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Algeria's Energy Transition: Exploiting Renewable Potentials and Pathways Toward 2035

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Abstract :

This study analyses Algeria's energy transition and its role in advancing renewable energy development toward the 2035 targets. Combining a descriptive policy review with an econometric analysis based on the STIRPAT model, it examines the determinants of renewable electricity production over 1990–2023 using the Autoregressive Distributed Lag (ARDL) model approach. Results indicate that rising energy demand is the main long-run driver of renewable deployment, while hydrocarbon revenues exert a crowding-out effect and carbon emissions reinforce fossil fuel dependence. Short-run effects show that oil rents support temporary investment but do not sustain long-term transition. Projections to 2035 reveal a stagnating trajectory under current policies, insufficient to meet national targets. The study concludes that accelerating Algeria's transition requires structural reforms, reduced reliance on hydrocarbon revenues, and stronger investment frameworks to unlock renewable potential.

Keywords : renewable energy- energy transition- solar energy-energy policy- 2035 targets.

JEL Classification Codes : P280 ; Q180

1. INTRODUCTION

Global Energy Crisis and the Imperative of Transition.

The global energy system is at an inflection point. Decades of dependence on fossil fuels, coal, oil, and natural gas, have propelled anthropogenic greenhouse gas (GHG) emissions to unprecedented levels, rendering the 1.5 °C warming target of the Paris Agreement increasingly difficult to achieve and amplifying the frequency and severity of climate-related hazards across every inhabited continent. The Intergovernmental Panel on Climate Change (IPCC) has consistently underscored that a rapid, deep, and systemic decarbonisation of the energy sector is the single most consequential lever available to limit catastrophic warming (Bergougui, 2024); (Müller, 2024). Simultaneously, the structural fragility of fossil-fuel-dependent economies, exposed to volatile commodity markets, depleting reserves, and mounting environmental liabilities, has catalysed a global policy

consensus around the strategic imperative of energy transition. The International Energy Agency projects that, under net-zero pathways, renewable energy must account for nearly 90% of global electricity generation by 2050, requiring an unprecedented acceleration of investment and institutional reform (Jiang, 2025) . Against this backdrop, the energy transition has ceased to be a long-term environmental aspiration and has become an immediate economic and geopolitical necessity.

Conceptualising Energy Transition.

Conceptually, energy transition denotes a structural and progressive shift from predominant reliance on carbon-intensive fossil fuels toward renewable and low-carbon energy sources, including solar, wind, hydropower, biomass, and geothermal, accompanied by systemic improvements in energy efficiency, grid modernisation, and storage technology. Rojey (as cited in (Duruisseau, 2014) characterises this shift as the movement from a model founded 80% on fossil fuels toward one in which non-carbon energies are dominant, emphasising the scale of structural reconfiguration required. (Bouchard, 2009) frames the transition as the passage from a pre-fossil to a post-fossil energy regime, highlighting the disproportionate vulnerability of resource-dependent territories to market shocks and climate disruption. (Bernard, 2011) operationalises the concept through three concurrent levers, energy sobriety, energy efficiency, and renewable deployment, that collectively enable the sustainable satisfaction of energy needs whilst phasing out finite primary resources. These perspectives converge on a shared understanding: energy transition is not merely a technological substitution but a multidimensional sociotechnical transformation encompassing the redesign of production, distribution, and consumption systems, with profound implications for economic governance, spatial planning, and social equity (Chabouni, 2024) .

Drivers of the Energy Transition

The drivers compelling this transformation span three interrelated dimensions. Environmentally, the primary imperative is the abatement of GHG emissions, particularly CO_2, which dominate anthropogenic contributions to global warming. Fossil fuel combustion further generates co-pollutants, particulate matter, sulphur and nitrogen oxides, linked to respiratory diseases, cardiovascular pathologies, and ecosystem acidification, yielding immediate public health co-benefits from clean energy transitions (Patricia, 2014) ; (Tagrerout, 2021).

Economically, energy transition reduces exposure to commodity price volatility, lowers long-run energy costs as renewable technologies achieve and surpass cost-parity with fossil alternatives, and stimulates job creation across manufacturing, installation, and maintenance value chains, benefits of particular salience for hydrocarbon-dependent economies seeking diversification (Fraser, 2018); (Daniel, 2023). Governments play an enabling role through regulatory reform, subsidy rationalisation, and public-private financing architectures.

Socially, the transition advances energy justice by extending clean, affordable, and reliable energy access to disadvantaged and remote populations, whilst targeted workforce

transition programmes cushion employment displacement in legacy fossil sectors and expand green economy opportunities (Nyasapoh, 2025); (Derradji, 2024). The renewable energy imperative thus emerges from a convergent set of environmental, fiscal, and developmental imperatives, rather than from any single driver in isolation.

The MENA and African Regional Context

Within the MENA region and Africa more broadly, these global dynamics are refracted through the specific structural realities of hydrocarbon-dependent economies. The region harbours some of the world's most exceptional solar and wind resources, a potential estimated by IRENA (2023) at over 27,000 TWh/year for solar alone in North Africa, yet renewable energy penetration remains strikingly low relative to this endowment. Institutional inertia, fossil fuel subsidy regimes, and the dominance of state-owned hydrocarbon incumbents have historically crowded out investment in clean energy alternatives (Ben Khaled, 2024) . Recent scholarship has highlighted the compounding effects of the EU Green Deal, which simultaneously opens green hydrogen export markets for MENA producers whilst accelerating the structural decline of fossil fuel revenues upon which these economies depend (Rivera-Escartin, 2025). The African experience further illustrates the paradox: Morocco's Noor Ouarzazate solar complex and Kenya's Lake Turkana wind project demonstrate the technical and economic viability of large-scale renewable deployment in high-potential zones, yet the region as a whole continues to struggle with the gap between target ambitions and actual renewable penetration (Eyime, 2025). Algeria occupies a central and analytically revealing position within this regional landscape.

Algeria's Structural Energy Challenge

Algeria exemplifies with particular acuity the structural tensions inherent in the global energy transition. As Africa's largest country by territory and a major hydrocarbon exporter, the national economy remains anchored to fossil fuels, which account for approximately 99.5% of the primary energy mix (Sonatrach, 2023) . Hydrocarbon revenues finance the preponderant share of the state budget and foreign exchange earnings, rendering the economy acutely vulnerable to commodity price shocks. This vulnerability is compounded by an accelerating domestic demand surge: national energy consumption increased by 42.2% between 2013 and 2024 against only 12% production growth, progressively eroding the exportable surplus by an estimated 10 Mtoe since 2016 (Kebour, 2025). Gas-fired power plants dominate electricity generation and are projected to represent 84% of installed capacity by 2028, entrenching a carbon lock-in that constrains genuine sector transformation and risks accumulating stranded assets as the energy landscape shifts (Ouki, 2024). Algeria's commitments under the Paris Agreement, including a Nationally Determined Contribution (NDC) targeting conditional GHG emission reductions, further underscore the tension between a rentier fiscal model and an imperative for structural decarbonisation. The simultaneous exposure to fiscal sustainability pressures, climate obligations, and regional competitive dynamics makes Algeria a critical case for understanding the energy transition

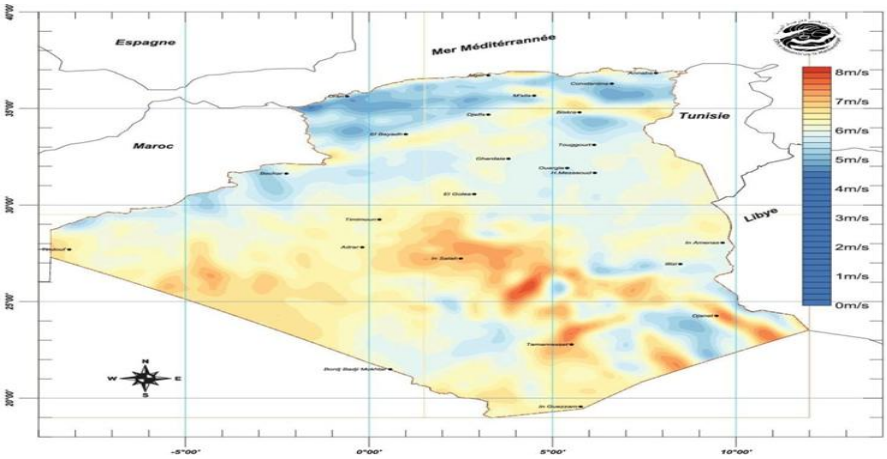
challenges of hydrocarbon-dependent middle-income economies ((Rivera-Escartin, 2025); (Cadi, 2025)).

Algeria's Renewable Energy Endowment

Against this structural backdrop, Algeria's renewable resource base presents a compelling foundation for transition.

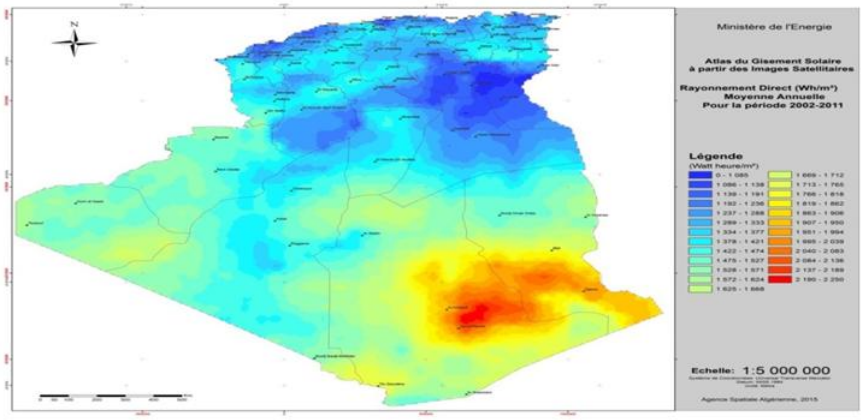
Solar energy constitutes the country's pre-eminent resource. Situated within the global solar belt, Algeria registers annual sunshine duration of up to 3,900 hours in the highlands and Sahara, with global horizontal irradiation averaging 1,700 kWh/m²/year in the north and surpassing 2,263 kWh/m²/year in the far south, values placing the country among the world's highest-irradiance territories ((MINISTRY OF ENERGY, 2012); (IRENA, 2023). A high-resolution GIS and multicriteria assessment by (Halimi, 2025) identify extensive "extremely suitable" zones for utility-scale solar PV concentrated in the southeastern Sahara, providing a spatially optimised foundation for large-scale deployment toward 2035 targets (Figure 1). Wind resources complement solar through spatial and temporal complementarity: high-plateau stations such as Tébessa, Biskra, and El Bayadh record speeds of 6–7 m/s, whilst the Great South exceeds 8 m/s in areas such as Tamanrasset, parameters compatible with utility-scale turbine operation. (Sekkal, 2024) demonstrate the technical and economic viability of wind-solar hybrid systems in the Naama high-plateau region, with turbine performance modelling confirming the potential for improved grid stability through complementary dispatch profiles (Figure 2). Algeria further holds geothermal resources concentrated in the northern regions, more than 200 hot springs identified, with peak temperatures reaching 118°C in Biskra across three high-potential zones, and an estimated 25 billion m³ of usable renewable surface water supported by over 50 operational dams (MINISTRY OF ENERGY, 2012); (IRENA, 2023) estimates the combined theoretical potential at 27,904 TWh/year for solar and 30,155 TWh/year for wind, figures that dwarf current national electricity consumption by several orders of magnitude and underscore the scale of the opportunity available.

Figure 1. Map of Average Annual Direct Global Irradiation in Algeria (2002–2011)



Source: (MINISTRY OF ENERGY, 2012), (Halimi, 2025)

Figure 2. Average Annual Wind Speed Map at 50 m Height in Algeria (2001–2010)



Source: (MINISTRY OF ENERGY, 2012)*;* (Sekkal, 2024)

National Policy Framework and the 2035 Targets

Translating this potential into deployable capacity requires a coherent institutional framework, which Algeria has progressively sought to construct through its National Renewable Energy Development Programme. Structured in two phases (Table 1), the programme originally targeted 22,000 MW of installed renewable capacity for the domestic market over 2015–2030, with photovoltaic solar as the dominant technology complemented by wind, CSP, biomass, cogeneration, and geothermal (MINISTRY OF ENERGY, 2012) .Subsequent strategic revisions moderated the timeline, converging on a current operational target of approximately 15 GW of grid-connected renewable capacity by 2035, primarily solar PV aiming for a 27–30% renewable share in national electricity production (Laib, 2024). Phase II envisions enhanced grid interconnection between the northern network and high-potential southern regions including Adrar, In Salah, Timimoun, and Béchar enabling large-scale desert solar installations. Algeria's ambitions extend to green hydrogen: (Boudghene Stambouli, 2024) document a national hydrogen strategy targeting exports of 30–40 TWh by 2040, a prospect reinforced by techno-economic HOMER Pro modelling that confirms the viability of PV-based hydrogen production across Algerian regions given available solar yields (Benchenina, 2025). Longer-horizon TIMES-DZA modelling by (Chabouni, 2024) demonstrates that renewable and hydrogen pathways to 2070 can align Algeria's energy diversification with SDG 7 and SDG 13 objectives, though their achievement is conditional on deeper climate policy commitment than currently enshrined in the NDC.

Table 1. National Renewable Energy Development Programme (2015–2030), MW

Technology	Phase I (2015–2020)	Phase II (2021–2030)	Total (MW)
Photovoltaic Solar	3,000	10,575	13,575
Wind	1,010	4,000	5,010

Concentrated Solar Power (CSP)	—	2,000	2,000
Cogeneration	150	250	400
Biomass	360	640	1,000
Geothermal	5	10	15
Total	**4,525**	**17,475**	**22,000**

Source: (MINISTRY OF ENERGY, 2012)

State of the Literature and Research Gap

A growing body of scholarship has examined various dimensions of Algeria's renewable energy transition, yet significant analytical gaps persist. (Cadi, 2025) addresses the dual challenge of sustaining hydrocarbon revenues whilst fulfilling climate commitments, emphasising the abundant solar and wind endowment as an underexploited asset. (Derradji, 2024) traces the environmental pressures rendering transition structurally inevitable, whilst (Khiati, 2024) examine the centrality of solar energy within national energy initiatives and its environmental contribution. From an econometric perspective, (Bergougui, 2024) demonstrates the asymmetric and non-linear relationship between fossil fuel consumption, renewable energy, and CO_2 emissions in Algeria, providing empirical grounding for the urgency of decarbonisation. (Ouki, 2024)delivers a critical analysis of fossil gas lock-in risks, showing how existing infrastructure commitments threaten to foreclose transition pathways through stranded asset accumulation (Müller, 2024) model cost-optimal power sector expansion scenarios, finding that a fully renewable electricity system is technically realisable but requires early, credible, and sustained policy commitment. (Chabouni, 2024) extend the horizon to 2070 through TIMES-DZA modelling, demonstrating the alignment of renewable and hydrogen pathways with sustainable development goals under more ambitious climate targets. The green hydrogen dimension is further developed by (Boudghene Stambouli, 2024) and (Benchenina, 2025), who confirm the techno-economic viability of PV-based hydrogen production and outline export infrastructure opportunities. At the resource assessment frontier, (Halimi, 2025) provide granular GIS-based solar suitability mapping, whilst (Sekkal, 2024) confirm the complementarity of wind and solar resources in hybrid system configurations. The political economy dimension is addressed by (Rivera-Escartin, 2025), who analyses hydrocarbon lock-in as a regime stability mechanism and examines the partial, contested nature of renewable reforms under (Sonatrach, 2023) dominance, and by (Ben Khaled, 2024), who identify institutional governance barriers to solar and wind deployment across the MENA region.

Collectively, these contributions illuminate specific dimensions of Algeria's transition challenge technological feasibility, economic modelling, political economy, resource mapping, and climate alignment but remain largely siloed within disciplinary and sectoral boundaries. No existing study integrates the full analytical arc from conceptual framing, resource endowment assessment, and programme architecture through to barrier

identification, strategic enablers, and forward-looking projections within a unified, policy-oriented framework. This fragmentation limits the actionable insights available to policymakers and investors navigating the complexity of Algeria's transition. The present study addresses this gap through a comprehensive descriptive-analytical synthesis that positions Algeria's energy transition challenge and opportunity within both global theoretical frameworks and the specific institutional realities of a hydrocarbon-dependent, resource-rich economy.

Against this backdrop, the central research question guiding this study is: How does the energy transition contribute to leveraging Algeria's renewable energy resources, and what structural factors condition its trajectory toward the 2035 national targets? Two hypotheses are examined: first, that economic imperatives, particularly the structural compression of hydrocarbon revenues and the accelerating surge in domestic energy demand, constitute the primary driver of Algeria's transition impetus; and second, that whilst the national renewable energy programmes and institutional frameworks established to date are consequential, they remain insufficient in the absence of deeper regulatory reform, investment liberalisation, and structural decoupling from the hydrocarbon rent economy. The study pursues five objectives: (i) to examine the conceptual framework of energy transition and its application to resource-dependent economies; (ii) to assess Algeria's renewable energy potential across solar, wind, geothermal, and hydraulic dimensions; (iii) to analyse the national programme architecture, its phased targets, and the emerging hydrogen strategy; (iv) to identify the principal structural barriers, financial, regulatory, technical, and institutional and the strategic role of public-private partnerships in overcoming them; and (v) to provide forward-looking insights on how a strategically managed energy transition can simultaneously advance environmental protection, economic diversification, and long-term energy security.

The study adopts a descriptive-analytical approach, combining a review of energy transition literature with an examination of Algeria’s energy context. Data are drawn from policy documents, international reports, and relevant academic studies.

2. METHODOLOGY

This study adopts a descriptive-analytical approach supplemented by econometric modelling. The descriptive part reviews official policy documents, national reports (Ministry of Energy, Sonatrach), and international sources (IRENA) to assess Algeria’s renewable potential, national programme, and implementation barriers. The econometric component, grounded in the STIRPAT framework, examines the determinants of renewable energy valorization in Algeria’s hydrocarbon-dependent economy.

Using annual time-series data (1990–2023), the model is specified in logarithmic form as:

$$\mathbf{LVALREN_t = \beta_0 + \beta_1\ LENC_t + \beta_2\ LCO2_t + \beta_3\ LHYDRO_t + \varepsilon_t}$$

where

- $\mathbf{LVALREN_t}$ is the log of renewable electricity production (dependent variable),
- $\mathbf{LENC_t}$ is the log of per capita energy consumption (demand pressure),

- $\mathbf{LCO2_t}$ is the log of per capita carbon emissions (environmental pressure),
- $\mathbf{LHYDRO_t}$ is the log of hydrocarbon exports (financing capacity), and
- $\boldsymbol{\varepsilon_t}$ is the error term.

The model is estimated using the Autoregressive Distributed Lag (ARDL) bounds testing approach in EViews 12, which is suitable for small samples and mixed integration orders. Dynamic forecasts are generated to project renewable electricity production up to 2035. This integrated methodology links qualitative context with quantitative evidence on the drivers shaping Algeria's energy transition toward its 2035 targets.

3. RESULTS AND DISCUSSION

3.1. Multicollinearity Diagnostic Test

Prior to model estimation, the potential presence of multicollinearity among the independent variables was examined using Pearson correlation coefficients and the Variance Inflation Factor (VIF), with results reported in Table 1.

Table 1. Correlation Matrix and Variance Inflation Factor (VIF) Results

Correlation Matrix	**ENC**	**CO2**	**HYDRO**
ENC	1		
CO2	0.730056	1	
HYDRO	0.149738	0.256028	1
Variance Inflation Factor (VIF)	**ENC**	**CO2**	**HYDRO**
	2.148049	2.247910	1.073549

***Source**: Compiled by the researcher using EViews 12 output.*

Based on the results in the table above (1), we find that all correlation coefficients between these variables, as shown in the correlation matrix, are less than 0.80, indicating a weak level of correlation. Furthermore, all VIF values for the variables were less than 10, indicating the absence of correlation in the standard model.

3.2. Unit Root Tests for Variable Stationarity

All-time series were subjected to the Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) unit root tests before model estimation. Under the ARDL framework, variables must be integrated of order I (0) or I (1), with none exceeding this bound Results are presented in Table 2.

Table 2. Unit Root Test Results for Study Variables

Variable	**ADF Test**				**PP Test**			
	At Level		**At First Diff.**		**At Level**		**At First Diff.**	
	t-Stat	**Prob.**	**t-Stat**	**Prob.**	**t-Stat**	**Prob.**	**t-Stat**	**Prob.**
VALREN	-3.699	0.037	-6.999	0.000	-3.689	0.037	-18.134	0.000
ENC	-2.307	0.419	-4.393	0.008	-2.273	0.436	-5.898	0.000

CO2	-1.858	0.653	-5.507	0.001	-1.810	0.677	-5.516	0.000
HYDRO	-1.641	0.755	-5.140	0.001	-1.729	0.715	-5.098	0.001

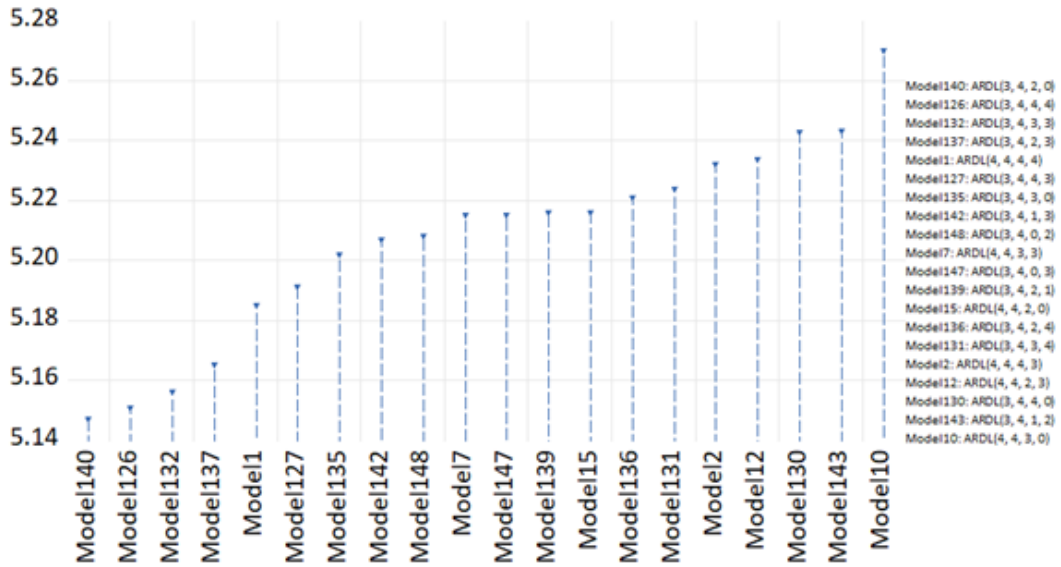
***Source**: Compiled by the researcher using EViews 12 output.*

Both the ADF and PP tests unanimously confirm that all variables are non-stationary at their levels but stationary at first difference, establishing uniform I(1) integration. This convergent result provides a solid econometric foundation for ARDL estimation and rules out the risk of spurious regression, a precondition particularly critical given the small sample size (T = 34) and the macro-financial nature of the series, consistent with the guidance of *Pesaran et al. (2001)*.

3.3. Optimal Lag Length Selection

Relying on the Akaike Information Criterion (AIC), the optimal specification identified is ARDL (3, 4, 2, 0), as illustrated in Figure 2. This structure accommodates the persistence in the dependent variable (LVALREN) and the distributed adjustment dynamics of the explanatory variables, ensuring that both short-run fluctuations and long-run equilibria are adequately captured without over-parameterisation.

Figure 2: Optimal Lag Length Selection — Top 20 ARDL Specifications by AIC



***Source**: Compiled by the researcher using EViews 12 output.*

3.4. Cointegration Test: Bounds Testing Approach

The Bounds Test of *Pesaran et al. (2001)* was applied to ascertain whether a stable long-run equilibrium relationship exists among the study variables. Results are summarised in Table 3.

Table 3. Bounds Test Results for Cointegration

F-Bounds Test		
K	**Value**	**Test Statistic**
3	8.859	F-Statistic
I(1) Bound	**I(0) Bound**	**Significance**
3.20	2.37	10%
3.67	2.79	5%
4.08	3.15	2.5%
4.66	3.65	1%

***Source**: Compiled by the researcher using EViews 12 output.*

The computed F-statistic (8.859) decisively exceeds the upper critical bound at all conventional significance levels (1%, 2.5%, 5%, and 10%), leading to the rejection of the null hypothesis of no cointegration. This confirms a stable long-run equilibrium relationship among renewable energy production, per capita energy consumption, carbon emissions, and hydrocarbon exports — a finding that corroborates the structural interdependence between Algeria's fossil fuel economy and its renewable energy trajectory highlighted by (Ouki, 2024) and (Bergougui, 2024) in the introduction.

3.5. ARDL Model Estimation

Table 4 presents the short-run dynamic estimates from the ARDL (3, 4, 2, 0) specification, examining per capita energy consumption (LENC), per capita carbon emissions (LCO2), and hydrocarbon exports (LHYDRO) as determinants of renewable electricity production (LVALREN).

Figure [Table 4]: ARDL (3,4,2,0) Estimation Results

Dependent Variable: LVALREN
Method: ARDL
Date: 03/16/26 Time: 12:16
Sample (adjusted): 1995 2023
Included observations: 29 after adjustments
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic): LHYDRO LENC LCO2
Fixed regressors: C
Number of models evalulated: 500
Selected Model: ARDL(3, 4, 2, 0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LVALREN(-1)	-0.267303	0.168298	-1.588269	0.1318
LVALREN(-2)	-0.382838	0.158399	-2.416921	0.0280
LVALREN(-3)	-0.471949	0.165488	-2.851863	0.0115
LHYDRO	3.213994	2.397428	1.340601	0.1988
LHYDRO(-1)	-3.112431	2.071540	-1.502472	0.1525
LHYDRO(-2)	-5.465898	2.160932	-2.529417	0.0223
LHYDRO(-3)	3.493852	2.350209	1.486614	0.1566
LHYDRO(-4)	-9.343240	2.920945	-3.198705	0.0056
LENC	89.95805	33.83609	2.658642	0.0172
LENC(-1)	46.40240	17.76913	2.611406	0.0189
LENC(-2)	33.84433	16.17343	2.092588	0.0527
LCO2	-122.2297	32.12686	-3.804596	0.0016
C	-1.066822	0.879729	-1.212671	0.2429

R-squared	0.754772	Mean dependent var	0.104212
Adjusted R-squared	0.570851	S.D. dependent var	4.164146
S.E. of regression	2.727911	Akaike info criterion	5.146794
Sum squared resid	119.0639	Schwarz criterion	5.759719
Log likelihood	-61.62851	Hannan-Quinn criter.	5.338754
F-statistic	4.103781	Durbin-Watson stat	1.688290
Prob(F-statistic)	0.004973		

***Source**: Compiled by the researcher using EViews 12 output.*

The model yields a satisfactory fit (R^2 = 75.4%) with strong overall significance (F = 4.10, $p < 0.01$). The Durbin–Watson statistic (DW = 1.68) indicates the absence of first-order serial autocorrelation. At the level of short-run dynamics, LCO2 exerts a highly significant negative effect ($p < 0.01$), while LENC shows a significant positive effect. LHYDRO displays statistically mixed lagged responses, particularly at lags two and four, consistent with the structural complexity of an economy in which hydrocarbon revenues simultaneously finance and constrain clean energy investment.

3.6. Long-Run and Short-Run Coefficient Estimates

Table 5. Long-Run, Short-Run, and Error Correction Model (ECM) Estimates Under the ARDL Approach

Long-Run Coefficients				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LHYDRO	-5.284281	2.429711	-2.174860	0.0450 **
LENC	80.20618	27.95881	2.868727	0.0111 **
LCO2	-57.59872	16.98911	-3.390331	0.0037 ***
C	-0.502722	0.438280	-1.147034	0.2682
Short-Run Dynamics				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(LVALREN(-1))	0.854788	0.212026	4.031530	0.0010 ***

D(LVALREN(-2))	0.471949	0.142198	3.318968	0.0043 ***
D(LHYDRO)	3.213994	1.808988	1.776680	0.0946 *
D(LHYDRO(-1))	11.31529	2.288743	4.943886	0.0001 ***
D(LHYDRO(-2))	5.849387	2.247265	2.602891	0.0192 **
D(LHYDRO(-3))	9.343240	2.108316	4.431612	0.0004 ***
D(LENC)	89.95805	17.59596	5.112427	0.0001 ***
D(LENC(-1))	-33.84433	11.63542	-2.908733	0.0103 **
Error Correction Model (ECM)				
CointEq(-1)	-2.122091	0.285186	-7.441071	0.0000 ***
Diagnostic Statistics				
R-squared (R^2)	0.902251	**Adjusted R^2**	0.863151	
Durbin-Watson	1.688290	**S.E. of regression**	2.439917	

***Source**: Compiled by the researcher using EViews 12 output. *** p<0.01, ** p<0.05, * p<0.10*

Long-run dynamics: The adjusted R^2 of 86.3% indicates strong explanatory power. The error correction term (CointEq(−1) = −2.12, $p < 0.001$) is highly significant, confirming the existence of a long-run equilibrium relationship. However, its absolute value exceeding unity suggests a rapid but potentially oscillatory adjustment process, implying that the renewable energy sector in Algeria is highly sensitive to short-run economic shocks.

In the long run, a clear structural paradox emerges. Hydrocarbon exports (LHYDRO) exert a statistically significant negative effect (−5.28, $p < 0.05$), revealing a crowding-out mechanism whereby oil rent revenues appear to suppress long-term incentives for renewable energy investment. Carbon emissions (LCO2) also show a strong negative long-run impact (−57.60, $p < 0.01$), indicating that Algeria's industrial and energy systems remain deeply entrenched in fossil-fuel-intensive pathways. In contrast, per capita energy consumption (LENC) emerges as the dominant positive driver (80.21, $p < 0.05$). This suggests that rising domestic energy demand acts as the primary structural force compelling policymakers to treat renewable energy development as an economic necessity rather than a purely environmental choice.

Short-run dynamics: In the short run, the relationship exhibits a markedly different pattern. The distributed lags of hydrocarbon exports (LHYDRO) display positive and statistically significant cumulative effects across several lags. This indicates that oil revenues are used in the short term as a financial source to support preparatory renewable energy investments, yet without translating into a sustained long-term strategic commitment.

The positive short-run effect of energy demand (LENC = 89.96, $p < 0.001$) and its subsequent negative correction at lag one further confirms that demand-side pressures generate immediate but temporary stimulus for renewable deployment. Overall, these findings highlight an asymmetry between short-run financing opportunities and long-run structural constraints, underscoring the need for stronger policy anchoring to maintain momentum.

3.7. Model Diagnostic Tests

Table 6 reports the results of post-estimation diagnostic tests applied to validate the statistical reliability of the estimated model.

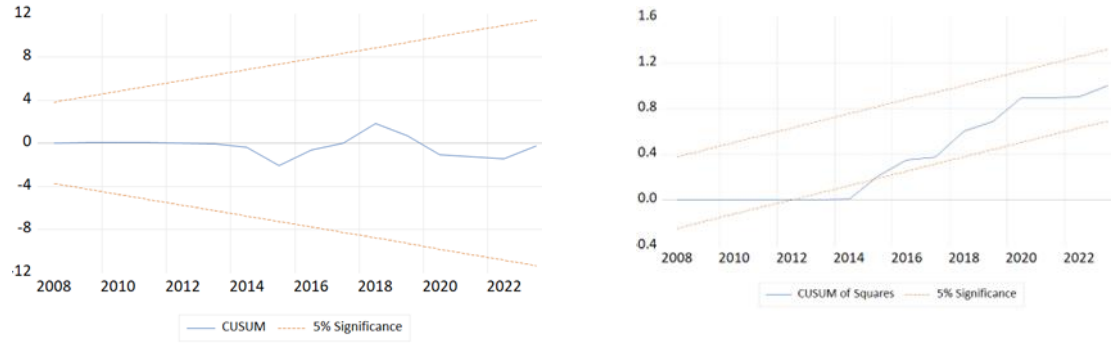
Table 6. Diagnostic Test Results for the Estimated Model

Diagnostic Test	**Statistic**	**Value**	**d.f.**	**Prob.**
Breusch–Godfrey LM (Serial Autocorrelation)	F-statistic	0.4913	(2, 14)	0.6220
	Obs*R-squared	1.9020	Chi²(2)	0.3863
ARCH (Cond. Heteroscedasticity)	F-statistic	0.5651	(1, 26)	0.4589
	Obs*R-squared	0.5956	Chi²(1)	0.4402
Jarque–Bera (Residual Normality)	JB statistic	1.7863	—	0.4093

Source: *Compiled by the researcher using EViews 12 output.*

All diagnostic probabilities exceed the 5% significance threshold. The Breusch–Godfrey LM test confirms no serial autocorrelation; the ARCH test verifies conditional variance homoscedasticity; and the Jarque–Bera statistic confirms normality of residuals. Collectively, these results establish the efficiency and unbiasedness of the estimated parameters, providing a robust methodological foundation for the forecasting exercise that follows. The CUSUM and CUSUMSQ structural stability tests (Figure 3) further confirm that model parameters remain stable over the full estimation period, ruling out structural breaks that could compromise the validity of the long-run estimates.

Figure 3: CUSUM and CUSUMSQ Structural Stability Test Results



Source: *Compiled by the researcher using EViews 12 output.*

Dynamic Forecasting of Energy Transition Through 2035: An Econometric Assessment of Current Policies

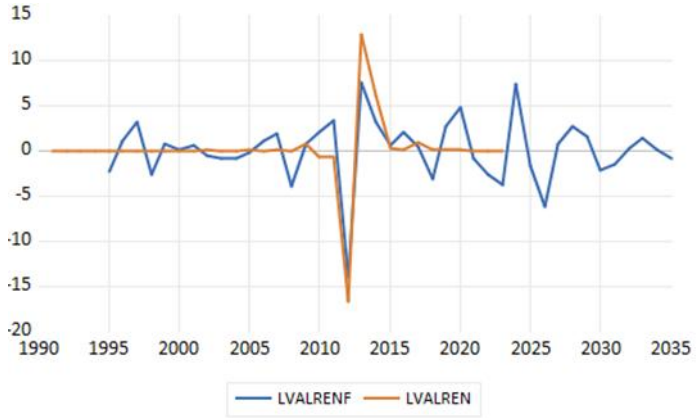
To explore the prospective trajectory of Algeria's renewable energy sector, this section applies dynamic forecasting within the estimated ARDL (3, 4, 2, 0) model, extrapolating future values for the explanatory variables via ARIMA methodology. This approach simulates a business-as-usual (BAU) scenario, assuming that the prevailing economic structure and energy policies evolve organically without structural shocks or exceptional sovereign interventions through 2035.

Table 7. Projected Trajectory of Renewable Energy Valorisation in Algeria (Outlook to 2035)

Year	Trajectory Classification	Projected Value (log)	Original Units
2024	Ex-ante Forecast Base Year (2024)	7.4100	1,652.532
2025	Short-term: Immediate Policy Response	−1.7245	0.1782
2030	Medium-term: Phase I Interim Assessment	−2.1029	0.1220
2035	Long-term: National 15,000 MW Programme Horizon	−0.8395	0.4318

Source: *Compiled by the researcher using EViews 12 dynamic forecast output.*

Figure 4: Prospective Trajectory of Renewable Energy Valorisation in Algeria (2024–2035)



Source: *Compiled by the researcher using EViews 12 output.*

The forecast results reveal a fragile and stagnant trajectory for renewable electricity production. Starting from a base-year value of 1,652.53 in 2024, the projections show a marked decline to an index value of 0.122 by 2030, followed by only a marginal recovery to 0.431 in 2035 far below the national programme's target of 15 GW installed renewable capacity.

This trajectory statistically confirms the inadequacy of the business-as-usual (BAU) scenario and the absence of a cumulative investment effect in green energy. The outcomes remain highly sensitive to transient fluctuations rather than following a path of sustained or exponential growth.

Overall, the findings indicate that reliance on current structural drivers is insufficient to achieve Algeria's 2035 renewable energy targets. The projected stagnation highlights the limitations of incremental progress and underscores the need for a decisive structural break from existing policies. Achieving meaningful progress will require a bold, insulated investment model, strengthen regulatory frameworks, and accelerate technological change to overcome the low-growth trap evident in the forecasts.

Key Findings of the Econometric Study

- Long-run estimates reveal that per capita energy consumption (LENC) is the dominant structural driver of renewable energy valorisation, exhibiting a very high positive elasticity (80.21). This confirms that domestic pressure from conventional energy demand constitutes the primary incentive for transitioning toward renewable alternatives in Algeria consistent with the demand-driven transition rationale advanced by Cadi (2025) and Müller et al. (2024).
- The significant negative long-run effects of hydrocarbon exports (LHYDRO) and carbon emissions (LCO2) jointly evidence a carbon lock-in and a hydrocarbon crowding-out mechanism that suppress renewable investment, corroborating the structural barriers identified by (Ouki, 2024), (Rivera-Escartin, 2025), and (Bergougui, 2024).
- The BAU forecast confirms that reliance on current structural determinants will leave Algeria substantially short of its 2035 renewable targets. A decisive structural break entailing an insulated investment model, regulatory reform, and accelerated technological change is a necessary, not optional, condition for overcoming the "low-growth trap" revealed by the econometric projections and anticipated in the policy modelling of (Chabouni, 2024)and (Benchenina, 2025).

CONCLUSION

Algeria's energy transition is a strategic necessity to reduce hydrocarbon dependency, mitigate carbon lock-in, and meet rising domestic demand while fulfilling climate commitments. The findings show that energy demand is the main long-run driver of renewable electricity development, whereas reliance on hydrocarbon revenues exerts a crowding-out effect and reinforces fossil fuel dependence. Projections to 2035 indicate a stagnant trajectory under current policies, falling short of national targets (15 GW and 27–30% renewable share).

Despite significant solar and wind potential, progress remains constrained by regulatory uncertainty, infrastructure gaps, and the distortive role of fossil fuel rents. While oil revenues may support short-term investments, they cannot sustain long-term transition without structural decoupling.

To accelerate the transition, Algeria must implement targeted reforms: enhance regulatory stability, gradually phase out fossil fuel subsidies, expand public–private partnerships, strengthen grid infrastructure, and support local industrial development in solar and green hydrogen. Increased cooperation with International Renewable Energy Agency and the EU will be critical for financing and technology transfer.

A coherent and decisive policy shift can enable Algeria to unlock its renewable potential, improve energy security, and achieve a resilient, low-carbon energy system by 2035.

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