

The State of Energy Security in Algeria – Stakes and Challenges

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Abstract:

This study aims to analyze the state of energy security in Algeria by examining the economic and geopolitical stakes, as well as the structural challenges facing the country's energy sector. It also explores Algeria's potential to transition toward renewable energy and sustainability. The findings reveal that despite Algeria's substantial oil and gas reserves and immense solar and wind potential, the country is still slow in implementing energy transition strategies. The study recommends reforming energy governance, boosting investments in renewable energy, and fostering international partnerships—especially with the European Union—to ensure long-term energy security.

Keywords: Energy security, Algeria, renewable energy, natural gas, energy transition, EU partnership, sustainability.

JEL Classification : Q41, Q42, Q43, Q48, Q01, O55, F15

1. **Introduction**

Energy security is one of the fundamental strategic pillars underpinning the economic and sovereign policies of nations, due to its close link to economic growth, social stability, and environmental balance. In the Algerian context, the topic assumes even greater importance, given that the national economy heavily relies on oil and gas exports as its primary source of income. With the profound transformations taking place in the global energy sector—rising demand, the shift toward clean and sustainable energy sources—it has become imperative to reassess the state of energy security in Algeria in light of multiple internal challenges and external pressures.

Despite its wealth in fossil energy resources, Algeria faces several critical issues concerning the sustainability of these resources, the growing domestic energy demand, aging infrastructure, and the accelerating impact of the global energy transition and climate change obligations. This reality raises a central research question that guides the present study :

▪ **Problem Statement :**

- ✓ what extent can Algeria ensure its energy security amid the multiple challenges facing its energy sector, and what strategic options are available to address them?

▪ **Sub-Questions :**

- ✓ What is the current state of Algeria's energy sector in terms of production, consumption, and exports?
- ✓ What are the main internal and external challenges hindering Algeria's energy security?
- ✓ How do global changes—particularly the energy transition and environmental commitments—affect Algeria's energy policy?
- ✓ How effective are the policies and strategies adopted by Algeria in securing its energy future?
- ✓ To what extent can renewable energy contribute to ensuring Algeria's long-term energy security?

▪ **Hypotheses :**

- ✓ Algeria's energy sector suffers from an imbalance between production levels and rising domestic demand, negatively impacting exports and energy security.
- ✓ Algeria faces both internal and external challenges to its energy security, including overdependence on fossil fuels, weak infrastructure, and volatile global energy markets.
- ✓ Global transformations, especially the shift toward clean energy and international environmental commitments, directly impact Algeria's ability to maintain its fossil-fuel-based energy security model.
- ✓ Current national energy policies and strategies lack a comprehensive long-term vision and do not sufficiently prioritize diversification and innovation.
- ✓ Despite Algeria's vast renewable energy potential, its contribution to energy security remains limited due to underinvestment, lack of political will, and delays in implementing strategic projects.

▪ **Objectives :**

- ✓ To analyze the current state of the energy sector in Algeria across its various components.
- ✓ To identify the key challenges and stakes affecting Algeria's energy security.
- ✓ To evaluate the impact of global transformations on Algeria's energy policy.

- ✓ To assess the effectiveness of Algeria's national energy strategies in responding to present and future challenges.
- ✓ To propose strategic recommendations for achieving sustainable and diversified energy security, with a focus on the role of renewable energy.

▪ **Significance of the Study :**

This study holds significant theoretical and practical importance. Theoretically, it contributes to academic discourse on energy security in a rentier state that heavily depends on hydrocarbon exports. Practically, it offers an analytical perspective on a vital sector that underpins the national economy, particularly in light of accelerating regional and global transformations. The study's findings are expected to assist policymakers in formulating more balanced and sustainable energy policies that can secure Algeria's energy future in the long term.

2. Algeria's Energy Resources – Current Situation and Potential:

Understanding a country's energy structure is a fundamental prerequisite for assessing its level of energy security and strategic autonomy. In the Algerian context, energy resources—particularly conventional hydrocarbons such as oil and natural gas—constitute the backbone of the national economy and represent a primary source of state revenues. As one of the largest energy producers and exporters in both Africa and the Arab world, Algeria holds significant hydrocarbon reserves and enjoys a geographic position that enables it to serve as a bridge between Africa and Europe in energy transit.

However, this strategic role cannot be evaluated solely through the lens of reserve volumes or production capacities. A deeper analysis is required—one that examines the national energy system's components, including infrastructure, domestic consumption levels, and challenges related to investment and technology. Moreover, Algeria's heavy reliance on hydrocarbon revenues, combined with the limited diversification of its economy, calls for a critical reassessment of its strategies for resource management and long-term sustainability.

This section, therefore, seeks to provide a comprehensive analytical overview of Algeria's energy resources, focusing on their volume, geographic distribution, production potential, and the structural challenges they face. This is a necessary step toward understanding the dynamics of national energy security and its future outlook.

2.1 General Context of Algeria's Energy Wealth:

Algeria is one of the leading energy-producing and exporting countries in North Africa. It plays a strategic role in ensuring the energy security of the Mediterranean region, particularly in supplying natural gas to Europe. This position is reinforced by Algeria's vast hydrocarbon reserves and its geographic proximity to European markets, enabling it to act as a key regional and global energy player (Aissaoui, 2019, p. 82).

Energy, in all its forms (oil, gas, and renewables), constitutes a central pillar of Algeria's national economic strategy. The hydrocarbon sector is the backbone of the national economy, providing most of the state's revenues, financing infrastructure development, and ensuring foreign currency reserves.

2.2 Hydrocarbon Reserves – Volume and Geographic Distribution: Hydrocarbon reserves are a key indicator in assessing a country's energy capacity, as they form the foundation upon which long-term energy strategies and economic policies are built. In Algeria's case, these

reserves play a dual strategic role: economically, they constitute the primary source of public revenues; geopolitically, they serve as a tool of influence, particularly in Algeria's energy relations with European importers.

Analyzing these reserves requires a two-fold approach: examining their actual volume based on geological and economic standards, and understanding their geographic distribution across the national territory. While the volume reflects future production and export potential, the spatial distribution influences the ease of extraction, infrastructure requirements, and transportation costs.

- ✓ **Crude Oil Reserves:** As of the end of 2023, Algeria's proven crude oil reserves are estimated at approximately **12.2 billion barrels**, according to the Organization of the Petroleum Exporting Countries (OPEC) (OPEC, 2023). These reserves are primarily located in the southeastern region of the country, notably in the **Hassi Messaoud** oil field, one of the largest in Africa.

Despite the significance of these reserves, the annual growth rate remains limited due to a decline in foreign investment and a slowdown in exploration activities (IMF, 2023, p. 43).

- ✓ **Natural Gas Reserves:** Algeria is a natural gas powerhouse, with **proven reserves exceeding 4.5 trillion cubic meters**, ranking it **10th globally** (BP, 2023, p. 62). Its strength lies not only in volume but also in infrastructure and geographical proximity to major markets in Europe (Italy and Spain in particular).

Additionally, Algeria holds the **third-largest technically recoverable shale gas reserves in the world**, estimated at more than **20 trillion cubic meters**, mainly in **In Salah** and **Bordj Omar Driss** (EIA, 2022). However, the exploitation of this resource remains limited due to environmental, technological, and social challenges.

2.3 Energy Infrastructure – Capabilities and Limitations: Energy infrastructure is one of the fundamental pillars of any country's energy security, as it serves as the physical bridge between production sites and target markets-whether domestic or international. In Algeria, energy infrastructure-particularly transport networks, export pipelines, and liquefaction facilities-has played a pivotal role in establishing the country as a reliable energy supplier, especially in the natural gas market.

However, evaluating infrastructure effectiveness goes beyond listing facility numbers or pipeline lengths. It requires an in-depth assessment of technical efficiency, equipment modernization, and adaptability to changing market demands, in addition to capacity and operational flexibility. The aging of many components within Algeria's energy infrastructure poses a significant challenge to the long-term sustainability and competitiveness of its energy sector, especially amid growing competition from other suppliers.

- ✓ **Transport and Export Networks:** Algeria possesses an extensive pipeline network of over 20,000 km (Sonatrach, 2022), including both domestic and international lines. Key pipelines include:
 - **TransMed:** links Algeria to Italy via Tunisia, with a capacity of 33 billion cubic meters per year.
 - **Medgaz:** directly connects Algeria to Spain under the Mediterranean Sea, recently upgraded to a capacity of 10.5 billion cubic meters per year (Website, 2023).

- ✓ **Liquefaction Plants and Export Terminals:** Algeria was one of the first countries in the world to enter the **liquefied natural gas (LNG)** market, with the construction of its first LNG plant in **Arzew** during the 1960s. Today, the country has:
 - Two main LNG plants: **Arzew** (Oran province) and **Skikda** (east).
 - Export terminals equipped to handle large LNG carriers, enhancing Algeria's market flexibility.
 - However, many of these facilities suffer from **technical aging**, insufficient maintenance, and a **lack of technological modernization**, undermining competitiveness on global markets (Rebah, 2020, p. 52).

2.3 The Economic Importance of Energy Sector: It is impossible to understand Algeria's economic structure without considering the central role played by the energy sector—particularly hydrocarbons—in shaping its foundations and financing its essential needs. Since independence, the Algerian economy has relied almost entirely on oil and natural gas exports as the main source of foreign currency and a primary tool for funding public budgets and development projects. This deep dependency has given rise to what is commonly referred to in economic literature as the "rentier state model," wherein energy revenues dominate public income while other productive sectors remain marginal.

However, this mono-resource-based economic model renders Algeria highly vulnerable to global energy market fluctuations and limits its capacity to steer sustainable economic development. Thus, analyzing the role of the energy sector in Algeria's economy requires more than just figures—it demands a structural understanding of the country's financial dependency, its implications for fiscal sovereignty and social stability, and its prospects for future economic reform.

- ✓ **Contribution to National Economy:** According to the Bank of Algeria, hydrocarbon exports accounted for approximately **93.3% of total exports** in 2023, and contributed nearly **58% of the national budget** (Algeria, 2023). Algeria's economy is thus highly **mono-resource dependent**, relying heavily on oil and gas revenues.
- ✓ **Risks of Overdependence:** This overreliance makes Algeria highly vulnerable to international oil and gas price fluctuations and limits its ability to develop autonomous financial and industrial policies. It also hinders economic diversification and perpetuates a **rentier economic model** (Zoubir, 2021, p. 76).

2.4 Rising Domestic Energy Demand- A Threat to Export Capacity: Due to population growth, urbanization, and industrial expansion, **domestic energy consumption has increased significantly**, especially for natural gas and electricity. According to the Algerian Ministry of Energy, around **43% of gas production was consumed locally** in 2023.

This upward trend poses a strategic concern, as it could reduce Algeria's gas export capacity and negatively affect its external energy commitments and financial stability. This highlights the urgent need for **energy efficiency policies, consumer awareness programs, and investment in alternative energy sources**, particularly solar and wind.

3. Energy Security in Algeria – Domestic Stakes and Geopolitical Challenges:

Energy security in Algeria is no longer solely a matter of resource availability or export capacity—it has become a multi-dimensional issue, intersecting economic, social, and geopolitical dynamics. In the context of rapid global energy transitions and recurring crises,

Algeria faces complex and evolving challenges that demand a strategic vision to reassess how it manages its energy resources, partnerships, and future pathways.

This axis explores the structural vulnerabilities threatening Algeria's energy security—from rising domestic consumption and outdated infrastructure to insufficient diversification. It also examines Algeria's geopolitical context, where competition for export markets and regional instability further complicate the energy security landscape.

3.1 Defining Energy Security – Theoretical Framework : Energy security refers to a state's ability to consistently meet domestic energy demand in a stable, affordable, and sustainable manner, while minimizing the risk of disruptions or excessive dependence on foreign partners¹. It encompasses multiple dimensions:

- **Physical security:** Ensuring reliable access to energy supplies.
- **Economic security:** Maintaining energy affordability and market competitiveness.
- **Environmental security:** Aligning production and consumption with sustainability goals.
- **Strategic autonomy:** Reducing vulnerability to external shocks or geopolitical pressures.

In Algeria, energy security takes on a unique profile, as the country is both a major producer and exporter. Yet it also faces internal threats such as soaring consumption, slow diversification, and lagging investment in the energy sector.

3.2 Internal Stakes of Energy Security in Algeria:

- ✓ **Rising Domestic Consumption:** As noted in Axis 1, Algeria consumed over 43% of its domestic natural gas production in 2023. This figure continues to rise due to sustained energy subsidies, population growth, and expanding industrial demand. Without effective energy-saving policies or pricing reforms, this consumption trajectory poses a serious threat to export volumes and long-term energy sustainability (ouznit & Pablo, 2016, pp. 93-94).
- ✓ **Limited Energy Diversification:** Despite Algeria's vast solar potential and favorable conditions for renewable energy development, renewable sources contribute less than 2% to the national energy mix. The country remains heavily reliant on fossil fuels. Transition programs often face delays or remain stalled at the regulatory level without large-scale implementation³.
- ✓ **Low Investment and Aging Infrastructure:** Algeria's energy sector suffers from limited foreign direct investment, largely due to regulatory complexity, bureaucratic inefficiencies, and perceived governance risks. Additionally, many key components of the energy infrastructure are outdated, reducing operational flexibility and increasing the risk of system disruptions⁴.

3.3 Geopolitical and Regional Challenges:

- ✓ **Regional Competition in European Markets:** Algeria is facing growing competition in the European gas market from countries such as Qatar, Norway, and Nigeria (which is advancing its Trans-Saharan Gas Pipeline project). To retain its market share, Algeria must improve contract flexibility, service quality, and infrastructure reliability⁵.

- ✓ **Political Instability in the Region:** Ongoing political crises in neighboring Libya, tense Algerian-Moroccan relations, and growing insecurity in the Sahel region all pose direct and indirect threats to energy cooperation and export routes. These geopolitical risks necessitate the strengthening of Algeria's strategic infrastructure and diversification of export partners⁶.
- ✓ **Global Pressure for Energy Transition:** As Europe and other major markets accelerate their shift toward cleaner energy sources, Algeria faces a dual challenge: preserving its fossil fuel revenue streams in a contracting market, while simultaneously preparing for a post-hydrocarbon era without compromising its social and economic stability.

4. Prospects for Energy Transition in Algeria – Between Economic Necessity and Environmental Shift:

In light of the growing challenges facing Algeria's energy security, the energy transition is no longer just an option—it is a strategic necessity. With fluctuating hydrocarbon prices, international market pressures, and global environmental commitments, it has become increasingly clear that continued dependence on fossil fuels is unsustainable in the long term.

Although Algeria possesses vast renewable energy potential—especially solar power—turning that potential into concrete results faces a number of institutional, economic, and technical obstacles. This axis aims to analyze Algeria's readiness for an energy transition, compare its progress to international trends, and identify both the challenges and opportunities ahead.

4.1 Drivers of Energy Transition in the Algerian Context:

- ✓ **Economic Pressures:** Overreliance on hydrocarbon revenues has made Algeria's economy highly vulnerable to global market volatility. Every downturn in oil or gas prices leads to significant fiscal shortfalls and stalled development plans. The energy transition is thus seen as a path toward decoupling economic growth from fossil fuel dependency.
- ✓ **Environmental and International Commitments:** As a signatory of the Paris Climate Agreement, Algeria is committed to reducing its greenhouse gas emissions, despite its relatively low global contribution. This requires a gradual shift toward cleaner energy sources while preserving national development goals¹.
- ✓ **Rising Domestic Energy Demand:** As highlighted in Axis 2, the continued rise in domestic energy consumption—particularly in gas and electricity—underscores the urgent need for alternative and sustainable sources to meet local demand without compromising export capacity.

4.2 Renewable Energy in Algeria – Current State and Potential:

- ✓ **Natural Potential:** Algeria has one of the highest solar radiation levels globally (over 3,000 hours/year in many southern regions).
- The vast Sahara provides ideal conditions for large-scale solar projects (both photovoltaic and CSP).

- Wind potential, particularly in the High Plateaus and southern regions, is promising but still underexploited².
- ✓ **National Strategies and Programs:** Algeria launched several plans, notably the National Renewable Energy Program (2011–2030), which targets 22,000 MW of renewable energy production by 2030.
- Despite these ambitions, actual implementation remains limited—installed solar capacity stood at less than 500 MW as of 2023³.
- ✓ **Institutional and Technical Barriers:** A lack of flexible and attractive regulatory frameworks for investors.
- Poor coordination between stakeholders (ministries, national companies, international partners).
- Shortage of technical expertise in renewable energy planning and implementation.
- Limited financing options and overly centralized decision-making for large-scale projects.

4.3 Toward a Balanced Energy Mix – Opportunities and Recommendations:

- ✓ **Transitioning to a Dual Production Model:** Encourage integration between renewables and natural gas—not as competitors, but as complementary sources enabling a smooth transition.
- Promote decentralized energy models, supporting small and medium-scale projects in interior regions.
- ✓ **Fostering Foreign Investment and Global Partnerships:** Open doors to partnerships with European and Asian companies specializing in clean technology.
- Improve transparency and investor confidence by reforming the investment code and updating energy sector regulations.
- ✓ **Reforming the Subsidy System:** Redirect energy subsidies to vulnerable populations instead of applying broad, generalized support—freeing public resources to invest in clean energy.
- Promote public awareness about energy efficiency and responsible consumption practices.

5. Opportunities for Transformation and Sustainability:

Despite the significant challenges facing energy security in Algeria, the country holds substantial potential to develop a more sustainable energy model—one that can better withstand global market fluctuations and reduce excessive reliance on fossil fuels.

5.1 Potential for Renewable Energy Development:

Algeria is one of the richest countries in terms of natural potential for solar energy, benefiting from over 3,000 hours of sunshine annually across most of its territory. This places it among the best regions in the world for solar power exploitation (Bouznit & Pablo-Romero, 2016). In addition, Algeria has considerable wind energy potential, particularly in its southern and semi-desert areas.

Although the “National Program for Renewable Energy Development” was launched in 2011, its implementation has remained slow. As of 2023, renewable energy contributed less than 2% to the national energy mix (Ministère de la Transition énergétique, 2023).

5.2 Partnership Opportunities with the European Union:

Algeria's importance to European energy security has increased, particularly after the Russia–Ukraine conflict and its impact on gas supplies. This geopolitical shift is pushing EU countries to seek long-term partnerships with Algeria—not only in natural gas but also in clean energy projects, including green hydrogen and sustainable technologies (Tagliapietra, 2022). As such, Algeria has the potential to become a central energy partner in the region's transition.

5.3 Necessary Structural Reforms:

To capitalize on these opportunities, Algeria must implement structural reforms that include:

- ✓ Developing a legal and fiscal framework attractive to renewable energy investors;
- ✓ Improving energy governance by reducing bureaucracy and enhancing transparency;
- ✓ Integrating academic research and universities into sustainable energy initiatives.

Moreover, stimulating the local private sector and facilitating access to financing through banks and financial institutions are key factors in achieving long-term objectives (Chevalier, 2019).

6. CONCLUSION

as a major hydrocarbon producer and supplier, particularly to Europe. It has also shed light on the country's pressing structural and environmental challenges, especially its high dependency on fossil fuel exports and limited diversification of energy sources.

▪ Key Findings:

- ✓ Algeria's energy sector remains heavily reliant on hydrocarbons, which account for the majority of national exports and state revenues.
- ✓ Despite its vast renewable energy potential, especially in solar and wind power, the country's transition toward a sustainable energy model has been slow and fragmented.
- ✓ Geopolitical shifts, such as the European search for alternative energy suppliers, have opened new strategic opportunities for Algeria to position itself as a reliable and long-term energy partner.
- ✓ Institutional weaknesses, aging infrastructure, and regulatory barriers continue to hinder progress toward greater energy security and sustainability.

▪ Recommendations: Based on these findings, the following recommendations are proposed to strengthen Algeria's energy security in the medium and long term:

- ✓ **Accelerate the energy transition** by scaling up investment in renewable energy infrastructure, especially solar and wind power, through public–private partnerships.
- ✓ **Reform the energy governance framework**, including simplifying bureaucratic procedures, ensuring transparency, and improving institutional coordination.
- ✓ **Foster regional and international cooperation**, particularly with the European Union, in areas such as green hydrogen production, technology transfer, and capacity-building.
- ✓ **Support energy efficiency measures** in both the industrial and residential sectors to reduce domestic energy consumption and improve long-term sustainability.
- ✓ **Enhance research and innovation** by integrating universities and research centers into national energy strategies and incentivizing innovation in clean energy technologies.

By addressing these strategic priorities, Algeria can build a more resilient and diversified energy system that not only secures its domestic energy needs but also strengthens its geopolitical standing in a rapidly evolving global energy landscape.

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