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LNG export diversification and security demand in Algeria

تنويع صادرات الغاز الطبيعي المسال وتأمين الطلب في الجزائر

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Abstract:

One of the fastest growing energy sources is natural gas and LNG is set to become a key driver in the development of the global gas industry and the economies of the world. Algeria is one of the top ten producer and exporter of natural gas. The large bulk of its revenue come from it. In this paper, one addresses a key issue within Algeria's LNG segment and evaluates the risk of Algerian gas security using the HHI index which take into account the concentration of LNG exports. After calculating the index and diagnosing the natural gas state, the country must come up with measures to improve and sustain its export market share by implementing new national and international strategies.

Keywords: LNG; Demand security; Diversification; Export; Strategy.
JEL Classification Codes: Q4, Q48

ملخص:

واحدة من أسـرع مصـادر الطاقة النامية هي الغاز الطبيعي، ومن المتوقع أن يصـبح الغاز الطبيعي المسـال عاملاً رئيسـيًا في تطوير صـناعة الغاز العالمية واقتصادات العالم. الجزائر هي واحدة من أكبر عشرة منتجين ومصدري الغاز الطبيعي. وتعتمد الجزء الأكبر من إيراداتها على هذا القطاع. في هذا الورقة، يتناول الباحث مشكلة رئيسية في قطاع الغاز الطبيعي المسال في الجزائر ويقيّم مخاطر أمان الغاز الجزائري باستخدام مؤشر HHI الذي يأخذ في الاعتبار تركيز صادرات الغاز الطبيعي المسال. بعد حساب المؤشر وتشخيص حالة الغاز الطبيعي، يجب أن تتخذ البلاد إجراءات لتحسين والحفاظ على حصتها في سوق التصدير عن طريق تنفيذ استراتيجيات جديدة على المستوى الوطني والدولي

كلمات مفتاحية:. الغاز الطبيعي المسال ، امن الطلب ، صادرات.، استراتجيات.، تنويع

تصنيفات JEL : Q48، Q4

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INTRODUCTION:

Hydrocarbon sector is considered as the backbone of the Algerian economy, roughly, representing 98% of export revenue and more than 50% of government budget (Senouci, 2023). The main source of income is natural gas. Globally, it has the 10th largest proven gas reserves, and the 3rd largest reserves of shale gas (EIA, 2013, 2019). it is the 7th largest exporter. The country exports its gas via pipelines as well as Liquefied Natural Gas (LNG). It is worthily to mention that Algeria used to be the pioneer of LNG (Oxford Analytica, 2018). Nevertheless, LNG deliveries has decreased in the past two decades from 25.68 Bcm In 2005 (BP, 2006) to 14.4 Bcm in 2022(EI, 2023), this sharp decline is due to several challenges that faced the Algerian gas industry. The world LNG trade is on the upswing reaching 371.3 million tons in 2021 which illustrates its significant role as a global energy source. Presently, there are 44 importing countries and 19 exporting (GIIGNL, 2022) countries demonstrating how the market is diversified. Nowadays, LNG is viewed as an instrument of energy security as a result of its flexibility and affordability for both exporting and importing countries. In a world where LNG is the fuel of choice and has seen an impressive expansion, Algerian LNG exportations trend plummeted. The research paper examines the developments regarding the diversification of Algerian LNG export during the period 2010-2022. One concentrates on answering the following research question: what are the key factors influencing LNG export diversification and ensuring demand security in Algeria? In attempt the answer the question, this hypothesis is stated:

H01: implementation of diversified LNG export markets and effective strategies will positively impact Algeria's demand security.

The study is structured as follows: section two represents a literature review about the concept of energy security, section three illustrates the methodology of the study and section four highlights the study's findings and finally the discussion part.

1- The concept of Energy Security for exporting countries

Access to energy is crucial for the well-being and sustainable development of modern societies. Without energy, it would be impossible to produce, deliver, or utilize mainstream commodities effectively. Energy plays a direct role in the economic, social, and environmental progress of a country. However, the global energy system faces numerous governance and policy challenges. The demand for energy worldwide is projected to increase by 45% between 2015 and 2030, and by over 300% by the end of the century, necessitating a tripling of infrastructure investment (Sovacool & Mukherjee, 2011).These statistics highlight the significant growth in global energy demand. Energy security is important for economic, social, and environmental reasons. It is an essential aspect for economic growth and development. Reliable energy supplies are necessary to support industrial activity, power businesses, and drive economic growth.

There is not a consensus definition of energy security, (Jakstas, 2020) mentioned that this term is complicated and contributes in different fields: political, economic, environmental, social, technical etc. (Yergin, 2006) sees it as a diversified of energy supply, besides, he argued that resilience, the reality of integration and the importance of information are essential to achieve energy security. For (Chester, 2010), argued that because the concept of energy security is a "polysemic" it is fundamentally "slippery". As for the International Energy Agency (IEA, n.d.)

it is: “the uninterrupted availability of energy sources at an affordable price”. it covers two dimensions: long-term energy security which is about investing in energy supplies in a promptly way according to economic development and environmental needs, and short-term energy security that focuses on the capability of the energy system to respond in a timely manner to sudden changes in the balance of supply and demand. It depends on the profile of each country whether it is an exporter, importer or transit, as well as its geographical location, energy vulnerability and its political (Al Qubeissi et al., 2020). According to Asian Pacific Energy Resources Center (APERC, 2007), the security of supply (SOS) can be classified into four A: Availability, Accessibility, Affordability and Acceptability. While (Hughes, 2009) referred to energy security by the four R which are: Review (understanding the problem), Reduce (using less energy), Replace (shifting to secure sources) and Restrict (limiting new demand to secure sources). (Le Coq & Paltseva, 2009) consider it as the continuity of energy supplies relative to demand and it is related with risks in their different types such as: technical risks, human risks /political instability and geopolitical implications as well as natural risks. According to (Rodríguez-Fernández et al., 2022) energy security can be defined as the integration of the three distinct perspectives: sovereignty, robustness and resilience. Based on the World Energy Council (2022) energy security is the capability of covering both present and future energy demands of a given country.

The majority of the existing research on energy systems pertains to countries and regions that have limited resources and rely on energy imports, Nevertheless, Energy security has not been a top priority in many resource-rich countries (Karatayev & Hall, 2020). According to (Willrich, 1976), there are pair sides of energy security, security of supply that is related to importing countries and security of demand that include exporting countries, focusing on the latter, An energy-exporting nation is primarily concerned with ensuring its ability to reach various markets and guaranteeing a consistent and reliable demand for its energy resources.

As of (Youngmin, 2022), energy security means being able to produce and export energy resources in a stable and economical manner to support their economic growth. According to (Novikau, 2021) Countries that depend on exporting energy prioritise energy security by ensuring a steady supply of affordable energy resources. This is important because the export of these resources generates a significant portion of their government revenues, which affects the stability and well-being of the state and its citizens. To achieve energy security, these countries also emphasise the need for stable demand for their energy exports. This view is shared by many energy policy experts. for (Jakstas, 2020), For energy-exporting countries, ensuring energy security can be defined in terms of securing a stable demand for their energy resources. As suppliers, these countries rely on a steady and diverse base of importers to maintain a consistent revenue stream. This necessitates the need for energy exporters to cooperate with multiple importers, thereby achieving what can be referred to as "diversification of demand."
Researchers and economists have studied this concept over time from different perspectives. Energy security for exporting countries is defined as the security of demand, which is mainly about exports and diversification of demand. To evaluate this concept, it is worth considering

indicators of diversification such as the Herfindahl-Hirschman Index (HHI). This index measures the concentration of a market and can help assess the level of diversification in a country's energy exports.

2- Methodology

In this paper, one measures the security of demand for Algeria in the liquefied natural gas sector using HHI (Herfindahl Hirschman Index). The Herfindahl index is a statistical measure of concentration that has been applied in different contexts (Rhoades, 1993). This concentration index has been used by many authors. (Le Coq & Paltseva, 2009) emphasise that is required to take into consideration the variety of energy sources in order to assess energy security in the natural gas field by using the HHI, as well as (Obadi & Korcek, 2020) and (Vivoda, 2019). (Islam et al., 2022) employed it for the electricity sector.

This aggregated indicator is widely used for importing countries, nevertheless, some recent researches studied it for exporting countries mentioning (Geng, 2021) and (Vivoda, 2022).

The formula of calculating HHI is defined according to:

$$HHI = \sum_{i=1}^{n} \mathrm{pi}^2$$

Where pi is the percentage that are delivered to the *n*th LNG importing countries. If LNG exported to one country, the HHI increases to a maximum value of 1. A value of one or very close to it denotes low levels of diversification, high level of concentration. A number of 0 or very close to it denotes a high degree of diversification.

As of the United States department of justice (2015), markets with an HHI of 1500 to 2500 points are considered moderately concentrated, while markets with an HHI of more than 2500 points are considered highly concentrated.

The data of Algerian LNG exports are retrieved from the annual British Petroleum Statistical review of world energy 2010-2022.

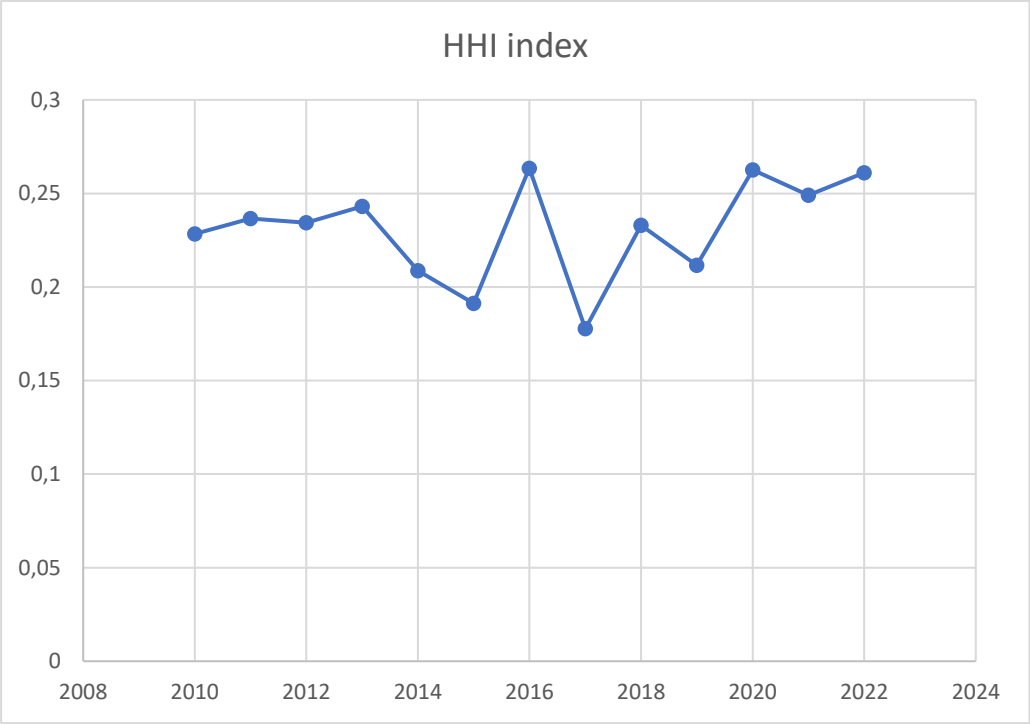
3- **Results**

Liquefied Natural Gas story began in 1964, with the delivery of the first commercial cargo from Algeria to Great Britain. It was the commencement of long-distance transportation of natural gas (Ambassade d'Algerie a Lisbonne, 2014). Algeria established its LNG facilities across three sites: Arzew, Bethioua, and Skikda and their plants are designated as GL1Z, GL2Z, GL3Z and GL1K (Mackenzie, 2021). Throughout the historical period, Algeria's LNG exports decreased year after year. Its share in global LNG exports plunged from 18% in 2000 to only 2.7% in 2022.

The majority of Algeria's LNG customers are from Europe, with Turkey and France holding the largest share that is varied between 20% and 38% for each during 2010-2021. The proportion of Greece and the United Kingdom is relatively modest. For Spain and Italy, their additional imports of natural gas in form of LNG are between 3% - 28% and 1% - 19% respectively, it should be noted that the largest share of imports for these two countries are by pipelines via the Enrico Mattei, Medgas and the Pedro Duran Farell (GME). When it comes to the Asian Pacific region and the Middle East, their share is very limited, it ranged amongst 1%

and 3%. The remainder of Algeria's LNG supplies have been absorbed by new markets such as Americas and other countries in the European Union.
As it is illustrated in the following figure, the trend of HHI of Algeria's LNG exports fluctuated during 2010-2021. Over this period, the HHI ranged between 0.177 and 0.263.

Figure (1): Herfindahl Hirschmann index (HHI) of Algerian liquefied natural gas (LNG) from 2010 to 2021.



Source: authors work based on BP statistical review of world energy 2010 - 2022.

From 2010 to 2013, the HHI values changed gradually ranging from 0.228 to 0.234 with only minor variation then it decreased to 0.191 in 2015 from 0.24 in 2013. However, the HHI experienced an upward trend reaching a maximum of 0.263 recorded in 2016 than decreased to hit its minimum of 0.177 in 2017 and from that year onwards it gets in fluctuations. According to the department of justice basis the Algeria's LNG market is moderately concentrated on whole, it has a consistent level of diversification.
The Algerian LNG exports, as measured by HHI in 2016 remained highly concentrated. In 2017, the HHI of Algerian LNG plummeted due to the entry of new destinations of importing countries including Jordan, Egypt and Thailand reflecting to a high level of diversification although, the HHI still indicated a moderate degree of diversification. In 2017, the share of France and Spain decreased in comparison with prior year, while the share of Turkey remained stable despite the growth of its volumes and maintained the status of the largest importer of Algerian LNG in the years that followed. In 2018, Algeria's share for LNG exports to France and Turkey has rebounded to 30% and 35%. The trend toward more diversification was inverted in 2020, with the share of France, Italy and Turkey increasing to 28%, 19% and 38% respectively, as measured by the HHI, at this year Algeria's exports were highly concentrated leading to an increase in the risk index and a decline in export security.

4- **Discussion**

After being the pioneer in the LNG industry in 1964, Algeria now takes the 9th place in LNG export markets (IGU, 2023). Exports are declining year over year because of several challenges that have been facing the natural gas industry essentially the struggling natural gas output due to the maturing fields particularly Hassi R'mel, insufficient investments, technical and infrastructure issues and persistent projects delays (Clemente, 2016). Fortunately, there are other projects coming on service that are expected to surge Algeria's production, according to (Ouki, 2019), the South West fields will provide both domestic demand that it is projected to increase by 28 Bcm by 2028 and exports engagements.

Furthermore, additional initiatives are beginning to take effects that are anticipated to boost Algeria's production, Sonatrach announced in 2022 the discovery of a massive gas field which might enhance its potential (Sonatrach, 2022a) and it has allocated around 42 billion dollars for research and exploration activities between 2023-2027 to support more growth (Medjelled, 2023).

when it comes to liquefaction process, the total of Algeria's installed capacity is 55.94Bcm per annum, with each facility having its own capacity. However, due to the aging plants GL1Z, GL2Z and GL1K which were commissioned since the 70s, the performance has not been sustainable over time. Despite this, there are positive signs of improvement as a result of recent renovation projects of some equipment in order to achieve the prime capacities.

Another threat that Algeria is facing is the soaring domestic gas demand that is estimated to grow at an average rate of 5% per annum (Ouki, 2019). Based on (CREG, 2019) this trend is expected to reach its peak by 2028, this growth is driven mainly by the industrial sector at an annual level of about 6%, followed by the public distribution. Power sector is predicted to slow down at an average of 2% annually.

The downward trend of cannot be solely attributed to the internal challenges, external factors also contributed to this decrease. One of the key contributing factors is the reduction of the demand in the European market. Additionally, there has been a growing trend among European countries to diversify their energy suppliers as a means of enhancing energy security. This has put Algeria in fierce competition with other gas-exporting nations.

It is evident that the HHI of Algerian LNG varies significantly during the analysis period, nevertheless, it is still at the moderate level of concentration.

As it is mentioned above, the major clients for Algeria's Gas are from Europe, one of the main factors that makes this cooperation is the geographic location. Basically, there are two common ways of transporting the natural gas of Algeria to the European regional market. one is in pipeline and the other is in form of LNG. The largest proportion of exports consists of piped gas, it accounted in 2022 about 35.5 Bcm of which 31.5 Bcm were received by the European Union and the remainder destined for other African countries. On the other hand, LNG exports stood at 14.4 Bcm based on (EI, 2023) .

Algeria heavily relies on its pipelines infrastructure and it is the third-largest supplier of natural gas to Europe, following Russia and Norway. This pipeline supply relationship may have reduced the opportunities for Algeria to export extra volumes of LNG.

In addition to the geographical proximity advantage, Algeria's proximity to the European continent also contributes to the cost-effectiveness of LNG transportation compared to other

regions such as the Americas and Asia. However, this advantage is reversed in terms of diversification of LNG supplies. At the historical period, nearly 95% of Algerian LNG deliveries have been directed to Europe annually. As measured by the HHI, whenever the share of the European countries decreases, the index decreases, which leads to more diversified market.

In 2017, when the HHI recorded its lowest level, was as a result of the penetration to new markets in the Middle East namely: Jordan and Kuwait. As well as Thailand in Asia. These exports were primary sold on the spot market, as reported by data from GIIGNL. Despite the amount of these countries is relatively modest, it contributes to lowering the risk index of LNG exports and an increase in export security.

In its SH2030 strategy and in a context of diversification goals the Algerian Public Company SONATRACH has set its sights on diversifying its customer base and prioritizing value over volumes with the aim of marketing approximately fifty percent of its gas to new customers. Thus, Sonatrach has identified the Asian market as a promising opportunity. The decision to target Asia is motivated by the region's increasing demand for gas, the presence of emerging markets with growing gas needs, and the high LNG prices prevalent in these markets. However, the specific course of action and how to achieve these goals are still unclear. Despite the launch of the SH2030 strategy and the expansion of Algeria's LNG fleet through the acquisition of two large tankers with a capacity of 171,800 m3 each (Elliot, 2018; Sonatrach, 2018). Unfortunately, five years from the commencement of the SH2030 strategy, Algeria’s LNG exports still at their previous levels and the desired diversification and penetrating new markets objectives have yet to be realized.

It is worthily to mention that Algeria faces a challenging task in attempting to penetrate and secure a significant share in the Asian LNG markets, considering the fierce competition posed by major global suppliers such as Qatar, Australia, the United States, and Russia. These countries have established themselves as leaders in the LNG industry and enjoy strong market positions.

Algeria faces not only competition in the Asian markets but also in the European market. Over the past decade, the emergence of US LNG exports has posed a threat to Algeria, particularly in its historical and largest customer, Spain. The United States has been expanding its LNG capacity and actively targeting European markets. Additionally, Russia, the second-largest gas producer globally after the US, has traditionally been the dominant supplier of natural gas to the European Union. However, Russia is now aiming for global dominance by improving its LNG exports and diversifying its customer base. Qatar, the world third largest exporter after Australia and the US and used to be the leader in LNG exports for several years, has also set its sights on increasing its liquefaction capacity and exports by 2027, further intensifying competition in both the Asian and European markets.

Moreover, there are other key players on the rise in the LNG industry, such as Nigeria, Mozambique, Egypt, and Azerbaijan. These countries have been making significant investments in expanding their LNG infrastructure and production capabilities, positioning themselves as competitive players in the global LNG market.

Under the current circumstances where the demand for natural gas worldwide is rising year on year reaching 4037.5 Bcm (BP, 2022) and the switching from coal to gas in order to meet the climate change goals as well as the Russia-Ukraine conflict that is remapping the world's natural gas supply landscape, Algeria should seize this opportunity in order to preserve its share and expand into new markets. As matter of fact, Algeria is now consolidating its position in its traditional market where the country has become a key destination for European countries. Greece, a longstanding customer of Algerian LNG has extended the long-term contract (Sonatrach, 2022c). yet the largest of the new agreements were signed to transport gas through pipelines to Italy, Spain, France and Slovenia (Sonatrach, 2023). The latter imported the Algerian gas from 1992 to 2012, and it has renewed a contract for a period of three years making Algeria to reposition in the Slovenian market (Sonatrach, 2022b). It should be noted that other countries expressed their intent to import the fuel from Algeria such as Poland. Furthermore, several countries are building new LNG regasification terminals in order to replace the Russian gas mentioning Germany that is constructing its first plant, France, Greece, Belgium are planning to increase their capacity.

it is now for Algeria to adopt a powerful strategy of diversification that combine both its internal and external objectives of performance in the natural gas sector. In actual fact, the country aims to meet domestic gas demand, particularly for electricity, by focusing on renewable energy sources especially solar energy in a context of energy transition which is by definition according to (Senouci, 2015): Energy transition refers to the shift towards a more rational energy model and consumption pattern, characterized by reduced reliance on fossil fuels and increased utilization of renewable energy sources (RE). It represents a potential pathway that encompasses the benefits of two major levers:

1. Energy savings, particularly in the realm of fossil fuels.
2. Development of renewable energy sources.

A program of generating 1000MW per year has been launched recently in order to achieve the goals of producing 22 GW by 2030 (Senouci, 2023). Moving toward an energy transition as a tool of energy diversification strategy will make Algeria reduce the consumption of gas for electricity and thus save more gas and LNG for export. effective management of its resources is required, the country should also invest in its offshore fields and creating joint ventures in order to improve its energy security in the field of LNG. Eventually, these are few points for improving its potential areas and achieve a great level of performance in order to maintain its market share and penetrate new emerging markets.

Conclusion

The last decade Algeria has known a difficult situation in terms of liquefied natural gas exports due to several constraints at the national scale as well as the international scale. The world now is entering a new phase in the global gas markets, it becomes imperative for Algeria to strengthen its position and align with evolving perspectives.

To achieve this, Algeria needs to carefully review and adapt its gas commercialization strategy. It should capitalize on its strong points, such as its substantial natural gas reserves and established infrastructure, while addressing the constraints it has faced. One significant opportunity lies in the increasing global gas shortage, which can be leveraged to Algeria's advantage. By ensuring its own energy security and maintaining a stable supply, Algeria can position itself as a reliable and secure source of gas for international markets.

Furthermore, Algeria should focus on promoting economic growth through its gas sector. This can be achieved by exploring new avenues for collaboration and investment, attracting international partners, and creating a favourable business environment. It is essential for Algeria to proactively engage in the global energy transition and align its gas commercialization strategy with the evolving demands of the market. This could involve diversifying export destinations, exploring emerging markets, and identifying new opportunities for LNG trade.

Additionally, investing in research and development, technology advancements, and innovation can enhance Algeria's competitiveness in the global gas markets. This includes exploring ways to optimize production, reduce costs, improve operational efficiency, and minimize environmental impacts.

Overall, by reviewing and enhancing its gas commercialization strategy, focusing on its strengths, and seizing the opportunities presented by gas shortage and changing market dynamics, Algeria can ensure its demand security, drive economic growth, and remain a significant player in the global gas markets.

References

Al Qubeissi, M., El-kharouf, A., & Serhad Soyhan, H. (Eds.). (2020). *Renewable Energy—Resources, Challenges and Applications*. IntechOpen. https://doi.org/10.5772/intechopen.81765

Ambassade d'Algerie a Lisbonne. (2014, October 14). Conférence internationale sur l'Industrie du Gaz en Algérie. *Ambassade d'Algerie a Lisbonne*. https://www.emb-argelia.pt/conference-internationale-sur-lindustrie-du-gaz-en-algerie/

Antitrust Division | Herfindahl-Hirschman Index. (2015, June 25). https://www.justice.gov/atr/herfindahl-hirschman-index

APERC. (2007). *A quest for energy security in the 21 century -Resources and constraints*. https://aperc.or.jp/file/2010/9/26/APERC_2007_A_Quest_for_Energy_Security.pdf

BP. (2006). *BP Statistical Review of World Energy*.

BP. (2022). *BP Statistical Review of World Energy*. British Pteroleum.

Chester, L. (2010). Conceptualising energy security and making explicit its polysemic nature. *Energy Policy*, *38*(2), 887–895. https://doi.org/10.1016/j.enpol.2009.10.039

Clemente, J. (2016). *Will Algeria Be Able To Export More Natural Gas And LNG?* Forbes. https://www.forbes.com/sites/judeclemente/2016/05/04/will-algeria-be-able-to-export-more-natural-gas-and-lng/

CREG. (2019). *Programme indicatif d'approvisionnement du marché national en gaz naturel 2019-2028*. http://www.creg.gov.dz/pdf/PIAMNG_2019-2028VF.pdf

EI. (2023). *EI Statistical Review of World Energy*. Energy Institut.

EIA. (2013). *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States*. https://www.eia.gov/analysis/studies/worldshalegas/pdf/fullreport.pdf

EIA. (2019, March 25). *Background Reference: Algeria*. https://www.eia.gov/international/analysis/country/DZA/background

Elliot. (2018, November 22). *Algeria's Sonatrach eyes increased LNG exports to Asia: Official*. https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/natural-gas/112218-algerias-sonatrach-eyes-increased-lng-exports-to-asia-official

Geng, Z. (2021). RUSSIAN ENERGY STRATEGIES IN THE NATURAL GAS MARKET FOR ENERGY SECURITY. *International Journal of Energy Economics and Policy*, *11*(2), 62–66. https://doi.org/10.32479/ijeep.10755

GIIGNL. (2022). *The LNG industry GIIGNL Annual Report*.

Hughes, L. (2009). The four 'R's of energy security. *Energy Policy*, *37*(6), 2459–2461. https://doi.org/10.1016/j.enpol.2009.02.038

IEA. (n.d.). *Energy security—Ensuring the uninterrupted availability of energy sources at an affordable price.* International Energy Agency. Retrieved 11 July 2023, from https://www.iea.org/about/energy-security

IGU. (2023). *2023 World LNG Report* (No. 14). https://www.igu.org/resources/lng2023-world-lng-report/

Islam, A., Al-tabatabaie, K. F., Karmaker, A. K., Biplob Hossain, Md., & Islam, K. (2022). Assessing energy diversification policy and sustainability: Bangladesh standpoints. *Energy Strategy Reviews*, *40*, 100803. https://doi.org/10.1016/j.esr.2022.100803

Jakstas, T. (2020). What does energy security mean? In *Energy Transformation Towards Sustainability* (pp. 99–112). Elsevier. https://doi.org/10.1016/B978-0-12-817688-7.00005-7

Karatayev, M., & Hall, S. (2020). Establishing and comparing energy security trends in resource-rich exporting nations (Russia and the Caspian Sea region). *Resources Policy, 68*, 101746. https://doi.org/10.1016/j.resourpol.2020.101746

Le Coq, C., & Paltseva, E. (2009). Measuring the security of external energy supply in the European Union. *Energy Policy*, *37*(11), 4474–4481. https://doi.org/10.1016/j.enpol.2009.05.069

Mackenzie, W. (2021, December 17). *Algeria LNG - Overall Project Summary*. https://www.woodmac.com/reports/lng-algeria-lng-overall-project-summary-8456967/

Medjelled (Director). (2023, February 22). *المدير العام للدراسات الاقتصادية والاستشراف بوزارة الطاقة والمناجم، ميلود مجلد*. https://www.youtube.com/watch?v=JwbK_5cktwQ

Novikau, A. (2021). What does energy security mean for energy-exporting countries? A closer look at the Russian energy security strategy. *Journal of Energy & Natural Resources Law*, *39*(1), 105–123. https://doi.org/10.1080/02646811.2020.1794108

Obadi, S. M., & Korcek, M. (2020). QUANTIFYING THE ENERGY SECURITY OF SELECTED EU COUNTRIES. *International Journal of Energy Economics and Policy*, *10*(2), 276–284. https://doi.org/10.32479/ijeep.8847

Ouki, M. (2019). *Algerian gas in transition: Domestic transformation and changing gas export potential*. Oxford Institute for Energy Studies. https://doi.org/10.26889/9781784671457

Oxford Analytica. (2018). *Algeria will aim to hold on to gas market share* (Emerald Expert Briefings) [Emerald Expert Briefings].

Rhoades, S. A. (1993). The Herfindahl-Hirschman Index. *Federal Reserve Bulletin*, *79*, 188.

Rodríguez-Fernández, L., Carvajal, A. B. F., & De Tejada, V. F. (2022). Improving the concept of energy security in an energy transition environment: Application to the gas sector in the European Union. *The Extractive Industries and Society*, *9*, 101045. https://doi.org/10.1016/j.exis.2022.101045

Senouci, B. (2015). *colloque sur les politiques d'utilisation des ressources énergétiques: Entre exigences du développement national et la sécurité des besoins internationaux, Les enjeux de la transition en Algérie*.

Senouci, B. (2023). *L'énergie en Algérie entre les exigences de la sécurité énergétique et l'inéluctable transition énergétique*. http://www.lequotidien-oran.com/index.php?news=5320075

Sonatrach. (2022a). *Sonatrach News N°37*.

Sonatrach. (2022b). *الجزائر،15نوفمبر2022سوناطراك، مديرية االتصال بيان صحفي سوناطراك والشركة السلوفينية 'جيوبلن' توقعان عقدا لشراء وبيع الغاز الطبيعي*. https://sonatrach.com/wp-content/uploads/2022/11/CP-du-15-11-2022-Ar_Fr_An-2.pdf

Sonatrach. (2023). *Achievements 2022 / SONATRACH Preliminary results*.

Sonatrach. (2018). *Une stratégie d'exportation prenant davantage en compte l'aspect valeur et non plus seulement celui de volume.* https://sonatrach.com/actualites/sonatrach-une-strategie-dexportation-prenantdavantage-en-compte-laspect-valeur-et-non-plus-seulement-celui-de-volume/

Sonatrach. (2022c, February 3). *SONATRACH: extension du contrat de vente de GNL destiné à la Grèce*. https://sonatrach.com/actualites/sonatrach-extension-du-contrat-de-vente-de-gnl-destine-a-la-grece/

Sovacool, B. K., & Mukherjee, I. (2011). Conceptualizing and measuring energy security: A synthesized approach. *Energy*, *36*(8), 5343–5355. https://doi.org/10.1016/j.energy.2011.06.043

Vivoda, V. (2019). LNG import diversification and energy security in Asia. *Energy Policy*, *129*, 967–974. https://doi.org/10.1016/j.enpol.2019.01.073

Vivoda, V. (2022). LNG export diversification and demand security: A comparative study of major exporters. *Energy Policy*, *170*, 113218. https://doi.org/10.1016/j.enpol.2022.113218

Willrich, M. (1976). International Energy Issues and Options. *Annual Review of Energy*, *1*(1), 743–772. https://doi.org/10.1146/annurev.eg.01.110176.003523

World Energy Trilemma Index | 2022. (2022). World Energy Council. https://www.worldenergy.org/publications/entry/world-energy-trilemma-index-2022

Yergin, D. (2006). Ensuring Energy Security. *Foreign Affairs*, *85*(2), 69. https://doi.org/10.2307/20031912

Youngmin, yoon. (2022). *Measuring Energy Security of Energy-exporting Countries: Focus on Russia*. *22*(4).