

Energy Transition in a Rentier Economy: Measuring the Impact of Green Economy Indicators on Sustainable Development in Algeria

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Abstract

This research paper aims to analyze Algeria's energy transition path within the context of the shift toward a green economy, covering the period from 2020 to 2026. The paper adopts a descriptive-analytical approach based on quantitative indicators from specialized energy reports and peer-reviewed academic studies, as well as reviewing field experiences in implementing renewable energy projects. The study finds that Algeria has, in recent years, embarked on a tangible shift from the planning phase to the actual implementation of solar energy projects, surpassing the stagnation phase the sector experienced in the previous decade. Operational renewable energy capacity reached 446 MW by the end of 2025, with 3,200 MW under construction to be commissioned during 2026, reflecting a new dynamism driven by an ambitious program targeting 15 GW by 2035. The paper also highlights the structural challenges facing this path, most notably the near-absolute dominance of solar energy at the expense of wind power, weak local investment in green innovation, and the absence of a clear national strategy for developing local industry. The study concludes that energy transition in Algeria represents a dual strategic bet: protecting gas export capacities through rationalizing domestic consumption, and enhancing the national economy's competitiveness in the face of European environmental protection mechanisms, which requires strengthening governance, diversifying financing sources, and building national capacities in manufacturing, research, and development.

Keywords: Energy Transition; Green Economy; Solar Energy; Algeria; Renewable Energy; Sustainable Development; Green Hydrogen; Energy Efficiency

Introduction

1. Research Problem

The issue of the energy transition is one of the most prominent challenges facing hydrocarbon-dependent rentier economies, particularly in light of global climate change and the international drive to reduce carbon emissions. Algeria, as a major producer of natural gas and oil in the region and the largest hydrocarbon producer in Africa, is confronted with a complex equation: how can it reconcile the preservation of hydrocarbon revenues, which constitute the backbone of the national economy, with the imperative of engaging in the green growth dynamics imposed by international developments?

This issue has gained increasing relevance in light of two simultaneous developments. First, the growing European demand for alternative sources of gas following the Russian-Ukrainian crisis

¹ Received: January 30, 2026; Accepted: May 15, 2026; Published: September 16, 2026

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has strengthened Algeria's strategic position as a major energy supplier to Europe. Second, the entry into force of European environmental protection mechanisms, such as the Carbon Border Adjustment Mechanism (CBAM), has imposed new constraints on the competitiveness of Algerian exports that are energy-intensive.

Accordingly, the research problem can be formulated through the following question: To what extent does the energy transition in Algeria contribute to achieving the objectives of the green economy, and what structural challenges hinder this process?

2. Research Objectives

This paper seeks to achieve a set of objectives, which can be summarized as follows:

- To analyze the current state of renewable energy in Algeria through quantitative indicators and official statistics.
- To identify and evaluate national energy-transition strategies and their implementation mechanisms.
- To determine the structural challenges and constraints hindering the transition toward a green economy.
- To explore the prospects of the energy transition in Algeria in light of international and domestic developments.
- To provide practical recommendations for strengthening the energy transition and achieving the objectives of the green economy.

3. Research Methodology

This study adopts a descriptive-analytical approach, whereby data and information were collected from official and academic sources and analyzed both quantitatively and qualitatively. The quantitative dimension of the paper draws on indicators published by the National Observatory of Energy and Mines, reports issued by the German Trade and Invest (GTAI), reports by Dii Desert Energy, and data from the International Energy Agency (IEA). The theoretical dimension, meanwhile, relies on a systematic review of peer-reviewed academic literature, particularly empirical and econometric studies examining the relationship between green economy indicators and sustainable development in Algeria.

4. Structure of the Study

This research paper is organized into five main sections. The first addresses the theoretical and conceptual framework of the energy transition and the green economy, while also examining the drivers of transformation in rentier economies. The second presents the current state of renewable energy in Algeria through quantitative data and indicators, supported by statistical tables. The third analyzes the national strategy and its implementation mechanisms, including Algeria's ambitions regarding green hydrogen. The fourth discusses the structural challenges and constraints facing the energy transition. Finally, the fifth section explores future prospects and formulates a set of recommendations.

First: The Theoretical and Conceptual Framework

1.1 Definition of the Energy Transition and the Green Economy

The Energy Transition refers to the gradual shift from energy systems based on fossil fuels toward systems relying on low-carbon energy sources, while improving energy-use efficiency. This concept is not limited to the technical dimension related to changing energy production sources; rather, it extends to social, economic, and institutional dimensions, as it requires restructuring energy markets, changing consumption patterns, and developing regulatory and legislative frameworks.

As for the Green Economy, it is defined by the United Nations Environment Programme (UNEP) as an economy that is low-carbon, resource-efficient, and socially inclusive, in which investment contributes to reducing carbon emissions and pollution, enhancing energy and resource efficiency,

and preventing the loss of biodiversity and ecosystem services. The green economy is based on three fundamental pillars: environmental sustainability, social equity, and economic efficiency.

The economic literature indicates the existence of a complementary relationship between the energy transition and the green economy. The former represents the mechanism or pathway, whereas the latter represents the objective or targeted economic model. Thus, the energy transition constitutes the principal instrument for achieving the objectives of the green economy by reducing the carbon intensity of economic activities and enhancing resource efficiency. An econometric study using the ARDL methodology over the period 2000–2023 demonstrated that green economy indicators in Algeria, represented by renewable energy consumption and energy-use efficiency, are dynamically associated with sustainable development indicators, with 42% of deviations being corrected annually.

1.2 Drivers of the Energy Transition in Rentier Economies

The drivers of the energy transition differ between hydrocarbon-exporting countries and energy-importing countries. In the case of Algeria, these drivers can be categorized into three fundamental dimensions, each with its own implications and consequences:

First: The Strategic Dimension:

This dimension concerns maintaining Algeria's share of the European energy market amid Europe's transition toward clean energy. The European Union, which is the main importer of Algerian natural gas, has set ambitious targets for achieving carbon neutrality by 2050, implying a gradual decline in demand for fossil fuels. In this context, Algeria is working to develop alternatives such as green hydrogen and green ammonia in order to remain a key player in the European energy mix. The Southern Hydrogen Corridor (SouthH2 Corridor) project, which connects Algeria with Tunisia, Italy, Austria, and Germany, represents a concrete manifestation of this strategic dimension.

Second: The Economic Dimension:

This dimension is reflected in the rationalization of domestic gas consumption, which exceeded 57 billion cubic meters in 2025, thereby limiting export capacity and reducing the state's foreign-currency revenues. It is estimated that every 1 GW of solar energy can save between 500 and 600 million cubic meters of natural gas annually, representing substantial savings that can be redirected toward exports. Moreover, the development of renewable energy contributes to diversifying the national economy and reducing dependence on hydrocarbon revenues, which account for more than 90% of Algeria's exports.

Third: The Environmental Dimension:

This dimension involves fulfilling Algeria's Nationally Determined Contributions (NDCs) under the Paris Agreement on Climate Change and reducing the carbon intensity of the economy. The national strategy aims to reduce carbon emissions by 25% by 2030 through improving energy efficiency, developing renewable energy sources, and promoting afforestation. Furthermore, engagement with the green economy constitutes a response to international trends that impose stringent environmental standards on products and services, thereby affecting the competitiveness of Algerian exports in global markets.

1.3 The Relationship Between Energy Transition and Sustainable Development

The energy transition represents a fundamental pillar for achieving the Sustainable Development Goals (SDGs), particularly Goal 7 (Affordable and Clean Energy), Goal 13 (Climate Action), and Goal 9 (Industry, Innovation and Infrastructure). In Algeria, the energy transition is closely linked to issues of energy security, financial sustainability, and social equity, as it contributes to:

Enhancing energy security: by diversifying energy production sources and reducing reliance on fossil fuels for electricity generation, thereby increasing the resilience of the energy system.

Creating employment opportunities: as the renewable energy sector is expected to contribute to the creation of approximately 30,000 direct and indirect jobs by 2030.

Reducing pollution: by lowering greenhouse gas emissions and improving air quality in urban and industrial areas.

Promoting social equity: by expanding access to energy in remote and southern regions through decentralized solar energy projects.

Second: The State of Renewable Energy in Algeria: Figures and Indicators

2.1 Installed Capacity and Projects Under Development

A quantitative assessment of the performance of Algeria's renewable energy sector reveals a disparity between announced ambitions and actual achievements. Nevertheless, the recent period has witnessed a notable acceleration in the pace of implementation. According to the MENA Energy Outlook 2025 report published by Dii Desert Energy, Algeria's operational renewable energy capacity reached 446 MW by the end of 2025, distributed as shown in the table below:

Table 01: Distribution of Operational Renewable Energy Capacity in Algeria (End of 2025)

Source	Capacity (MW)	Percentage
Solar Photovoltaic (PV)	411	92.2%
Concentrated Solar Power (CSP)	25	5.6%
Wind Energy	10	2.2%
Total	446	100%

Source: Prepared by the researcher based on data from Dii Desert Energy, 2025.

This table reflects the almost absolute dominance of photovoltaic solar energy within the renewable energy mix, indicating a clear technological choice underpinning the national strategy, while surpassing other options such as concentrated solar power and wind energy. This dominance can be attributed to several factors, including the abundance of solar irradiation across the national territory, averaging between 1,900 and 2,650 kWh/m² per year; the lower cost of photovoltaic panels compared with other technologies; the availability and technological maturity of photovoltaic systems; and their relative ease of installation and maintenance.

However, the most significant indicator of the dynamics of the energy transition is the volume of capacity currently under construction, which experienced a notable acceleration in 2025. The Ministry of Energy and Renewable Energies announced the commissioning of a 3,200 MW program during 2025, comprising 21 photovoltaic solar power plants distributed across 14 provinces, with capacities ranging from 50 to 300 MW per plant. These projects fall within the framework of the tenders launched by Algeria in 2023 for a total capacity of 3,000 MW, in addition to the award of three further projects in 2025, with a combined capacity of 520 MW.

The capacity under development also includes 500 MW of wind power, 400 MW of concentrated solar power, and 1,000 MW of photovoltaic solar energy at the tender-announcement stage. This means that the total capacity under construction, development, or tendering exceeds 6,000 MW, reflecting a qualitative shift in the scale of national ambitions.

2.2 Field-Level Achievements: Indicators of an Accelerating Pace

The period 2025–2025 witnessed a qualitative leap in the number of completed projects, reflecting the effective translation of political commitments into physical infrastructure. In April 2025, two solar power plants, each with a capacity of 200 MW, entered service in the provinces of El Meghaier and Biskra, adding to previously completed projects in several provinces. An additional 1,400 MW is scheduled to be injected into the national grid before the end of 2025. By mid-2025, the

completion rate of works at 22 solar power plants under construction had reached approximately 40%.

Table No. (02): Evolution of Electricity Generation Indicators in Algeria (May 2025 – May 2025)

Indicator	May 2025	May 2025	Change Rate
National electricity generation (GWh)	7,067	7,506	+6.2%
Share of renewable energy in electricity generation (%)	Estimated at 4%	9%	+125%
Installed rooftop solar capacity (MW)	Not specified	615 (485 residential + 130 industrial/agricultural)	–
Peak demand (MW)	3,211	3,182	-0.9%

Source: Prepared by the researcher based on data from the National Observatory of Energy and Mines, May 2025.

The second table shows a 6.2% increase in national electricity generation, accompanied by a notable contribution from renewable energy sources, which accounted for 9% of the electricity mix, compared with only 4% one year earlier. This increase reflects the initial impact of newly implemented projects on the structure of electricity generation. The growing deployment of rooftop solar energy in the residential and industrial sectors also reflects the beginning of a transition toward decentralized electricity generation, with approximately 485 MW installed in the residential sector and 130 MW in the industrial and agricultural sectors.

It should be noted that these figures reflect estimates provided by the National Observatory, which indicated that renewable energy sources accounted for 8% of electricity generation in May 2025, while national electricity generation from renewable energy sources reached 613 GWh during that month, subsequently increasing to 9% in May 2025. It should also be noted that this percentage includes the contribution of solar power plants, whereas the contribution of wind energy remains limited.

2.3. Evolution of Green Economy Indicators: An Econometric Approach

At the academic level, several studies have attempted to measure the impact of green economy indicators on the development trajectory in Algeria. These studies have employed both descriptive and econometric approaches, using econometric tools such as the Autoregressive Distributed Lag (ARDL) model and the Error Correction Model (ECM).

A study by Ben Chehida (2024), using the ARDL model over the period 1990–2022, concluded that there is an inverse relationship between renewable energy consumption and the green economy in the long run. This finding suggests that the contribution of renewable energy to gross domestic product (GDP) remains limited and that its impact on reducing emissions requires time to materialize. The researcher interpreted this result as reflecting the initial stage of the transition, during which investment costs are high while direct returns remain relatively low.

In contrast, the study by Hammadi and Berkane (2025) indicated a positive effect of energy-use efficiency in both the short and long terms. The error correction model showed that deviations are corrected at a rate of 42% annually, reflecting a gradual response of the Algerian economy to green economy variables. The study employed the ARDL methodology over the period 2000–2023, and its findings demonstrated that energy efficiency contributes to improving sustainable development indicators, with its impact becoming more pronounced in the long run (**Hammadi, 2025**).

These findings indicate that the Algerian economy is still at an early stage of the energy transition and that the positive impact of renewable energy on economic growth and sustainable development requires the accumulation of time and sustained investment, in addition to the development of infrastructure and the institutional framework.

2.4 International Comparison

To place Algeria's situation within a regional and international context, the main indicators can be compared with those of selected countries with similar characteristics in the region.

Table 3: Comparison of Renewable Energy Indicators in Algeria and Selected Countries (2025)

Country	Operational Renewable Capacity (GW)	Share of the Electricity Mix	Ambitious Target
Algeria	0.446	9%	15 GW by 2035
Saudi Arabia	4.11	42%	52% by 2030
Egypt	6.2	20%	42% by 2035
Tunisia	0.8	15%	30% by 2030

Source: Prepared by the researcher based on reports from the International Energy Agency (IEA) and the International Renewable Energy Agency (IRENA), 2025–2025.

The above table shows that Algeria still lags behind some regional countries, particularly Saudi Arabia and Egypt, in terms of operational renewable energy capacity and the percentage share of renewables in the electricity mix. However, the scale of projects currently under construction (3.2 GW) indicates the potential to narrow this gap over the coming years (**Djaballah, 2019**)

Third: Algeria's Energy Transition Strategy: Objectives and Mechanisms

3.1 Institutional Framework and National Programs

The official framework for the energy transition in Algeria was established pursuant to Law No. 15-19 of 16 December 2015 concerning the development of renewable energy, which set out the initial objectives of the National Renewable Energy Program. These objectives were subsequently updated within the framework of the national program, with the target set at 15 GW by 2035, alongside an intermediate milestone of achieving a 15% share of the energy mix by 2030, compared with approximately 4% in 2025.

Institutional responsibilities are distributed among several key stakeholders:

Ministry of Energy and Renewable Energies: It is responsible for formulating public policies, developing strategies, and coordinating the implementation of programs.

National Agency for the Promotion and Rationalization of Energy Use (APRUE): It serves as the Ministry's implementing arm and is responsible for promoting renewable energies and energy efficiency, conducting studies, and supporting projects.

Sonelgaz: The public company responsible for electricity generation and distribution, playing a central role in project implementation through its specialized subsidiaries.

National Renewable Energy Committee: An advisory body comprising experts and representatives from the relevant sectors. It provides advice to the government on energy policy matters.

The main mechanisms for implementing this strategy include:

National tenders: In 2023, the government launched a tender for 3,000 MW of solar energy capacity, followed by the award of three additional projects totaling 520 MW in 2025. These tenders constitute the main instrument for attracting both domestic and international investors.

International partnerships: Algeria joined the Global Green Growth Institute (GGGI) as its 52nd member, reflecting its commitment to international standards of green growth. Work is also underway on a subsea electricity interconnection project between Algeria and Italy to transmit decarbonized electricity. This is a strategic project extending approximately 200 kilometers beneath the Mediterranean Sea.

Infrastructure development: A 400-kV high-voltage transmission line project extending over 880 kilometers is currently being implemented to connect the southern and northern regions. This will enable the integration of large-scale solar power generation from the southern regions, where major projects are concentrated due to the abundance of solar radiation and the availability of vast areas of land.

3.2 Green Hydrogen Ambition: The Strategic Dimension

The National Hydrogen Strategy, launched in 2023, sets ambitious targets, including achieving an annual production capacity of between 1.2 and 1.5 million tonnes by 2040, with approximately 75% of this production allocated for export. Algeria is relying on its competitive advantages in this field, particularly:

Geographical proximity to Europe: Algeria is less than 200 kilometers from the Italian and Spanish coasts, which reduces transportation costs compared with hydrogen producers located in other regions.

Existing infrastructure: Existing gas pipelines can potentially be repurposed to transport hydrogen, thereby reducing the investment required. The Southern Hydrogen Corridor project is an embodiment of this advantage.

High solar irradiation: Solar irradiation exceeds 3,900 hours annually in the southern regions, making the cost of electricity generation from solar energy among the lowest in the world and, consequently, making the cost of green hydrogen production competitive.

Within this framework, Algeria is hosting the preparatory meetings for the SouthH2 Corridor project, with international participation involving Tunisia, Italy, Austria, and Germany. This major infrastructure project aims to transport green hydrogen produced in Algeria to the heart of Europe. Work is also underway on two pilot projects in the field of green hydrogen, with an initial production capacity of 50 MW, one located in Adrar Province and the other in Biskra Province, in partnership with national and foreign institutions. These projects are expected to become operational by 2028.

3.3 Financing Mechanisms and Investment Incentives

The budget allocated to the energy and renewable energy sector for 2025 amounted to approximately DZD 409 billion (around USD 2.9 billion), intended to finance new energy projects, maintain existing infrastructure, and develop research and training programs. The Ministry has adopted a blended financing approach based on covering 60% of investments through public financing and 40% through private-sector investment, including public-private partnerships (PPPs), for which a financial allocation of approximately DZD 100 billion has been earmarked.

The new financial and tax incentives include:

Customs exemptions of up to 70% on equipment and machinery imported for renewable energy projects.

Tax reductions of 50% for industrial enterprises that use clean energy in their production processes, for a period of five years.

Concessional loans at reduced interest rates from public banks for investors in the renewable energy sector, backed by guarantees from the Investment Guarantee Fund.

Allocation of land for major projects in the southern regions, together with exemptions from registration fees for a period of ten years.

Fourth: Structural Challenges and Constraints

Despite the recorded momentum, Algeria's energy transition faces a range of structural challenges that limit the pace of transformation and hinder the achievement of its ambitious objectives. These challenges can be classified into four main categories:

4.1 Imbalance in the Renewable Energy Mix

As shown in the first table, photovoltaic solar energy dominates the renewable energy mix, accounting for more than 92%, while wind energy represents no more than 2.2% and concentrated solar power accounts for 5.6%. This imbalance can be attributed to several factors, most notably:

The absence of a clear and specific national strategy for the development of wind energy. At present, there is only one wind farm in Adrar, with a capacity of 10.2 MW. It is a pilot facility that has not undergone any expansion since its establishment.

The lack of diversification in financing sources and technologies, as most investments have been directed toward photovoltaic solar energy due to its lower cost and ease of implementation.

The limited number of geophysical studies assessing wind energy potential across different regions, despite indications of significant potential in the southwestern regions and the High Plateaus.

Although studies are currently being conducted in cooperation with the World Bank to develop an additional 1,000 MW of wind power capacity distributed across ten sites, the pace of implementation remains slow, and no specific tenders for these projects have yet been announced. It is noteworthy that the 2025 program includes 500 MW of wind power as part of projects with a total capacity of 2,000 MW, indicating an attempt to gradually address this imbalance. However, this share remains relatively small compared with the available potential.

4.2 Dependence on Imports and Weaknesses in Local Manufacturing

Despite efforts to develop a national industry in the field of solar energy, reliance on foreign suppliers remains substantial, particularly given the need to import solar panels and equipment to meet the rapidly accelerating pace of project development. Available data indicate that solar panel imports increased sharply from 0.35 GW in 2024 to 2.1 GW in 2025, placing Algeria among the top five African countries in terms of solar market size. At the same time, however, this reflects an almost complete dependence on imported technologies, particularly from China.

The local industry faces several challenges, including:

The absence of an integrated value chain for the photovoltaic industry, as local production is largely limited to assembling panels from imported components, without extending to the manufacturing of solar cells or electronic wafers.

Limited technical capabilities and a shortage of specialized human resources, owing to insufficient specialized training programs and the migration of skilled professionals.

The lack of competitiveness of locally manufactured products in terms of price and quality compared with imported products, due to the absence of economies of scale and adequate state support for domestic production.

The absence of a clear national strategy for developing local manufacturing, apart from a number of fragmented and poorly coordinated initiatives.

The study by Ben Yahia (2021) points to the absence of a specialized national industry in concentrated solar power and photovoltaic technologies, as well as a shortage of the technical expertise required to develop large-scale projects. The study calls for the establishment of a national training and research program in renewable energy technologies, along with the development of

technological partnerships with developed countries to facilitate the transfer of knowledge and expertise.

4.3 Weaknesses in Financing, Research, and Development

Despite the budget allocated to the sector, heavy reliance on public financing makes renewable energy programs vulnerable to fluctuations in oil prices, which directly affect the state's financial resources. Furthermore, the implementation rate of the programs outlined in the 2025 budget reached 83%, reflecting an improvement, but still falling short of the desired level and indicating the existence of administrative and implementation-related obstacles.

The main financing constraints include:

The limited contribution of the private sector, which accounts for no more than 20% of total investment in renewable energy, despite the incentives announced.

The limited availability of innovative financing instruments, such as green bonds and specialized investment funds.

The absence of specialized insurance companies providing coverage for the risks associated with renewable energy projects.

Insufficient investment in research and development, with the budget allocated to scientific research in the field of renewable energy accounting for no more than 2% of the sector's overall budget, compared with approximately 13% in France and more than 10% in Germany.

The literature indicates the limited availability of financing allocated to green investment in Algeria. The share of renewable energy in the energy mix amounted to less than 2% in 2018. Although this share has improved slightly since then, it remains relatively modest (**Ben Chahida, 2024**)

4.4 Structural Challenges in the Electricity Sector

Data from the National Energy and Mining Observatory indicate that Sonelgaz continues to dominate electricity generation, accounting for 91%, while electricity imports cover 9% of the needs of the domestic market. This reflects several structural challenges, including:

Weak competition in the electricity generation sector and the slow transition of the market structure toward a competitive model, despite the electricity law allowing independent power producers to enter the market (**Ali, 2024**)

A monopoly over transmission and distribution, which limits independent power producers' ability to access the electricity grid.

Slow licensing and approval procedures, which hinder the entry of new investors into the sector.

Limited implementation of the Feed-in Tariff (FIT) mechanism, which is intended to encourage independent power producers, as no clear pricing mechanism has yet been established (**Meflah, 2025**)

4.5 Governance and Transparency Challenges

Previous studies have identified the “ambiguity of public strategies and policies” and “inadequate bureaucracy” as major obstacles to accelerating the energy transition. This ambiguity is manifested in several ways:

The reduction of the target from 22 GW by 2030 to 15 GW by 2035, which reflects a more realistic reassessment of the country's ambitions, but also raises questions regarding the credibility of the timelines and the continuity of political commitment.

The lack of clarity regarding the mechanisms for implementing the strategy at the local level, as well as the delegation of powers to provincial authorities (Walis) and local authorities.

Fifth: Future Prospects, Scenarios, and Recommendations

5.1 Potential Scenarios

In light of the available data and the challenges at hand, three potential scenarios can be envisaged for the trajectory of Algeria's energy transition over the coming years: **(Kafi, 2025)**

Scenario 1: Planned Acceleration:

If the current pace of implementation continues, accompanied by improved governance and a broader investor base, Algeria could achieve its target of 15 GW by 2035. This would contribute to saving approximately 8 billion cubic meters of natural gas annually, according to expert estimates, strengthen export capacities toward Europe, and create approximately 30,000 new jobs. Achieving this scenario would require strengthening international partnerships, developing local industry, and improving the investment climate.

Scenario 2: Dual Dependence:

This scenario involves the continued dominance of solar energy and the marginalization of wind energy, which could expose the electricity system to intermittency risks and limit the long-term viability of the program, particularly in the absence of effective energy-storage solutions. Under this scenario, the electricity grid may become unstable during peak hours, while operating costs may increase due to the need to operate backup gas-fired power plants, thereby reducing the anticipated economic benefits.

Scenario 3: The Technological Bet:

If the ambitions for green hydrogen are achieved at the announced pace, Algeria could undergo a qualitative transformation in its position as an energy actor, shifting from a fossil-fuel exporter to a clean-energy supplier, particularly through the Southern Hydrogen Corridor project linking Algeria with Europe. This scenario would require massive investments in infrastructure, the development of hydrogen markets, and the establishment of technological partnerships with European countries. It is the most ambitious scenario, but also the most challenging in terms of economic and technical feasibility in the foreseeable future.

5.2 Recommendations

Based on an analysis of the current state of Algeria's energy transition and the challenges it faces, a set of practical recommendations can be put forward to strengthen the country's transition toward a green economy:

First: Diversifying the Renewable Energy Mix:

Efforts should focus on intensively developing wind energy through the launch of dedicated tenders, conducting comprehensive geophysical assessments of available potential, and encouraging investment in both onshore and offshore wind projects. The potential of geothermal energy in the southern regions should also be explored, alongside bioenergy derived from agricultural and industrial waste. **(Adjal, 2025)**

Second: Strengthening Local Manufacturing

Developing a clear national strategy for the advancement of the solar and wind energy industries, with specific quantitative targets and defined timeframes; establishing technological partnerships with leading global companies to facilitate knowledge and technology transfer; providing attractive tax and financial incentives for investors in local manufacturing; and establishing specialized industrial zones dedicated to renewable energy.

Third: Developing Research, Development, and Innovation

Increasing the budget allocated to scientific research in the field of renewable energy; establishing specialized research centers in partnership with universities and international research institutions; promoting innovation in energy storage and green hydrogen technologies; and establishing specialized business incubators to support start-ups operating in green technology.

Fourth: Improving Governance and Transparency

Establishing clear and stable regulatory frameworks that encourage private investment; simplifying licensing and approval procedures; strengthening coordination among government sectors; and launching a transparent national platform for monitoring project implementation and disseminating information and data to investors and the general public.

Fifth: Diversifying Financing Sources

Encouraging private-sector participation through public-private partnerships; issuing green bonds to mobilize financing; establishing a national green investment fund; and strengthening cooperation with international financial institutions and development banks **(Benyahou, 2021)**

Sixth: Building Human Capacities

Developing specialized training programs in renewable energy at universities and technical institutes; organizing training programs for engineers and technicians; launching national awareness programs highlighting the importance of the energy transition and the green economy; and involving civil society in supporting the transition process.

Conclusion

Algeria represents a typical case of a rentier economy embarking on a structural transformation toward a green growth model, driven by a combination of external factors, particularly the transition of European markets toward clean energy, and internal factors, including the desire to diversify the national economy, reduce dependence on hydrocarbons, and rationalize domestic energy consumption. Field data and official figures indicate that the country has made tangible progress in moving from the planning stage to implementation, with a qualitative expansion in solar energy capacity and projects currently under development. In this regard, 3,200 MW of capacity came into operation in 2025, while the share of renewable energy in the electricity mix increased to 9%

However, this trajectory is not without significant challenges, most notably the excessive focus on a single technological option—photovoltaic solar energy—at the expense of other sources such as wind energy; weak local manufacturing capacity and near-total dependence on imports; limited funding for research and development; the dominance of the public utility over the electricity market; and weaknesses in governance and transparency in the implementation of energy programs.

Therefore, the success of Algeria's energy transition and the achievement of its green economy objectives require a comprehensive and integrated approach that combines accelerating project implementation, diversifying renewable energy sources, particularly wind energy, building national capacities in manufacturing and innovation, and developing scientific research, while strengthening governance and ensuring a clear strategic vision. This is particularly important in the field of green hydrogen, which represents a strategic opportunity for the future and has the potential to redefine Algeria's position on the global energy map, transforming it from a hydrocarbon-exporting country into a major player in the clean energy sector.

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