International Journal of Innovation and Economic Development
ISSN 1849-7020 (Print)
ISSN 1849-7551 (Online)
URL: https://doi.org/10.18775/ijied.1849-7551-7020.2015.111.2003
DOI: 10.18775/ijied.1849-7551-7020.2015.111.2003

Volume 11
Issue 1
February, 2025
Pages 21-33

Factors Influencing Natural Gas and LNG Market Prices in the Global Energy Economy: A Comprehensive Review

[1] Asa Romeo Asa, [2] Johanna Pangeiko Nautwima

[1,2] Namibian - German Institute for Logistics, Namibia University of Science and Technology, Windhoek, Namibia

Abstract: This literature review examines the key factors that influence natural gas and liquefied natural gas (LNG) market prices in the context of the global energy economy. The study highlights the significance of the natural gas and LNG sectors, which are vast and dynamic, with major suppliers such as Russia, the United States, and Qatar, as well as major consumers from the US, China, and Europe. This review emphasises the importance of LNG in enabling global trade, decoupling production from consumption, and contributing to energy diversification and security. The factors influencing natural gas and LNG market price determination are technological advancements, geographical positioning and transportation-related costs, the market dynamics of demand and supply, and geopolitical factors. The review also discusses the limitations of the LNG supply chain, such as challenges in transportation infrastructure development, the implications of geopolitical factors, and the significance of environmental regulations. The impact of these limitations on price fluctuations and trading patterns is analysed, focusing on price volatility and disruptions, the influence of geopolitical tensions, and the effect of environmental regulations on cost escalation. This study highlights the expected future trends in the natural gas and LNG markets, including the expansion of liquefaction capacity, the need to overcome transportation issues, and the growing importance of environmental concerns and renewable energy.

Keywords: Natural Gas, Liquefied Natural Gas (LNG), Global Energy Economy, Market Prices, Geopolitical Factors

1. Introduction

The prices of natural gas and liquefied natural gas (LNG) have been volatile due to supply dynamics, geopolitical influences, and an evolving global energy marketplace. To investigate the drivers of price movements in energy markets as they undergo major transformations catalysed by emerging technologies, shifting government policies, and growing sustainability awareness. This literature review is a critical analysis for synthesising existing knowledge and identifying prevailing trends or gaps in understanding the need for further exploration. This approach enhances the analytical context for market behaviour while providing insight to help decision-makers, investors, and industry participants comprehend the complexities of the global energy landscape.

Globally, natural and liquefied natural gas (LNG) sectors are massive and dynamic in the broader geopolitical energy landscape (Bridge & Bradshaw, 2017; Nikhalat-Jahromi et al., 2017). Natural gas is marketed as an environmentally friendly substitute for fossil fuels because of its numerous uses and environmental benefits. LNG enables the global trade of natural gas and decouples the production process from consumption, drastically altering the

market dynamics. The natural gas sector has several suppliers and buyers. Some of the top suppliers of LNG are Russia, the United States, and Qatar (Sim, 2023). As developed economies, such as the US, China, and Europe, consume vast volumes of natural gas (Sim, 2023), the demand for this resource highly depends on their development—wide global economic links to diverse global supply and demand trajectories. Deficiencies in natural gas liquefaction practices contribute significantly to the supply versus demand discrepancy in the natural gas marketplace (Nikhalat-Jahromi et al., 2017). Liquefying natural gas can then be compressed and transported at great distances without a complex pipeline system. Owing to the wide-ranging influence of innovation on market forces, natural gas and LNG represent global goods (Obrenovic & Jalilov, 2014; Yusuf & Al-Ansari, 2023). Liquefied natural gas (LNG) makes manufacturing sites far from the market (Bradshaw & Bradshaw, 2017; Bradshaw & Boersma, 2020). This provides flexibility in supply and reduces the potential effects of proximity restrictions.

Owing to the development of infrastructure, such as liquefaction and regasification plants, shipping fleets, and a set of trading standards, liquefied natural gas (LNG) is traded independently of production and consumption. As a result of this disequilibrium of demand concerning supply, the market has become increasingly liquid, competition on price has become fiercer, and supply has stabilised (Costantini et al., 2007). Previously, natural gas distribution was determined by pipelines and political considerations, but in the age of new technology, providers could serve customers across the globe (Yegorov & Wirl, 2011). Natural gas and LNG have a large number of producers and consumers globally. The introduction of LNG has led to a drastic shift in market dynamics in an era of improved flexibility and global trade (Filimonova et al., 2022). The natural gas and liquefied natural gas (LNG) industry has evolved into one that is strong and well-linked due to differences in supply and demand (Brauers et al., 2021). The cooling of natural and liquefied natural gas that has been cooled to form a liquid is now an integral part of the global energy infrastructure. The potential of these materials paves the way for the diversification of green energy (Chu & Majumdar, 2012). This study comprehensively scrutinises the factors affecting fluctuations in natural gas and liquefied natural gas (LNG) prices. Therefore, this study examines the factors that affect the market prices of natural gas and liquefied natural gas in the global energy economy.

2. Methodology

This study examined the literature and provided insights into what drives prices in the global energy economy's natural and liquefied gas (LNG) markets. This was achieved through an extensive literature review of recent publications on natural and liquefied natural gas. The article was chosen to ensure that the studies answered a specific research question by identifying, selecting, and assessing research (Dewey & Drahota, 2016; Nautwima & Asa, 2022). This review involved a comprehensive and transparent combination search of keywords such as *("Natural Gas", "Liquefied Natural Gas", "Market Prices", AND "Global Energy Economy")* through the Google Scholar database to explore factors influencing natural gas and liquefied natural gas market prices in a global energy economy. The main question answered in this study is, "What drives natural gas and liquefied natural gas market prices in the global energy economy?". This review identifies, critiques, and reports significant factors guided by the main research question by relying on recent studies.

3. The Global Natural Gas and LNG Market: Overview

This study comprehensively review scrutinises the factors affecting fluctuations in natural gas and liquefied natural gas (LNG) prices. Therefore, this study provides an overview of the market prices of natural gas and liquefied natural gas in the global energy economy.

3.1. Suppliers and Consumers

The natural gas sector comprises a vast global system of interlinked producers and consumers. Big players, such as Russia, the United States, and Qatar, play a considerable role in the global natural gas supply network (Meza & Koç, 2021). However, the US, China, and the EU are the major consumers of this resource. The growing liquefied natural gas (LNG) trade has added a new dimension to the market, enabling the decoupling of production and consumption (He et al., 2018). Transportation across extreme distances for international commerce without the need for extravagant pipeline infrastructure establishes this particular commodity as a truly global commodity (Klass & Meinhardt, 2014) because the liquid state enables the flow of this substance. Arguably, the demand-supply dynamics, be it energy or any commodity market in general, hold a vital role in price stabilisation (Asa et al., 2013).

3.2. The Significance of LNG

Liquefied natural gas (LNG) is an important energy source for other sectors, including power generation, industry, and transportation, and it supports industrial and economic development (Litvinenko, 2020; Kumar et al., 2011). LNG's widespread availability and affordability support economic growth and progress in developing and developed countries. Global access to liquefied natural gas (LNG) has contributed to the diversification of energy sources, improving energy security. Countries have the means to procure liquefied natural gas (LNG) from multiple suppliers, thus alleviating the risks associated with relying on a single natural gas source (Sakmar, 2013). The transformation of liquefied natural gas (LNG) is important in the global energy industry. This component plays a considerable role in transitioning towards a more sustainable and linked energy environment because it can stimulate international commerce and separate production and consumption. It, therefore, offers a cleaner energy source compared to coal and oil (United Nations Environment Programme [UNEP], 2011).

Several essential variables make Liquefied Natural Gas (LNG) crucial in the global energy market:

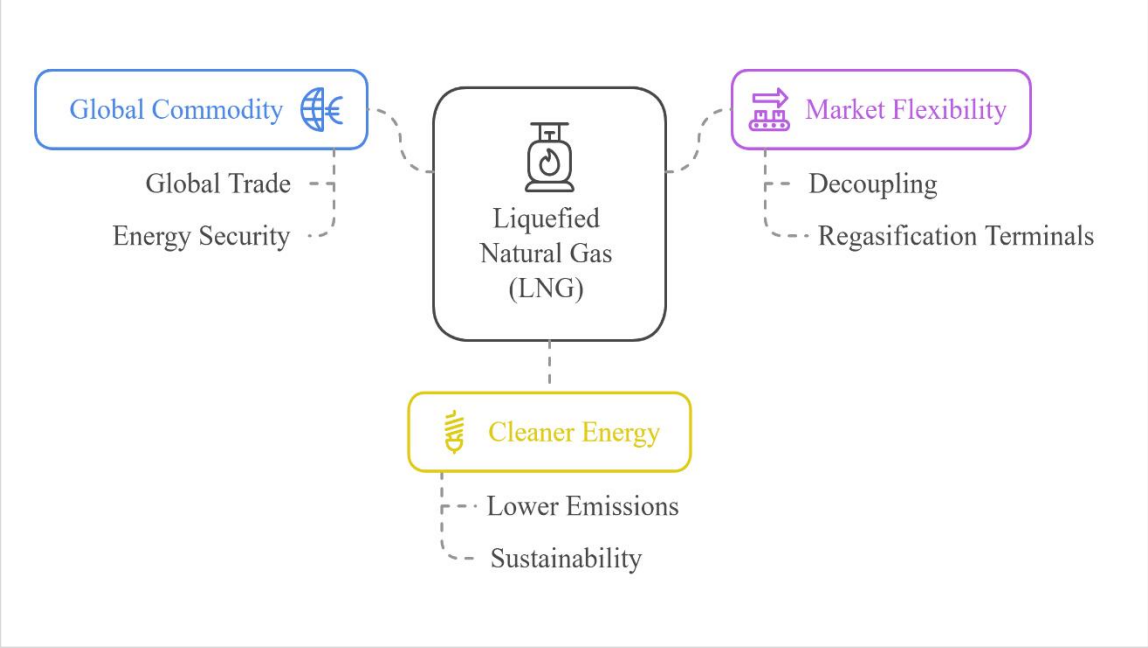


Figure 1: Significance of Liquified natural gas in the global energy market

Source: Authors' work (2024)

Liquified natural gas (LNG) strongly influences the natural gas market and has evolved into a global commodity. Unlike traditional natural gas, which can only be transported via pipelines, liquefied natural gas (LNG) can cover long distances across oceans and reach distant markets (Ebinger et al., 2012). This has led to the globalisation of the natural gas trade and enabled producers to ship liquefied natural gas (LNG) to remote, far-flung locations around the world from where it was produced. This technological milestone has contributed significantly to the increased energy security and diversification of global natural gas supply.

One of the key benefits of liquefied natural gas (LNG) is its ability to decouple the process from production to consumption. Conventional natural gas pipeline systems must be located near the production area, which limits their operational flexibility (Mokhatab et al., 2013). Regasification Terminals convert Liquefied Natural Gas (LNG) from a liquid state to a gaseous state and vice versa. This property enables the spatial separation of manufacturing sites from dominant consuming areas, thus minimising the dependence on tube technology (Bridge et al., 2017; Cebolla et al., 2022). This spatial dichotomy has given rise to increased market flexibility, heightened pricing competition, and minimised geopolitical restrictions (Bridge & Bradshaw, 2017)

leaner Energy, compared to coal and oil; LNG are often considered greener energy sources (Kumar et al., 2011). Its lower emissions make it attractive to all nations that promote sustainability and want to comply with existing environmental regulations. LNG can be used to develop a greener energy portfolio capable of alleviating the worst fragments of climate change and can be rapidly developed (Borowski, 2022; Sun et al, 2022).

4. Factors Influencing Natural Gas and LNG Market Price Determination

The following factors are correlated and collectively inform the complex dynamics of natural gas and LNG pricing in the global energy market. The interplay and interdependence of these factors can result in price volatility and fluctuations over time.

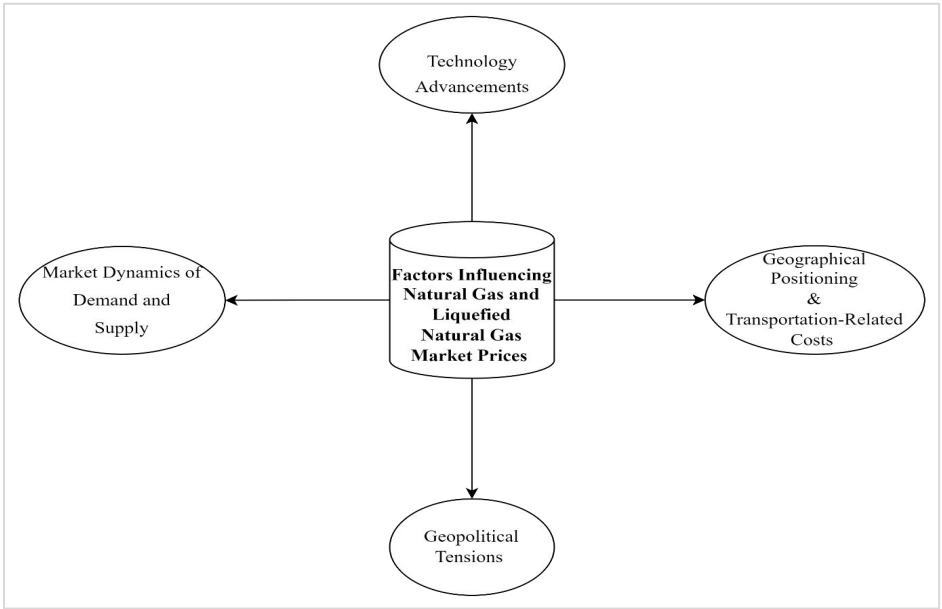
Figure 2: Factors influencing natural gas and LNG market price determination
Source: Authors' work (2024)

4.1. Advancements in Technology

Significant reductions in production costs and breakthroughs in natural gas and LNG at all levels have wide-ranging implications for supply and demand. Hönig et al. (2019) emphasise the cost-saving potential of more efficient extraction and liquefaction processes. Natural gas and LNG prices are sensitive to radical technological changes. More proficient procedures concurrently enhance the extraction process (Hönig et al., 2019). Although mixed refrigerant (MR) based technologies dominate onshore LNG. Obrenovic and Qin (2014) and Khan et al. (2017) highlight a trend towards optimisation driven by process knowledge, which is especially relevant for onshore facilities. This article covers all aspects of natural gas processing, including extraction, transportation, storage, treatment, market, and costs (Mazyan et al., 2016). Ritz (2019) and Liss (2014) also refer to the implications of these developments beyond the U.S., with the former examining the status of pipeline gas competition vis-à-vis LNG and the latter to the game-changing nature of shale gas technology revolutionising the U.S. energy marketplace. These studies demonstrate the influence of technological advances in the natural gas and LNG sectors.

4.2. Geographical Positioning and Transportation-Related Costs

Geographical positioning and transportation-related costs are primarily based on the expense of a company's physical site and logistics expenses for day-to-day operations. Thus, the literature on how geographical positioning and transportation costs affect the natural gas market is complex. Natural gas proximity to deposits is crucial for transportation charges, as shorter transportation periods favour locations near consumers or LNG terminals (Economides & Wood, 2009). However, import prices do not necessarily fall when transport prices reduce (Rosendahl & Sagen, 2009; Ulvestad & Overland, 2012), as the deduction of the former from the latter is contingent on both the distances to markets and the technology choices adopted to deliver the commodity at the consumption end (Rosendahl & Sagen, 2009; Yu et al., 2023), and how natural gas and CO2 prices affect the cost efficiency of liquefied natural gas (LNG) and pipelines (Ulvestad & Overland, 2012). Furthermore, understanding the effects of natural gas supply costs and other endogenous transportation costs on gas flow, investment in



infrastructure, and price convergence highlights the importance of this understanding in the natural gas market (Oglend et al., 2016; Zhang et al., 2016).

4.3. Market Dynamics of Demand and Supply

The volume and availability of natural gas resources greatly shape market dynamics, as more resources mean more accessibility and lower prices (Hauser, 2016). This is particularly pertinent given the shale gas boom, which has made natural gas an increasingly significant part of international trade (Li, 2019). Natural gas price interactions during periods of convergence and temporary divergence between the Chinese and US natural gas markets have also played a role in the regional pricing mechanism (Zhu et al., 2018). This latter aspect is vividly represented by the macro transition occurring in North American natural gas markets owing to the shale gas revolution through cheap hydraulic fracturing (Huntington, 2016) and resource concerns affecting pricing methods. From a market dynamics perspective, non-discriminatory access to pipeline systems results in capacity overallocation, potentially affecting pricing (Poudineh et al., 202; Cardinale, 2023). High-quality natural gas resources are an important part of the market momentum. Prices tend to sink if resources are abundant and easily accessed, and prices are more likely to climb if they are scarce and remote. Attributes of gas reserves, their influence on market functioning, and potential effects of resource issues on pricing methods.

4.4. Geopolitical Factors

Geopolitical tensions heavily influence the prices of natural gas and LNG. Transformative geopolitical developments, such as the emerging Gulf between Russia and the West, have ramifications for Russian gas supplies and the integration of the global gas market (Stern et al., 2014). Geopolitical Factors, the Effects of which Must Be Geopolitical Contexts, Meet the Criteria to Assess the Geopolitical Priority of Paying Attention to Accommodating European Dependence on Russian Natural gas (Siddi, 2019). Moreover, the spread of liquefied natural gas over pipeline natural gas is influenced by geopolitical factors, leading to an imbalance between the supply and demand of natural gas in China (Chai et al., 2021). Geopolitical tensions can also influence gas market uncertainty, boosting the expansion of renewable energy and suppressing gas demand (Anser et al., 2021). Therefore, these geopolitical tensions are important in natural gas and LNG markets, affecting prices and market dynamics.

5. Weaknesses in the Supply Chain of LNG

The subsequent section discusses the challenges and dynamics of the global energy market's natural gas and LNG supply chain. Additionally, the section analyses the impact of supply chain weaknesses on price volatility and fluctuations over time.

5.1. Challenges in the Supply Chain of LNG

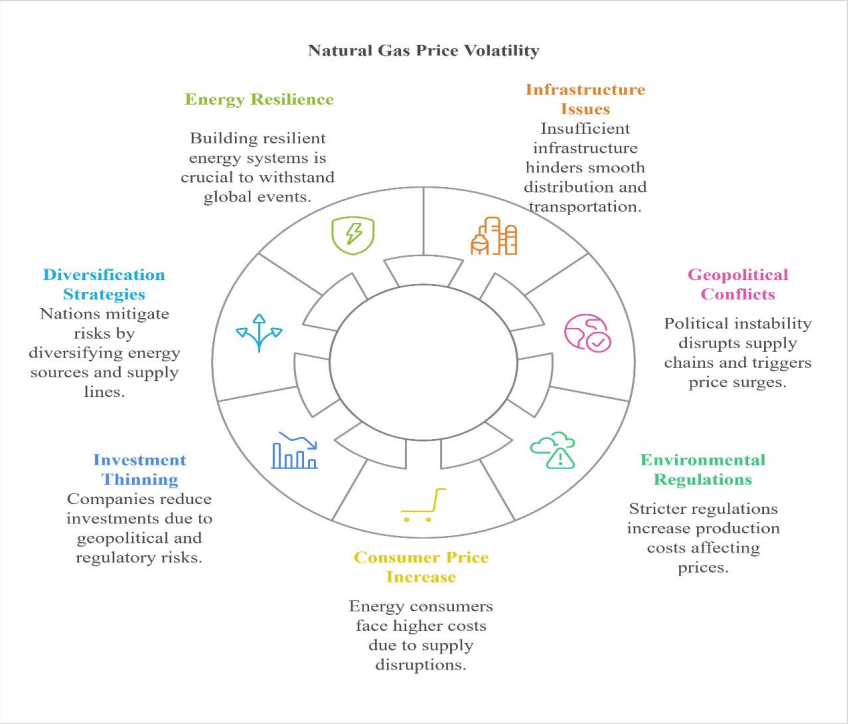
5.1.1. Dilapidated Transportation Infrastructure

The transportation infrastructure sector suffers numerous problems that diminish its effectiveness and efficiency. Poor funding and dilapidated infrastructure remain two major causes of such problems. Transport: The current means of transport are a major bottleneck in the distribution of natural gas and LNG. This can reduce the efficiency with which pipelines and liquefied natural gas (LNG) terminals transport these resources if they are difficult to access.

5.1.2. Geopolitical Instability

Natural and liquefied natural gas (LNG) markets have become highly sensitive to geopolitical events. Wars and political instability in important production areas can disrupt supply chains and cause the market to become volatile (Lund et al., 2020). This can lead to large, unforeseen price fluctuations. This section discusses the potential impact of geopolitical factors on the natural gas market's supply, pricing, and security.

5.1.3. Environmental Regulations in Contemporary Society



A clear trend towards establishing stricter environmental norms and standards can be observed due to the evolving global awareness and commitment towards environmental sustainability (Coenen et al., 2021; Javaid et al., 2022). Because these regulations have a major impact on gas reserve exploration and extraction, enforcing strict requirements can lead to higher production costs and, as a result, affect price dynamics. Here, we provide an overview of environmental regulations and their impact on the natural and liquefied natural gas (LNG) industries.

5.2. Impact of the Supply Chain Weaknesses

5.2.1. The impact of Price Volatility and Disruptions

Price volatility and disruptions in the natural and liquefied natural gas (LNG) markets could have major implications for the energy industry. Various factors lead to this volatility, and practical examples illustrate the impact of these disruptions (Rasoulian et al., 2017). Figure 3 analyses the drivers of price volatility and disruption.

Figure 3: Natural gas price volatility and disruption
Source: Authors' Work

The absence of sufficient infrastructure, such as pipelines and LNG terminals, can hinder the smooth distribution and transportation of NG and LNG in the supply chain. Price changes can occur when a proper material cannot be delivered owing to supply chain restrictions.

Geopolitical conflicts can lead to supply chain distress due to political instability in major producing regions. For example, geopolitical tensions, sanctions imposed on important gas suppliers, and disputes over transit routes could trigger sudden price surges.

The adoption of more stringent environmental regulations can shape the development of gas reserves. These strictures can lead to higher manufacturing costs and affect prices.

The real-world instances point to controversies surrounding gas transportation from Ukraine and Russia, which concern not only the price of natural gas but also the choice of routes, leading to interruptions in supply to European consumers. Price changes have influenced

consumers and energy corporations due to current geopolitical tensions. Climate-driven disruptions can significantly affect natural gas and liquefied natural gas (LNG) transportation/transport. Severe weather events (e.g. hurricanes and severe cold snaps) can interrupt several of these processes. Often, these interruptions lead to increased demand, creating price movements.

Price volatility and interruptions can have many consequences, such as;

- One possible outcome of supply disruptions is that the prices faced by energy consumers would increase. This could lead to higher costs for both consumers and industries.
- In the energy sector, investment thins when companies face geopolitical risk or regulatory changes, prompting them to invest in infrastructure and exploration.

Nation utilisation of diversification strategies is a way of mitigating the risks of price volatility and disruptions by diversifying energy sources and supply lines.

- Energy resilience is as important as any other point of vulnerability within the growing list of energy systems that must be built and cyber-resilient, as events around the globe make this point starkly clear.

Price oscillation, as well as disruptions in the natural gas and LNG markets, is a complicated issue with broad implications. There is also a need for cooperation with international organisations, where policy action, security, and energy supply should focus on a cohesive framework to guarantee energy supply as an effective policy and open relations for developing the infrastructure. Supply chain disruptions can lead to price volatility from multiple sources. Suppose your customer is a politician in an era in which they have their specific infrastructure for pumping oil and cannot export on high seas (due to wars or conflicts). In this case, prices will likely rise due to insufficient supply to meet demand. This section offers an in-depth examination of price volatility and disruptions, exploring real-life examples and their impact on the energy market.

5.2.2. The Impact of Geopolitical Tensions on Price Fluctuations

Recent historical events are stark examples of how geopolitical considerations could lead to pronounced swings in supply and price. Geopolitical warfare has been a key culprit throughout history as one of the major political drivers impacting supply and price volatility. Sanctions on major gas providers and changes in global relations could significantly impact supply and demand, thereby producing major price swings. This section discusses the historical and modern geopolitical events that form market patterns.

Historical geopolitical events change international relations and political geography and define history. Such events vary from the Russian-Ukrainian conflicts, the challenge to Russian energy supremacy in the region, and the consistent friction of Western opinion over European dependence on Russian energy sources. The period from 2006 to 2009 was marked by gas conflicts between Russia and Ukraine, which disrupted the natural gas supply to many European countries (Richter & Holz, 2015). These conflicts caused price spikes and highlighted European energy security's vulnerability to geopolitical factors. An example of such a geopolitical event impacting energy markets can be demonstrated in the OPEC Oil Embargo of 1973 about oil (Krane & Medlock III, 2018). As with higher price pressures leading to the OPEC oil embargo, the oil crisis resulted from geopolitical events, such as the Yom Kippur War and a massive rise in crude oil prices. This also has a knock-on effect on natural gas prices. Sanctions imposed by Western countries in reaction to Russia's activities in Ukraine and other geopolitical issues have also severely hampered Russia's energy industry (Chen et al., 2023;

Obrenovic et al., 2023). By imposing sanctions on the country, access to the world energy market will be limited, which is an important factor in shaping supply and price.

Persistent wars and geopolitical differences in the Middle East, especially in oil-exporting countries, can impact natural gas costs through spillover effects (Ahram, 2020). Amid the ambiguity prevailing across the domain, it could disrupt the supply chain and spike the price. Only with some combination, geopolitical tensions on the variations of prices prove the importance of the diversity of sources of energy, resilience of infrastructure, and coordination at an international level. Implementing energy security measures and contingency plans remains key to successfully weathering the impact of such events on the energy market. History and modernity merge in the tangled web of geopolitical realities which shape the supply and pricing of natural gas and LNG. Energy stakeholders and policymakers must understand these events and their potential ramifications to ensure the energy supply remains stable and secure.

5.2.3. The Influence of Environmental Regulations on the Escalation of Costs

Implementing environmental standards can increase production costs, which affects price dynamics (Wu, Hao & Ren, 2020). Businesses that use greener technologies to meet environmental standards may incur higher customer costs (Albitar et al., 2023; Gu et al, 2023; Khan, Yu & Farooq, 2023). Examining the effects of environmental concerns and regulatory developments on natural gas and liquefied natural gas (LNG) pricing methods is important to understand and minimise costs.

6. Conclusion and Recommendations

In conclusion, this study primarily focused on the global natural gas and LNG markets due to their status as the largest and most rapidly expanding market segment in the global energy economy. Supply, demand, and price determination mechanisms are subject to numerous variables. The study observes significant changes in the natural and liquefied natural gas (LNG) markets. The sector experiences profound transformations, including an expansion of liquefaction capacity. The anticipated increase in worldwide demand for liquefied natural gas (LNG) drive further investment in developing liquefaction capacity. Based on this expansion plan, LNG liquefaction plants constitute an efficient solution for the export of liquefied natural gas (LNG) to various regions globally. Analyses on the forecasted developments in the liquefied natural gas (LNG) industry and the potential consequences associated with the expansion of liquefaction capacity are given below:

- Overcoming transportation Issues and how to do it successful

The industry's next trajectory is to prioritise unblocking the limitations of modern infrastructure. Therefore, the balance between the natural and liquefied natural gas (LNG) supply chain can be achieved by effectively and reliably delivering it to terminals and pipelines. The investment and development of LNG offers challenges and opportunities associated with developing transport infrastructure in ensuring effective supply chain is attained.

- The environmental concerns and the advancement of renewable energy

With the growing importance of environmental issues and the emergence of renewable energy, it needs to enter a new age. The increasing use of renewable energy can affect the fundamental demand and price of natural and liquefied natural gas (LNG). It examines how environmental considerations and developments in renewables could affect the future of the natural gas industry.

References

- Ahram, A. I. (2020). War and conflict in the Middle East and North Africa. *John Wiley & Sons*.
- Albitar, K., Borgi, H., Khan, M., & Zahra, A. (2023). Business environmental innovation and CO2 emissions: The moderating role of environmental governance. *Business Strategy and the Environment*, *32*(4), 1996-2007. CrossRef
- Anisie, A. (2014). Natural gas pricing and competitiveness: the impact of natural gas prices upon the industry's dynamics. Universidad Pontificia Comillas.
- Anser, M. K., Syed, Q. R., Lean, H. H., Alola, A. A., & Ahmad, M. (2021). Do economic policy uncertainty and geopolitical risk lead to environmental degradation? Evidence from emerging economies. *Sustainability*, *13*(11), 5866. CrossRef
- Asa, A. R., Prasad, N. S., & Htay, M. M. (2013). Balanced scorecard: A paradigm measure of business strategy and firm performance. *International Journal of Scientific & Technology Research*, *2*(4), 121-125.
- Borowski, P. F. (2022). Mitigating climate change and the development of green energy versus a return to fossil fuels due to the energy crisis in 2022. *Energies*, *15*(24), 9289.
- Bradshaw, M. J., & Boersma, T. (2020). *Natural gas*. *John Wiley & Sons*.
- Brauers, H., Braunger, I., & Jewell, J. (2021). Liquefied natural gas expansion plans in Germany: The risk of gas lock-in under energy transitions. *Energy Research & Social Science*, *76*, 102059. CrossRef
- Bridge, G. and Bradshaw, M., (2017). Making a global gas market: territoriality and production networks in liquefied natural gas. *Economic Geography*, *93*(3), pp.215-240.
- Bridge, G., & Bradshaw, M. (2017). Making a global gas market: territoriality and production networks in liquefied natural gas. *Economic Geography*, *93*(3), 215-240.
- Bridge, G., Barr, S., Bouzarovski, S., Bradshaw, M., Brown, E., Bulkeley, H., & Walker, G. (2018). Energy and society: A critical perspective. *Routledge*.
- Cardinale, R. (2023). From natural gas to green hydrogen: Developing and repurposing transnational energy infrastructure connecting North Africa to Europe. *Energy Policy*, *181*, 113623. CrossRef
- Cebolla, R. O., Dolci, F., & Weidner, E. (2022). Assessment of hydrogen delivery options: Feasibility of transport of green hydrogen within Europe. *Publications Office of the European Union*, Luxembourg, 2022, doi:10.2760/869085, JRC130442
- Chai, J., Zhang, X., Lu, Q., Zhang, X., & Wang, Y. (2021). Research on imbalance between supply and demand in China's natural gas market under the double-track price system. *Energy Policy*, *155*, 112380.
- Chen, Y., Jiang, J., Wang, L., & Wang, R. (2023). Impact assessment of energy sanctions in geo-conflict: Russian–Ukrainian war. *Energy Reports*, *9*, 3082-3095.
- Chu, S., & Majumdar, A. (2012). Opportunities and challenges for a sustainable energy future. *nature*, *488*(7411), 294-303.
- Coenen, J., Bager, S., Meyfroidt, P., Newig, J., & Challies, E. (2021). Environmental governance of China's belt and road initiative. *Environmental Policy and Governance*, *31*(1), 3-17.

- Costantini, V., Gracceva, F., Markandya, A. and Vicini, G., (2007). Security of energy supply: Comparing scenarios from a European perspective. *Energy policy*, *35*(1), pp.210-226.
- Ebinger, C., Massy, K., & Avasarala, G. (2012). Liquid markets: Assessing the case for US exports of liquefied natural gas. *Policy*.
- Economides, M.J. and Wood, D.A., 2009. The state of natural gas. *Journal of Natural Gas Science and Engineering*, *1*(1-2), pp.1-13.
- Filimonova, I. V., Komarova, A. V., Sharma, R., & Novikov, A. Y. (2022). Transformation of international liquefied natural gas markets: New trade routes. *Energy Reports*, *8*, 675-682.
- Gu, X., Firdousi, S. F., Obrenovic, B., Afzal, A., Amir, B., & Wu, T. (2023). The influence of green finance availability to retailers on purchase intention: A consumer perspective with the moderating role of consciousness. *Environmental Science and Pollution Research*, 30(27), 71209–71225. CrossRef
- Hauser, P., Schmidt, M., & Möst, D. (2016, June). Gas markets in flux: Analysis of components and influences for natural gas pricing in Europe. In *2016 13th International Conference on the European Energy Market (EEM)* (pp. 1-8). IEEE.
- He, T., Nair, S. K., Babu, P., Linga, P., & Karimi, I. A. (2018). A novel conceptual design of hydrate-based desalination (HyDesal) process by utilizing LNG cold energy. *Applied Energy*, *222*, 13-24. CrossRef
- Hönig, V., Prochazka, P., Obergruber, M., Smutka, L., & Kučerová, V. (2019). Economic and technological analysis of commercial LNG production in the EU. *Energies*, *12*(8), 1565.
- Huntington, H. G. (2016). Introduction: North American natural gas markets in transition. *Energy Economics*, *60*, 401-404.
- Javaid, M., Haleem, A., Singh, R. P., Suman, R., & Gonzalez, E. S. (2022). Understanding the adoption of Industry 4.0 technologies in improving environmental sustainability. *Sustainable Operations and Computers*, *3*, 203-217.
- Khan, M. S., Karimi, I. A., & Wood, D. A. (2017). Retrospective and future perspective of natural gas liquefaction and optimization technologies contributing to efficient LNG supply: A review. *Journal of Natural Gas Science and Engineering*, *45*, 165-188.
- Khan, S. A. R., Yu, Z., & Farooq, K. (2023). Green capabilities, green purchasing, and triple bottom line performance: Leading toward environmental sustainability. *Business Strategy and the Environment*, *32*(4), 2022-2034.
- Klass, A.B. and Meinhardt, D., 2014. Transporting oil and gas: US infrastructure challenges. *Iowa L. Rev.*, *100*, p.947.
- Krane, J. and Medlock III, K.B., (2018). Geopolitical dimensions of US oil security. *Energy Policy*, *114*, pp.558-565.
- Kumar, S., Kwon, H. T., Choi, K. H., Lim, W., Cho, J. H., Tak, K., & Moon, I. (2011). LNG: An eco-friendly cryogenic fuel for sustainable development. *Applied Energy*, *88*(12), 4264-4273. CrossRef

- Li, B. (2019). Pricing dynamics of natural gas futures. *Energy Economics*, *78*, 91-108.
- Liss, W. E. (2014). Impacts of shale gas advancements on natural gas utilization in the United States. *Energy Technology*, *2*(12), 953-967.
- Litvinenko, V. (2020). The role of hydrocarbons in the global energy agenda: The focus on liquefied natural gas. *Resources*, *9*(5), 59.
- Lund, S., Manyika, J., Woetzel, J., Barriball, E. and Krishnan, M. (2020). Risk, resilience, and rebalancing in global value chains. McKinsey Global Institute.
- Mazyan, W., Ahmadi, A., Ahmed, H., & Hoorfar, M. (2016). Market and technology assessment of natural gas processing: A review. *Journal of Natural Gas Science and Engineering*, *30*, 487-514.
- Meza, A., & Koç, M. (2021). The LNG trade between Qatar and East Asia: Potential impacts of unconventional energy resources on the LNG sector and Qatar's economic development goals. *Resources Policy*, *70*, 101886. CrossRef
- Moher, D., Shamseer, L., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., Shekelle, P., Stewart, L.A. and Group, P.-P. (2015), "Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement", Systematic Reviews, Vol. 4 No. 1. CrossRef
- Mokhatab, S., Mak, J. Y., Valappil, J. V., & Wood, D. (2013). *Handbook of liquefied natural gas*. Gulf Professional Publishing.
- Nautwima, J. P., & Asa, A. R. (2022). Exploring the challenges and factors impeding effective public service delivery at a municipality in Namibia. *Int. J. Innov. Econ. Dev*, *8*, 15-24.
- Nautwima, J. P., & Asa, A. R. (2022). The impact of quality service on customer satisfaction in the banking sector amidst Covid-19 pandemic: A literature review for the state of current knowledge. *International Journal of Management Science and Business Administration*, *8*(3), 31-38.
- Nikhalat-Jahromi, H., Fontes, D. B., & Cochrane, R. A. (2017). Future liquefied natural gas business structure: a review and comparison of oil and liquefied natural gas sectors. *Wiley Interdisciplinary Reviews: Energy and Environment*, *6*(4), e240.
- Obrenovic, B., & Jalilov, S. (2014). Building a better national innovation system through effective knowledge sharing: A case of Croatia. *International Journal of Management Science and Business Administration*, 1(1), 41–51.
- Obrenovic, B., & Qin, Y. (2014). Understanding the concept of individual level knowledge sharing: A review of critical success factors. *Information and Knowledge Management*, 4(4), 110–119.
- Obrenovic, B., Godinic, D., & Njavro, M. (2023). Sustaining company performance during the war-induced crisis using sourcing capability and substitute input. *Environment, Development and Sustainability*, 1–26. CrossRef

- Oglend, A., Kleppe, T. S., & Osmundsen, P. (2016). Trade with endogenous transportation costs: The case of liquefied natural gas. *Energy Economics*, *59*, 138-148.
- Poudineh, R., Sen, A., & Fattouh, B. (2020). An integrated approach to electricity sector reforms in the resource-rich economies of the MENA. *Energy Policy*, *138*, 111236.
- Rasoulian, S., Grégoire, Y., Legoux, R. and Sénécal, S., 2017. Service crisis recovery and firm performance: Insights from information breach announcements. *Journal of the Academy of Marketing Science*, *45*, pp.789-806.
- Richter, P. M., & Holz, F. (2015). All quiet on the eastern front? Disruption scenarios of Russian natural gas supply to Europe. *Energy Policy*, *80*, 177-189.
- Ritz, R. A. (2019). A strategic perspective on competition between pipeline gas and LNG. *The Energy Journal*, *40*(5), 195-220.
- Rosendahl, K. E., & Sagen, E. L. (2009). The global natural gas market: will transport cost reductions lead to lower prices?. *The Energy Journal*, *30*(2).
- Sakmar, S.L., (2013). Energy for the 21st century: Opportunities and challenges for liquefied natural gas (LNG). University of San Francisco School of Law, USA. CrossRef
- Siddi, M. (2019). The EU's botched geopolitical approach to external energy policy: The case of the Southern Gas Corridor. *Geopolitics*, *24*(1), 124-144.
- Sim, L. C., 2023. Russia-GCC-Asia energy dynamics: Is the Ukraine War a game changer. *Asia in the GCC: A New strategic partner*, 40-47.
- Stern, J., Rogers, H., Yafimava, K., Pirani, S., El-Katiri, L., Honore, A., ... & Dickel, R. (2014). Reducing European Dependence on Russian Gas–distinguishing natural gas security from geopolitics. The Oxford Institute for Energy Studies. University of Oxford.
- Sun, C.-W., Obrenovic, B., & Li, H.-T. (2022). Influence of virtual CSR co-creation on the purchase intention of green products under the heterogeneity of experience value. *Sustainability*, 14(20), 13617. CrossRef
- Ulvestad, M., & Overland, I. (2012). Natural gas and CO2 price variation: impact on the relative cost-efficiency of LNG and pipelines. *International Journal of Environmental Studies*, *69*(3), 407-426.
- United Nations Environment Programme. International Resource Panel. (2011). *Decoupling natural resource use and environmental impacts from economic growth*. UNEP/Earthprint.
- Wu, H., Hao, Y., & Ren, S. (2020). How do environmental regulation and environmental decentralization affect green total factor energy efficiency: Evidence from China. *Energy Economics*, *91*, 104880.
- Yegorov, Y., & Wirl, F. (2011). Gas transportation, geopolitics and future market structure. *Futures*, *43*(10), 1056-1068.
- Yu, Y., Hu, W., Dong, C., Gu, X., & Obrenovic, B. (2023). E-commerce development and green technology innovation: Impact mechanism and the spatial spillover effect. *Sustainability*, 15(17), 12988. CrossRef

- Yusuf, N., & Al-Ansari, T. (2023). Current and future role of natural gas supply chains in the transition to a low-carbon hydrogen economy: A comprehensive review on integrated natural gas supply chain optimisation models. *Energies*, *16*(22), 7672.
- Zhang, Q., Li, Z., Wang, G., & Li, H. (2016). Study on the impacts of natural gas supply cost on gas flow and infrastructure deployment in China. *Applied Energy*, *162*, 1385-1398.
- Zhu, Q., Ding, L., Wu, Y., & Zuo, R. (2018). Trends in the natural gas pricing mechanism reform in China: a perspective of dependency between China and the US natural gas markets. *International Journal of Internet and Enterprise Management*, *9*(1), 40-57.