

Energy security in Algeria Between Reality and Aspirations: A
SWOT Analysis

Benabbas Sahra ^{1*}, Hadji Fatima ²

¹ University of Mohamed El Bachir El Ibrahimi, Bordj Bou Arreridj, (Algeria),
sahra.benabbas@univ-bba.dz

² University of Mohamed El Bachir El Ibrahimi, Bordj Bou Arreridj, (Algeria),
fatima.hadji@univ-bba.dz

Received: 14/08/2024 Accepted: 21/11/2024 Published: 01/12/2024
.....

Abstract:
This study uses SWOT methodology to analyze Algeria's energy security, examining sector strengths, weaknesses, opportunities, and threats. It proposes two strategies aligned with Algeria's current energy situation to enhance security. The research suggests implementing these strategies can lead to a more stable energy future, supporting long-term economic sustainability. Contributing to discussions on energy security in developing economies, it offers insights for countries with similar challenges. The study aims to guide Algeria's transition towards a more secure energy landscape, providing clear perspectives on sector improvements.
Keywords: Energy security, SWOT Analysis, Algeria, Renewable Energy, Economic Sustainability.
Jel Classification Codes : Q40; Q42; Q48; O55.

* Corresponding author

1. INTRODUCTION

Energy security (ES) is considered one of the main priorities for many countries worldwide, especially those heavily dependent on energy imports. Major energy producers are also developing their energy strategies to use their fossil resources sustainably and diversify their energy portfolio, whether in terms of supply markets or energy sources. For these reasons, global energy systems are currently changing, with enhancing ES perhaps being the most important driver of this transformation.

All countries seek to achieve ES from their perspective, particularly in light of the exponential changes the world is witnessing and highly influential geopolitical interests. It has become clear that traditional energy sources such as fossil fuels are limited and are one of the main causes of environmental degradation and political instability.

Algeria, in turn, seeks to achieve a secure energy transition towards reliable, cost-effective, and sustainable energy sources that make it more resilient to shocks and enhance its energy security.

The main objective of this study is to assess the status of ES in Algeria by conducting a SWOT analysis to reveal the strengths, weaknesses, opportunities, and threats affecting this vital sector. The study also aims to provide suggestions for enhancing ES in Algeria.

ES is vital for Algeria, as the country is an important producer and exporter of oil and natural gas. Additionally, energy plays a crucial role in achieving sustainable development and economic diversification. The importance of using the SWOT tool lies in analyzing the current situation of the energy sector in Algeria by identifying internal strengths and weaknesses, and external opportunities and threats that may affect energy security.

The study's problem stems from the following main question: What is the reality of ES in Algeria in light of current transformations, and what are the ways to enhance it in the future?

To answer this problem, the study follows a descriptive-analytical approach based on reviewing literature and previous studies, along with analyzing available data and statistics on the energy sector in Algeria. A SWOT analysis will also be conducted to identify the strengths, weaknesses,

opportunities, and threats affecting energy security. The study will conclude by providing recommendations and suggestions to enhance ES in Algeria in the future.

This study has been divided into two main sections: The first section addresses the conceptual framework of ES (definition, dimensions, challenges), while the second section is dedicated to the SWOT analysis of ES in Algeria

2. Conceptual Framework for Energy Security

2-1- Definition of Energy Security

ES is an old concept related to ensuring that countries obtain their energy needs in a sustainable and secure manner. The concept and its developments can be approached more closely by addressing it from the perspective of each of: international bodies and institutions, energy importers, energy exporters, and companies active in the energy sector:

2-1-1- ES from the Perspective of International Bodies and Institutions

The World Bank: For the World Bank, ES means: "Ensuring countries' ability to produce and use energy sustainably at a reasonable cost in order to: facilitate economic growth and reduce poverty through it, and directly improve people's quality of life by expanding access to modern energy services." (Energy security issues, 2024, pp. 2-3).

International Energy Agency (IEA): The IEA defines energy supplies as "secure" if they are adequate, affordable and reliable. It also defines a state of energy insecurity as "the loss of economic welfare that may occur as a result of a change in energy prices and availability."

European Union: The European Union defines ES as "stable and abundant energy supplies," which is crucial for its prosperity and security. To address long-term ES challenges, the EU's strategy outlines several key objectives: enhancing energy efficiency, developing new technologies, increasing energy production, diversifying suppliers and supply routes, strengthening emergency response mechanisms, and protecting infrastructure. (Mouraviev & Koulouri, 2019).

World Energy Council: For the World Energy Council, ES is based on three main axes: effective management of energy supply from domestic

or external sources, reliability of energy infrastructure, and finally the ability of energy providers to meet current and future demand (World Energy Outlook 2023, 2023)

2-1-2- ES from the Perspective of Energy Importers

Major industrialized countries that import energy prioritize uninterrupted supply, source diversification, and infrastructure security in producing countries. They also focus on implementing modern technologies to reduce consumption. This approach aims to ensure a stable energy flow and minimize vulnerabilities (Alshaghel, 2017).

China, as the world's largest energy consumer, adopts a dual strategy for energy security. Internally, it increases domestic production, promotes efficiency, and develops alternative energy sources. Externally, China secures foreign supplies through strategic partnerships and investments, viewing ES as a critical national security issue (Aidouni & Aiouadj, 2023, p. 61).

2-1-3- ES from the Perspective of Energy Exporters

Energy-exporting countries consider both demand and supply security essential. Demand security focuses on ensuring stable markets for their products, as increased exports lead to higher revenues and economic improvement. Supply security involves maintaining their ability to deliver energy to markets consistently, an aspect often overlooked by international organizations (Nyga Lukaszewska & Napiórkowski, 2022, p. 3).

Exporters generally view ES through the lens of accessible consumer markets, fair pricing, and infrastructure development. They also prioritize maintaining sovereignty over resources, ensuring stable export revenues, and preserving the efficiency of their oil and gas sectors within their economies (Isaeva, Vasić, & Radovanovic, 2018, p. 18).

2-2- Dimensions of Energy Security

Derived from the commonly accepted definition of energy security, four main dimensions can be identified, although some researchers in the field mention many more:

Availability: Most studies consider it the most important dimension of energy security. It represents stable and uninterrupted energy supplies as

well as their independence. It refers to the physical existence of energy resources in a specific area and the possibility of replacing them with alternative resources. This dimension includes four components: energy resource reserves, self-sufficiency, diversity of energy mix, and renewable energy potential (Fuertes, et al., 2020, p. 20).

Affordability: Or the ability to bear costs, meaning providing energy services at reasonable prices and reducing consumption. It is measured based on many elements including retail electricity prices, retail fuel prices and their stability, and energy efficiency (Sovacool & Brown, 2010, p. 10).

Accessibility: Or reliability, and some express it as infrastructure. It represents stable and uninterrupted supplies. Its measurement is linked to the following qualitative measures: import stability, trade, political stability, flexibility, safety and reliability, and other qualitative measures (Paravantis & Kontoulis, 2020, p. 10).

Acceptability and environmental sustainability: This dimension emphasizes the importance of sustainability and includes qualitative measures such as: environment, social satisfaction, national governance, international governance, transparency, investment and employment (Paravantis & Kontoulis, 2020, p. 11).

2-3- ES Challenges

Challenges include all changes that could cause instability in the energy market, whether caused by unexpected factors in geopolitical and internal political factors, or by environmental, natural and technological factors.

2-3-1- Natural, Environmental and Technological Challenges

Natural, environmental, and technological challenges to ES manifest in various forms. Natural disasters like earthquakes and floods can disrupt energy production and distribution, while the depletion of fossil fuel resources, especially in unstable regions, threatens long-term energy availability. The worsening global warming phenomenon leads to climate changes that stress energy systems. Additionally, the energy sector often lacks adequate environmental protection standards. The low technical level of energy infrastructure, due to outdated equipment or failure to adopt new technologies, further compounds these challenges, collectively posing

significant risks to energy security.

2-3-2- Social and Political Challenges

Political and social instability can pose a threat to energy security. Some of its forms include:

- Terrorist attacks targeting energy infrastructure leading to supply disruptions or price fluctuations, such as the hostage crisis at the Tiguentourine gas plant in Algeria (January 16-19, 2013), which was the first major terrorist strike on a large energy facility, or the cyber-attack on 35,000 computers belonging to Saudi Aramco (Saudi oil company that supplied 10% of global oil demand; August 15, 2012) (Paravantis & Kontoulis, 2020, p. 4).
- Public movements against unconventional forms of energy such as nuclear energy and shale gas energy.
- Labor strikes: For example, the strike by workers of Venezuela's Petroleos during 2002 and 2003 led to a temporary decrease in global oil supplies of 3% of total global supply and an increase in oil prices, showing the world's dependence on oil supplies from Venezuela and the importance of ES for both oil-exporting and importing countries (Cherp, 2015, p. 34).
- Geopolitical conflicts in countries and regions through which energy is transported, which lead to instability in the energy market, such as the halt of Russian gas supplies to Europe due to the Russian-Ukrainian war or the stoppage of the Algerian gas pipeline through Morocco.

2-3-3- Economic Challenges

Forms of economic challenges to ES include:

- Fuel price fluctuations: Market-driven price changes can affect the ability of states and societies to purchase fuel, threatening ES (Sovacool & Brown, 2010, p. 10).
- Growing global energy consumption: Increasing worldwide demand impacts global energy reserves.
- Investment deficit: Lack of investment can reduce production capacities, requiring additional efforts to maintain and increase output. High production costs may reduce competitiveness in global markets.
- Export diversification challenges: Natural gas, mainly transported via

pipelines, is less flexible in redirecting supply compared to oil, which is primarily shipped by sea and can more easily adapt to changing market demands.

3. EXPERIMENTAL- SWOT Analysis of ES in Algeria

3-1-The Reality of ES in Algeria

Historically, Algeria did not achieve its ES until after the nationalization of hydrocarbons in 1971, which is referred to as the political dimension of energy security, meaning state sovereignty or control over energy resources and protecting them from external interventions and actions. Although the nationalization process was known as a hostile action against foreign companies in oil-exporting countries, most countries, including developed ones, seek to extend their influence over their energy resources. For example, in 2005, the U.S. government intervened to prevent the purchase of an American oil company - Unocal - by the China National Offshore Oil Corporation (CNOOC). The United Kingdom also opposed an attempt by Russia's Gazprom to acquire one of the local distribution companies (Cherp, 2015, p. 30).

The initial reaction to the interruption of oil supplies due to the Arab embargo was the establishment of the International Energy Agency in 1974, which required member countries to allocate strategic oil reserves to enhance their short-term energy security. ES is an important concept for countries, referring to ensuring they obtain sufficient and sustainable energy supplies to meet their economic, social, and military needs. Algeria currently enjoys a comfortable position, where the production capacities of national oil and gas fields meet the consumer demand for energy at acceptable prices (subsidized by the government). Sonelgaz has also worked to provide modern energy services (electricity and natural gas) to about 99% of the population with electricity and 65% with gas (Sonalgaz, 2024).

One study conducted an assessment of ES performance in Algeria during the period from 1980-2020. The study proposed a quantitative index (ESIA) based on five dimensions: availability, affordability, applicability, governance, and acceptability. The study reported that the period from 1980 to 1986 was characterized by a 10% decrease in overall ES performance.

The second period from 1987 to 2004 saw some fluctuations, but performance remained moderate. The third period from 2005 to 2020 saw a net improvement in ES by 28% compared to previous periods (Benamirouche, Megherbi, Djedaa, & Bouferkas, 2022, p. 22)

3-2-Overview of the Energy Sector in Algeria

In the following table, we will review the most important data and indicators related to the energy sector in Algeria.

Table (1): Shows energy-related indicators in Algeria for: 2020-21-22

Energy-Related Indicators	2020	2021	2022
Proven gas reserves (billion cubic meters) **	4504	4504	4504
Total production (MT of oil equivalent) *	175.9	185.2	189.6
Commercial production of primary energy (MT of oil equivalent) *	144.3	164.4	165.3
Energy imports (MT of oil equivalent) *	1.97	1.34	0.92
Energy exports (MT of oil equivalent) *	80.7	95.0	93.7
Total national energy consumption (MT of oil equivalent) *	62.3	67.2	69.1
Final energy consumption (MT of oil equivalent) *	46.5	50.2	53.1

Source: Prepared by the researchers based on Sonatrach* data from the website www.sonatrach.dz and BP** data from the website <https://www.bp.com/>

As shown in the table, Algeria is considered one of the countries rich in oil and natural gas. Algeria also enjoys enormous potential in renewable energy, thanks to its strategic geographical location and vast area. In the field of solar energy, Algeria is one of the world's leading countries, with sun exposure duration across its territory ranging between 2000 and 3900 hours annually, with the highest rates in highland and desert areas.

This abundance of sunlight translates into significant energy potential. The average daily solar energy received on a horizontal surface of one square meter ranges between 5.1 kWh in the north of the country and 6.6 kWh in the far south. As for direct solar radiation, which is particularly important for concentrated solar thermal energy applications, it ranges from 5.5 kWh in the capital Algiers in the north to 7.5 kWh in the Illizi region in the south, daily per square meter (Yassaa & Khelif, 2020, pp. 57-58).

In addition to solar energy, Algeria has promising potential in wind energy. At an altitude of 80 meters, wind speeds in some southern regions, especially in the southwest such as Tindouf, Adrar, and In Salah, reach

between 7 and 8 meters per second, making them ideal areas for harnessing this renewable energy source.

3-3- SWOT Analysis for the Future of ES in Algeria

SWOT is a commonly used strategic analytical tool for assessing internal strengths and weaknesses, as well as external opportunities and threats in a project or business. SWOT analysis is used in various fields such as strategic planning, marketing, project management, research studies, and others. It is a concept that allows for a systematic analysis of threats and opportunities, as well as aligning them with the strengths and weaknesses of a specific organization (Božanić, Pamucar, Milić, & Bojanic, 2011, p. 66). In our case, it applies to a part of the energy sector, as well as a part of the state's security sector that deals with energy issues.

The two main components of SWOT analysis are: indicators of the internal situation described by current strengths and weaknesses, and indicators of the external environment described by current opportunities and threats.

SWOT analysis is considered one of the brainstorming tools, where based on its assessments, possible strategies and scenarios for the future are developed in various fields. Accordingly, this study attempted to use this tool to foresee the future state of ES based on the analysis and evaluation of available data related to the components of the energy system in Algeria and even globally.

After completing the SWOT analysis based on data about internal and external environmental indicators of the research field, some researchers suggest designing four strategies and selecting what is suitable among them for the studied case (Fuertes, et al., 2020, p. 11):

Maximum-Maximum strategy (SO): This strategy maximizes both internal strengths and external opportunities, and can be chosen when there is an abundance of strengths and favorable external opportunities.

Minimum-Maximum strategy (WO): This strategy minimizes weaknesses and maximizes opportunities, and can be chosen in a critical situation where strengths are rare and threats are increasing.

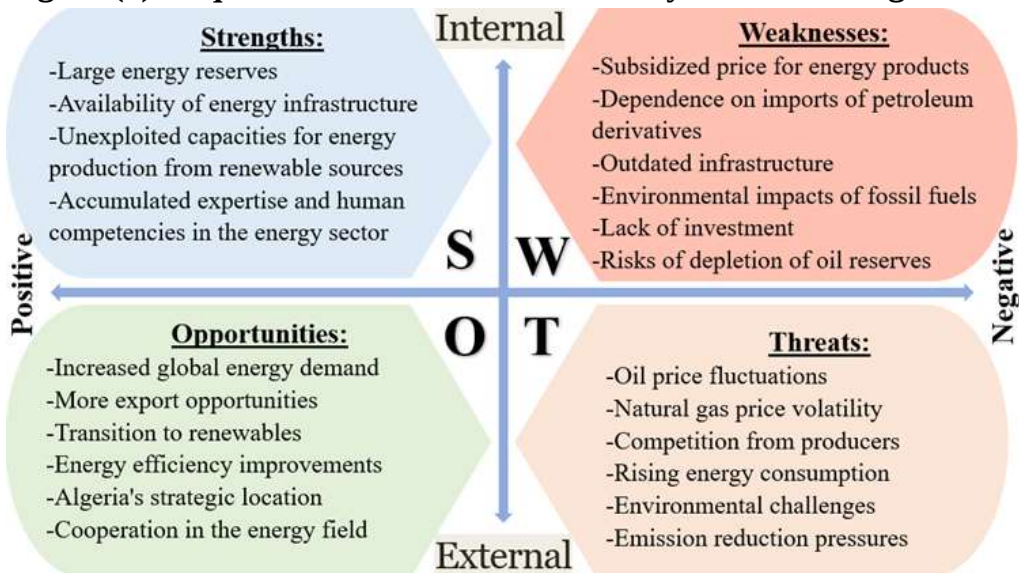
Maximum-Minimum strategy (ST): This strategy relies on enhancing and employing internal strengths to reduce external risks. It is considered an appropriate option in critical cases, where optimal investment in self-

capabilities may be the most effective means to face and overcome major challenges.

Minimum-Minimum strategy (WT): This strategy works to reduce both weaknesses and threats, and can be chosen in a complex situation where strengths are rare and threats are increasing.

Through the data presented earlier, a SWOT matrix can be formed as follows (Figure1):

Figure (1): A quadrant chart for SWOT analysis of ES in Algeria



Source: Prepared by the researchers

Our analysis of the future of ES in Algeria will be based on four main criteria widely recognized among specialized researchers. These criteria are: availability, reliability, affordability, and acceptability. By examining these criteria, we will be able to assess the current state of ES in Algeria and determine whether it enjoys a positive status or faces serious threats. Based on this analysis, we will identify and formulate the most important strategies that can be adopted to enhance ES in the future, taking into account the potential challenges and opportunities in the Algerian energy sector. The elements shown in (Figure 1) can be analyzed as follows:

3-3-1-Strengths

- Energy reserves: Algeria relies on its large oil and gas reserves to meet

its energy needs, ensuring its independence and low import dependency. The 2.4% increase in production capacity compared to 2021 is attributed to new discoveries, with Sonatrach recording 13 discoveries in 2021 and 15 new discoveries in 2022, including three joint discoveries.

- Algeria also possesses large shale gas reserves, estimated at about 707 trillion to 741 trillion cubic feet according to Sonatrach estimates. These reserves could potentially be an alternative to natural gas in electricity generation in Algeria for the coming decades, contributing to its energy security. Despite the environmental challenges faced by this source, technological developments can limit risks and allow for the exploitation of this wealth.
- Existing infrastructure for energy production and exploitation: Algeria has an interconnected network of transmission lines, both for gas transmission and electricity transmission. These networks, connecting electricity producers, ensure high-quality internal transmission and cross-border electricity exchange.
- Untapped capacities for energy production from renewable sources: Algeria has significant potential in solar energy, wind energy, geothermal energy sources, and biomass, which can lead to diversifying the energy mix, especially in electricity generation. These will form a main source of energy and important revenues for the national economy if exported.
- Accumulated human expertise and competencies in the energy sector: Sonatrach and Sonelgaz, two main national companies along with other companies, carry out most of the energy product production and distribution operations in Algeria. Sonatrach has extensive experience in the energy field, translated into the company's ability to enter partnerships or even engage in investments in the renewable energy sector. Sonatrach's expertise also gives it the ability to manage a sustainable and secure energy transition, and it is a secure and reliable partner on the international energy stage, which enhances the standard of long-term energy availability.

3-3-2-Weaknesses

- Subsidized prices for energy products: Whether for primary products or electricity, the low price of electricity compared to production costs has a negative impact on energy security. The low price of energy products also

affects the increase in investments in clean and energy-efficient technologies (Sokołowski & Heffron, 2022, p. 10).

- Algeria's dependence on petroleum product imports, despite its abundant oil resources, represents a significant challenge to the country's energy security. This situation negatively affects the availability of certain types of energy and the stability of their supplies, and increases the country's exposure to global market fluctuations. Importing petroleum products such as gasoline (estimated at 4 MT at the beginning of 2020) and diesel, with a deficit estimated at about 1.5 MT, or 15% of the needs estimated at 10%, is more costly than producing them locally, which may lead to higher prices for consumers (Yassaa & Khelif, 2020, p. 83).
- To enhance energy security, Algeria needs to invest in developing local refining capabilities, promote economic sustainability by considering all stages of the energy value chain, and ensure more secure and stable energy supplies in the long term.
- Aging infrastructure in need of modernization: Recent assessments of ES include the reliability of the energy supply chain from its beginning (upstream) to the final energy consumer, including infrastructure. Many incidents have shown this chain's vulnerability to disruptions due to factors such as natural disasters, and although Algeria has not witnessed a similar incident, the aging infrastructure of the electricity grid could lead to interruptions in energy supplies.
- The small scale of renewable energy investment in Algeria is mainly due to investment recovery risks. Renewable energy, including solar, requires intensive capital with the majority allocated in the initial project phase. This is due to the poor investment climate in Algeria. Despite notable progress in recent years, renewable energy production (especially photovoltaic and wind) still occupies a secondary place in primary energy production, constituting only 0.1%. Hydrocarbons remain by far the main component of primary energy resources in Algeria (Ministry of Energy, 2022).
- Risks of oil reserve depletion in the long term with increased demand: In Algeria, as the annual demand growth rate increases, the rate of access to energy decreases, due to the depletion of reserves and the end of the

lifespan of operating plants. According to BP data, the reserves-to-production ratio (R/p) indicates that Algeria's total gas reserves will ensure it more than 50 years of its current production, while for oil, the ratio drops to 22.5 years, putting Algeria in the biggest and most dangerous future challenge to provide energy services (bp, 2024, pp. 14–32). With increasing energy consumption, Algeria could transition from an oil and gas exporting country to one that imports them to meet its needs, which would have a negative impact on its energy security.

- Environmental impacts of fossil fuel extraction and consumption: Heavy reliance on fossil fuel extraction and consumption leads to greenhouse gas emissions and environmental pollution. Carbon dioxide emissions reached 148.6 MT s in 2020, decreasing by 7.5% from 160.9 MT in 2019, according to BP data. Consequently, its environmental, social, and international unacceptability is expanding in a sustainable energy system.

3-3-3-Opportunities

- The rising global energy demand presents Algeria with significant export opportunities. To capitalize on this, Algeria can preserve its oil and gas reserves for export by reducing domestic consumption and improving efficiency, develop the green hydrogen sector using existing pipeline infrastructure, and secure shares in traditional or new markets. These strategies can boost Algerias energy export revenues, supporting economic growth and enhancing energy security.

- Algeria's strategic diversification into renewable energy sources, particularly solar, wind, and biomass, offers promising prospects for improving energy security. Investing in these sustainable, cost-competitive sources can enhance energy availability and reliability, opening up new horizons for Algeria's energy sector.

- According to global forecasts, demand for renewable electricity, especially solar, will see a significant rise until 2050, and the green hydrogen market is expected to grow substantially. These trends give Algeria exceptional opportunities to diversify its energy exports and strengthen its position in the global clean energy market. The shift towards renewable energies is not only limited to improving internal ES but extends to enhancing Algeria's economic position on the international stage, making

it a multi-beneficial strategy.

- Promising opportunities to improve energy efficiency: From the table above, we notice a continuous increase in national energy consumption from 62.3 to 69.1 MT of oil equivalent between 2020 and 2022. This trend highlights the urgent need to improve energy efficiency as it can significantly reduce energy consumption. Reducing pressure on local energy resources extends the life of reserves, and the available surplus can be allocated for export. Achieving a better balance between domestic consumption and exports enhances Algeria's long-term ES and supports sustainable development.
- Algeria's strategic geographical location positions it as a key player in global energy, serving as an essential transit point for energy transport. Its importance as a reliable energy source for Europe has grown, especially in light of the Russian-Ukrainian conflict. Algeria can further diversify its export markets and reduce risks by investing in pipeline infrastructure and maritime carriers, thereby enhancing its export revenues which constitute a significant portion of its budget.
- International and regional cooperation in the energy field: This provides Algeria with multiple opportunities such as exchanging experiences and knowledge, attracting foreign investments in renewable energy, establishing partnerships to ensure energy supply security, and creating shared infrastructure, which enhances energy supply security and facilitates its exchange.

3-3-4-Threats

- Fluctuations in global energy prices increase investment risks in the energy sector, potentially discouraging further investments. Declining oil and gas prices reduce Algeria's export revenues, leading to a decrease in the general budget. This reduction in spending on services and infrastructure may raise domestic energy prices. Consequently, citizens' ability to access affordable energy is threatened, impacting overall energy security.
- Algeria faces increasing competition in the global energy market due to the global energy transition. The European Union, a major market for Algeria, is reducing fossil fuel imports in response to environmental

concerns and energy independence goals. This shift is causing a contraction in the traditional energy market, intensifying competition among energy-exporting countries. As securing stable markets is crucial for ES in fossil fuel-exporting countries, this situation poses a significant threat to the demand security of Algerian energy exports.

- In light of these changes, Algeria finds itself facing a dual strategic challenge: the need to diversify its markets and enhance its competitiveness in a changing global market, while urgently engaging in the energy transition process and developing its capabilities in the field of renewable energies.
- Increase in energy consumption: According to the reports of the Ministry of Energy and Mines for 2021 and 2022, national energy consumption in Algeria rose from 62 MT of oil equivalent in 2020 to 67.2 MT of oil equivalent in 2021 and 69.1 MT of oil equivalent in 2022. This increase is primarily attributed to the rise in final energy consumption, by 8.0% in 2021 (50.2 MT of oil equivalent), and by 5.9% in 2022, reaching 53.1 MT of oil equivalent. This increase is mainly driven by electricity (12.7%) and natural gas (6.5%) (Ministry of Energy, 2022, p. 3). This figure is expected to rise with population growth, economic development, and climate changes that increase the need for cooling and heating. This continuous increase in domestic energy demand threatens long-term ES and contributes to accelerating the depletion of Algeria's oil and gas reserves. It also puts pressure on the energy infrastructure and requires increased investment in renewable energy sources (Jab Allah, 2020, p. 10).
- Algeria faces increasing pressure to reduce carbon emissions due to international commitments. This necessitates reducing dependence on natural gas for electricity generation and petroleum consumption in transportation and industry. The transition may lead to energy supply disruptions and economic structural changes. Higher energy production costs are inevitable due to investments in pollution reduction technologies and clean alternatives, potentially threatening energy availability and affordability.
- Algeria's trend towards energy transition and increased reliance on renewable energies presents a significant challenge. The country's

shortcomings in research and development result in heavy dependence on foreign technology in the renewable energy sector. This dependency extends to essential raw materials for manufacturing renewable energy components. The reliance on external sources for both technology and vital minerals poses a strategic challenge to Algeria's energy transition sustainability and effectiveness.

4. RESULTS AND DISCUSSION

Based on the analysis of strengths, weaknesses, opportunities, and threats, we can construct two strategies that align with Algeria's current ES situation and work towards improving it in the future:

➤ **Maximum-Maximum Strategy (SO):** This strategy exploits Algeria's strengths and available opportunities. Key actions in this framework include:

- Leveraging Algeria's large oil and gas reserves to increase exports and generate more revenue, especially with rising global energy demand. This not only ensures its continued role as a reliable energy source but also opens new avenues for cooperation in clean energy with traditional partners, particularly in the European Union.
- Investing in renewable energy sources to diversify the energy mix, meeting increasing domestic consumption demand and exporting renewable electricity, capitalizing on Algeria's immense solar and wind energy potential. The government should enhance the private sector's role in renewable electricity production through pricing incentives, encouraging local investors to redirect investments towards this sector, allowing them to benefit from price differentials and contributing to renewable energy development. The government should also work on attracting experienced foreign investors, enhancing technology transfer and supporting state efforts by improving Algeria's investment climate.
- Strengthening regional and international cooperation in the energy sector, allowing Algeria to benefit from successful experiences and advanced technologies in this sector, in addition to attracting foreign direct investment in the Algerian energy sector, contributing to infrastructure modernization and developing the country's production and export

capacities. Through this cooperation, Algeria can establish strategic energy partnerships with leading countries and international institutions in traditional energy or projects developing new renewable energy technologies, or even cooperation in cross-border energy transmission and distribution.

- Algeria's strategic geographical location enables it to play a pivotal role in the global energy map. Its prime position on the Mediterranean coast, between Europe and Africa, makes it a key transit point for energy resources. Algeria can invest in this advantage by developing advanced energy transportation and storage infrastructure, establishing logistics centers, and investing in renewable energy transmission technologies. It can also enhance its role as an intermediary in energy trade between continents and participate in regional projects for energy market integration. This approach will strengthen Algeria's energy security, increase its economic and geopolitical influence, and ensure it a fundamental role in the global energy future.

➤ **Maximum-Minimum Strategy (ST):** This strategy focuses on exploiting strengths to overcome threats. Key approaches include:

- Enhancing and expanding the blue and green hydrogen industry in Algeria is vital for achieving economic diversification. This approach aims to create alternative and stable income sources, reducing the excessive dependence on traditional oil and gas exports. While hydrocarbon revenues are subject to sharp fluctuations due to changes in global prices, the hydrogen industry can provide greater stability in revenue. This diversification not only enhances Algeria's economic resilience in facing global energy market challenges but also positions it as a leader in the future green economy, ensuring the long-term sustainable growth of the national energy sector.
- Investing in clean energy technologies to reduce carbon emissions in line with international commitments. Sonatrach has placed carbon footprint reduction at the core of its strategy and intends to be an active player in the renewable energy value chain. Sonatrach is promoting effective energy transition by developing new renewable energy sources across all its activities, an option that ensures long-term ES for the country and meets the needs of future generations.
- Improving the efficiency of oil and gas reserves exploitation and energy
Improving the efficiency of exploiting oil and gas reserves and energy

transmission networks to reduce waste, and rationalizing energy consumption to preserve traditional stocks, through the effective implementation of the Energy Efficiency Program 2030. It is crucial to strengthen oversight on the application of energy efficiency standards, especially in electrical appliances and equipment. Additionally, adherence to environmentally conscious architectural design principles in building construction should be maintained, contributing to achieving a balance between optimal energy consumption and environmental preservation.

- Enhancing exploration and prospecting efforts for new oil and gas fields is vital for Algeria. With the gradual depletion of existing reserves and the increasing growth in domestic energy demand, it has become necessary to intensify geological survey operations and exploratory drilling. This is crucial to compensate for the decrease in current reserves resulting from continuous extraction, as well as to ensure sufficient supplies to meet growing domestic needs. This strategy can help maintain Algeria's position as a reliable energy source, both for domestic consumption and export, thereby enhancing its ES and supporting its economy in the long term.

By applying these two strategies, Algeria can enhance its long-term energy security, exploit its strengths and growth opportunities, while addressing potential threats it may face.

4. CONCLUSION

The SWOT analysis of ES in Algeria has shown that the country faces numerous challenges in this vital sector, but it also possesses significant strengths and opportunities to enhance its ES and leverage its position as a key player in global energy markets. By following the Maximum-Maximum (SO) and Maximum-Minimum (ST) strategies, Algeria can achieve these desired objectives and ensure the provision of affordable energy to its citizens, as well as achieve long-term economic sustainability.

One of the key steps is to exploit the vast oil and natural gas reserves to increase Algeria's exports and boost its financial revenues necessary for economic development. This can be achieved through intensifying efforts to search for new reserves, along with improving the efficiency of natural resource exploitation and energy transport networks to ensure their availability and Reducing losses, while strongly focusing on rationalizing energy consumption and improving its efficiency to address the growing

domestic demand. The country should also invest heavily in renewable energy sources and clean energy technologies, with the aim of diversifying its energy mix and reducing environmentally harmful carbon emissions, and maximize the benefits of its strategic geographical location and enhance regional and international cooperation to attract more investments, exchange expertise, and establish fruitful energy partnerships.

Although there are weaknesses and threats to ES in Algeria that need to be addressed, there are practical solutions available to Algeria. Through the adoption of comprehensive and carefully studied strategies, Algeria can secure its energy future and strengthen its position as a leading and influential global actor in this vital field.

5. Bibliography List :

Aidouni, L., & Aiouadj, M. (2023, June). Algeria and the transition to renewable energy: the path to achieving energy security. *Journal of Finance, Investment and Sustainable Development*, 8, 058–077. Retrieved September 4, 2023, from <https://www.asjp.cerist.dz/en/article/224247>

Alshaghel, H. (2017, September). Energy Securit. *Energy Securit.* Retrieved July 10, 2023, from <https://political-encyclopedia.org/dictionary/أمن الطاقة/>

Benamirouche, H., Megherbi, A., Djedaa, N. E., & Bouferkas, R. (2022, July). ES index of Ageria: an integrated approach. *Les cahiers du CREAD*, 38, 229–260. Retrieved May 4, 2024, from <https://www.asjp.cerist.dz/en/article/197239>

Božanić, D., Pamucar, D., Milić, A., & Bojanic, D. (2011, March). APPLICATION OF SWOT ANALYSIS ON THE ANALYSIS OF ES OF THE REPUBLIC OF SERBIA. *Energija, ekonomija, ekologija*, 13, 65–70.

BP. (2024, July). Statistical Review of World Energy 2020. *Statistical Review of World Energy 2020*. Retrieved July 7, 2024, from <https://www.bp.com>

Cherp, A., Adenikinju, A., Goldthau, A., Hernandez, F., Hughes, L., Jansen, J., Davidson, O. (2012). Energy and Security. In T. B. Johansson, N. Nakicenovic, A. Patwardhan, & L. Gomez-Echeverri (Eds.), *Global Energy Assessment (GEA)* (pp. 325–384). Cambridge: Cambridge University Press. doi:10.1017/CBO9780511793677.011

ES issues. (2024, May). *ES issues*. Retrieved May 4, 2024, from <https://documents.worldbank.org/en/publication/documents-reports/documentdetail/464811468175435408/Energy-security-issues>

Fuentes, S., Villafafila-Robles, R., & Lerner, E. (2020, August). Composed Index for the Evaluation of the ES of Power Systems: Application to the Case of Argentina. *Energies*, 13, 3998. doi: <https://doi.org/10.3390/en13153998>

Fuertes, G., Alfaro, M., Vargas, M., Gutierrez, S., Ternero, R., & Sabattin, J. (2020, January). Conceptual Framework for the Strategic Management: A Literature Review—Descriptive. *Journal of Engineering*, 2020, 1–21. doi:10.1155/2020/6253013

Isaeva, O., Vasić, B., & Radovanovic, M. (2018, March). Ensuring global ES – the role of Russian energy policy. In *Energy Security: Perspectives, Improvement Strategies and Challenges*.

Jab Allah, M. (2020, May). Determinants of electricity demand in Algeria. *Revue des reformes Economique et intégration dans l'économie mondiale*, 14, 395–406. Retrieved May 2, 2024, from <https://www.asjp.cerist.dz/en/article/115348>

Nyga Lukaszewska, H., & Napiórkowski, T. (2022, March). Does Energy Demand Security Affect International Competitiveness? Case of Selected Energy-Exporting OECD Countries. *Energies*, 15, 1991. doi:10.3390/en15061991

Paravantis, J., & Kontoulis, N. (2020, September). ES and Renewable Energy: A Geopolitical Perspective. doi:10.5772/intechopen.91848

Sokołowski, M. M., & Heffron, R. J. (2022, February). Defining and conceptualising energy policy failure: The when, where, why, and how. *Energy Policy*, 161, 112745. doi: 10.1016/j.enpol.2021.112745

Sonalgaz. (2024, May). Sonelgaz. *Sonalgaz*. Retrieved May 5, 2024, from <https://www.sonelgaz.dz/ar/3859/alkhrba>

Sovacool, B. K., & Brown, M. A. (2010, November). Competing Dimensions of Energy Security: An International Perspective. *Annual Review of Environment and Resources*, 35, 77–108. doi:10.1146/annurev-environ-042509-143035

World Energy Outlook 2023. (2023, October). *World Energy Outlook 2023*. Retrieved July 6, 2024, from <https://www.iea.org>

Yassaa, N., & Khelif, M. (2020). *Transition in Algeria: Lessons, Current Situation and Prospects for Accelerated Development of Renewable Energies*. Tech. rep., Algeria.