

The Geopolitical and Legal Implications of Global Energy Security Volatility for Algeria

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Abstract:

This study analyzes Algeria's energy transition in light of its international legal obligations regarding climate change and energy security. As a hydrocarbon-reliant state, Algeria faces the dual challenge of preserving energy sovereignty while fulfilling its commitments under the Paris agreement. The research explores legal and institutional reforms, including constitutional changes and national legislation promoting sustainable energy. It also examines Algeria's nationally determined contribution (NDC) and its efforts in deploying renewable energy and green hydrogen. The findings reveal that Algeria's energy transition is increasingly influenced by international climate governance and the need for legal coherence.

Keywords: energy transition, climate law, algeria, international law, renewable energy, NDC.

1-Introduction:

In the twenty-first century, energy security has emerged as a pivotal geostrategic and legal concern within the international system. The volatility of global oil and gas markets—aggravated by geopolitical instability, climate-induced regulatory shifts, and technological disruptions—has transformed energy from a mere commodity into an instrument of international power projection and legal contestation. For energy-exporting states, particularly those whose fiscal stability is overwhelmingly dependent on hydrocarbon rents, the oscillation of global energy prices constitutes not only an economic hazard but a multidimensional legal and policy dilemma. The international legal architecture governing energy flows—rooted in fragmented treaties, investment frameworks, and principles of state sovereignty often fails to provide coherent mechanisms of stabilization in the face of such disruptions¹.

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¹ R. Leal-Arcas, and A. Filis, "The Fragmented Governance of the Global Energy Economy: A Legal-Institutional Analysis," *Journal of World Energy Law and Business* 6, no. 4 (2013).

Within this precarious configuration, Algeria stands as a paradigmatic example of a resource-dependent economy navigating the asymmetries of global energy volatility. Hydrocarbon exports account for an estimated 98% of Algeria's total exports, contributing to 35% of its GDP and approximately 62% of government revenues². The 2014 oil price collapse and subsequent market instabilities starkly exposed Algeria's structural vulnerabilities, engendering fiscal deficits and constraining public expenditure. In response, Algerian policymakers initiated legal reforms aimed at promoting energy diversification, notably through Law No. 04-09 of 14 August 2004, which provides a legislative framework for the promotion of renewable energy within the paradigm of sustainable development³. However, the extent to which such domestic laws can effectively shield the country from exogenous energy shocks—absent robust international legal support mechanisms—remains subject to critical scrutiny.

- **Research Problem**

How does global energy market volatility affect Algeria's economic and legal stability, and what international and domestic legal instruments can be leveraged to mitigate its impact?

- **Research Objectives**

This study seeks to interrogate the nexus between international energy law and Algeria's legal response to energy market volatility. Specifically, it aims to: (1) critically examine the repercussions of global energy price fluctuations on Algeria's macroeconomic and legal stability; (2) evaluate the effectiveness and adaptability of Algeria's national energy legislation; and (3) propose legally grounded strategies to enhance Algeria's energy security within a fluctuating international regime.

- **Research Significance**

While existing literature has extensively examined Algeria's economic dependency on hydrocarbons, insufficient scholarly attention has been accorded to the legal dimension of energy vulnerability—particularly within the framework of international energy law. This research fills that lacuna by integrating doctrinal legal analysis with empirical evaluation, thereby contributing to a nuanced understanding of Algeria's juridical posture in the global energy order.

- **Research Methodology**

This article adopts a qualitative, doctrinal and descriptive–analytical methodology. It relies primarily on the interpretation of international legal instruments related to energy security and climate change (such as the UNFCCC, Kyoto Protocol and the Paris Agreement), as well as Algerian constitutional and statutory provisions governing hydrocarbons and renewable energy (notably Laws No. 19-13 and 04-09). These legal sources are complemented by official economic and energy data (Bank of Algeria, OPEC and national

² M. Ouki, *Algerian Gas in Transition: Domestic Transformation and Changing Gas Export Potential* (2019).

³ S. Abado, and S. Khennas, "Algeria Beyond Oil and Natural Gas: Challenges and Options," in *The Politics of Algeria* (Routledge, 2019).

institutions) in order to assess the concrete impact of global energy price volatility on Algeria. The study combines normative legal analysis with an empirical reading of statistical indicators and, where appropriate, draws limited comparative insights from other hydrocarbon-exporting states to contextualize Algeria's experience.

- **Structure of the Study**

This research unfolds across four interlinked sections. The first delineates the conceptual underpinnings and normative contours of energy security in international law. The second provides a structural diagnosis of Algeria's energy sector, underscoring its fiscal reliance on hydrocarbons. The third explores the impact of global energy volatility on Algeria's economic-legal apparatus. The final section evaluates the domestic legal framework and its alignment with international legal standards, culminating in a set of policy and legislative recommendations.

- **Previous studies**

The study by (Zemri & Khetib, 2024)⁴ addresses the concept of state responsibility in the context of environmental degradation. The research explores the extent to which international law holds states accountable for cross-border environmental harm. The findings emphasize that environmental protection has gradually evolved into a shared international responsibility, reinforced by customary international law and multilateral agreements. The study further examines Algeria's engagement in multilateral environmental frameworks and highlights its legal and ethical obligations to contribute to the global climate governance structure. Another study by addresses the key question of how Algeria can reconcile its economic dependency on fossil fuel exports with international commitments to decarbonization and sustainable development. It concludes that the strategic adoption of clean energy technologies and legislative reforms are essential not only to safeguard national energy security but also to honor Algeria's obligations under the Paris Agreement and related international legal frameworks.

The study by (Roknia & Boubchiche, 2025)⁵ explores how Algeria has aligned its national legal instruments with its obligations under the United Nations Framework Convention on Climate Change (UNFCCC). The central research problem lies in assessing the legislative harmonization between domestic environmental law and Algeria's ratification of international climate agreements. The study finds that Algeria has progressively incorporated climate-related commitments, particularly those stemming from the Paris Agreement, into its legislative framework. These legal adjustments reflect a growing willingness to fulfill international obligations, especially concerning emissions reduction and environmental protection.

⁴ Bouazza Elamine Zemri, and Sidi Mohamed Boumediene Khetib, "Can Sustainable Economic Development Curtail Carbon Dioxide Emissions? Insights from Algeria's Industry," *Gospodarka Narodowa. The Polish Journal of Economics* 319, no. 3 (2024).

⁵ S. Roknia, and R. Boubchiche, "Regional Cooperation to Address the Effects of Climate Change: Algeria's Role in North Africa," *إفانق للعلوم* 10, no. 2 (2025).

Another relevant contribution is the paper by (Bergougui & Meziane, 2025)⁶ investigates the normative development of environmental rights within both global and national contexts. The primary question addressed is how Algeria has embedded the right to a healthy environment in its legal system in line with international legal standards. The research demonstrates that Algerian constitutional and environmental reforms increasingly reflect global norms, reinforcing the legal obligation to protect the environment as a fundamental human right. These developments illustrate the convergence between international environmental law and domestic legislative priorities.

To study this topic and attempt to cover all its aspects, we will follow the descriptive analytical approach by analyzing and describing most of the global energy fluctuations and their impact on energy security in Algeria.

2- The Concept of Energy Security

2-1 Historical and Theoretical Foundations

The conceptualization of energy security has undergone a profound evolution over the decades. Originally, the term was framed narrowly, focusing solely on the uninterrupted supply of fossil fuels to support industrial economies. Its meaning broadened significantly following the oil crises of the 1970s, which demonstrated that disruptions in energy supply could destabilize not only economies but also national security architectures⁷. These crises prompted governments and international organizations to reassess the legal and policy structures underpinning energy access, driving a shift from mere resource availability to considerations of geopolitical stability, economic resilience, and environmental sustainability.

From a theoretical perspective, energy security is now understood as a multidimensional construct. It encompasses the diversification of energy sources to reduce dependency on a single supplier, the creation of robust supply chains that are resilient to shocks, and the promotion of renewable energy to mitigate environmental impacts. These dimensions are further reinforced by the legal frameworks that govern state conduct and international cooperation, making energy security not only an economic and technical concern but also a critical legal and policy domain.

2-2 Sovereignty over Natural Resources and Its Implications for Energy Security

Permanent sovereignty over natural resources is a principle that lies at the heart of energy security discourse. It asserts the right of states to control and exploit their natural wealth, including energy reserves. However, this sovereign right is tempered by several obligations under international law. For instance, states must ensure that their exploitation of resources does not cause transboundary harm, in line with customary international law and

⁶ Brahim Bergougui, and Said Meziane, "Assessing the Impact of Green Energy Transition, Technological Innovation, and Natural Resources on Load Capacity Factor in Algeria: Evidence from Dynamic Autoregressive Distributed Lag Simulations and Machine Learning Validation," *Sustainability* 17, no. 5 (2025).

⁷ M. K. Kahn, "Detente with Nature: The Politics of Energy Extraction and Environmental Protection, 1969-1980" (Northwestern University, 2016).

various environmental treaties. They are also encouraged to engage in equitable resource-sharing arrangements with neighboring states when resources span international boundaries.

The principle of sovereignty also intersects with sustainable development goals, which require states to balance economic growth with environmental protection. This balance is particularly relevant to energy security as the global community transitions toward greener energy solutions . While states retain control over their resources, the international legal framework increasingly pressures them to adopt policies that are environmentally sound, socially inclusive, and economically equitable. In this sense, sovereignty is not an absolute barrier but a platform for engaging in cooperative and legally sound resource management strategies that enhance both national and global energy security.

2-3 Multilateral Legal Frameworks Governing Energy Security

The legal infrastructure supporting energy security is characterized by a series of multilateral agreements and institutions designed to stabilize markets, protect investments, and ensure sustainable resource use. One of the most comprehensive is the Energy Charter Treaty (ECT), which establishes legal principles for the transit of energy, the protection of foreign investments, and the resolution of disputes. The ECT underscores the importance of transparency, non-discrimination, and fair treatment in the global energy market, thereby reducing legal uncertainties and fostering stable energy supplies . In addition to the ECT, the United Nations Convention on the Law of the Sea (UNCLOS) contributes significantly to the legal framework of energy security. UNCLOS sets out rules for maritime zones, granting coastal states exclusive rights to explore and exploit resources within their exclusive economic zones. At the same time, it imposes obligations to protect the marine environment and prevent pollution from resource extraction activities. This dual mandate ensures that the pursuit of energy security does not come at the expense of environmental sustainability.

Other legal instruments, such as the Paris Agreement, indirectly influence energy security by encouraging states to adopt renewable energy technologies and reduce reliance on carbon-intensive fuels. While the Paris Agreement is primarily a climate treaty, its implementation promotes energy diversification and resilience—key components of energy security. In essence, the multilateral legal framework for energy security is both complex and dynamic, reflecting the interconnected nature of energy markets, environmental challenges, and international law ⁸.

3- The Structure and Dynamics of the Energy Sector in Algeria

The energy sector in Algeria constitutes the cornerstone of the country's economic system, serving as the primary engine of fiscal consolidation, industrial development, and geopolitical relevance . Characterized by vast hydrocarbon reserves and immense renewable energy potential, Algeria occupies a strategic position in both regional and global energy

⁸ Esmat Zaidan, and Imad Antoine Ibrahim, "Achieving Energy Justice: The Role of Supervisory and Compliance Mechanisms in Global Frameworks and the International Community," *Energy Strategy Reviews* 52 (2024).

markets. This section presents a comprehensive and critically detailed account of Algeria's energy matrix, encompassing both non-renewable and renewable energy resources, institutional infrastructure, legislative frameworks, investment strategies, and the multifaceted challenges impeding the sector's sustainability.

3-1 Non-Renewable Energy Resources: Dominance and Structural Dependence

Algeria's energy landscape is historically and structurally dominated by fossil fuels, particularly crude oil and natural gas. The country is home to the third-largest proven oil reserves in Africa and the tenth-largest reserves of natural gas globally. As of 2024, oil accounts for nearly 90% of the nation's total export revenues and contributes over 40% to the GDP⁹.

- Crude Oil: Algeria's crude oil production fluctuates around 1.2 to 1.5 million barrels per day, positioning the country as a mid-tier OPEC member. The sector is managed primarily by the state-owned enterprise Sonatrach, which oversees exploration, production, refining, and export logistics. Despite being a mature producer, Algeria continues to expand its upstream activities, leveraging Enhanced Oil Recovery (EOR) techniques and entering into production-sharing agreements with foreign firms to access deep reserves and marginal fields. As aptly noted by Daniel Yergin, oil is "10% economics and 90% politics," a formulation that rings true in Algeria's context where the strategic deployment of hydrocarbon rents serves both developmental and political objectives¹⁰. Nonetheless, the economy's overdependence on oil revenues exposes it to acute vulnerabilities triggered by international price volatility, technological disruption, and shifts in global demand patterns, particularly in the post-COVID green transition era.

- Natural Gas: Algeria's natural gas sector is even more significant in terms of both production and exports. With an annual production exceeding 100 billion cubic meters and massive investments in liquefaction facilities (notably at Skikda and Arzew), Algeria is a key supplier to Southern Europe. The TransMed, Medgaz, and GALSI pipelines provide direct conduits to Italy and Spain, reinforcing Algeria's geopolitical leverage. Despite the sector's strategic significance, it faces infrastructural obsolescence, declining well productivity, and mounting competition from LNG exporters. Moreover, the domestic consumption of natural gas has surged due to state-subsidized pricing, which undermines export potential and exacerbates energy inefficiency. The gas sector's long-term viability necessitates substantial capital injection, regulatory reform, and pricing rationalization.

3-2 Renewable Energy Potential: Latent Capacities and Strategic Imperatives

In parallel with its fossil fuel wealth, Algeria is endowed with exceptional renewable energy resources, particularly solar and wind. Given the global decarbonization agenda and

⁹ B. Weber, "The Eu External Energy Governance and the Neighbouring Gas Suppliers Azerbaijan and Algeria" (Université Paris, 2016).

¹⁰ Nikolaus Supersberger et al., "Algeria—a Future Supplier of Electricity from Renewable Energies for Europe?," *Wuppertal Institute for Climate, Environment and Energy, Wuppertal, Germany and CREAD, Algiers* (2010).

Algeria's commitment to the Paris Agreement, the diversification of its energy portfolio has transformed from an ecological preference into a legal and strategic necessity.

- Solar Energy: Algeria possesses some of the world's most favorable solar irradiation indices. With over 3,500 hours of sunlight annually in the southern highlands and Sahara, and an average daily solar energy potential exceeding 5 kWh/m², the country is poised to become a solar powerhouse. The Algerian Renewable Energy and Energy Efficiency Program (RENEEP) aims to generate 22 GW of electricity from renewable sources by 2030, with the majority from solar PV and concentrated solar power (CSP) ¹¹. Two primary technologies dominate the solar domain: photovoltaic systems that convert sunlight directly into electricity and CSP systems that use mirrors or lenses to focus sunlight for turbine-based generation. While pilot projects have been initiated in Ghardaïa and Adrar, the full exploitation of this resource remains constrained by high capital costs, weak institutional coordination, and regulatory fragmentation.

- Wind, Hydropower, Biomass, and Geothermal Resources: Wind energy has demonstrated strong regional viability. Locations such as Tindouf, Adrar, and El Bayadh experience wind speeds exceeding 6 m/s, making them suitable for wind energy projects. However, technical issues related to intermittency and grid capacity remain obstacles. Hydropower constitutes a minor yet historically relevant component of Algeria's energy mix.

Table N°1. The principal hydropower stations and their installed capacities

Station	Capacity (MW)	Station	Capacity (MW)
Mansouria	100.0	Derguina	71.5
Aghil M'da	24.0	Oued El Fodda	15.6
Arguin	16.0	Ghrib	7.0
Gouraya	6.4	Tizi Medina	4.6
Siouq El Djemaa	8.1	Bouhanifia	5.7
Tisseala	4.2	Azerrane Chbel	2.7

Source: Bank of Algeria 2021

Biomass resources, though underutilized, present significant potential. Algeria's forests span approximately 2.5 million hectares, contributing an estimated theoretical energy potential of 37 million tons of oil equivalent (Mtoe), with an effective recovery rate of around 10%. Urban and agricultural waste adds approximately 5 million tons annually, corresponding to a potential of 1.33 Mtoe. Geothermal energy is another emerging avenue, with over 200 hot springs identified across northern Algeria, some reaching temperatures up to 96°C,

¹¹ Abado, and Khennas, in *The Politics of Algeria*.

particularly in Guelma. The total estimated geothermal capacity stands at 700 MW, especially in southern geothermal basins such as the Albian aquifer¹².

2.3 Legal and Institutional Architecture

The Algerian energy sector operates under a complex legal and institutional framework. The foundational law governing hydrocarbons is Law No. 19-13 (December 2019), which revises the previous Hydrocarbon Law No. 05-07. The revised law provides incentives for foreign investment, introduces cost recovery mechanisms, and delineates the roles of ALNAFT (the national hydrocarbon agency) and ARH (the regulatory authority for hydrocarbons). In the renewable energy domain, the legal reference is Law No. 04-09 of August 14, 2004, which articulates Algeria's strategic orientation toward sustainable energy development. The National Program for Renewable Energies (PNER) further establishes a roadmap for expanding renewable capacity and integrating energy efficiency norms into public policy. Despite these advancements, legal ambiguity, bureaucratic inertia, and inconsistent policy implementation remain significant barriers to effective energy governance. The dichotomy between centralized control and the need for market liberalization creates a regulatory tension that inhibits investor confidence and technological innovation.

2.4 Energy Consumption Trends and Structural Shifts

Energy consumption in Algeria has witnessed a substantial upward trajectory since the 1980s, increasing from 13.9 million tons of oil equivalent (Mtoe) in 1980 to over 58 Mtoe by 2018. This growth reflects Algeria's demographic expansion, urbanization, industrialization, and improved living standards.

Table N°2. The final energy consumption across various sectors

Year	Non-Energy Industry Use (ktoe)	Energy Industry Consumption (ktoe)	Final Consumption (ktoe)	Losses (ktoe)	Total Consumption (ktoe)
2000	1,930	7,288	18,300	2,741	29,995
2005	2,040	7,023	24,437	2,320	35,156
2010	2,185	6,234	31,650	3,293	43,362
2015	4,330	7,841	42,458	3,890	58,265
2018	4,586	7,750	48,146	3,690	58,341

Source: Bank of Algeria 2021

¹² Bouazza Elamine Zemri, "Green Growth in Algeria: Balancing Industry and Environment for Sustainable Economic Development," *Dirassat Journal Economic Issue* 15, no. 1 (2024).

As shown in Table 2, final energy consumption is mainly composed of natural gas and electricity, which together represent nearly 70% of total final demand. The sectoral breakdown is as follows:

- Households and services: 46.7%
- Transport: 30.6%
- Industry and public works: 22.7%

This consumption pattern underlines the criticality of demand-side management, especially in residential and transport sectors. The adoption of tiered pricing systems by Sonelgaz and the promotion of energy efficiency practices are pivotal in mitigating the burden on national energy resources.

2.5 Investment Flows and Strategic Outlook

Investment in Algeria's energy sector exceeded USD 9 billion in 2023, with a substantial portion allocated to upstream oil and gas exploration. Nevertheless, renewable energy projects attract less than 10% of total energy investments, reflecting a risk-averse financial climate and policy incoherence¹³.

Looking forward, Algeria's strategic challenge lies in recalibrating its energy model to reconcile export dependency with domestic needs, fossil fuel revenues with green transition goals, and state sovereignty with international collaboration. The country must prioritize the liberalization of energy markets, the reinforcement of legal safeguards for investors, the expansion of transmission infrastructure, and the development of local manufacturing capacities for renewable technologies. The Algerian energy sector embodies both profound potential and structural rigidity. It is at a critical juncture where policy foresight, legal reform, and investment strategy must converge to ensure energy sovereignty, environmental sustainability, and economic resilience in an increasingly uncertain global energy landscape.

3. The Volatility of Global Energy Prices and Its Implications for Algeria

3.1 The Impact of Global Energy Price Volatility on Algeria

The global energy market has witnessed unprecedented volatility over the last two decades, driven by an intricate web of geopolitical disruptions, economic crises, technological shifts, and environmental constraints. Algeria, as a rentier state heavily dependent on hydrocarbon revenues, is particularly vulnerable to the shocks induced by fluctuating oil and gas prices. The country's macroeconomic stability, fiscal planning, social programs, and infrastructure investments are intrinsically linked to the performance of the global energy market. Algeria's energy exports account for more than 95% of total exports and approximately 60% of government revenues (OPEC, 2022). Thus, even minor shifts in international oil prices can reverberate across its entire economic architecture. For instance, the oil price collapse between 2014 and 2016—when Brent crude plummeted from over \$100

¹³ Keshav Bhattarai, and Mahmoud Yousef, "Petroleum Resources and Energy Transitions in the Mena Region: Geopolitical and Economic Implications," in *The Middle East: Past, Present, and Future* (Springer, 2025).

per barrel to under \$30—forced Algeria to draw heavily from its foreign reserves, which declined from \$194 billion in 2013 to less than \$45 billion by the end of 2020 .

The COVID-19 pandemic and the subsequent economic slowdown exacerbated these vulnerabilities. In 2020 alone, hydrocarbon revenues fell by over 40%, prompting the government to resort to unconventional financing and halt numerous public investment programs (Ministry of Finance, 2021).

Table N°.3: Algeria's Hydrocarbon Export Revenues and Foreign Reserves (2010–2020)

Year	Oil Price (Brent avg., USD)	Hydrocarbon Revenues (USD bn)	Foreign Reserves (USD bn)
2010	79.5	57.4	162.2
2013	108.6	63.1	194.0
2016	43.7	27.3	114.1
2020	41.9	20.2	44.9

Source: Bank of Algeria 2021

The data presented in Table 3 encapsulates the deep structural vulnerability of the Algerian economy to international hydrocarbon price fluctuations. A cursory glance reveals a direct and proportional relationship between Brent crude prices, export revenues from hydrocarbons, and the state's foreign reserve holdings. This tripartite dependency reflects the rentier nature of Algeria's fiscal architecture; whereby public finance remains overwhelmingly reliant on volatile global commodity markets.

Between 2010 and 2013, Algeria experienced a windfall period characterized by high oil prices averaging USD 108.6/barrel, which corresponded to peak hydrocarbon revenues of USD 63.1 billion and a record USD 194 billion in foreign reserves. This era of abundance reinforced a public finance model built around expansive subsidies, social spending, and limited diversification. However, the subsequent collapse in oil prices to USD 43.7 in 2016—triggered by global oversupply and geopolitical shifts—resulted in hydrocarbon revenues dropping by more than 56%, and foreign reserves deteriorating by over 41% within just three years¹⁴. The data for 2020 further accentuates this trend, as the dual shock of the COVID-19 pandemic and oil market contraction saw oil revenues drop to a mere USD 20.2 billion, while reserves plummeted to USD 44.9 billion—a critical threshold for external solvency.

From a legal-policy perspective, this table evidences the urgent need to reconceptualize Algeria's energy governance framework. The pronounced volatility in revenues impairs long-term fiscal planning and renders existing energy sector legislation (e.g., Law 19-13, Law 04-09) insufficient if not coupled with a dynamic legal regime capable of absorbing external shocks. Algeria's Constitution (as amended in 2020) defines energy resources as part of national public patrimony, with the state entrusted to guarantee their

¹⁴ Bhattarai, and Yousef, in *The Middle East: Past, Present, and Future*.

rational exploitation. Yet, this normative commitment remains undermined by inadequate economic buffering mechanisms, as evident from the dramatic depletion of reserves without any legal thresholds or “fiscal stabilization clauses” embedded in budgetary law to preserve intergenerational equity.

3.2: Algeria’s Energy Transition Policy and Global Energy Security

3.2.1 Evolution of Algeria’s Energy Transition Policy

Historically reliant on rentier economic models centered on hydrocarbon exports, Algeria was relatively late in adopting an energy transition policy. However, various internal and external developments have increasingly necessitated a shift toward renewable and sustainable energy systems. These developments include¹⁵:

- Decline in hydrocarbon exports post-2007 due to production decreases and growing domestic energy consumption.
- Fluctuating hydrocarbon revenues amid international market instability.
- Intergenerational equity and the need for sustainable development.
- Alignment with international environmental commitments.

Phases of Evolution:

Phase I: Pre-2016

- Mid-1980s: Establishment of APRUE and CDER.
- Late 1990s-2000s: Limited decentralised solar projects (e.g., Solaire Balisage).
- 2011: Launch of PNEREE aiming for 40% renewable electricity by 2030. However, it was overly ambitious, targeting 22,000 MW (10,000 MW for export) and requiring approximately \$20 billion.
- 2015: Program updated to reflect reduced renewable costs, focusing on solar photovoltaics.

Phase II: Post-2016

- 2016: Introduction of the "New Growth Model" emphasizing energy efficiency and diversification.
- 2020: Government Action Plan prioritized energy transition, targeting 15,000 MW of renewables by 2035 and energy efficiency measures (building insulation, LED lighting, conversion of vehicles to LPG/CNG).
- 2020: Creation of the Ministry of Energy Transition and inclusion of energy resources in constitutional amendments.

Legal and Institutional Framework:

- Laws such as 09-04 (renewable energy promotion) and 09-09 (creation of national energy transition funds).
- Establishment of institutions: CEREF, SKTM, NEAL, CREDEG, CRTSE, and specialized research centers.

¹⁵ Youcef Himri et al., "Overview of the Role of Energy Resources in Algeria’s Energy Transition," *Energies* 15, no. 13 (2022).

Incentives:

- Allocation of 1% of royalties to renewable energy funds.
- Guaranteed purchase tariffs.
- Fiscal incentives for energy-saving equipment.

3.2.2 Centrality of Natural Gas in the Energy Transition Strategy

Natural gas plays a pivotal role in Algeria's transitional energy matrix. Its strategic positioning is based on¹⁶:

a. Improving Energy Efficiency & Reducing Emissions:

- Natural gas offers a cleaner-burning alternative compared to coal and oil, thereby lowering greenhouse gas emissions.
- Algeria's 2011 energy efficiency program targets key sectors (building, transport, industry).

b. Gas-Solar Hybridization:

- Algeria's SPPI station at Hassi R'mel, operational since 2011, combines solar power and gas to produce 150 MW, with 20% solar input. This hybrid model enhances reliability and reduces emissions.
- The high cost of concentrated solar power (CSP) makes gas-solar hybridization a cost-effective alternative.

c. Gas as a Feedstock for Hydrogen:

- Algeria's gas infrastructure is an asset for developing blue hydrogen via carbon capture and storage (CCS).
- Potential for green hydrogen using renewables. Studies estimate integration of hydrogen into gas turbines up to 30% by 2050.
- Algeria can leverage its gas pipelines for hydrogen exports to Europe.

d. Strategic Export Positioning:

- Post-Ukraine crisis, Europe seeks alternative suppliers to Russian gas, reviving Algeria's role as a major gas exporter (over 11% of Europe's supply).
- However, this raises a dilemma: should Algeria prioritize short-term fossil fuel revenues or long-term decarbonization?

3.2.3 Gradual Shift Toward Renewable Energies and Green Hydrogen

Algeria has developed multiple strategic programs to support its renewable agenda:

- Renewable Energy Programs:

- **2011:** Initial program aimed to reach 22,000 MW by 2030 (12,000 MW domestic, 10,000 MW export).
- **2015 Revision:** Emphasis on PV, with goal to meet 27% of electricity needs from renewables by 2030.

¹⁶ Azzedine Layachi, "The Changing Geopolitics of Natural Gas: The Case of Algeria," *Work Pap., Belfer Cent., Harv. Univ., Cambridge, MA/Baker Inst., Rice Univ., Houston, TX.* <http://www.bakerinstitute.org/media/files/Research/5b21ebcc/CES-pub-GeoGasAlgeria-110113.pdf> (2013).

- **2020 Action Plan:** Target of 16,000 MW by 2035, with 1,000 MW off-grid by 2030.
 - **Key Projects:**
 - 24 solar PV stations (2014-2022), totaling 354.1 MW.
 - 10.2 MW wind station.
 - Hybrid plant at Hassi R'mel.
 - TAFOUK project (2020): 4,000 MW of solar PV; estimated investment of \$3.2-\$3.6 billion; 56,000 jobs in construction phase.
 - **Sectoral Integration:**
 - Solar-powered schools, telecom sites, rural electrification.
 - Public lighting (15,150 solar-powered light points).
 - Water pumping using PV and wind.
 - **Institutional Collaboration:**
 - Partnerships with German and Italian firms for joint projects.
 - Establishment of CDER, SKTM, NEAL, CREDEG.
 - Regulatory reforms to support off-grid and grid-connected projects.
 - **Green Hydrogen Strategy:**
 - Presidential commitment (2022) to position Algeria as a major green hydrogen player.
 - 2023: Launch of national strategy; targets include production of 2 million tons of hydrogen (10% of EU demand).
 - Collaboration with Germany: pilot project at Arzew (50 MW), \$20 million German funding.
 - Proposed export corridor via the Mediterranean (H2 South Corridor).
- Algeria's energy transition strategy is increasingly aligning with global energy security imperatives. While the country still heavily relies on hydrocarbons, a suite of legal, institutional, technological, and strategic initiatives is progressively reshaping its energy landscape. Natural gas serves as a transitional pillar, while substantial efforts are being made to harness Algeria's solar potential and venture into green hydrogen. Nonetheless, achieving long-term energy security and economic diversification will depend on consistent investment, technological partnerships, and a robust policy framework that bridges short-term economic needs with long-term sustainability goals.

4- Algeria in Light of International Legal Commitments Regarding Energy Security and Climate Protection

4-1- The International Legal Framework Governing Energy Transition

The global legal framework concerning energy transition and climate protection has evolved significantly over the past three decades, driven by the imperative to combat climate change, ensure environmental sustainability, and safeguard global energy security. Algeria, as part of the international community, is subject to a set of legally binding and soft law instruments that shape its national energy and environmental policies .

1. United Nations Framework Convention on Climate Change (UNFCCC) and Related Protocols¹⁷

- **Rio Earth Summit (1992):** The United Nations Conference on Environment and Development in Rio de Janeiro marked a turning point in international environmental governance. The resulting UNFCCC laid the groundwork for collective action against global warming and introduced the principle of "common but differentiated responsibilities."
- **Kyoto Protocol (1997):** Algeria ratified this protocol, which set binding emission reduction targets for developed countries. While Algeria, as a developing country, was not subject to binding targets, its participation affirmed its commitment to global climate action.
- **Paris Agreement (2015):** A legally binding international treaty adopted at COP21, the Paris Agreement sets the overarching goal of limiting global temperature rise to well below 2°C above pre-industrial levels, while striving for 1.5°C. Algeria ratified the agreement in 2016, thereby committing to reduce its greenhouse gas emissions through a nationally determined contribution (NDC) and adopt adaptation strategies.

2. Agenda 2030 and the Sustainable Development Goals (SDGs)

- **Goal 7: Affordable and Clean Energy:** This goal calls for universal access to modern energy services, a substantial increase in renewable energy in the global energy mix, and improvements in energy efficiency. Algeria's energy policies align with these objectives, particularly through its National Renewable Energy and Energy Efficiency Program (PNEREE).
- **Goal 13: Climate Action:** Mandates urgent action to combat climate change and its impacts. Algeria's commitment to climate mitigation and adaptation, as expressed in its NDC, contributes directly to the achievement of this goal.

3. Regional and International Agreements on Energy and Emissions Reduction

- Algeria maintains active participation in regional cooperation frameworks with the European Union (EU), the African Union (AU), and the Union for the Mediterranean (UfM) to promote energy security, clean energy transition, and sustainable development. Notably, the EU's Green Deal and energy diplomacy strategies have implications for Algeria's energy export policies and regulatory frameworks.

4.2. Algeria's Commitments under International Energy and Environmental Agreements

Algeria's international energy and environmental obligations stem not only from multilateral treaties but also from its bilateral partnerships and evolving domestic legal framework that seeks coherence with global standards .

¹⁷ Laurence Boisson de Chazournes, "Kyoto Protocol to the United Nations Framework Convention on Climate Change," *UN's Audiovisual Library of International Law* (<http://untreaty.un.org/cod/avl/ha/kpccc/kpccc.html>) (1998).

1. Paris Agreement and Algeria's Nationally Determined Contribution (NDC)¹⁸

- Algeria's NDC, submitted in 2016 and updated in 2021, outlines a national commitment to reduce greenhouse gas (GHG) emissions by 7% unconditionally and up to 22% conditionally by 2030, relative to business-as-usual projections. This includes efforts in renewable energy development, energy efficiency, waste management, and forestry.
- The NDC represents both a legal and political commitment, guiding Algeria's transition policies and resource allocation in line with global climate governance.

2. Roadmap to 2030 and Institutional Mechanisms

- The implementation of the NDC is supported by a national roadmap developed in coordination with line ministries, regulatory agencies, and civil society stakeholders. The roadmap includes legal reforms, technological deployment, capacity building, and financing strategies.
- The establishment of the Ministry of Energy Transition and Renewable Energies in 2020 underscores Algeria's institutional commitment to fulfilling its climate obligations and fostering a sustainable energy paradigm.

3. Domestic Legal Framework Aligned with International Commitments

Algeria's domestic legal order has progressively internalised its international energy and climate obligations, not only at the level of formal legislation but also through mechanisms of judicial review and administrative supervision. At the constitutional level, Articles 20 and 21 of the 2020 Constitution affirm that natural resources, including energy resources, form part of the national public domain and must be exploited in a rational and sustainable manner in the interest of present and future generations. These provisions incorporate into the Algerian legal system core principles of international environmental law, such as sustainable development and intergenerational equity, and provide a constitutional basis for challenging policies that unduly sacrifice environmental protection for short-term economic gains.

Statutorily, Law No. 09-04 of 14 August 2004 on the promotion of renewable energy in the framework of sustainable development, the Hydrocarbon Law No. 19-13 of 2019, and sector-specific environmental codes set out detailed obligations relating to environmental impact assessment, emission control, and energy-efficiency standards. Finance Acts adopted since 2010 have created dedicated funds for renewable energies and energy efficiency, thereby giving budgetary effect to Algeria's climate-related commitments. However, the effectiveness of these norms depends on the existence of credible enforcement mechanisms.

From a judicial perspective, several avenues of oversight exist. The Constitutional Court (formerly the Constitutional Council) may review the conformity of legislation with constitutional provisions protecting the environment and the public patrimony of natural resources, either a priori or a posteriori through the mechanism of constitutional review by

¹⁸ Brian Dawson, and Matt Spannagle, "United Nations Framework Convention on Climate Change (Unfccc)," in *The Complete Guide to Climate Change* (Routledge, 2008).

way of exception. In parallel, the administrative courts and the Conseil d'État exercise control over regulatory acts and administrative decisions authorising energy and industrial projects. In principle, they can annul permits or licences that contravene environmental legislation or fail to comply with mandatory impact-assessment procedures. Criminal courts are also competent to prosecute offences relating to pollution and illegal exploitation of natural resources, although the practical use of criminal sanctions in environmental matters remains limited.

At the institutional level, several specialised bodies are entrusted with monitoring compliance with energy and environmental law. These include the Ministry in charge of the environment, the Ministry of Energy and Mines, the Hydrocarbon Regulatory Authority (ARH), the national hydrocarbon agency ALNAFT, the Electricity and Gas Regulatory Commission (CREG) and the National Commissariat for Renewable Energies and Energy Efficiency (CEREFE), among others. These institutions are responsible for issuing licences, conducting inspections, imposing administrative sanctions, and collecting data relevant to Algeria's reporting obligations under the Paris Agreement and other treaties. Yet, their effectiveness is constrained by overlapping competences, limited technical and human resources, and occasional political interference. Civil-society organisations and local communities have only a modest role in environmental oversight, which weakens societal pressure for strict enforcement.

Overall, while Algeria possesses a relatively dense body of constitutional, legislative and institutional norms aligned with its international commitments, the internal mechanisms that should guarantee their implementation—judicial review, regulatory supervision and participatory control remain under-utilised. Strengthening these mechanisms is therefore essential for translating Algeria's international climate and energy obligations into tangible domestic practice.

4-Conclusion:

International climate law. It provided a comprehensive legal and geopolitical analysis of the current challenges facing Algeria as a hydrocarbon-dependent economy within a rapidly decarbonizing global energy landscape. Through an in-depth examination of historical data, legal instruments, institutional reforms, and international agreements, the research delineated how Algeria's national energy strategy is gradually shifting from a rent-based model towards a more diversified, sustainable, and law-abiding framework. In this sense, Algeria's vulnerability is not only economic but also institutional and legal, as the under-utilisation of domestic judicial and regulatory mechanisms undermines the robustness of its energy security framework.

- **Findings**

The main findings can be summarized as follows:

1. Structural vulnerability to price volatility: The volatility of global oil and gas markets has exposed the structural fragility of Algeria's rent-based economic model and demonstrated the urgent need to diversify its energy mix and sources of public revenue.

2. Uneven progress in renewable energy deployment: Algeria has made notable, though uneven, progress in designing and implementing renewable energy programmes and energy-efficiency measures. These initiatives are supported by an expanding institutional framework such as the Ministry of Energy Transition and Renewable Energies and by statutory reforms aligned with international commitments.
3. Formal legal and political commitment to decarbonization: Algeria's accession to the Paris Agreement and the formulation and updating of its Nationally Determined Contributions (NDCs) reflect a clear legal and political will to decarbonize its energy sector and to integrate climate objectives into national development planning.
4. Natural gas as a transitional pillar: Natural gas continues to play a strategic bridging role in Algeria's energy mix, simultaneously serving domestic demand and export obligations. It also constitutes a technical and infrastructural platform for the development of blue and green hydrogen, thereby linking short-term energy security with long-term decarbonization.
5. Evolution of the domestic legal framework: The Algerian constitutional and regulatory framework has increasingly recognized environmental protection, sustainable development and the rational exploitation of natural resources as core components of energy sovereignty. Nevertheless, implementation gaps and regulatory instability still limit the effectiveness of these norms.
6. Limited activation of domestic enforcement mechanisms: Despite the existence of a relatively dense body of environmental and energy legislation and several specialised regulatory agencies, the weak and sporadic use of judicial review and administrative oversight reduces the internal legal guarantees of energy security and hampers the effective domestic translation of Algeria's international obligations.

• Recommendations

Based on the above findings, several recommendations can be made:

1. Strengthen legal enforceability: Algeria should reinforce the binding nature and enforceability of its environmental and energy-related legislation by adopting clear secondary regulations, measurable implementation mechanisms, and independent monitoring and sanctioning bodies.
2. Enhance institutional coordination: Greater horizontal coordination is needed between the energy, environment, finance, planning and research sectors in order to avoid overlapping mandates and to ensure coherent implementation of energy-transition policies.
3. Improve the investment climate for renewables: The domestic legal framework should be further aligned with international standards on energy governance and investor protection, in order to attract long-term, sustainable investment in renewable energy and green hydrogen projects. This includes legal guarantees on tariff stability, transparency and access to dispute-settlement mechanisms.
4. Promote public-private partnerships and local capacity-building: The State should actively encourage public-private partnerships, support local manufacturing of renewable-energy

technologies, and invest in human capital through specialized training and research programmes.

5. Consolidate energy diplomacy in the Euro-Mediterranean space: On the external front, Algeria ought to strengthen its energy diplomacy by positioning itself not only as a supplier of conventional hydrocarbons but also as a future exporter of clean energy particularly green hydrogen and solar electricity to European and African markets.

In terms of research prospects, this article opens several promising avenues. There is a need for interdisciplinary studies that combine legal analysis with economic modelling to quantify the costs and benefits of different energy-transition scenarios. Empirical assessments of the effectiveness of Algeria's institutional and legislative reforms in the renewable energy sector remain scarce and warrant further investigation. Comparative research with other hydrocarbon-exporting countries in the MENA region and the Global South could also yield valuable insights into best practices for integrating legal frameworks into sustainable energy strategies. Finally, future scholarship should explore the potential legal risks and opportunities associated with Algeria's participation in transnational hydrogen corridors and international green-finance mechanisms.

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