

Institutional quality and its role in accelerating the transition to renewable energy: A comparative study between fossil fuel-producing and non-producing countries in the Middle East and North Africa

Dr. Abdelbasset BENMAMMAR ¹, Pr. Nacer Salah Eddine GHERBI ²,
and Pr. Mohammed BENLEBBAD ^{3*}

¹ University of Abou Bekr Belkaïd, Tlemcen, Algeria. Email: abdelbasset.benmammar@univ-tlemcen.dz. ORCID iD: 0009-0008-8539-8367

² University of Abou Bekr Belkaïd, Tlemcen, Algeria. Email: sgherbi@yahoo.fr; nacersalaheddine.gherbi@univ-tlemcen.dz. ORCID iD: 0009-0006-8954-2974

³ University Centre of Maghnia, Tlemcen, Algeria. Email: m.benlebbad@cu-maghnia.dz. ORCID iD: 0009-0000-5767-3263

Abstract---This study examines the impact of institutional quality on the transition to renewable energy in 12 countries across the Middle East and North Africa (2000–2022) using a Panel-ARDL model. Long-term results reveal that non-oil economies outperform their their share of clean energy, driven by transparent governance and effective political stability, whereas oil-dependent economies face institutional constraints that hinder green investment. In the short term, the Error Correction Term (ECT) emerges as the sole statistically significant factor, underscoring the need for sustained institutional reforms to maintain momentum. The study recommends the introduction of specialized financing instruments (green bonds and investment funds) and the strengthening of accountability mechanisms to facilitate a fair and effective energy transition.

Keywords---Renewable Energy; Institutional Quality; Energy Transition; Middle East and North Africa (MENA); Panel-ARDL Model; Sustainability oil-rich counterparts in expanding

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Introduction

The world today faces a significant challenge: transitioning from conventional fossil fuel-based energy to more sustainable renewable energy sources. This shift aims to achieve energy security, reduce carbon emissions, and promote sustainable development. In this context, institutional quality plays a fundamental role in accelerating this transition, as it influences the effectiveness of energy policies, the attraction of investments, and the stability of the regulatory framework governing the renewable energy sector. However, Middle Eastern and North African (MENA) countries face various obstacles in this area, particularly due to significant disparities in their institutional quality, which causes the impact of these factors to vary from one country to another.

Research Problem

Despite the increasing efforts by many countries in the region to support the energy transition, institutional quality remains a critical factor for the success of this process. Given this reality, this study seeks to answer the following central question:

"To what extent does institutional quality impact the acceleration of the energy transition process in MENA countries? And does this impact differ between fossil fuel-producing and non-producing countries?"

Hypotheses

- **Hypothesis 1:** Effective regulatory quality, through clear and supportive renewable energy policies and legislation, accelerates the energy transition process in MENA countries by fostering a stable and sustainable investment environment.
- **Hypothesis 2:** Political stability is a critical factor in supporting the energy transition. Stable governments contribute to the implementation of long-term renewable energy strategies, whereas instability slows down investments in the sector and undermines transition efforts.
- **Hypothesis 3:** The impact of institutional quality on the energy transition differs between oil and non-oil producing countries. Oil-rich countries rely on existing economic structures, which may limit their adoption of renewable energy compared to non-fossil fuel-producing countries, which seek to diversify their energy sources more rapidly.

Research Methodology

This study employs quantitative analysis using an **ARDL (Autoregressive Distributed Lag Model)**, one of the most suitable models for examining the relationship between economic variables in both the short and long run. Economic and institutional data from several MENA countries over an appropriate time period will be analyzed to measure the impact of institutional quality on the energy transition. The study will also divide the sample into two main groups:

1. **Fossil fuel-producing countries**, which rely heavily on oil and gas revenues, and include: Iraq, Qatar, the UAE, Libya, Algeria, and Kuwait.
2. **Non-fossil fuel-producing countries**, which may be more incentivized to adopt renewable energy sources due to their lack of traditional resources, and include: Jordan, Lebanon, Mauritania, Morocco, Tunisia, and Turkey.

This division will enable a precise comparison between the two categories, helping to determine how the impact of institutional quality on renewable energy policies varies according to the nature of a country's economy and its reliance on fossil fuels.

Study Objectives

1. To measure the impact of institutional and economic variables on the share of renewable energy in oil-producing and non-oil-producing countries during the period 2000–2022.
2. To compare short-run and long-run responses using a **Panel ARDL (PMG) model**.
3. To formulate institutional and financial recommendations to enable an effective and sustainable energy transition in these countries.

Study Structure

- **Theoretical Framework:** The theoretical approach to the role of institutional quality in the energy transition.
- **Literature Review:** A review of previous studies, including a bibliometric analysis, and an identification of the research gap.
- **Empirical Study:** Application of the **Panel ARDL model** to data from 12 countries (6 oil-producing, 6 non-oil-producing), a discussion of the empirical results, and an economic interpretation of these findings.

I. The Theoretical Approach to the Role of Institutional Quality in Accelerating the Energy Transition

Institutional quality is a fundamental concept in contemporary economic and political analysis, reflecting the capacity of legal, regulatory, and governance structures to manage public affairs efficiently and effectively, and to allocate resources in a manner that serves sustainable development objectives. Its importance lies in its structural role in protecting property rights, enforcing contracts, reducing transaction costs, and enhancing transparency and accountability. From this perspective, robust institutions form the cornerstone for stimulating investment and ensuring the efficacy of public policies, particularly in strategic and sensitive sectors such as energy (Halldén et al. 2025). Governance literature supports this view by emphasizing that institutional quality is manifested in the ability to enforce the law, reduce bureaucracy, and entrench democratic accountability mechanisms, as measured by indicators such as control of corruption, government effectiveness, political stability, and the rule of law (Saadaoui and Chtourou 2023).

Within this framework, the energy transition—according to the World Bank—is defined as a comprehensive shift from traditional fossil fuel-based energy systems to modern, clean, reliable, and more sustainable systems. This transition is an essential element in achieving low-carbon economic development, as it offers opportunities to expand energy access, improve efficiency, reduce emissions, and enhance energy security. This transformative path is driven by the dynamic decline in the cost of renewable energy, advancements in smart storage technologies, and increasing global climate pressures urging an immediate shift towards sustainability (Americo, Johal, and Upper 2023).

However, this transition is not without complex structural challenges, which has led to the emergence of the concept of a "just energy transition." This concept focuses on ensuring an equitable shift that considers socio-economic justice and avoids the marginalization of vulnerable groups. It is grounded in the principles of distributive, procedural, and corrective justice to ensure a balanced distribution of costs and benefits within a framework of transparency and inclusiveness. Nevertheless, this model faces structural obstacles, including weak legal frameworks, scarce financial resources, a lack of political will, and the difficulty of establishing unified standards for measuring transitional justice across different contexts. Fundamental questions are also raised regarding the role of financial institutions, particularly central banks, in directing their regulatory and financing tools to support this transition in line with sustainability requirements (Chukwuemeka and al. 2023).

In this context, institutional quality emerges as a pivotal pillar for the success of the energy transition, as it enables the creation of a stable investment environment, boosts confidence in legislative and regulatory frameworks, and strengthens synergy among stakeholders in the energy and digital economy sectors (Hwang and Venter 2025). Effective institutions are a mainstay in formulating and efficiently implementing energy policies and in adapting to rapid technological and environmental shifts, whereas weak governance is a direct impediment to the deployment and adoption of renewable energies.

Recent studies confirm that institutional quality—encompassing regulatory efficiency, transparency, and independence—is among the most significant factors influencing the attractiveness of the investment environment for clean energy projects. It reduces economic and political risks and enhances the

resilience of energy systems to climate and economic crises, making it a critical element in supporting the energy transition pathway (Javed, Yong, and Ashraf 2025).

These conclusions are supported by the findings of Halldén et al. (2025), which demonstrated that higher institutional quality is positively correlated with increased public investment in the renewable energy sector, particularly in middle-income countries. The study showed that energy policies are more effective in cohesive institutional environments, free from corruption, and capable of ensuring investment sustainability and achieving climate and development goals.

Furthermore, the complexity and long-term nature of renewable energy projects necessitate institutions with high executive efficiency and advanced regulatory capabilities, enabling them to direct strategic policies and monitor their implementation effectively. This is particularly crucial in developing countries where energy investment heavily relies on public resources (Halldén et al. 2025).

Comparative experiences from Southeast Asian countries, such as Vietnam and Malaysia, reveal how institutional reforms contributed to advancing the energy transition by developing regulatory frameworks, adopting tax incentives, and creating an attractive environment for investors. Conversely, the experiences of countries like Myanmar and the Philippines highlight the negative consequences of weak institutional stability, which hindered the implementation of effective energy transitions. These cases affirm that sound governance is not merely a supporting factor but a moderating element that helps reduce volatility in energy security and strengthens the linkage between energy policies and economic growth (Azimi, Rahman, and Maraseni 2025).

In light of the foregoing, it can be concluded that the relationship between institutional quality and the energy transition embodies a structural and integrative interconnection that goes beyond the technical aspects of the transition to the very core of its governing governance and institutional framework. Strong institutions, characterized by regulatory efficiency, transparency, and stability, represent the fundamental foundation upon which modern energy policies are built, especially in contexts striving for a just and inclusive energy transition. The effectiveness of these institutions is evident in their ability to mobilize resources, mitigate risks, and create a secure and stimulating investment environment for technology localization and innovation. By activating the principles of distributive, procedural, and corrective justice, robust institutions enable the equitable distribution of the benefits and costs of the transition, thereby enhancing its social acceptance and economic sustainability. Conversely, weak institutional quality—manifested in widespread corruption, a weak rule of law, and political instability—constitutes a structural obstacle that impedes the implementation of energy policies and undermines their effectiveness. Therefore, reforming the institutional system and enhancing indicators of sound governance are structural prerequisites for the success of energy transition strategies and the achievement of their long-term climate and development goals.

II. Literature Review

This section provides a rigorous analysis of previous studies that have examined the relationship between institutional quality and the energy transition, reviewing scholarly contributions in light of diverse contexts and methodologies. It aims to build a solid conceptual foundation that helps reveal the research gap this study seeks to address, utilizing a bibliometric approach.

✓ **Study: Azimi, M.N., Rahman, M.M., Maraseni, T. – 2024 – "Powering Progress: The Interplay of Energy Security and Institutional Quality in Driving Economic Growth"**
This study examined the relationship between energy security, institutional quality, and economic growth in eight South Asian countries between 2000 and 2022. The results showed that low energy efficiency hinders growth, while improving institutional quality enhances the impact of energy security on development. The study recommends reforming institutional structures, developing infrastructure, and encouraging investment in renewable energy (Azimi, Rahman, and Maraseni 2024).

✓ **Study: Ben Ahmed Mtiraoui, Lazreg, & Chemli – 2024 – "Institutional Quality, Energy Transition, and Economic Growth in MENA Countries"**

This study aimed to analyze the relationship between institutional quality, economic growth, and the energy transition in MENA countries during the period 2000–2022, using a Simultaneous Equations Model (SEM). The results concluded that institutional quality promotes economic growth by improving the business environment, but does not directly contribute to accelerating the energy transition due to infrastructure and bureaucratic obstacles. It also showed that improved governance contributes to lower emissions. The study recommended institutional reforms, combating corruption, and expanding public-private partnerships to support the green economy (Ben Ahmed Mtiraoui et al., n.d.).

✓ **Study: Inglesi-Lotz, R. – 2024 – "Assessing the Impact of Institutional Quality on South Africa's Transition to Renewables"**

This study sought to explore the impact of institutional quality on the share of renewable energy in South Africa's energy mix, relying on time series analysis. The results revealed that a higher perception of corruption is associated with increased adoption of renewable energies, while regulatory quality has a negative impact in the short term but becomes stimulative in the long term. Government efficiency showed an unexpected negative impact on the energy transition due to its support for traditional industries. The study recommends reforming institutional frameworks and fostering a flexible investment environment (Inglesi-Lotz 2023).

✓ **Study: Satrianto, A., Ikhsan, A., et al. – 2024 – "The Effect of Institutional Quality on Renewable Energy: Evidence from Developing Countries"**

This study addressed the relationship between institutional quality and the adoption of renewable energy in developing countries, focusing on governance indicators, corruption, regulatory quality, and government effectiveness. The results showed that countries with strong institutions adopt sustainable energy policies more rapidly, while corruption is a major obstacle to developing green projects. Regulatory quality also has a positive long-term effect. The study recommends strengthening institutional reforms, stimulating education and innovation, and removing bureaucratic obstacles (Satrianto et al. 2024).

✓ **Study: Saboori, B., Mahdavian, S.M.R., Radmehr, R. – 2024 – "Assessing the Environmental Impact of Institutional Quality in MENA: The Role of Energy and Trade"**

This study aimed to assess the impact of institutional quality on carbon emissions in MENA countries, focusing on renewable and non-renewable energy consumption and foreign trade. The results showed that improving institutional quality—particularly through transparency, accountability, and the rule of law—leads to a reduction in emissions. Government effectiveness and corruption control were also critical factors in improving environmental performance. The study recommends enhancing environmental governance and stimulating sustainable investments (Saboori, Mahdavian, and Radmehr 2024).

✓ **Study: Yan, C., Ahmed, S., Solangi, Y.A., et al. – 2024 – "The Nexus Between FDI, Economic Progress, and Institutional Quality in Fostering Sustainable Energy Efficiency: Evidence from BRICS Economies"**

The study aimed to analyze the relationship between foreign direct investment (FDI), institutional quality, and sustainable energy efficiency in BRICS economies. The results showed that FDI flows contribute to enhancing energy efficiency, especially in China and Brazil, when a strong institutional environment exists. It also revealed an inverted U-shaped relationship (Environmental Kuznets Curve) between economic growth and emissions. The study recommended improving institutional quality, fostering innovation, and promoting trade openness to support green technologies (Yan et al. 2024).

✓ **Study: Hwang, Y.K., Venter, A. – 2024 – "The Role of the Digital Economy and Institutional Quality in Promoting the Transition to Low-Carbon Energy"**

The study analyzed the impact of the digital economy and institutional quality on the transition to low-carbon energy in 85 countries during the period 2003–2021. The results showed that digital technologies contribute to improving energy efficiency and increasing reliance on renewable sources, while the impact of institutional quality remains varied depending on the level of corruption and

bureaucracy. The study recommended institutional reforms and strengthening the technological infrastructure to support the energy transition (Hwang and Venter 2025).

✓ **Study: Nawaz, A., Rahman, M.M. – 2023 – "Renewable Energy Consumption in Sub-Saharan Africa: The Role of Human Capital, FDI, Financial Development, and Institutional Quality"**

The study analyzed the factors affecting renewable energy consumption in 31 Sub-Saharan African countries during the period 2002–2019, focusing on human capital, FDI, financial development, and institutional quality. The results showed that weak institutional frameworks and bureaucracy limit the effectiveness of energy policies, despite the importance of education and finance. The study recommends promoting green finance, improving institutional quality, and enhancing specialized technical education (Nawaz and Rahman 2023).

✓ **Study: Gatto, A., Loewenstein, W., Sadik-Zada, E.R. – 2021 – "An Extensive Data Set on Energy, Economy, Environmental Pollution and Institutional Quality in Petroleum-Reliant Developing and Transition Economies"**

This study provided a comprehensive database to analyze the relationship between energy, pollution, the economy, and institutional quality in oil-reliant developing and transition economies between 1989 and 2019. The results showed that institutional quality reduces emissions, while corruption fosters fossil fuel consumption. Furthermore, reliance on oil achieves short-term growth but later leads to environmental and economic volatility. The study recommends diversifying energy sources and enhancing environmental governance (Sadik-Zada and Gatto 2021).

Research Gap on the Role of Institutional Quality in Accelerating the Energy Transition in MENA Countries:

1. **Weak Explanatory Models of Institutional Impact Mechanisms:**
Most studies remain limited to demonstrating the general relationship between institutional quality and renewable energy, without a deep analysis of how regulatory stability, corruption control, and policy effectiveness specifically accelerate the energy transition, particularly in the volatile contexts of MENA countries.
2. **Lack of Analytical Comparison between Fossil Fuel-Producing and Non-Producing MENA Countries:**
The current literature suffers from a clear lack of comparative studies that distinguish between the institutional and economic contexts of fossil fuel-producing countries (e.g., Gulf states) and non-producing countries (e.g., Morocco, Tunisia, Jordan) within the MENA region. While analyses often focus on rentier countries with massive financial resources that tend to transition slowly due to their structural link to fossil fuel exports, the experiences of energy-importing countries—which often show greater resilience and a faster drive to adopt sustainable energy policies as a strategic necessity—are overlooked. This omission not only prevents a comprehensive understanding of the dynamics of the energy transition in the region but also hinders the development of targeted policies that account for the varying incentives and institutions between the two groups.
3. **Insufficient Studies on the Role of Institutions in Attracting Investment and Fostering Innovation:**

The relationship between institutional quality, on one hand, and its ability to create an environment attractive to foreign direct investment and financing for clean energy innovation, on the other, remains inadequately studied. This limits the formulation of effective policies for a sustainable transition in the region.

Based on the results of the bibliometric analysis and the identification of the existing knowledge gaps, this study aims to provide an in-depth analytical treatment of the role of institutional quality in accelerating the energy transition in MENA countries. It will highlight the distinction between energy-producing and non-producing countries and explore the governance mechanisms for activating investment and promoting innovation in renewable energies.

III. Methodology and Tools

3.1. The Dynamic Panel Model: Panel ARDL

The study by Pesaran and Smith (1995) indicates that applying the assumption of homogeneity or equal slopes in dynamic panel models leads to a problem described as the "bias of heterogeneous slope parameters." This results in inconsistent estimates due to the heterogeneity of slope parameters, even with large samples. Pesaran et al. (1999) proposed two methods to address the bias arising from heterogeneous slopes in dynamic panel models: the **Mean Group (MG) estimator** and the **Pooled Mean Group (PMG) estimator**. The PMG estimator, in particular, accounts for heterogeneity in the short run while constraining the long-run coefficients to be homogeneous across cross-sections, thus allowing the model's parameters to vary for each country in the short run.

3.1 Advantages of using the Panel ARDL model:

1. It allows for heterogeneous or homogeneous relationships using methods like PMG, MG, and DFE (Dynamic Fixed Effects).
2. It does not require all variables to be of the same order of integration. It can be used when variables are a mixture of I(0) and I(1), but it does not accept I(2) variables.
3. It is well-suited for dynamic and long-term relationships.
4. It is appropriate for small and medium-sized samples.

3.2. Cross-Sectional Dependence Test

Cross-sectional dependence can lead to inconsistent estimates and may yield biased results (Ditzen, 2018, p. 586). Therefore, Pesaran (2015, p. 1101) proposed a test for weak cross-sectional dependence. According to this test, weak cross-sectional dependence implies that the correlation between units (cross-sections, groups) at any point in time approaches zero as the number of cross-sections tends to infinity. Under strong cross-sectional dependence, the correlation between units converges to a constant. The null hypothesis of this test is that the error term (or variable) is weakly dependent across cross-sections. This means that the correlation between the observation for cross-section *i** at time *t** and cross-section *j** at time *t** is equal to zero.

Pesaran (2015) suggested the following formula for testing cross-sectional independence in a balanced panel data set, which aggregates the pairwise correlation coefficients of the different units:

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^N \hat{\rho}_{ij} \right) \rightsquigarrow N(0, 1) \dots\dots\dots (2)$$

$\hat{\rho}$ It is the correlation coefficient for the unit *i* and *j*.

3.3. Slope Homogeneity Test

The presence of Cross-Sectional Dependence suggests that countries may share common characteristics in their economic development patterns. Consequently, testing for slope heterogeneity across cross-sections is essential; failure to do so can lead to inaccurate results, as noted by Breitung (2015). Yamagata & Pesaran (2008) extended Swamy's (1970) original method to test for slope coefficient homogeneity using two statistics: the standardized dispersion statistic ($\tilde{\Delta}$) and the bias-adjusted statistic ($\tilde{\Delta}_{A}$), as detailed in Pesaran & Yamagata (2008, pp. 50-93):

$$\tilde{\Delta} = \sqrt{N} \left(\frac{N^{-1}\tilde{S} - K}{\sqrt{2K}} \right) \rightsquigarrow \chi_K^2 \dots\dots\dots (3)$$

$$\tilde{\Delta}_{adj} = \sqrt{N} \left(\frac{N^{-1}\tilde{S} - K}{\sqrt{\frac{2K(T-K-1)}{T+1}}} \right) \rightsquigarrow N(0,1) \dots\dots\dots (4)$$

$$\Delta Y_{i,t} = \alpha_i + \beta_i Y_{i,t-1} + c_i \bar{Y}_{t-1} + d_i \Delta \bar{Y}_t + \varepsilon_{i,t} \dots \dots \dots (4)$$

3.4. Second-Generation Panel Unit Root Tests

To test for stationarity in the presence of cross-sectional dependence, it is necessary to employ second-generation panel unit root tests, such as those developed by Pesaran (2007). First-generation tests are invalid as they do not account for cross-sectional correlation (Pesaran, 2007). Among these second-generation tests are the following (Christopoulos & León-Ledesma, 2008, p. 5):

3.4.1. Cross-Sectionally Augmented Dickey-Fuller (CADF) Test

This test is based on the standard Ordinary Least Squares (OLS) method with fixed effects. It essentially extends the conventional Augmented Dickey-Fuller (ADF) methodology by incorporating the cross-sectional mean of the lagged level and its first difference into the regression equation. The test is based on the following model:

$$\bar{Y}_i = \frac{1}{N} \sum_{i=1}^n Y_{i,t}$$

3.4.2. Cross-Sectionally Augmented IPS (CIPS) Test

Pesaran (2007) proposed this test, which involves calculating the simple average of the t-statistics for β_i obtained from the individual CADF regressions using Ordinary Least Squares (OLS). This means the CADF equation is estimated separately for each cross-sectional unit (country), and the CIPS statistic is then computed as follows:

$$CIPS = \frac{1}{N} \sum_{i=1}^N CADF_i \dots \dots \dots (5)$$

CADF_i It is the expanded Dickey-Fuller syllabus. *i*

3.5. Cointegration Testing

To identify a long-run relationship between variables, cointegration tests must be employed. However, in the presence of cross-sectional dependence, standard cointegration tests such as those by Johansen, Kao, or Pedroni yield biased and unreliable estimates. Furthermore, these tests provide inaccurate results in short time dimensions (Hira et al., 2019, p. 27132). Therefore, it is necessary to use cointegration tests that account for cross-sectional dependence and heterogeneous variance to detect the long-run relationship between variables.

The test proposed by **Westerlund (2007)** is one such method. It reliably identifies the properties of cointegration in heterogeneous and cross-sectionally dependent panel data. The four panel cointegration tests proposed by Westerlund (2007) are designed to test the null hypothesis of *no cointegration* by determining whether error correction exists for individual panel units (countries) or for the panel as a whole. These tests permit a significant degree of heterogeneity, both in the long-run cointegrating relationship and in the short-run dynamics, while also allowing for cross-sectional dependence (Shuaibu & Soo Yean, 2020, p. 1151).

Results and Discussion

Table (1): Results of the CD Test for Detecting Cross-Sectional Dependence in Residuals and Variables :

Test CD_{NT}^{2015} For Variables								
RQ	RL	PS	GE	GDPG	FDI	FD	enrr	CO2
1.006	-2.17 ^b	1.763	0.64	4.89	3.034 ^a	4.125 ^b	1.337 ^a	-0.116

a is significant at the 1% significance level, b is significant at the 5% significance level, c is significant at the 10% significance level

Source: Prepared by the researcher using Stata software output. 17

Table (1) shows the statistical significance of the cross-sectional correlation test, both for the residuals and for the variables. Therefore, we reject the null hypothesis and accept the alternative hypothesis,

meaning there is a correlation between the cross-sections of ENRR, GDPG, FDI, and RL. We also accept the null hypothesis, meaning there is no correlation between the cross-sections of CO2, GDPG, GE, PS, and RQ.

Table (2): Results of the homogeneity test for the regression parameters:

Test statistic	$\bar{\Delta}$	$\bar{\Delta}_{adj}$
Valeur statistic	0.989(p=0.014-	-0.018(p=0.985

Source: Prepared by the student based on the outputs of the Stata.17 program.

Based on the results obtained in Table (2), which shows the results of the homogeneity test for the regression parameters, we accept the null hypothesis that the regression parameters are homogeneous. We reject the alternative hypothesis, i.e., that there is homogeneity in the slopes across units. Therefore, we should rely on dynamic panel models that take slope homogeneity into account, such as the PMG (Pandora-Maximum Dynamics Model) ARDL panel.

Table (3): Results of the IPS Stability Test:

IPS Test		
First diff	At level	Variables
-	-1.961 ^b	<i>CO2</i>
	-5.66 ^a	<i>GDPG</i>
-6.10 ^b	-0.47	<i>GE</i>
-	-1.935 ^b	<i>PS</i>
-8.70 ^a	-0.83	<i>RQ</i>

Table (03), which shows the results of the unit root tests for the panel data according to the IPS test, indicates the absence of a unit root for both CO2, GDP, and PS. Therefore, they are stable at level 1, i.e., integral of degree I(0). Meanwhile, the results showed that each variable, GE and RQ, is stable after the first difference test, and therefore integral of degree I(1).

Table (04): Results of the CIPS Stability Test

CIPS Test		
First diff	At level	Variables
-4.888 ^b	1.537-	<i>ennr</i>
	^b 3.042-	<i>FD</i>
-	-2.951 ^a	<i>FDI</i>
	^a 3.780-	<i>RL</i>

a is significant at the 1% significance level, b is significant at the 5% significance level, c is significant at the 10% significance level

Source: Prepared by the researcher based on the outputs of the Stata.17 program.

Table (04), which shows the results of the unit root tests for the panel data according to the CIPS test, reveals the absence of a unit root for FD, FDI, and RL. Therefore, they are stable at the Level, i.e., integrals of degree I(0). Meanwhile, the results showed that each ENNR variable is stable after the first difference test, and therefore integrals of degree I(1).

0.0512	prob	0.13	prob
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a is significant at the 1% significance level, b is significant at the 5% significance level, c is significant at the 10% significance level

4 Interpretation of the Econometric Results

First: Long-Run Results

1. Oil-Producing Countries

- **CO₂ Emissions (+0.047):** This result, indicating that a 1% increase in carbon emissions leads to only a marginal 0.05% rise in the renewable energy share, reveals a clear deficiency in the effectiveness of the institutional tools and economic incentives used in oil-based economies to stimulate the energy transition. This low level of elasticity underscores the limitations of environmental and fiscal policies in redirecting investments from fossil fuels toward renewable resources, necessitating a fundamental review of the incentive framework and the development of green market instruments to ensure the achievement of sustainable energy goals.
- **Economic Growth (+0.021):** The estimated elasticity for economic growth (+0.021) suggests that a 1% increase in GDP leads to a meager 0.021% rise in the renewable energy share. This indicates that economic expansion remains primarily dependent on fossil fuels and calls for enhanced incentive measures and structural reforms to ensure an effective transition towards clean energy sources.
- **Government Effectiveness (-0.005) and Political Stability (-0.030):** In oil-producing countries, the negative coefficient for Government Effectiveness (-0.005) reflects the fragility of formal institutions in combating corruption and directing investments towards sustainable projects, where fossil fuel infrastructure with quick returns is often favored over renewable energy. Furthermore, weak Political Stability (-0.030) increases the risks associated with long-term investment in the clean energy sector, creating a dual constraint that hinders an effective energy transition.
- **Foreign Direct Investment, FDI (-0.0015):** The negative coefficient for FDI, estimated at -0.0015 (significant at the 5% level), indicates that increases in foreign capital inflows do not practically contribute to enhancing the renewable energy share in oil economies. This reflects the tendency of international investors to focus on hydrocarbon projects, which offer quick returns and lower risks, at the expense of financing long-term green infrastructure.
- **Financial Development (+2.81):** The high elasticity of Financial Development (+2.81) suggests that developed financial markets in oil-producing countries are theoretically capable of injecting significant capital. However, the lack of statistical significance for this relationship clarifies that this liquidity is not actually directed towards renewable energy projects but remains dominated by financing high-return fossil fuel infrastructure, highlighting a shortcoming in the structuring of financial instruments to support the energy transition.

2. Non-Oil-Producing Countries

- **Carbon Dioxide, CO₂ (-12.48):** The estimated elasticity of -12.48 reveals a profound fragility in the energy transition of non-oil economies: a mere 1% increase in carbon emissions leads to a contraction of the renewable energy share by over 12%. This sharp decline is attributed to the absence of effective legislative and regulatory incentives, which reinforces the dominance of fossil fuel industries and prevents the attraction of investments towards green projects, favoring short-term performance over long-term environmental and developmental goals.
- **Economic Growth, GDPG (-0.452):** The negative elasticity of GDP (-0.452) in non-oil countries reveals that achieved growth levels and their current financing channels lack the sufficient financial strength to drive the transition towards clean energy sources; growth revenues remain primarily directed towards supporting traditional sectors, unlike oil-producing countries which have oil windfalls allowing them to allocate a portion of their revenues to finance renewable energy projects.
- **Government Effectiveness (+0.386) and Political Stability (+0.286):** In non-oil-producing countries, a 1% improvement in Government Effectiveness leads to a 0.386% increase in the renewable energy share, while Political Stability raises green investments by 0.286%. These substantial elasticities

translate into increased investor confidence due to clear regulatory frameworks and effective contract enforcement guarantees, which reduce project risks and lower transaction costs. Tax incentives and credit facilities also help attract banks and financial institutions to finance clean energy technologies. In this picture, sound governance and political stability emerge as critical elements for enabling these countries to achieve a sustainable energy transition and diversify their sources.

- **Foreign Direct Investment, FDI (+0.897):** In non-oil-producing countries, the FDI coefficient estimated at +0.897 stands as strong evidence of these economies' capacity to attract foreign capital into the renewable energy sector; a 1% increase in FDI flows implies an increase of nearly 0.9% in the clean energy share. This large effect reflects investor confidence in clear legislative policies and available financial incentives, confirming that improving the investment environment accelerates the pace of the energy transition and the achievement of sustainability goals.
- **Financial Development (+36.87):** In non-oil-producing countries, the elasticity of Financial Development is exceptionally high at +36.87 (significant at 5%), reflecting the ability of financial systems in these countries to intensively mobilize capital towards renewable energy projects once a supportive institutional environment is available, which has served as a powerful lever to accelerate the path towards a sustainable energy transition.

Second: Short-Run Results

In the short-run equations, the coefficients for ΔCO_2 , ΔGDPG , ΔGE , ΔPS , ΔFDI , and ΔFD were all statistically insignificant, with the role of the variables limited to correcting deviations solely through the Error Correction Term (ECT) only (-0.4416 in oil-producing countries, -0.1901 in non-oil-producing ones). This indicates that energy transition measures—such as building green infrastructure, updating regulatory frameworks, and establishing investment incentives—require a long-term horizon to bear fruit, unlike immediate shocks which lack the capacity to change the course instantly. From an economic perspective, this short-term rigidity is attributed to high transition costs, the necessity of accumulated technical expertise, and the need for long-term financing, confirming the importance of formulating integrated policies and strategies spanning years to achieve a sustainable and effective energy transition.

5. Testing the Study Hypotheses

- **Hypothesis 1 (Regulatory quality accelerates the energy transition): Confirmed.** Strong institutional frameworks demonstrated an ability to attract green investments and lower transaction costs for the rapid expansion of renewable infrastructure.
- **Hypothesis 2 (Political stability is a critical factor): Confirmed.** Political stability provided the foundation for formulating and implementing long-term energy policies and increasing investor confidence in clean projects.
- **Hypothesis 3 (The institutional impact varies between oil and non-oil contexts): Confirmed.** The study showed that the strength of the institutional impact on the energy transition was greater in non-oil countries, where effective governance regulatory frameworks provided incentives for green investment, while the impact was limited or marginal in oil economies with weaker rentier frameworks, confirming the varying effect of institutional quality depending on the nature of the economy.

Conclusion

The energy transition constitutes one of the fundamental pillars for achieving environmental and economic sustainability in light of global challenges related to climate change, energy security, and economic independence. This study reveals that the success of this transition depends primarily on institutional quality, where regulatory frameworks, effective governance, and political stability play a crucial role in attracting investments and ensuring the implementation of effective and sustainable energy policies.

In the Middle East and North Africa (MENA) region, the energy transition faces substantial challenges linked to weak governance, the dominance of rentier interests, and sluggishness in adopting legal

reforms supporting clean energy. Despite efforts in some countries to promote renewable energy investments, bureaucracy, lack of transparency, and weak coordination between energy policies and climate strategies remain major obstacles to accelerating this transition.

On the other hand, international experiences show that countries that have adopted strong institutional policies, such as some in Southeast Asia and Latin America, have managed to achieve significant progress in their energy transition by strengthening the legal framework, providing investment incentives, and ensuring the involvement of the private sector and local communities in decision-making.

Recommendations

1. **Enhance Governance and Transparency in the Energy Sector**
 - Reform regulatory institutions by strengthening their independence and reducing political influences on their decisions.
 - Combat corruption through strict oversight mechanisms that ensure integrity in the implementation of renewable energy projects.
 - Adopt transparent strategies that ensure clarity of vision for investors in the energy sector, reducing regulatory risks and boosting private sector confidence.
2. **Reform Legal and Regulatory Frameworks**
 - Enact binding legislation that guarantees an increase in the share of renewable energy in the national energy mix.
 - Facilitate investment procedures in renewable energy by reducing administrative obstacles and simplifying licensing.
 - Align energy policies with climate strategies to ensure a sustainable transition that enhances both energy and economic security simultaneously.
3. **Stimulate Investments in Renewable Energy and Clean Technology**
 - Provide financial and tax incentives for private investments in the renewable energy sector, such as tax reductions and soft loans.
 - Enhance public-private partnerships by providing a legal and regulatory environment attractive to long-term investments.
 - Invest in research and development to support innovation in energy storage, smart grids, and green hydrogen, contributing to reduced reliance on fossil fuels.
4. **Strengthen Regional and International Cooperation**
 - Establish strategic partnerships with countries leading in the energy transition, such as the European Union and East Asian nations, for technology transfer and leveraging international expertise.
 - Develop a regional renewable energy market among MENA countries, contributing to the integration of power grids and the exchange of clean energy between nations.
 - Utilize international financing mechanisms, such as climate funds and major financial institutions, to support energy transition projects and reduce the financial burdens on developing economies.
5. **Long-Term Institutional Monitoring and Accountability:**
 - Adopt a long-term national plan (10-15 years) with defined milestones and quantifiable Key Performance Indicators (KPIs) for renewable energy share, emission levels, and FDI volume, establishing an independent evaluation body comprising academic and civil society experts for semi-annual assessment.
 - Publish an annual report on progress in governance and energy transition indicators to ensure performance transparency and incentivize executive bodies to continue implementing projects according to the best international standards.

With this integrated strategy, combining deep institutional reform, innovative financial tools, and effective partnerships, oil-producing countries can escape the dilemma of the fossil fuel rentier model, and non-oil countries can bolster their momentum towards a robust and sustainable green economy, thereby achieving climate and development goals in a sound and effective manner.

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