consumption increased, reaching 4.01 billion metric tons in 2020. Notably, consumption dropped only during the 2008/2009 financial crisis (Sönnichsen, 2021). Renewables grew significantly but still lag behind other energy sources (*see figure 5*). Fourteen countries hold 93.5% of global proven oil reserves, ranging from 25.2 billion to 304 billion barrels.

Table 1: Proven Oil Reserves by Countries – Top 10 Largest

| Ran k | Country | Oil Reserves (billion barrels) | Share of Global Reserves |
|------------------|------------------|---------------------------------------|-------------------------------------|
| #1 | Venezuela | 304 | 17.80% |
| #2 | Saudi Arabia | 298 | 17.20% |
| #3 | Canada | 170 | 9.80% |
| #4 | Iran | 156 | 9.00% |
| #5 | Iraq | 145 | 8.40% |
| #6 | Russia | 107 | 6.20% |
| #7 | Kuwait | 102 | 5.90% |
| #8 | UAE | 98 | 5.60% |
| #9 | United States | 69 | 4.00% |
| #10 | Libya | 48 | 2.80% |

(Source: BP Statistical Review of World Energy, 2020)

1.1.3. The Ghanaian Oil Industry

Ghana's oil sector comprises upstream and downstream segments. New exploration fields boosted production, with an expected 2% increase in 2022 (Fitch, 2020). By 2023, production could rise to 420,020 barrels per day due to ongoing field developments (The News Editor, 2019).

1.2. Research Problem

Crude oil's economic power and inelastic demand have shaped global development. Despite calls for alternative fuels, oil's influence endures. Uncertainties necessitate the understanding of global oil dynamics, especially for an oil-dependent economies like Ghana.

1.3. Research Questions

- What are the contemporary and future demand and supply dynamics of the global oil industry?
- What do key experts perceive to be the implications for Ghana?
- What strategies should Ghana adopt, considering its oil dependence?

1.4. Research Relevance

This study's findings aid governments, policymakers, and multinational firms in making informed investment decisions in the oil sector. The insights guide economic diversification efforts. The oil industry's significance underscores the importance of this topic for stakeholders.

2: LITERATURE REVIEW

2.1. Theoretical Review

2.1.1. Demand Theory

Demand theory, as discussed by Whelan and Msefer (1996), outlines that consumer demand is determined by preferences and purchasing power. This theory applies to oil demand, where individuals require both the desire for oil products and the financial means to acquire them. The relationship between demand and price is evident in the demand curve, showing that higher prices lead to lower demand.

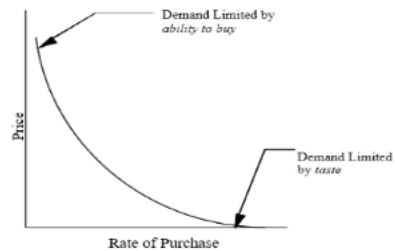


Figure A: Simple Demand Curve (Whelan and Msefer, 1996).

The frequency at which customers would like to purchase a product for a specified price.

2.1.2. Supply Theory

Supply theory, also presented by Whelan and Msefer (1996), explains that suppliers offer more at higher prices to maintain profitability. This principle is illustrated by the upward-sloping supply curve, indicating that higher prices justify increased production costs.

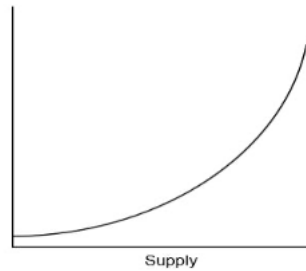


Figure B: Simple Supply Curve (Whelan and Msefer, 1996).

When prices are large, there is more motivation to increase a good's output. A short-term estimate of classical economic theory is depicted in the figure.

2.1.3. Interaction Between Demand and Supply

Adam Smith's concept of the "invisible hand" demonstrates the interaction between demand and supply, with prices adjusting to achieve market equilibrium (Smith, 1776). The elasticity of demand, highlighted by Alfred Marshall, influences how price changes impact demand. Oil, due to its inelastic demand, remains vital despite price fluctuations (Marshall, 1890).

2.2. Empirical Review

2.2.1. Economic Factors underlying Oil Demand and Supply

Oteng-Abayie et al. (2018) studied crude oil consumption determinants in Ghana, finding a positive relationship between real GDP per capita and crude oil demand. Allsopp and Fattouh (2011) identified global economic activity, technology advancements, and regulatory initiatives as factors affecting oil demand. Hosseini et al. (2021) developed a system dynamics model showcasing how spot prices and predictions influence oil demand and supply.

2.2.2. Geopolitical Factors Underpinning Demand and Supply

Stevens (2019) discussed energy geopolitics, highlighting the disparities in hydrocarbon energy supplies that drive global energy dynamics. Yergin (1991) discussed Enrico Mattei's influence in shifting power to oil-producing nations. Geopolitical decisions of major oil countries, like Saudi Arabia's production cuts, impact oil markets and minor oil nations like Ghana.

2.3. Conclusion

Existing literature focuses on economic and geopolitical factors, often using quantitative data. This study contributes by offering a qualitative perspective on the impact of global dynamics on African oil producers, particularly Ghana. It addresses the gap by providing insights into how Ghana should strategically invest in its oil industry to optimize earnings.

3: METHODOLOGY OVERVIEW

3.1. Research Design

A research design outlines the framework for the research process, from forming research questions to presenting results (Lavrakas, 2008). This descriptive study aims to understand contemporary and future demand and supply dynamics of the global oil industry and their implications for Ghana. A cross-sectional design was chosen to analyze the oil and gas sector's divisions. Primary data was collected through in-depth, semi-structured interviews with stakeholders from the three divisions of petroleum industry.

3.2. Sampling Strategy

The sample focused on Ghana, with the primary sample including the Ghana National Petroleum Corporation (GNPC) from the upstream petroleum industry. Sub-samples comprised an International Oil Company (IOC), local Oil Marketing Companies (OMCs), and policy experts due to the cross-sectional design's requirements. These selections provided insights from various players in the sector.

3.3. Data Collection Tools

3.3.1. Research Instrument

Semi-structured interviews were the chosen research tool for primary data collection. This approach allowed for adaptability during interviews and the exploration of new concepts.

Interview guides were tailored to each segment of the sample, with an average interview duration of 30 minutes.

3.3.2. Data Sources

Primary data was collected through one-on-one interviews with stakeholders, including representatives from Hallmark Oil Limited, GNPC, Houston University professor specialized in oil and gas economics, global energy specialists, and Tullow Oil representatives.

3.3.3. Data Collection Procedure

Purposive stakeholder sampling and snowballing were employed. Purposive sampling involved selecting respondents to best answer research questions. Snowball sampling was used due to challenges in contacting participants. Initial contacts facilitated recommendations and introductions.

3.4. Data Analysis Techniques

Thematic text analysis was utilized for data analysis. Data from interviews were categorized into themes, revealing trends and connections to the literature. This approach allowed the examination of meanings attached to oil industry dynamics and their implications for Ghana.

3.5. Ethical Considerations

Ethical considerations were addressed through a Human Subjects Review Board application. Participant permissions were obtained before interviews, and data integrity and confidentiality were maintained.

3.6. Limitations of the Study

The primary limitation was the difficulty in locating and accessing stakeholders for interviews due to their busy schedules.

4: DATA FINDINGS, DISCUSSION AND ANALYSIS

4.1. Introduction

This section 4 (Data Finding, Discussion and Data Analysis) presents primary data findings from interviews with eight stakeholders in the oil and gas industries in Ghana and the USA. It identifies themes in the collected data and links it to reviewed literature. The section 4 assesses contemporary and future supply and demand dynamics in the global oil industry, discusses its outlook, and examines implications for African and Ghanaian contexts. The fourth objective, recommending strategies for Ghana's oil industry, is addressed in Section 5.

Participant Demographics: Eight stakeholders were interviewed, representing the industry in Ghana and the USA. Of the nine participants, one was female, reflecting the industry's gender disparity. 75% were from Ghana, the rest from the USA. Participants were aged 35 and above, with 15-20 years' experience in OMCs and IOCs, and 21+ years in GNPC, General Electric, and expert roles. Interviews lasted 30-40 minutes.

4.2. Contemporary and Future Supply and Demand Dynamics

4.2.1. Factors Affecting Global Oil Supply

Global oil supply is significantly shaped by geopolitics. Respondents highlighted how major oil-producing economies, such as Gulf States, OPEC, Russia, and the United States, control supply and decide production levels. The discovery of shale oil technology in the US led to increased production, triggering excess supply and price drops. This is aligned with Stevens' (2019) emphasis on geopolitics' influence on energy markets. Recent events like Russia's actions

in Kuwait demonstrated how geopolitics can impact oil prices. Russia, the second-largest oil exporter and leading natural gas producer, holds sway over prices. Geopolitical tensions and disruptions can lead to supply shortages, driving up costs and affecting importing nations.

The strategic locations of oil deposits play a significant role in where it is exported (Dike, 2014). Proximity of oil deposits to extraction sites is vital for global supply. Transport costs influence export decisions. Economic progress relies on oil, especially in industrializing countries. Dependency on oil creates vulnerabilities; shortages halt productivity and economic activities.

Market-driven climate change mitigation strategies, like energy efficiency and renewable subsidies, impact oil demand. Government-driven policies such as carbon taxes distort the market. Renewable energy adoption and carbon reduction efforts have led big oil firms to reduce investments in crude oil. Financing challenges arise as banks are cutting back on funding for fossil fuel projects, favoring renewables. Countries pledging to halt oil project financing also impact capacity and supply.

4.2.2. Factors Affecting Global Oil Demand

The demand for global oil is influenced by various factors, including a country's economic vitality and the income level of its population. Gross's (2020) findings emphasize how crude oil drives economic activity and prosperity. The industrial revolution, powered by crude oil, propelled global development and lifted millions from poverty. With over 80% of economies having low to middle-income residents, a growing global population and vehicle saturation underscore the reliance on oil-based products for transportation. Stable economies, consistent GDP growth, disposable income, exchange rates, and political stability contribute to oil demand.

Energy generation significantly drives demand for hydrocarbon-based fuels like oil. Crude oil serves as a reliable source of power generation globally. In Africa, where renewable technologies are less accessible and industries rely on oil, fossil fuels remain essential for power.

The COVID-19 pandemic halted global oil demand, causing a negative turn in crude oil markets. A surplus led to price drops, illustrating the inverse relationship between supply and demand. Recent geopolitical tensions caused fluctuations in prices and demand, showcasing the dynamic nature of the market.

Environmental concerns impact demand. Pushes for energy efficiency and renewable adoption have led oil companies to invest less in crude oil projects. Climate change advocacy groups aim to divert funding from oil and gas, indicating a shift in perception regarding these resources' economic significance. Global agreements, like Canada's commitment to move away from oil, can redirect billions to clean energy initiatives. Such shifts could reshape the energy mix, potentially sidelining crude oil's role. Friedman (2021) agrees with this conclusion.

4.3. The Future Outlook of the Global Oil Industry

The global oil industry is poised for transformation over the next few decades due to increasing concerns about climate change. Key countries like the United Kingdom and the UAE are driving change with ambitious decarbonization goals (Lin, 2022). The UK's plan to transition to a carbon-free society by 2050 and the UAE's efforts to diversify its economy away from crude oil signify a shift in the industry. Major oil-producing nations are seeking economic diversification opportunities and gradually moving away from fossil fuels.

While complete phasing out of crude oil is challenging to predict, its significance in the energy mix will diminish. Presently, fossil fuels contribute to 84% of global energy production, with crude oil projected to remain a primary energy source (BP Global, n.d.). Alternative sources like natural gas, solar, and renewables will see increased adoption, but technology advancements will mitigate the environmental impact of crude oil.

The goal globally is to prioritize renewable energy sources over fossil fuels. The United States, parts of Europe, and Africa aim to rely more on renewables in the coming decades. This presents an opportunity for countries like Ghana to invest fossil fuel earnings into renewable energy, considering the developmental stage of their economies. Africa's economic growth has driven fossil energy demand, making a swift transition to renewables potentially disruptive.

In Africa, where electricity grids are often unreliable, a gradual transition from fossil fuels to renewables is necessary. Younger generations show preference for renewable energy careers, posing a challenge to traditional oil and gas industries. This existential threat is another factor reshaping the industry's future.

4.4. Implications for Ghana

The intricate interplay of supply and demand forces in the global oil industry reverberates across smaller African oil-producing nations like Ghana. These dynamics prompt developing countries to emulate practices of major oil producers, causing significant economic shifts. The plunge in oil prices in 2015 compelled Ghana to revise budgeted oil earnings, resulting in a 58% decline in oil income. Geopolitical tensions, exemplified by the Russia-Ukraine conflict, project potential revenue surges for countries including Nigeria, Angola, Libya, and Ghana, as oil prices soar due to global events (Annor, 2022). However, this geopolitical volatility could disrupt projects and investments in Ghana if oil prices become unfavorable.

Rising oil prices can enhance revenue streams for smaller producers, including Ghana, contributing to increased petroleum taxes and funding for social and developmental projects. This is backed by Hosseini, Shakouri, and Peighami, who discovered that oil producers use virtually identical techniques to maximize economic added value from the oil market; that is, a rise in oil prices should theoretically result in increased oil production to profit from the new high

prices (2021). While Ghana's economy is less dependent on oil revenue compared to nations like Nigeria or Angola, reduced crude oil output and exports could impact the country's finances. Nonetheless, Ghana's position as a net exporter of crude oil buffers it from severe implications of global oil market dynamics.

However, there are concerns about Ghana's ability to adapt. Investors and foreign oil companies are shifting focus to renewable energy, potentially leading to technology transfer losses for Ghana. The technical skills gap may hinder Ghana's ability to take over ongoing oil projects, impacting its technological autonomy. The financial challenge of funding capital-intensive oil projects could be exacerbated as investors withdraw. Despite these challenges, the shift of major players to renewable energy might confer a competitive advantage to countries that remain in fossil fuel production, allowing Ghana to capitalize on its fossil fuel assets. As major oil players exit, a potential supply shortage could lead to substantial revenues for countries like Ghana, which can cater to global demand and benefit from regional oil supply. Furthermore, Africa's slow transition to renewable energy, coupled with existing oil infrastructure, sustains oil's dominance in the region's energy mix.

5: CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusion

The analysis of data and literature underscores that global industry dynamics exert minimal influence on Ghana. These dynamics encompass governmental, environmental, economic, corporate, and health-related factors, perpetually evolving. However, collaboration among government and industry stakeholders is crucial to implement the recommended measures, ensuring the industry's sustained viability.

5.2. Recommendations

Ghana's policymakers must swiftly facilitate the exploration and extraction of its oil reserves, capitalizing on the impending transition from fossil fuels to renewables. Attracting investors necessitates favorable tax and fiscal frameworks.

Moreover, leveraging oil revenue to incentivize technological learning and modern infrastructure is essential. Supporting entrepreneurs through subsidies and overseas education can drive innovation and renewable energy adoption, aligning with global shifts. As the world diversifies energy sources, Ghana must follow suit.

REFERENCES

- Allsopp, C., & Fattouh, B. (2011). Oil and international energy. *Oxford Review of Economic Policy*, 27(1), 1–32. <http://www.jstor.org/stable/43741260>
- Annor, I. (2022). Experts forecast big boost in oil revenue for some African economies. VOA. Retrieved March 11, 2022, from <https://www.voanews.com/a/experts-forecast-big-boost-in-oil-revenue-for-some-african-economies/6478151.html>
- BP global. (n.d.). Crude oil prices 1861-2020 (\$ per barrel). Retrieved September 27, 2021, from <https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/oil.html>.
- Dike, J. C. (2014). "Does Climate Change Mitigation Activity Affect Crude Oil Prices? Evidence from Dynamic Panel Model", *Journal of Energy*, vol.1 <https://doi.org/10.1155/2014/514029>
- Fitch. (2020). Ghana's oil production to increase 2% in 2021 – Report. Petroleum

- Commission Ghana. Retrieved September 21, 2021, from <https://www.petrocom.gov.gh/ghana-president-akufo-addo-cuts-sod-for-us-25m-gnpcs-operational-headquarters-in-takoradi-3-2-3-2-2/>
- Friedman, G. (2021). Governments are choking funding for new overseas oil and gas projects. will the strategy work? financialpost. Retrieved March 9, 2022, from <https://financialpost.com/commodities/energy/oil-gas/governments-are-choking-funding-for-new-overseas-oil-and-gas-projects-will-the-strategy-work>
- Gross, S. (2020). Why are fossil fuels so hard to quit? Brookings. Retrieved October 10, 2021, from <https://www.brookings.edu/essay/why-are-fossil-fuels-so-hard-to-quit/>
- Hosseini, S. H., Shakouri, G. H., & Peighami, A. (2016). A conceptual framework for the oil market dynamics: A systems approach. *Energy Exploration & Exploitation*, 34(2), 171–198. <https://www.jstor.org/stable/90007392>
- Lin, M. T. (2022). *UAE wants to transform from a petrostate to renewable and Hydrogen powerhouse*. IHS Markit. Retrieved March 10, 2022, from <https://cleanenergynews.ihsmarkit.com/research-analysis/uae-wants-to-transform-from-a-petrostate-to-renewable-and-hydr.html>
- Lavrakas, P. J. (2008). *Research design*. Sage Research Methods. Retrieved September 27, 2021, from <https://dx.doi.org/10.4135/9781412963947.n471>
- Oteng-Abayie, E. F., Ayinbilla, P. A., & Eshun, M. E. (2018). Macroeconomic Determinants of Crude Oil Demand in Ghana. *Global Business Review*, 19(4), 873–888. <https://doi.org/10.1177/0972150918772923>
- Sönnichsen, N. (2021). Global oil consumption in million metric tons 1970-2020. Statista.

Retrieved September 27, 2021, from <https://www.statista.com/statistics/265261/global-oil-consumption-in-million-metric-tons/>

Sönnichsen, N. (2021). Global oil Reserves volume in billion barrels 2020. Statista.

Retrieved September 27, 2021, from

<https://www.statista.com/statistics/236657/global-crude-oil-reserves-since-1990/>

Sönnichsen, N. (2021). Statistics and facts about the global oil industry. Statista.

https://www.statista.com/topics/1783/global-oil-industry-and-market/#topicHeader__wrapper.

Stevens , P. (2019). The geopolitical implications of future oil demand.

www.chathamhouse.org. Retrieved March 18, 2022, from

<https://www.chathamhouse.org/2019/08/geopolitical-implications-future-oil-demand>

The News Editor. (2019). Ghana's oil Production estimated to go up to 500,000 barrels per day by 2024. Ministry of Finance | Ghana. Retrieved September 22, 2021, from <https://www.mofep.gov.gh/press-release/2019-02-14/ghana%27s-oil-production-estimated-to-go-up-to-500%2C000-Barrels-per-day-by-2024>.

Whelan, J., & Msefer, K. (1996). Economic Supply & Demand (dissertation). MIT, Cambridge, Massachusetts.

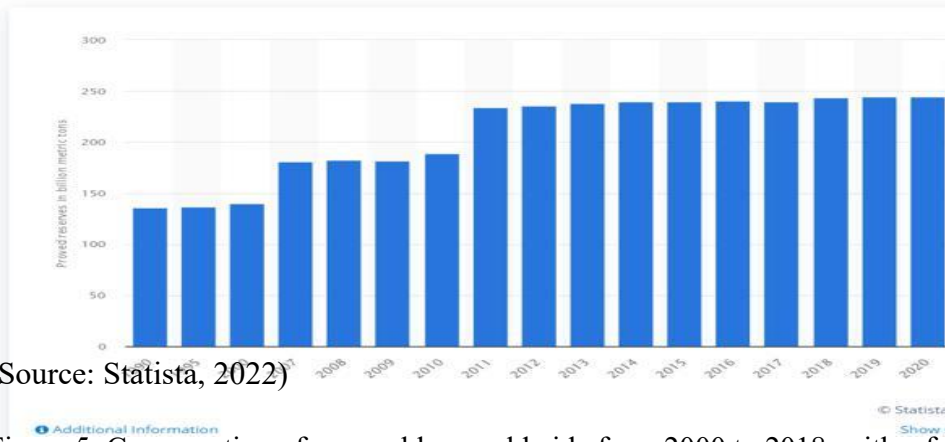
Yergin, D. (1991). The prize: The epic quest for oil, money and power by Daniel

Yergin. Simon & Schuster: New York.

APPENDICES

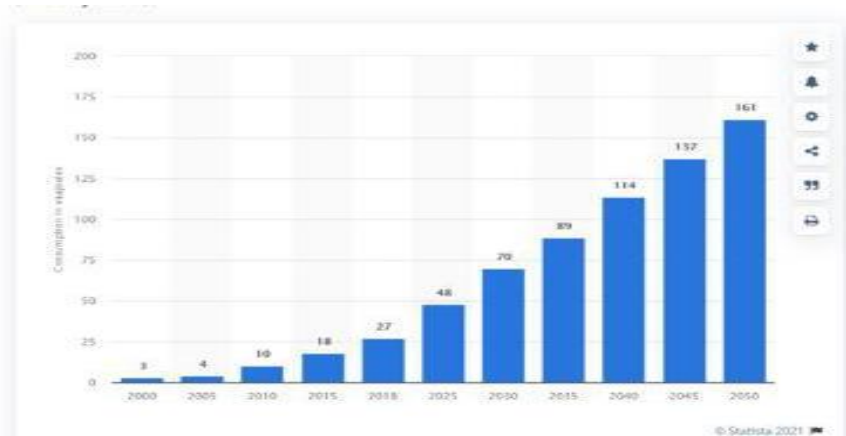
Figure 2: Global Oil Reserves

Proved oil reserves worldwide from 1990 to 2020*
(in billion metric tons)



(Source: Statista, 2022)

Figure 5: Consumption of renewables worldwide from 2000 to 2018, with a forecast until 2025 (in exajoules).



(Source: Statista, 2022)