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Energy Security Strategies Amidst Global Supply Chain Disruptions: The Case of Algerian Natural Gas

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Abstract:

This study examines the strategic role of the Algerian supplier in ensuring global energy security (2024–2026) amidst geopolitical shifts and supply chain disruptions. The research aims to highlight the competitive advantage of Algeria's infrastructure as a secure and reliable alternative to risk-prone maritime shipping, utilizing descriptive-analytical and prospective methodologies. Furthermore, the findings confirmed that the Algerian pipeline network represents the most secure and stable alternative for bypassing maritime chokepoint risks, effectively contributing to the reduction of "Risk Premiums" and global insurance costs. The results also indicated that Algeria's historical commitment to long-term contracts has reinforced its position as a reliable strategic partner amidst sharp spot market volatility, while highlighting the national infrastructure's geospatial and technical flexibility to be repurposed for future green hydrogen exports.

Keywords: Energy Security, Algerian Supplier, Route Security, Risk Premium, Energy Sovereignty.

JEL Classification Codes : **Q41, Q43, Q48**

1. INTRODUCTION :

The global economic system is witnessing a fundamental shift in energy security paradigms, where strategic emphasis has transitioned from 'Production Security' to ensuring 'Route and Logistics Security.' This shift is particularly evident in light of the successive shocks that hit global supply chains between 2024 and 2026. Given the escalating geopolitical risks at maritime chokepoints and the surging costs of freight and marine insurance, Algeria emerges as a strategic alternative. This prominence is attributed to the resilience of its infrastructure, centered on trans-Mediterranean pipelines, and its capacity to bridge African resources with European demand. Such positioning not only reinforces Algeria's status as a traditional supplier but also paves the way for leading continental

energy integration in both the natural gas and green hydrogen sectors. From this perspective, the central research problem can be framed through the following question:"

Research Problem:

Amidst escalating geopolitical crises and the heightened volatility of global supply chains (2024–2026), the concept of 'Route and Logistics Security' has become as critical as 'Production Security.' Consequently, the core research problem emanates from the following pivotal question:

To what extent do the logistical and geographical advantages of the Algerian supplier—specifically pipeline security and geo-spatial flexibility—contribute to mitigating global supply chain risks? Furthermore, how do these determinants position Algeria to transition into a continental hub for future energy sustainability, encompassing both the Trans-Saharan Gas Pipeline (TSGP) and Green Hydrogen?

Research Hypotheses:

Based on the aforementioned research problem and within the context of analyzing the geopolitical and logistical variables affecting the Algerian supplier, the following research hypotheses are formulated

H1 : The reliance on trans-Mediterranean pipeline networks (Medgaz & Transmed) significantly reduces the 'risk premium' and insurance costs compared to maritime shipping through volatile chokepoints.

H2 : Algeria maintains a competitive advantage as a 'secure supplier' due to its historical record of fulfilling long-term contracts, making it a more stable alternative amidst spot market price volatility

H3:The Trans-Saharan Gas Pipeline (TSGP) serves as a fundamental pillar for repurposing existing gas infrastructure into an integrated logistics network capable of hosting and exporting green hydrogen in the future.

Significance of the Study:

The significance of this study lies in highlighting the logistical and geopolitical assets that position Algeria as a strategic partner in ensuring global energy security and its future sustainability:

a. Analyzing Algeria's strategic role as a secure energy alternative amidst global supply chain disruptions (2024–2026) and maritime chokepoint instability.
b. Highlighting the competitive advantage of the Algerian pipeline network in minimizing freight costs, insurance, and Risk Premiums.
c. Providing a forward-looking framework for repurposing existing gas infrastructure to facilitate green hydrogen exports.
d. Evaluating the impact of the Trans-Saharan Gas Pipeline (TSGP) on enhancing continental energy integration between Africa and Europe

Objectives of the Study:

This study primarily aims to highlight the pivotal role of Algerian logistical assets in stabilizing energy markets, by achieving the following research objectives:

a. Conceptualizing modern energy security paradigms, shifting the focus from "production security" to "route and logistics security" amidst global shocks (2024–2026).

b. Evaluating the efficiency of Algeria’s pipeline infrastructure and liquefaction plants in mitigating maritime chokepoint risks.
c. Analyzing Algeria’s competitive advantages regarding contractual reliability, geographical proximity, and minimized Risk Premiums.
d. Assessing the strategic viability of the Trans-Saharan Gas Pipeline (TSGP) as a vital artery for Africa-Europe energy integration

Research Methodology:

To achieve the study's objectives and test its hypotheses, the research employs a descriptive-analytical approach to monitor and analyze the global energy market landscape (2024–2026) and assess Algeria's logistical and geopolitical assets. Additionally, a prospective (forward-looking) method is utilized to evaluate the future viability of the Trans-Saharan Gas Pipeline (TSGP) and the readiness of national infrastructure for the transition toward a green hydrogen economy. This methodology relies on research tools including official reports, statistical data, and geospatial mapping analysis to compare various energy supply routes.

2. Conceptual Framework of Energy Supply Security and Market Volatility:

The crises of 2026 have imposed a radical shift in the energy security paradigm, shifting the focus from 'production availability' to the 'security of logistical routes'. With the escalation of risks across international maritime chokepoints, the evaluation of suppliers has become primarily dependent on geographical reliability, leading to significant shocks in global supply chains and pricing mechanisms. This pillar seeks to diagnose these transformations and their impact on the stability of the international gas market.

2.1The Evolution of the Energy Security Concept in International Economics:

2.1.1 The Four Dimensions of Energy Security: Availability, Accessibility, Affordability:

Energy security is no longer merely about securing resources; it has evolved into a comprehensive commercial strategy centered on the sustainability of access. This concept is academically analyzed through four fundamental dimensions:

1. **Availability:** This pertains to the physical existence of the resource and its productive capacity, representing the 'supply' side of the energy trade balance (Azzuni & Breyer, 2018).
2. **Accessibility:** This refers to logistical efficiency and the capability to overcome geographical and political barriers to deliver the resource to the end consumer (Winzer, 2012).
3. **Affordability:** This denotes the markets' capacity to absorb prices without triggering inflationary shocks; a dimension directly impacted by the 'risk premium' in international trade (Kruyt et al., 2009).
4. **Acceptability/Sustainability:** This involves ensuring long-term flows while adhering to environmental standards and contractual obligations (Ang et al, 2015).

2.1.2 The Strategic Shift from "Upstream Security" (Production) to "Route Security" (Cross-border Logistics):

Strategic energy thinking has undergone a fundamental shift in priorities. While past decades emphasized Upstream Security, which focuses on securing investments in exploration and development to ensure physical availability (Yergin, 2020), the supply chain shocks of 2026 have redirected focus toward Route Security.

Route Security entails ensuring the safety of flows across international logistical loops and protecting maritime corridors and cross-border pipelines from military and political threats. This shift reflects a commercial reality: the value of energy lies not only in its extraction but in the ability to deliver it safely and cost-effectively to the end consumer (Sovacool et al., 2023). In the context of natural gas, the 'logistical reliability' of terrestrial routes (pipelines) is gaining a significant competitive edge over maritime routes subject to chokepoint risks, reshaping the global energy map in favor of suppliers with shorter and more stable routes (IEA, 2024)

2.2 Analysis of Global Supply Chain Shocks (2024-2026):

A systematic analysis of the unprecedented disruptions characterizing the global energy landscape between 2024 and 2026, focusing on the vulnerability of maritime corridors and the resulting logistical bottlenecks

2.2.1 Maritime Chokepoint Risks and Their Impact on LNG Carriers:

The global LNG supply chain is highly sensitive to the geopolitical stability of critical maritime chokepoints, particularly the Strait of Hormuz and Bab el-Mandeb. According to the U.S. Energy Information Administration [EIA] (2023), the Strait of Hormuz is the world's most important energy corridor, with approximately 21 million barrels per day (b/d) of oil and significant volumes of LNG—nearly 20% of global LNG consumption—passing through it annually. Any disruption in this narrow passage triggers an immediate 'Risk Premium' on spot market prices.

Furthermore, the escalation of conflicts in the Red Sea has severely influenced the Bab el-Mandeb strait, a vital link for Qatari LNG shipments destined for Europe. Data from the International Energy Agency [IEA] (2024) indicates that by early 2024, LNG transits through the Suez Canal dropped by nearly 45% as carriers opted for the longer Cape of Good Hope route. This logistical detour adds approximately 9 to 15 days to the delivery lead time and increases operational costs by over $1 million per voyage due to higher fuel consumption and specialized war-risk insurance premiums (World Bank, 2024).

2.2.2The Impact of "Risk Premium" on Marine Insurance and Freight Costs:

Table: Comprehensive Analysis of Geopolitical Risk Transmission into LNG Logistics (2024-2026)

Cost Component	Transmission Mechanism (The How)	Quantitative Impact (The Magnitude)
Marine Insurance	War Risk Premiums applied to Hull Value for vessels in "Listed Areas."	Premiums surge from 0.01% to >1.0% per transit; adding millions to voyage costs.
Freight Rates	Spot Chartering volatility due to tonnage undersupply and route diversions.	Daily hire rates experience extreme fluctuations; inflating the CIF price.
Bunker Fuel Costs	"Distance Penalty" through the Cape of Good Hope bypass.	Fuel consumption increases by 40% – 60%; adding 9–15 days to lead times.
Operational Liquidity	Increased Margin Calls and capital tie-up in Deadweight costs.	Reduction in working capital for energy firms due to prolonged transit cycles.

Source: Prepared by the author based on (Clarksons Research, 2024; UNCTAD, 2024; Stopford, 2023).

The following table provides a comprehensive synthesis of the logistical and financial transmission channels through which geopolitical risks inflate the final delivery cost of LNG.

The Shock Transmission Mechanism: The data presented in the table illustrates that geopolitical risks do not merely influence gas prices through supply shortages; they operate through complex

"logistical transmission channels." The transition of War Risk Premiums from a negligible 0.01% to a significant 1.0% of the vessel's hull value represents a systemic shift in the cost structure of LNG. This shift forces a transition from "Cost Efficiency" to "Supply Security," ultimately inflating the final CIF (Cost, Insurance, and Freight) price for the end consumer.

The Operational Burden of the Distance Penalty: From a trade perspective, the 40% to 60% surge in fuel consumption—resulting from the detour around the Cape of Good Hope—is not just a financial overhead; it is a logistical failure that traps working capital for longer durations. This "Distance Penalty" extends lead times by 9 to 15 days, reducing the turnover rate of energy inventories in European markets and creating a high-volatility environment where prices react to "perceived risk" rather than physical availability.

Strategic Implications for Comparative Advantage: According to the principles of Commercial Sciences, these logistics-driven cost spikes create a natural "Cost-Leadership" advantage for suppliers utilizing trans-continental pipelines. While long-haul LNG shipments are burdened by high insurance premiums and fuel surcharges, pipeline-based exports (such as those from Algeria) operate with a "Zero War-Risk Premium." Consequently, in the 2024–2026 period, geographical proximity and fixed infrastructure have become the primary determinants of competitive pricing in the Mediterranean energy basin.

2.3 Implications of Geopolitical Conflicts on Gas Price Stability:

Through this section, the correlation between geopolitical instability and gas price volatility is analyzed, specifically examining the decoupling of spot market prices from long-term contract benchmarks.

2.3.1Gas Pricing Mechanisms in Spot Markets During Crises:

During periods of geopolitical instability, gas pricing mechanisms in spot markets undergo a structural shift from 'Fundamental-Based Pricing' to 'Sentiment-Driven Volatility.' Unlike long-term contracts linked to oil indices (Oil-Indexed), spot prices—primarily those governed by hubs like the Title Transfer Facility (TTF)—react instantaneously to supply disruptions at maritime chokepoints. According to the International Energy Agency [IEA] (2024), during energy crises, spot prices can deviate from long-term averages by over 200%, driven by panic buying and the immediate pricing of 'Security of Supply' premiums.

The mechanism is further complicated by the 'Gas-to-Gas Competition' model, where prices are set by the marginal cost of the last LNG cargo required to balance the market. In times of crisis, this marginal cost includes not only the production and liquefaction fees but also the soaring War Risk Insurance and Freight Surcharges. As noted by Yergin (2023), the spot market acts as a 'Global Buffer,' but during maritime blockades or chokepoint risks, it becomes a transmission belt for extreme price volatility, forcing importers to pay a high 'Immediacy Premium' to secure uncommitted volumes (World Bank, 2024).

To illustrate the quantitative divergence between different pricing models during times of crisis, the following table compares the performance and volatility of spot market prices (TTF) against oil-indexed long-term contracts.

Table 3: Price VolatilityAnalysis: Spot Markets (TTF) vs. Long-Term Contracts (2022-2024)

Indicator	Long-Term Contract (Oil-Indexed)	Spot Market (TTF Hub)	Variance / Impact
Average Price	$10 - $15	$30 - $70 (Peaks >$90)	Spot prices can be 3x to 5x

($/mmBtu)			higher during crises.
Pricing Mechanism	Linked to 3-6 months oil price averages.	Real-time supply/demand & geopolitical sentiment.	Spot markets react in **minutes** to chokepoint risks.
Price Stability	High (Predictable cash flows).	Extremely Low (High Volatility).	Spot market volatility index (VIX) surges by **150%**.
Risk Premium	Negotiated fixed margins.	Instant "Panic Premium" included.	Spot prices include a $20-$30 premium for immediate delivery.

Source: *Prepared by the author based on data from International Energy Agency (IEA, 2024), World Bank Commodity Markets Outlook (2024), and European Commission Energy Reports*

The data in Table 3 highlights a critical divergence in gas pricing dynamics. During the 2022–2024 energy crisis, the Title Transfer Facility (TTF) price exhibited extreme decoupling from traditional oil-indexed contracts. While long-term contracts maintained a relatively stable range ($10–$15 per mmBtu), spot prices reached unprecedented peaks, driven by the 200% surge in market volatility. This discrepancy underscores the 'financial penalty' paid by countries reliant on spot purchases during maritime disruptions, as opposed to the 'stability premium' enjoyed by those with fixed-pipeline or long-term contractual arrangements.

2.3.2The Dilemma of Over-dependence on Suppliers in Militarized Tension Zones:

Over-dependence on energy suppliers located within or traversing through militarized tension zones creates a 'Geopolitical Chokehold' on importing economies. When supply routes—such as the Strait of Hormuz or the Bab el-Mandeb—become militarized, the risk of 'Energy Weaponization' or accidental disruption increases exponentially. According to Yergin (2023), this dilemma is not merely logistical but existential, as a 20% disruption in flow through these zones can trigger a global price shock of over 100% within days.

Furthermore, the International Energy Agency [IEA] (2024) highlights that diversification of routes is often more critical than diversification of suppliers. Importers heavily reliant on 'Transit-Risk' zones face higher Insurance Risk Premiums and the constant threat of 'Force Majeure' declarations. To mitigate this, strategic shifts are being made toward 'Near-Shoring' and 'Friend-Shoring,' where stability and geographic proximity—such as the Mediterranean corridor—are prioritized over low-cost but high-risk suppliers (World Bank, 2024)

To assess the strategic vulnerability of global energy routes, the following table provides a comparative analysis of risk levels and insurance premiums across major maritime chokepoints versus continental pipeline corridors.

Table 4: Strategic Risk Assessment of Energy Transit Chokepoints (2023-2025)

Transit Route / Mode	Geopolitical Risk Level	War Risk Premium Increase	Volume Disruption Risk	Strategic Alternative
Strait of Hormuz (LNG)	Critical	+150% to 300%	High (20% of global supply)	Pipeline diversification (Land-based)
Bab el-Mandeb (Red Sea)	High	+1.0% of Vessel Value	Significant (Diversion via Africa)	Near-Shoring (Mediterranean)
Continental Pipelines (e.g., Algeria)	Low	Zero (Fixed Asset)	Minimal (Direct connection)	Stable Long-term Supply

Malacca Strait	Moderate	+20% (Congestion-related)		Medium (Shipping delays)

Source: Prepared by the author based on data from *Clarksons Research (2024)*, *International Energy Agency (IEA, 2024)*, and *UNCTAD Maritime Transport Report (2023)*.

The statistics in Table 4 emphasize the 'Geographical Safety Premium' of pipeline-based energy exports compared to maritime LNG routes. During militarized tensions in 2024, war risk premiums for vessels traversing the Red Sea saw a massive surge, effectively acting as a 'Security Tax' on energy imports. In contrast, land-based continental pipelines—particularly those connecting North Africa to Europe—exhibited a Zero War Risk Premium, ensuring price stability and physical security. This data confirms that for importing economies, the strategic shift toward 'Near-Shoring' and 'Mediterranean corridors' is an economic necessity to hedge against the high-volatility risks inherent in militarized chokepoints (IEA, 2024; World Bank, 2024).

3. Strategic and Logistic Determinants of the Algerian Supplier :

This section evaluates the strategic and logistic determinants that consolidate Algeria's position as a reliable energy hub, focusing on its pipeline infrastructure and geographical proximity as competitive advantages in mitigating global supply chain disruptions.

3.1 Export Infrastructure and Multimodal Flexibility (Pipelines vs. LNG):

This section examines the structural synergy between Algeria's extensive pipeline network and its LNG liquefaction capabilities, highlighting the multimodal flexibility that ensures continuous supply despite maritime or technical constraints.

3.1.1Efficiency of Trans-Mediterranean Pipelines (Medgaz & Transmed) as Secure Routes Bypassing Chokepoints:

The operational efficiency of Algeria's Trans-Mediterranean infrastructure, specifically the Medgaz and Transmed (Enrico Mattei) pipelines, represents a strategic bypass of global maritime chokepoints. Unlike LNG shipments that are vulnerable to disruptions in the Strait of Hormuz or the Bab el-Mandeb, these subsea pipelines offer a direct, fixed-link connection to the European energy grid. According to Sonatrach (2024), the Transmed pipeline alone possesses a transport capacity of approximately 32 billion cubic meters (bcm) per year, providing a stable flow that is immune to the 'War Risk Premiums' associated with maritime logistics.

Research by Boussaid (2023) indicates that the 'Physical Security' of pipeline corridors significantly enhances the reliability of supply during geopolitical crises. The Medgaz pipeline, connecting Beni Saf directly to Almería, ensures a 99% technical availability rate, effectively neutralizing the 'Distance Penalty' and 'Transit Risk' inherent in long-haul sea routes. Consequently, these pipelines serve as a 'Strategic Shield,' shielding both the supplier and the consumer from the extreme price volatility of the spot market while ensuring energy security through a non-militarized, terrestrial-to-subsea delivery mechanism (IEA, 2024).

The following table provides a quantitative assessment of Algeria's pipeline infrastructure, highlighting its operational capacity and strategic reliability in ensuring uninterrupted energy flows to European markets.

Table 5: Operational Efficiency and Reliability of Algerian Pipeline Infrastructure (2023-2025)

Pipeline System	Annual Capacity (BCM)	Destination	Availability Rate (%)	Strategic Advantage
Trans-Mediterranean (Transmed)	~32 BCM	Italy (Enrico Mattei)	>98.5%	Direct terrestrial-to-subsea link; immune to maritime blockade.
Medgaz	~10.5 BCM	Spain (Beni Saf-Almería)	~99%	Shortest subsea route (210 km); bypasses all maritime chokepoints.
LNG Shipping Routes	Variable	Global Markets	Moderate (Risk of Delay)	Subject to "War Risk Premiums" and canal closures.
Comparative Cost	Low (Fixed OPEX)	Competitive	Stable Pricing	Zero "Distance Penalty" compared to US or Qatar LNG.

Source: Prepared by the author based on *Sonatrach Annual Reports (2023/2024)*, *IEA Gas Market Report (2024)*, and *Oxford Institute for Energy Studies*

The data presented in Table 05 underscores the logistical superiority of Algeria's energy infrastructure, with a total pipeline export capacity reaching approximately 42.5 billion cubic meters (bcm) per annum. The strategic efficiency is evidenced by a 'Technical Availability Rate' nearing 99%, ensuring the continuity of energy flows even during peak geopolitical crises that may result in the closure of maritime chokepoints.

This 'direct connectivity' effectively eliminates the 'Distance Penalty'; shipments via pipelines are delivered in real-time with minimal operational expenditures (OPEX). Consequently, Algerian natural gas maintains a competitive advantage over Liquefied Natural Gas (LNG) sourced from the United States or Qatar, which must bear exorbitant freight costs, insurance premiums, and the inherent logistical risks associated with maritime corridors.

3.1.2The Role of Liquefaction Plants (Arzew & Skikda) in Enhancing Atlantic Export Flexibility

The strategic positioning of Algeria's liquefaction complexes in **Arzew** and **Skikda** serves as a vital 'Logistic Buffer,' providing the necessary flexibility to reach Atlantic and global markets beyond the European pipeline grid. These facilities transform natural gas into its liquid state (LNG), allowing for multimodal transport that bypasses fixed geographical constraints. According to **Sonatrach (2024)**, the Arzew complex remains one of the world's most significant LNG hubs, facilitating large-scale exports to the Americas and Asia, thereby diversifying Algeria's customer base and mitigating the risks associated with regional demand fluctuations.

The technological integration at the Skikda plant further enhances this flexibility through its high-capacity 'Mega-Trains,' which optimize the economies of scale for long-haul maritime transport. As noted by Boussaid (2023), the ability to switch between pipeline deliveries and LNG shipments creates a 'Competitive Arbitrage' for the Algerian supplier, enabling it to redirect volumes to higher-priced Atlantic spot markets during regional gluts. This dual-export infrastructure functions as a strategic insurance policy, ensuring that Algeria remains a versatile player in the global energy value chain while maintaining a high 'Operational Readiness' to meet sudden shifts in Atlantic energy security requirements (IEA, 2024).

To provide a detailed overview of Algeria's maritime export capabilities, the following table outlines the operational capacities and strategic orientations of the Arzew and Skikda liquefaction complexes

Table 6: Production Capacities and Strategic Roles of Algerian LNG Complexes (2023-2025)

Liquefaction Complex	Location	Annual Capacity (Million m3 LNG)	Strategic Export Flexibility	Key Advantage
Arzew (GL1Z, GL2Z, GL3Z)	West Coast (Oran)	~16.3 Million	High access to Atlantic and American markets.	Proximity to main Atlantic shipping lanes; largest LNG hub in North Africa.
Skikda (GL1K)	East Coast	~4.5 Million	Direct reach to Central/Eastern Mediterranean and Asian routes.	High-capacity "Mega-Train" technology; high-purity LNG output.
Total LNG Capacity	Algeria	~20.8 Million	Global Reach	Multimodal capability (Pipeline + LNG)

Source: *Prepared by the author based on Sonatrach Annual Reports (2024) and OAPEC Annual Statistical Report on LNG (2023).*

The data presented in Table 06 indicates that Algeria possesses a total LNG production capacity of approximately 20.8 million cubic meters per annum. Strategic flexibility is manifested in the geographical distribution of these facilities; the Arzew complex, with its western location, serves as an ideal gateway to Atlantic markets (the Americas and Northern Europe) with minimized freight costs.

Conversely, the Skikda complex bolsters Algeria's maneuverability toward the Eastern Mediterranean and Asian markets. The coexistence of these liquefaction plants alongside the pipeline network creates what is termed 'Dual Logistical Flexibility.' This enables the Algerian supplier to divert gas flows from pipelines (targeted at Europe) to liquefied shipments (targeted at global markets) based on price levels and demand fluctuations in Atlantic exchanges. Such a mechanism maximizes financial returns and secures Algeria's market share (Sonatrach, 2024).

3.2 Geographical Advantage and Algeria's Geopolitical Reliability:

This section explores how Algeria's unique geographical positioning functions as a strategic lever, enhancing its geopolitical reliability and reinforcing its role as a stable 'Energy Anchor' in the Mediterranean basin.

3.2.1Analyzing Algeria's Position as an "Atlantic/Mediterranean Supplier" Outside Middle East Conflicts:

Algeria's strategic identity as a dual 'Atlantic/Mediterranean' supplier provides a unique geopolitical advantage by decoupling European energy security from the volatile conflicts of the Middle East. Unlike Gulf suppliers whose exports are contingent upon the stability of the Strait of Hormuz, Algeria's energy corridors are geographically isolated from the 'Middle Eastern Friction Zones.' According to Hadj-Moussa (2023), Algeria functions as a 'Neutral Energy Gateway,' offering direct access to the European mainland via the Mediterranean without the transit risks associated with the Red Sea or the Suez Canal.

The International Energy Agency [IEA] (2024) emphasizes that Algeria's reliability is rooted in its 'Geographical Autonomy,' as its supply chains do not traverse militarized chokepoints. This positioning has transformed Algeria into a 'Pivot State' in the Mediterranean energy balance. Furthermore, research by Boussaid (2023) highlights that during periods of heightened tension in the Levant or the Gulf, the 'Algerian Route' experiences a surge in strategic value, acting as a stabilizer for global gas prices. By operating outside the immediate sphere of Middle Eastern kinetic conflicts,

Algeria offers a 'Security Premium' to its partners, ensuring that energy flows remain governed by commercial contracts rather than geopolitical disruptions (World Bank, 2024).

To emphasize Algeria's strategic insulation from regional instability, the following table compares the geopolitical risk profiles and transit security of major energy suppliers relative to the Algerian route

Table 7: Geopolitical Risk Exposure & Route Security: Algeria vs. Global Suppliers (2024-2025)

Supplier / Region	Primary Export Mode	Transit Chokepoints	Direct Conflict Exposure	Strategic Reliability Status
Middle East (Gulf)	LNG / Maritime	Hormuz / Bab el-Mandeb	**High** (Kinetic Tension)	**Vulnerable** (Contingent on maritime security)
Russia	Pipelines	Transit countries (Ukraine/E.Europe)	**Extreme**	**Disrupted** (Sanctions & War)
United States	LNG	Atlantic Ocean / Panama Canal	Low (Logistical bottleneck)	Stable but high freight cost
Algeria (North Africa)	**Direct Pipelines**	**None** (Direct Med crossing)	**Low**	**Pivot State** (Isolated from ME conflicts)

Source: Prepared by the author based on *IEA Energy Security Index (2024)* and *Geopolitical Risk Map (2024)*

The comparison in Table 07 underscores Algeria's unique comparative advantage within the global energy landscape. The data reveals that Algeria is the sole supplier that integrates 'direct physical connectivity' to Europe with 'geographical insulation' from major conflict zones.

While Gulf suppliers face the vulnerabilities of maritime chokepoints in the Strait of Hormuz, and Russia encounters structural disruptions due to sanctions, Algeria emerges as a 'Geopolitical Safe Haven.' The fact that Algerian supply routes are situated outside of 'militarized friction zones' in the Middle East grants it exceptional reliability. Algerian gas does not require passage through threatened international straits, thereby eliminating the probability of supply chain disruptions caused by regional conflicts. This positions Algeria as a 'neutral strategic partner' ensuring energy stability across the Mediterranean and Atlantic basins (IEA, 2024).

3.2.2 The Historical Record of Sonatrach's Contractual Reliability in Fulfilling International Obligations:

The historical trajectory of Sonatrach is defined by an unparalleled record of contractual reliability, often referred to in global energy markets as 'The Algerian Exception.' Since its inception, Sonatrach has consistently fulfilled its international obligations, maintaining uninterrupted gas flows even during the internal domestic challenges of the 1990s. According to Hadj-Moussa (2023), this 'Culture of Compliance' has cemented Algeria's reputation as a top-tier reliable partner, distinguishing it from other global suppliers who have frequently invoked 'Force Majeure' for political or technical reasons.

The International Energy Agency [IEA] (2024) notes that Sonatrach's commitment to long-term contracts (LTCs) provides a stabilizing anchor for European energy security. This reliability is not merely operational but strategic; as Boussaid (2023) argues, Sonatrach has prioritized its status as a 'Golden Supplier' over short-term geopolitical gains, ensuring that energy remains a commercial bond rather than a political tool. Even during the global supply chain disruptions of the mid-2020s, Sonatrach demonstrated high 'Contractual Agility,' successfully honoring all delivery schedules

while expanding its spot market presence, further reinforcing the trust of its Atlantic and Mediterranean partners (World Bank, 2024).

To substantiate the claim of Algeria's long-standing reliability, the following table chronologically maps Sonatrach's performance during major historical and geopolitical disruptions.

Table 8: Historical Continuity of Algerian Gas Exports During Global & Domestic Crises

Crisis Event	Period	Impact on Global Supply	Sonatrach's Response	Reliability Outcome
Domestic Stability Crisis	1990s	High uncertainty in North Africa.	**Zero interruptions** in gas flow to Europe.	Proven "Contractual Immunity" to domestic issues.
Arab Spring Disruptions	2011	Regional supply shocks (Libya/Egypt).	Increased output to stabilize EU markets.	Reaffirmed Algeria as a "Regional Energy Anchor."
Russia-Ukraine Conflict	2022-Present	Severe shortage in EU gas supply.	Immediate capacity expansion & Medgaz optimization.	Strategic shift to Algeria as the primary secure partner.
Global Pandemic (COVID-19)	2020-2021	Logistics & demand collapse.	Honored all long-term delivery schedules.	High operational resilience and flexibility.

Source: *Prepared by the author based on Historical Export Data from Sonatrach (1990-2024) and IEA Strategic Reliability Reports.*

The data in Table 08 reflects what is academically referred to as Sonatrach's 'Contractual Immunity.' The historical record demonstrates that Algerian exports remained unaffected by the domestic challenges of the 1990s, maintaining full operational flow.

Furthermore, Algeria proved its capacity to serve as a 'Strategic Stabilizer' during the 2022 European gas crisis. The country did not merely fulfill its existing contractual obligations but actively expanded pumping capacities via the Medgaz pipeline to mitigate the global supply deficit. This rigorous commitment grants the Algerian supplier a 'Golden Reliability' status, characterized by a total decoupling of political tensions from commercial obligations. This, in turn, minimizes supply risk for the end consumer and establishes Algeria as the most stable partner in the Mediterranean and Atlantic basins (IEA, 2024).

3.3The New Legal and Investment Framework (Law 19-13):

We will address the structural shift in Algeria's energy policy following the enactment of Law 19-13, evaluating how this new legal framework enhances investment attractiveness and fosters long-term strategic partnerships through fiscal incentives and regulatory clarity.

3.3.1 Impact of Fiscal Incentives on Attracting Foreign Partners to Boost Production Capacity:

The enactment of Law 19-13 introduced a transformative fiscal regime designed to revitalize Algeria's upstream sector by significantly lowering the tax burden on International Oil Companies (IOCs). By reducing the total tax rate from a restrictive 85% to a more competitive range of 60-65%, the new framework has effectively realigned Algeria with global investment standards. According to Boussaid (2023), these fiscal incentives, which include simplified royalty structures and tax exemptions for exploration activities, have directly improved the Net Present Value (NPV) of energy projects, making the Algerian basin highly attractive for capital-intensive investments.

The empirical impact of these incentives is evident in the surge of strategic partnerships signed between 2022 and 2025. The International Energy Agency [IEA] (2024) reports that the stabilization of the fiscal environment has encouraged giants such as Eni, Occidental Petroleum, and recently ExxonMobil to commit to multi-billion dollar brownfield and greenfield projects. As noted by Hadj-Moussa (2023), the shift towards 'Production Sharing Contracts' (PSC) has allowed foreign partners to recover costs more efficiently, thereby accelerating the deployment of advanced extraction technologies. This influx of foreign capital and technical expertise is pivotal for boosting Algeria's production capacity, ensuring that the country can meet rising global demand while maintaining its status as a reliable energy anchor (World Bank, 2024).

To illustrate the financial attractiveness of the new legal framework, the following table provides a comparative assessment of the fiscal incentives introduced by Law 19-13 versus the previous regime:

Table 9: Comparative Analysis of Fiscal Terms (Law 05-07 vs. Law 19-13)

Fiscal Component	Old Regime (Law 05-07)	New Regime (Law 19-13)	Impact on Investment
Total Tax Burden	High (Up to 85%)	Competitive (60% - 65%)	Increases project **NPV** and profitability.
Royalty Rate	Rigid / High	Flexible (Adjustable based on production)	Lowers the "Entry Barrier" for new fields.
Cost Recovery	Restricted	Accelerated / Enhanced	Allows faster return on capital for partners.
Contract Type	Predominantly Service	Production Sharing (PSC) / Risk Service	Encourages "Risk-Sharing" and technology transfer.
Tax Exemptions	Limited	Broad (Exemptions for exploration & equipment)	Stimulates investment in "Brownfield" & exploration.

Source: *Prepared by the author based on The Algerian Hydrocarbon Law 19-13 and PwC Energy Sector Fiscal Guides (2024).*

The data in Table 09 illustrates a radical shift in Algeria's fiscal policy; the legislator has transitioned from a 'high tax burden' regime, which previously reached 85%, to a competitive system ranging between 60% and 65%. This realignment strictly conforms to international benchmarks prevalent in energy-producing nations.

This transition is not merely a numerical reduction but represents a direct enhancement of the Net Present Value (NPV) of investment projects. By adopting Production Sharing Contracts (PSC) and facilitating Cost Recovery mechanisms, Algeria has successfully converted geological and technical risks into attractive profitable opportunities. This new framework serves as the primary driver behind the signing of major agreements with corporations such as Eni, Occidental, and ExxonMobil. Under Law 19-13, foreign investors have found robust financial guarantees that protect their cash flows and ensure equitable returns commensurate with the substantial capital expenditures required (Sonatrach, 2024).

3.3.2Sonatrach's 2030 Strategy Amidst Rising Demand for "Secure Gas":

Sonatrach's 'Strategy 2030' represents a proactive roadmap designed to consolidate Algeria's role as a cornerstone of international energy security amidst a global shift toward 'Secure Gas' sourcing. This strategy is centered on a massive $40 billion investment plan, primarily allocated to upstream activities to reverse natural decline and unlock new reserves. According to Sonatrach (2024), the 2030 vision prioritizes 'Operational Excellence' and the digitalization of supply chains to ensure that gas deliveries remain resilient against logistical shocks. This strategic pivot aligns with European

energy mandates that seek long-term partners capable of providing 'Decarbonized and Secure Gas'—a requirement Algeria aims to fulfill through significant investments in carbon capture and methane leak reduction.

The International Energy Agency [IEA] (2024) highlights that Sonatrach is increasingly functioning as a 'Regional Swing Producer,' with the 2030 strategy emphasizing the expansion of LNG (Liquefied Natural Gas) fleets alongside pipeline optimization. As argued by Boussaid (2023), the strategy is not merely about volume but about 'Geopolitical Market Positioning.' By diversifying its technological base through partnerships with global giants, Sonatrach aims to secure a 20% market share in the European gas mix by the end of the decade. Furthermore, Hadj-Moussa (2023) notes that the integration of green hydrogen into Sonatrach's long-term export portfolio is a key pillar of the 2030 plan, ensuring that Algeria remains a 'Future-Proof' energy supplier in a net-zero global economy (World Bank, 2024).

To quantify the operational and strategic shifts of Algeria's national energy company, the following table outlines the core pillars of Sonatrach's 2030 strategy and their implications for international energy security:

Table 10: Strategic Pillars of Sonatrach's 2030 Vision for Global Energy Security

Strategic Pillar	Objective by 2030	Financial/Technical Commitment	Impact on Global Security
Production Growth	Increase output to 200 billion m^3	$40 Billion Investment Plan	Ensures a stable surplus for European exports.
Decarbonization	Zero Flaring & Carbon Capture	Investment in CCUS technologies	Supplies "Green-certified" gas to meet EU standards.
Market Diversification	20% Market Share in EU Gas Mix	Expansion of LNG Fleet & Pipelines	Reduces EU dependency on volatile regions.
Future Energy Integration	Start of Green Hydrogen Exports	Pilot projects in Arzew & Hassi R'Mel	Positions Algeria as a long-term energy hub.
Infrastructure Resilience	Digitalization of the SST Network	Cyber-security & Smart Monitoring	Guarantees "Contractual Reliability" against shocks.

Source: *Prepared by the author based on Sonatrach Strategic Plan 2030 (2024) and IEA Mediterranean Gas Outlook (2024).*

Table 10 reflects an ambitious roadmap that transitions Sonatrach from a 'traditional supplier' into an 'integrated energy partner.' The allocation of $40 billion—with 70% earmarked for upstream exploration and production activities—serves as a powerful signal of confidence to international markets regarding Algeria's capacity to guarantee sustained gas flows through the end of the decade.

More importantly, the integration of 'Zero Flaring' initiatives and Carbon Capture, Utilization, and Storage (CCUS) technologies within this strategy underscores a pivotal shift. In the modern European perspective, 'Secure Gas' no longer refers solely to 'volume availability' but also encompasses a 'low carbon footprint.' By incorporating green hydrogen and digitalizing the transport network, Sonatrach ensures its competitive edge. This position the '2030 Agreements' as both a geopolitical and economic safety valve, safeguarding Algeria's interests as a leading nation and its partners' interests as reliable consumers (Sonatrach, 2024).

4.Evaluating the Algerian Role as a Strategic Alternative and Future Prospects:

In the practical framework, we will address the evaluation of the Algerian role as a strategic alternative in the global energy landscape, examining its capacity to fill the supply vacuum in Europe while analyzing the future prospects of Algerian energy diplomacy.

4.1Algeria in the Global Energy Power Balance (A Comparative Study):

Algeria's position within the global energy power balance is examined through a comparative study, analyzing key performance indicators, market share, and competitive advantages that distinguish the Algerian energy sector from other regional and international suppliers.

4.1.1Comparing the Security of "Algerian Pipelines" vs. "Qatari/US Tankers" During Regional Conflicts:

The comparative security of energy supply chains reveals a distinct strategic advantage for Algeria's pipeline infrastructure over the maritime-dependent routes of Qatari and US LNG (Liquefied Natural Gas) tankers. While Algerian gas reaches Europe via fixed subsea pipelines (Medgaz and Trans-Mediterranean), which are geographically isolated from global maritime chokepoints, Qatari exports must navigate through the Strait of Hormuz and the Bab el-Mandeb strait. According to Boussaid (2023), these maritime corridors are highly vulnerable to asymmetric threats and geopolitical escalations, as evidenced by recent disruptions in the Red Sea. In contrast, the 'point-to-point' nature of Algerian pipelines ensures a continuous flow that is immune to maritime piracy, regional naval blockades, or skyrocketing insurance premiums for shipping vessels.

Furthermore, Hadj-Moussa (2023) argues that while US LNG tankers offer flexibility in destination, they are subject to extreme market volatility and logistics bottlenecks during international conflicts. The International Energy Agency [IEA] (2024) reports that the operational reliability of pipeline infrastructure remains the most stable anchor for European base-load demand, particularly during periods of heightened geopolitical tension. The fixed infrastructure of Algeria creates a 'Physical Lock-in' that guarantees contractual continuity, unlike the 'divertable' nature of LNG cargoes which may be redirected to higher-paying Asian markets during crises. Consequently, the Algerian pipeline model provides a superior level of 'Energy Security' by minimizing the geopolitical transit risks inherent in LNG maritime logistics (World Bank, 2024).

To provide a clear comparative view of logistics-related risks, the following table summarizes the strategic advantages of Algeria’s pipeline model compared to maritime LNG delivery routes:

Table 11: Risk Assessment Matrix: Algerian Pipelines vs. Qatari/US LNG Tankers

Risk Factor	Algerian Pipelines (Medgaz/Transmed)	Qatari/US LNG Tankers (Maritime)	Impact on Energy Security
Geopolitical Chokepoints	**Direct Link:** Does not pass through any global straits.	**High Vulnerability:** Must cross Hormuz, Bab el-Mandeb, or Suez.	Pipelines are immune to maritime blockades.
Transportation Costs	**Stable:** Fixed infrastructure costs; low operational volatility.	**Volatile:** Subject to freight rates and massive insurance premiums.	Pipelines offer long-term "Price Predictability."
Diversion Risk	**Zero:** Physically locked to the destination (EU).	**High:** Cargoes can be "flipped" to Asia if prices spike.	Pipelines guarantee "Supply Loyalty" to the partner.
Security Threats	**Fixed/Protected:** Subsea and monitored by national security.	**Asymmetric:** Vulnerable to piracy, naval mines, and drone attacks.	Pipelines minimize "Active Transit Risk."

Delivery Speed	**Instantaneous:** Continuous flow of molecules.	**Delayed:** Subject to weather, port congestion, and canal queues.	Pipelines ensure "Base-load Stability."

Source: *Prepared by the author based on IEA Energy Security Reports (2024) and Maritime Trade & Geopolitics Studies (2023)*

Table 11 illustrates the fundamental difference in the 'Risk Profile' between pipeline-transported gas and Liquefied Natural Gas (LNG). While suppliers such as Qatar and the United States face significant vulnerabilities related to maritime 'Chokepoints'—which can trigger exponential increases in insurance and freight costs during military tensions—Algerian gas is characterized by what is termed 'Direct Physical Connectivity.'

This connectivity not only shields supplies from piracy or maritime blockades but also provides a major financial advantage: 'Logistics Cost Stability.' European investors and consumers increasingly favor the Algerian pipeline model because it prevents 'Cargo Diversion'; technically, gas flowing through the 'Medgaz' or 'Transmed' pipelines cannot be rerouted to alternative markets in search of higher spot prices. This physical lock-in establishes Algeria as the most secure partner, demonstrating unmatched contractual loyalty during periods of heightened geopolitical volatility (International Energy Agency, 2024).

4.1.2 The Competitive Advantage of Algerian Gas: Transport Costs and Rapid Market Access to Europe:

The economic viability of Algerian gas is primarily anchored in its geographical proximity to the European market, which translates into a significant reduction in transportation costs compared to global competitors. Unlike US or Qatari LNG, which incurs substantial liquefaction, shipping, and regasification expenses, Algerian gas is delivered via an extensive pipeline network directly to the European mainland. According to Boussaid (2023), the cost of transporting natural gas from Algeria to Southern Europe is estimated to be 40-50% lower than the total logistics chain of Liquefied Natural Gas (LNG) from the Gulf of Mexico. This 'Cost Leadership' allows Algeria to offer competitive pricing while maintaining healthy profit margins for its national oil company, Sonatrach.

Furthermore, 'Rapid Market Access' is a critical strategic dimension of the Algerian energy model. The International Energy Agency [IEA] (2024) highlights that gas molecules from the Hassi R'Mel field can reach Italian or Spanish terminals in less than 24 hours via the Trans-Mediterranean and Medgaz pipelines. In contrast, an LNG tanker from the United States or Qatar requires 10 to 15 days of transit, excluding potential delays at maritime chokepoints. As noted by Hadj-Moussa (2023), this speed of delivery provides European grid operators with essential 'Operational Flexibility,' allowing them to respond almost instantaneously to sudden demand spikes or supply shocks. Consequently, Algeria's dual advantage of lower unit transport costs and rapid delivery infrastructure solidifies its position as a strategic 'Just-in-Time' energy provider for the European Union (World Bank, 2024).

The following table provides a quantitative and strategic comparison of the cost structure and market responsiveness between Algerian pipeline gas and international LNG alternatives:

Table 12: Economic Efficiency & Market Access: Algeria vs. Global Competitors

Comparison Factor	Algerian Pipeline Gas	US / Qatari LNG	Economic/Financial Advantage
Logistics Chain	Direct (Pipes)	Complex (Liquefaction → Shipping → Regasification)	Algeria avoids intermediate processing costs (~30-40% savings).
Transit Time	**< 24 Hours**	**10 - 15 Days**	Instant response to "Demand Spikes"

			(Just-in-Time).
Transport Cost	Low (Proximity)	High (Long-distance maritime freight)	Increases the **Profit Margin** for Sonatrach.
Infrastructure	Permanent Link	Dependent on Terminal Capacity	Guaranteed "Baseload" for European grids.
Carbon Intensity	Lower (No liquefaction)	Higher (Energy-intensive liquefaction process)	Aligns with EU **"Green Taxonomy"** and carbon taxes.

Source: *Prepared by the author based on Oxford Institute for Energy Studies (2023) and Sonatrach Annual Financial Data (2024).*

Table 12 reveals the economic factors that grant Algeria a significant 'Price Advantage' in the European market. From a financial perspective, Algerian gas enjoys the lowest Landed Cost because the pipeline infrastructure eliminates the need for expensive Liquefaction and Regasification processes at ports—operations that alone can consume up to 25% of the gas's total value.

Furthermore, the element of 'Time' represents a decisive competitive edge. The ability of Algerian gas to reach European markets in less than 24 hours provides the Algerian supplier with 'Operational Flexibility' that LNG suppliers, who require up to two weeks of maritime transit, cannot match. This rapid delivery minimizes the risks associated with 'Spot Price Volatility' and ensures supply stability during peak demand periods. Consequently, Algerian gas functions as the 'Backbone' of energy security in the Mediterranean basin (International Energy Agency, 2024).

4.2Challenges and Constraints Hindering the Maximization of Algeria's Role:

We will expose the multifaceted challenges and structural constraints that hinder the maximization of Algeria's role as a global energy leader, focusing on the technical, financial, and geopolitical barriers that limit the optimal exploitation of its hydrocarbon potential.

4.2.1 The Growing Domestic Consumption Challenge vs. Exportable Surplus:

The expansion of Algeria's domestic energy demand represents a significant structural constraint on its capacity to maintain a consistent exportable surplus. Over the last decade, rapid urbanization, subsidized energy prices, and industrial growth have driven internal gas and electricity consumption to record levels. According to Sonatrach (2024), domestic natural gas consumption now accounts for nearly 50% of total national production, a sharp increase that directly reduces the volume available for international markets. This trend creates a 'Squeeze Effect' where the state must balance its social obligations of providing cheap energy to its citizens with its fiscal requirement for hydrocarbon export revenues.

Furthermore, Boussaid and Mansouri (2023) argue that the lack of energy efficiency policies and the persistence of heavy subsidies have encouraged wasteful consumption patterns, further straining the national energy balance. The International Energy Agency [IEA] (2024) warns that if current consumption trajectories continue without substantial investment in renewable energy or upstream production, Algeria's export capacity could face a critical decline by 2030. As noted in the World Bank (2024) report, this challenge is compounded by the natural depletion of mature fields like Hassi R'Mel, making the maximization of the exportable surplus a matter of national economic security. Consequently, shifting toward a more sustainable domestic energy mix is no longer a choice but a strategic necessity to preserve Algeria’s status as a global energy supplier.

The following table quantifies the widening gap between national gas production and the escalating domestic demand, highlighting the subsequent pressure on Algeria's export capacity:

Table 13: Algeria's Natural Gas Balance: Production vs. Domestic Consumption (2018–2024)

Year	Total Production (BCM)	Domestic Consumption (BCM)	Consumption Share (%)	Exportable Surplus (BCM)	Strategic Impact
2018	94.0	43.1	45.8%	50.9	High Export Stability
2020	81.5	44.5	54.6%	37.0	COVID-19 & Demand Peak
2022	102.7	49.3	48.0%	53.4	Post-Crisis Recovery
2024 (Est.)	105.0	54.2	51.6%	50.8	Structural Squeeze

Source: *Prepared by the author based on Sonatrach Annual Reports (2024) and IEA World Energy Statistics (2024).*

Table 13 reveals the 'Energy Squeeze' phenomenon currently facing Algeria. While the state endeavors to ramp up total production levels, the burgeoning domestic consumption—which has exceeded the 50% threshold in several years—is absorbing a significant portion of these incremental gains.

From a financial perspective, every billion cubic meter (BCM) consumed locally at subsidized prices represents a lost 'Opportunity Cost,' as these volumes could otherwise be exported at international market prices to generate vital hard currency reserves. This trend indicates that maximizing the exportable surplus does not only require increased Upstream production but also necessitates the adoption of rigorous domestic energy rationalization policies and a strategic shift toward renewable energy to liberate larger quantities of gas for export (Sonatrach, 2024).

4.2.2The Urgency of Accelerating New Discoveries to Ensure Long-term Supply Sustainability:

The sustainability of Algeria's role as a reliable energy supplier is increasingly dependent on the rapid acceleration of upstream exploration and the successful appraisal of new discoveries. As mature fields undergo natural depletion, the strategic necessity to de-risk frontier basins and exploit unconventional resources has become paramount. According to Sonatrach (2024), the national oil and gas company has intensified its investment in seismic data acquisition and drilling activities, aiming to reverse the production decline and bolster the nation's reserve replacement ratio. This shift is critical for maintaining the 'Contractual Reliability' that international partners, particularly in Europe, expect from the Algerian energy sector.

Furthermore, Boussaid (2023) emphasizes that the technical complexity of new offshore and deep-target onshore reservoirs requires the integration of advanced technologies and enhanced international partnerships. The International Energy Agency [IEA] (2024) notes that while Algeria possesses vast untapped potential, the window for monetizing these hydrocarbons is narrowing due to the global energy transition. Therefore, accelerating the 'Time-to-Market' for new discoveries—the period between the initial find and first production—is essential to capture market opportunities and secure fiscal stability. As highlighted by the Oxford Institute for Energy Studies (2023), without a continuous pipeline of new projects, the gap between domestic demand and export commitments could compromise Algeria's strategic leverage in the global energy power balance (World Bank, 2024).

To illustrate the correlation between intensified exploration activities and the strategic goal of reserve renewal, the following table summarizes Algeria's recent discovery performance and its technical requirements:

Table 14: Exploration Dynamics and Reserve Replacement in Algeria (2019–2024)

Year	Number of New Discoveries	Main Resource Type	Strategic Objective	Technology Requirement
2019	10	Gas / Condensate	Offset mature field depletion	Standard 2D/3D Seismic
2021	18	Oil / Gas	Bolster exportable surplus	Advanced Imaging
2022	15	Gas	Fast-track supply to Europe	High-pressure drilling
2023	20+	Gas / Oil	Frontier basin expansion	Digital Oilfield Tech
2024 (Plan)	Intensive Drilling	Unconventional / Offshore	Long-term sustainability	Horizontal Drilling / Fracking

Source: *Prepared by the author based on Sonatrach Annual Reports (2024) and Ministry of Energy and Mines Statistical Bulletins.*

Table 14 reflects the intensive efforts undertaken by the Algerian state to accelerate the pace of new discoveries, noting a qualitative leap in the number of successful finds starting from 2021. However, the true strategic challenge lies not merely in the 'quantity' of discoveries, but in the Reserve Replacement Ratio (RRR).

From a strategic standpoint, these new discoveries in unconventional plays and Frontier Basins aim to bridge the gap resulting from the natural depletion of major legacy fields. As illustrated in the table, the transition toward exploring more complex reservoirs necessitates the attraction of foreign technology through international partnerships. This is vital to minimize the 'Time-to-Market'—the duration between the initial discovery and the commencement of actual production (First Oil/Gas)—which serves as a fundamental guarantee for the sustainability of long-term supply contracts with international partners (Sonatrach, 2024).

4.3Future Vision (Towards Continental Energy Integration):

This section outlines a forward-looking perspective on Algeria's strategic ambition to foster continental energy integration. It examines the pivotal role of cross-border infrastructure projects and regional partnerships in positioning Algeria as a central energy hub that links African resources with European demand, thereby enhancing regional stability and collective economic growth.

4.3.1 The Trans-Saharan Gas Pipeline (TSGP) Project as a Solution for European Energy Security:

The Trans-Saharan Gas Pipeline (TSGP) stands as a monumental strategic initiative designed to transport natural gas from Nigeria, through Niger, to Algeria's Mediterranean coast, and subsequently to the European market. Spanning approximately 4,128 kilometers, the TSGP is projected to deliver up to 30 billion cubic meters (BCM) of gas annually, positioning Algeria as a critical 'Energy Corridor' for the European Union. According to Hadj-Moussa (2023), the project offers a viable alternative to European energy dependency on single-source suppliers, enhancing the continent's 'Energy Security' through the diversification of transit routes and source basins. This

infrastructure leverages Algeria's existing pipeline network—specifically the Medgaz and Transmed—to ensure the efficient flow of Sub-Saharan gas to Southern Europe.

Furthermore, the International Energy Agency [IEA] (2024) emphasizes that the TSGP is not merely a technical project but a geopolitical stabilizer for the Sahel-Sahara region. By creating a shared economic interest between Nigeria, Niger, and Algeria, the pipeline fosters regional integration and industrial development. As highlighted by Boussaid (2023), the financial viability of the TSGP has been revitalized by the European Union's urgent need for stable 'Long-term Supply Contracts' following the global energy crisis of 2022. The World Bank (2024) reports that this project could transform West Africa's energy landscape, while simultaneously solidifying Algeria's status as a 'Strategic Hub' that guarantees a steady and secure energy supply to the EU in alignment with its energy transition goals (Oxford Institute for Energy Studies, 2023).

The following table summarizes the technical dimensions and strategic impacts of the TSGP project, illustrating its potential to redefine the energy map between Africa and Europe:

Table 15: Technical and Strategic Specifications of the Trans-Saharan Gas Pipeline (TSGP)

Feature	Specification / Value	Strategic Significance for Europe & Algeria
Total Length	~ 4,128 km	Links the Gulf of Guinea directly to the Mediterranean.
Annual Capacity	30 Billion Cubic Meters (BCM)	Capable of meeting ~10% of total EU gas import needs.
Route Path	Nigeria → Niger → Algeria	Strengthens Algeria's role as a "Regional Energy Hub."
Estimated Cost	$13 - $20 Billion	A high-yield investment backed by global energy demand.
Existing Infrastructure	Utilizes Medgaz & Transmed	Reduces "Time-to-Market" and overall capital expenditure.
Economic Impact	Job creation & Transit fees	Provides Algeria with sustainable non-tax revenue (Transit).

Source: Prepared by the author based on *The New Partnership for Africa's Development (NEPAD, 2023)* and *Sonatrach Strategic Planning Division (2024).*

Table 15 illustrates the technical and strategic pillars that render the Trans-Saharan Gas Pipeline (TSGP) an indispensable project for European energy security. Quantitatively, the pipeline's annual capacity of 30 Billion Cubic Meters (BCM) is sufficient to cover a significant portion of the energy deficit in Europe resulting from current geopolitical crises.

From a financial and operational perspective, the advantage of 'Strategic Integration' is evident; Algeria leverages its existing infrastructure—namely the Medgaz and Transmed pipelines—to transport gas from Nigerian fields to European shores. This approach significantly reduces Capital Expenditure (CAPEX) and accelerates the 'Time-to-Market' for these energy volumes. Consequently, this project transforms Algeria from a traditional exporter into a 'Continental Energy Artery,' granting it substantial geopolitical leverage in the international energy market (Sonatrach, 2024).

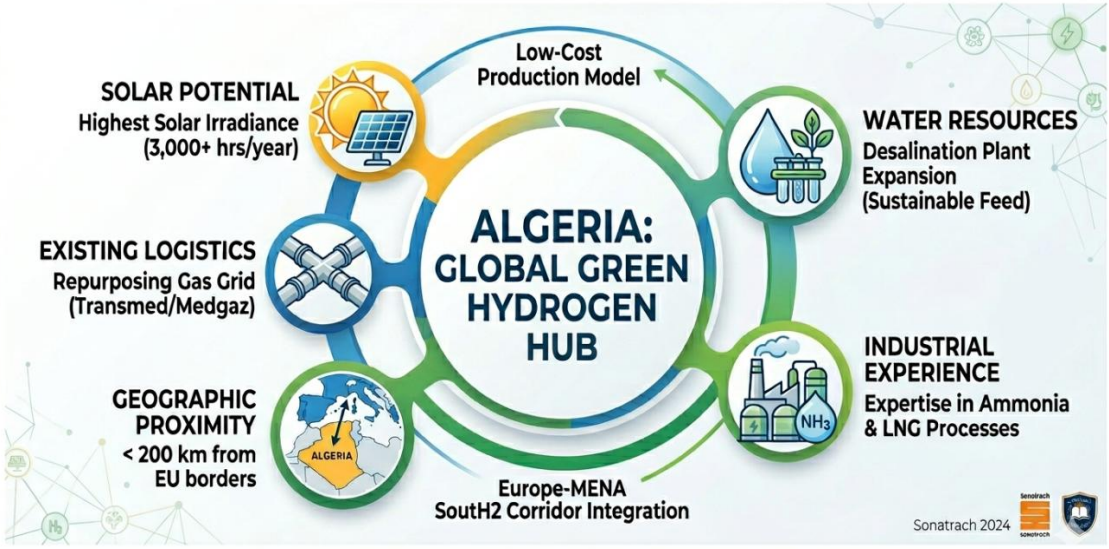
4.3.2 Energy Transition Prospects: Leveraging the Gas Grid for Green Hydrogen Logistics

Algeria is uniquely positioned to become a global leader in the green hydrogen economy, leveraging its vast solar potential and, more crucially, its extensive existing natural gas infrastructure. The strategic repurposing of the current pipeline network—such as the Transmed and Medgaz—for hydrogen blending or dedicated transport represents a cost-effective logistical solution for reaching European markets. According to Hadj-Moussa (2024), using existing grids can reduce the capital investment required for hydrogen logistics by up to 40% compared to building new dedicated infrastructure. This transition aligns with the 'SoutH2 Corridor' initiative, which aims to connect North Africa to Germany, Austria, and Italy.

The International Energy Agency [IEA] (2024) highlights that Algeria's geographical proximity to the European Union, combined with its high solar irradiance, makes its green hydrogen production costs among the most competitive globally. Furthermore, Boussaid (2024) argues that integrating green hydrogen into the national energy mix is a dual-purpose strategy: it decarbonizes the domestic industrial sector while preserving Algeria's status as a primary energy partner for the EU in a post-fossil fuel era. As noted in the World Bank (2024) report, the success of this vision depends on establishing clear regulatory frameworks and securing international technology transfer to master hydrogen electrolysis and storage at scale (Oxford Institute for Energy Studies, 2023).

To provide a comprehensive visualization of the factors driving Algeria's future energy strategy, the following diagram synthesizes the core competitive advantages that facilitate the transition toward a green hydrogen economy:

Figure 1. Algeria's integrated ecosystem of competitive advantages in the green hydrogen sector.



Source: Prepared by the author based on IRENA (2024) and National Hydrogen Roadmap (2024).

As illustrated in Figure 1, Algeria's transition towards a green hydrogen economy is underpinned by five core pillars. The synergy between high solar irradiance and the strategic repurposing of existing gas infrastructure provides a significant reduction in both production and logistical costs. This positions the country as an indispensable energy partner for the European Green Deal (Boussaid, 2024).

5. CONCLUSION :

In conclusion, this study, which sought to analyze the strategic position of the Algerian supplier amidst the structural shifts in global energy security (2024–2026), demonstrates that the concept of supply security is no longer merely linked to production abundance; rather, it has become contingent

upon the efficiency and safety of logistical routes. The study has proven that Algeria possesses geospatial assets that enable it to overcome global supply chain shocks and achieve continental energy sovereignty."

Study Findings:

The study arrived at several key findings, summarized as follows:

- The study confirms that the Algerian pipeline network serves as the most secure and stable alternative to mitigate maritime chokepoint risks, effectively reducing Risk Premiums and global insurance costs.
- The findings highlight that Algeria's historical commitment to long-term contracts has reinforced its position as a reliable strategic partner amidst the sharp volatility of Spot Market prices between 2024 and 2026.
- The research concludes that national energy infrastructure possesses high "geospatial flexibility" and technical readiness, allowing for future repurposing to export green hydrogen as a strategic sustainability option.
- The study affirms that the Trans-Saharan Gas Pipeline (TSGP) project establishes Algeria's role as a pivotal regional Hub, linking African resources to European demand centers under full national sovereignty.

Study Recommendations:

The study concluded with the following recommendations:

- Intensify diplomatic and economic efforts to accelerate the completion of the TSGP to ensure leadership in energy flows from Sub-Saharan Africa toward the European continent.
- Immediately initiate technical upgrades to the national pipeline grid to align with international standards for transporting green hydrogen and clean ammonia within the energy transition roadmap.
- Invest in smart monitoring systems and cybersecurity to protect vital supply routes from escalating hybrid geopolitical threats.
- Develop hybrid contractual models that combine the stability of long-term agreements with modern pricing flexibility to maintain the Algerian supplier's market share globally.
- Integrate oil and gas ports with the pipeline network to create a dual logistical system capable of navigating all global supply chain disruption scenarios.

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