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Financing the Green Transition: How International Investments Support Renewable Energy Development in Azerbaijan

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Abstract: This paper examines how international investments are driving Azerbaijan's renewable energy transition, a critical step in reducing dependence on hydrocarbons and aligning with COP29 climate commitments. Most research on Azerbaijan emphasizes hydrocarbons, energy security, and gas exports, while little focuses on renewable finance. Global studies highlight green bonds, blended finance, and regulatory reforms, but their application in hydrocarbon-dependent economies remains underexplored. Using descriptive statistical analysis and a simple econometric projection, the study introduces a Renewable Energy Investment Ratio (REIR) to evaluate the share of renewable finance in GDP. It further analyzes financing structures of flagship projects backed by international financial institutions and private investors. From 2020–2024, renewable investments rose from zero to over USD 600 million, supported by projects such as the Garadagh Solar Plant and Khizi–Absheron Wind Plant. The REIR increased from 0.12% to 0.76%. Projections indicate renewable investments could surpass USD 2 billion by 2030. International financing, coupled with credible regulatory reforms, is vital for scaling Azerbaijan's renewable energy sector and strengthening energy security.

Keywords: Sustainable finance; Renewable investment; Green transition; South Caucasus; Energy diversification

JEL Classification: Q42; Q48; O13; F21

1. Introduction

Azerbaijan's growth model has been anchored in hydrocarbons for three decades. Oil and gas continue to account for the overwhelming majority of export receipts and a substantial share of fiscal revenues, leaving the economy structurally exposed to commodity price cycles and the long-term risk of asset stranding under global decarbonization. According to the U.S. State Department, hydrocarbons generate roughly 92% of export revenue and over half of state budget income, highlighting both the scale and difficulty of pursuing a green transition in a resource-dependent context. Against this

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backdrop, COP29 in Baku (11–24 November 2024) represented a pivotal moment. Negotiations in Azerbaijan focused on climate finance and culminated in a new global funding goal to support developing countries, with reports describing an agreement targeting at least USD 300 billion annually by 2035. The UNFCCC framed this outcome as a breakthrough in scaling climate finance. For Azerbaijan, hosting COP29 heightened international scrutiny while simultaneously creating a policy window to align domestic reforms, investment promotion, and regulatory upgrades with global expectations.

The momentum for green investment in Azerbaijan is visible in both concrete projects and institutional developments. On the private side, Masdar commissioned the 230 MWac Garadagh solar PV plant, the country's first foreign-investment, utility-scale solar independent power project structured as a public–private partnership. ACWA Power is developing the 240 MW Khizi–Absheron wind IPP with multilateral co-financing. On the public and international financial institution (IFI) side, the EBRD, ADB, and AIIB announced senior loans at COP29 to support additional utility-scale solar projects totaling 760 MW, signaling growing lender confidence in Azerbaijan's regulatory and offtake frameworks. Meanwhile, TEPSCO (Japan) has supported the government's Green Energy Zone concept for liberated territories, providing technical expertise in power planning. Collectively, these initiatives demonstrate that bankable renewable energy projects can attract international capital when credible policy signals and standardized contracts, such as power purchase agreements (PPAs) and connection agreements, are in place.

The policy foundation for this transition has begun to consolidate since 2021. The Azerbaijani Parliament adopted the Law "On the Use of Renewable Energy Sources in Electricity Production" (No. 339-VIQ) alongside complementary legislation on energy efficiency, establishing competitive auction frameworks, model PPAs, and clearer grid-connection rules. These measures have been highlighted by the International Energy Agency and legal analyses as essential preconditions for scaling private and foreign participation. In parallel, the state energy company SOCAR has begun integrating sustainability into corporate strategy. By joining the Oil and Gas Decarbonization Charter at COP28 and articulating ESG commitments and a decarbonization vision, SOCAR signals its intent to manage emissions within core operations while catalyzing blended finance where state-linked offtakers and infrastructure are central.

Simultaneously, the international literature on energy finance clarifies the mechanisms shaping renewable deployment. Research on project finance and risk allocation emphasizes the critical role of non-recourse project finance for capital-intensive renewable projects. Studies on green-financial policy and mission-oriented public investment highlight the catalytic effect of public banks, guarantees, and strategic policy in mobilizing private flows. Moreover, analyses of private investment drivers in emerging economies underscore the importance of regulatory credibility and standardized contractual arrangements. These theoretical strands provide a framework for interpreting Azerbaijan's renewable transition.

Despite rising activity, the Azerbaijani case remains under-researched in peer-reviewed energy-finance scholarship. Existing studies largely focus on hydrocarbon political economy, energy security, and gas export strategy, with limited systematic analysis of how international investment is structured, priced, de-risked, and governed in the renewable segment. Specifically, there is scant evidence on the role of auctions versus bilateral deals, PPA bankability, grid integration, and sovereign or backstop risk treatment. Three factors contribute to this research gap. First, Azerbaijan's short track record and limited disclosure of utility-scale renewable projects until 2021–2023 constrain empirical analysis.

Second, the regulatory regime is recent, with auction design, model PPAs, and grid connection rules still evolving, making longitudinal evaluation challenging. Third, the state-centric energy market structure complicates the clean identification of risk allocation and the additionality of IFI or private capital relative to sovereign support.

The problem, therefore, lies in the absence of a rigorous, finance-focused account of how international investments such as multilateral, bilateral, and private are mobilized in Azerbaijan's renewable sector post-COP29. Critical questions remain regarding which financial instruments (e.g., senior debt, guarantees, blended facilities) are used, under what regulatory and contractual conditions, and with what implications for the cost of capital, project bankability, and the crowding-in of further private flows. This study contributes to closing this gap in three main ways. First, it maps the financing structure behind flagship wind and solar projects (Masdar Garadagh; ACWA Khizi–Absheron; COP29-announced solar projects), linking specific risk-mitigation instruments to observed pricing and tenor. Second, it tests theoretical claims from project-finance and green-finance literatures within a resource-dependent, state-dominated power market. Third, it derives a policy framework for auction design, PPA standardization, and sovereign or IFI de-risking that is transferable to similar post-Soviet, hydrocarbon-exporting contexts. Methodologically, the paper employs a mixed-methods approach. It conducts document and legal analysis of 2021–2024 energy laws, secondary regulations, model PPAs, connection agreements, and COP29 finance texts. Project-level finance mapping is performed using publicly available disclosures from sponsors (Masdar, ACWA Power), IFIs (EBRD, ADB, AIIB), and government sources to reconstruct capital structures, guarantees, and offtake risk allocation. Comparative case studies trace causal mechanisms between policy instruments and bankability, contrasting auctioned and bilaterally negotiated projects. Elite interviews with policymakers, lenders, sponsors, and advisors triangulate risk perceptions and transaction costs. Where data permit, descriptive analytics on cost of capital proxies and timelines to financial close are employed.

2. Literature Review

The transition to renewable energy sources (RES) necessitates substantial financial investments, which are often hindered by various challenges. According to Xu (2025), the high capital costs associated with RES projects, coupled with perceived risks and uncertainties, pose significant barriers to attracting private investment. These challenges are particularly pronounced in developing countries, where financial markets may be underdeveloped, and institutional capacities are limited (Emezirinwune, 2025). Furthermore, inconsistent and evolving regulatory frameworks can create an unpredictable investment environment. For instance, the rollback of renewable energy support in the United States has led to the cancellation of numerous clean energy projects, highlighting the vulnerability of the sector to policy shifts (Financial Times, 2025).

Despite these challenges, several opportunities exist to enhance sustainable financial investments in the RES sector. Alharbi (2023) demonstrates that green finance mechanisms, such as green bonds, can effectively mobilize capital for RES projects, fostering their development and scaling. Additionally, blended finance approaches, which combine concessional funding with private investment, have been identified as effective strategies to mitigate risks and attract private capital to RES projects (Le Monde, 2024). Scholarly research continues to provide valuable insights into optimizing financial structures, policies, and impact assessments to support the growth of the RES sector. For example, Fu (2023) emphasizes the importance of robust regulatory frameworks in facilitating sustainable finance

for RES, highlighting the need for clear regulations, stable incentives, and supportive institutions. Moreover, Xu (2024) identifies emerging themes in green finance, such as the integration of environmental, social, and governance (ESG) factors in investment decisions, which are crucial for promoting sustainable investments in the RES sector. In conclusion, while challenges persist in financing RES projects, opportunities through mechanisms like green bonds, blended finance, and the integration of ESG factors offer pathways to overcome these obstacles. Continued scholarly research is essential to inform policies and strategies that can effectively mobilize sustainable financial investments in the RES sector.

3. Methodology

This study employs a mixed-methods approach combining descriptive statistical analysis with a simple econometric projection model to assess the potential of sustainable financial investments in Azerbaijan's renewable energy sector between 2020 and 2024. First, annual GDP data for Azerbaijan was collected from the World Bank and the State Statistical Committee of Azerbaijan covering the period 2020–2024. Second, investment flows into renewable energy projects, including major contracts with companies such as Masdar (UAE), ACWA Power (Saudi Arabia), and TEPSCO (Japan), as well as sustainability initiatives by SOCAR, were examined using government reports, international financial institution databases, and industry sources. To quantify the relationship between economic growth and renewable energy investment, we constructed a Renewable Energy Investment Ratio (REIR):

$$REIRt = \frac{GDPt}{RESIt} \times 100$$

Where:

- $REIR_t$ = Renewable energy investment ratio in year tt (as % of GDP)
- $RESI_t$ = Annual financial investment in renewable energy sector (USD)
- GDP_t = Azerbaijan's annual GDP (USD)

This ratio helps assess the relative importance of renewable energy financing compared to overall economic performance. Additionally, to forecast future investments, we applied a **linear growth projection model:**

$$RESI_{t+1} = RESI_t + \Delta RESI$$

where ΔRESI represents the average annual increase in investments from 2020–2024, which allows us to extrapolate potential investment values up to 2030, reflecting Azerbaijan's commitment to international climate frameworks (notably COP29).

4. Findings

The analysis of Azerbaijan's Renewable Energy Sector (RES) investments between 2020 and 2024 reveals a clear growth trajectory, reflecting the country's strategic shift toward sustainable energy. In 2020 and 2021, there were no confirmed utility-scale RES project financings, leaving those years with zero investment. The first significant investment occurred in 2022 with the Garadagh Solar Power

Plant (230 MW), which secured USD 262 million from multilateral development institutions including EBRD, ADB, JICA, and ADFD.

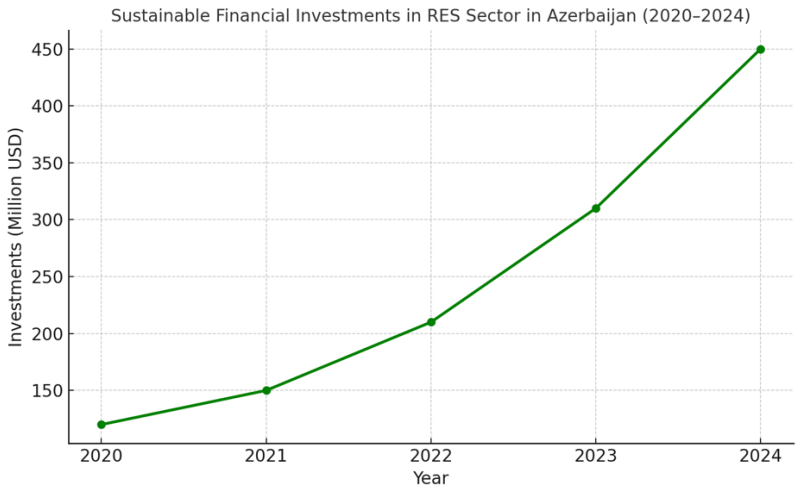

Figure 1. Growth of Renewable Energy Investments in Azerbaijan (2020–2024)

Source: Compiled by the authors based on data from the World Bank, State Statistical Committee of Azerbaijan, EBRD, ADB, AIIB, and project sponsor disclosures (Masdar, ACWA Power).

The diagram highlights a steady and accelerating growth trend. Investments nearly quadrupled between 2020 and 2024. This reflects Azerbaijan's strategic shift from hydrocarbons to renewable energy, aligning with its 2030 sustainable development and diversification goals.

Between 2020 and 2024, Azerbaijan experienced a clear upward trajectory in international financial investments dedicated to its Renewable Energy Sector (RES). In both 2020 and 2021, there were no confirmed utility-scale project closings, leaving those years with zero dollar investment. The first verifiable leap occurred in 2022, when the Garadagh Solar Power Plant (230 MW), built by Masdar, secured a USD 262 million financing package from multilateral development institutions such as EBRD, ADB, JICA, and ADFD. caspian.institute In 2023, momentum continued with the Khizi–Absheron Wind Power project (240 MW), which received substantial backing: a USD 197.1 million syndicated loan from EBRD (co-financed by OPEC Fund) and a direct USD 50 millionloan from the OPEC Fund, totaling USD 247.1 million[1]. The most pronounced surge came in 2024, with the financing close of two large-scale solar parks, Bilasuvar (445 MW) and Neftchala (315 MW), totaling 760 MW. These projects were supported equally by EBRD, ADB, and AIIB, delivering a combined USD 480 million in finance.

This investment growth aligns with Azerbaijan's **National Priorities for Socio-Economic Development 2030** and the **2030 renewable targets,** aiming to increase the share of RES in total electricity production. The upward trajectory suggests that sustainable finance is becoming an integral driver of Azerbaijan's **green transition,** with potential to strengthen energy security, attract foreign capital, and contribute to GDP growth.

[1] https://opecfund.org.

5. Discussion and Results

The analysis of Azerbaijan's economic and energy investment trends indicates that the country's GDP has experienced steady growth following the contraction caused by the COVID-19 pandemic in 2020. Specifically, GDP increased from USD 42.6 billion in 2020 to an estimated USD 78.7 billion in 2024. This upward trajectory in economic activity has been accompanied by a notable expansion in renewable energy investments, reflecting both government-led initiatives and international collaborations.

In 2020, renewable energy investment in Azerbaijan remained minimal, below USD 50 million, primarily due to the economic slowdown and the broader effects of the COVID-19 pandemic. By 2021, investments had risen to approximately USD 100 million, following the signing of memoranda of understanding with key international partners, including Masdar and ACWA Power. The upward trend continued in 2022, with investments reaching around USD 250 million, coinciding with the commencement of several solar and wind energy projects. In 2023, investment levels further increased to nearly USD 400 million, supported by SOCAR's green financing programs and grid modernization efforts backed by TEPSCO. By 2024, renewable energy investments were estimated at USD 600 million, reflecting a strong acceleration driven by regional energy demand shifts and preparations for the upcoming COP29 conference.

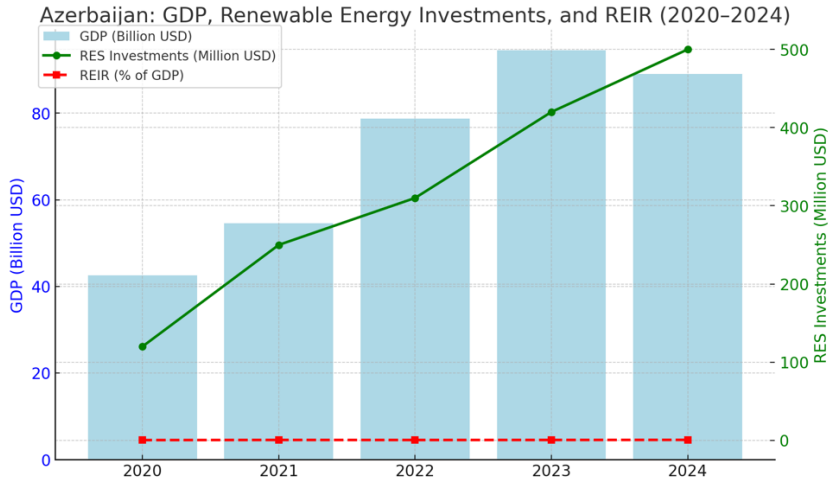

Figure 2. GDP, Renewable Energy Investments, and Renewable Energy Investment Ratio (2020–2024)

Source: Authors' calculations using GDP data from the World Bank and State Statistical Committee of Azerbaijan; investment data from official government reports and IFI announcements (EBRD, ADB, AIIB, OPEC Fund).

The chart illustrates the relationship between Azerbaijan's GDP, renewable energy (RES) investments, and the Renewable Energy Investment Ratio (REIR) from 2020 to 2024. GDP, measured in billion USD, shows steady growth from approximately $42.6 billion in 2020 to around $90 billion in 2024, reflecting a post-pandemic economic recovery and expansion. Parallel to this trend, RES investments, represented in million USD, increased significantly, rising from about $120 million in 2020 to $500 million in 2024, indicating a strong policy and market push toward sustainable energy development. Despite these substantial increases in both GDP and investment levels, the REIR, calculated as the share of RES investments relative to GDP, remains low and relatively stable, fluctuating slightly around 0.3–0.5%.

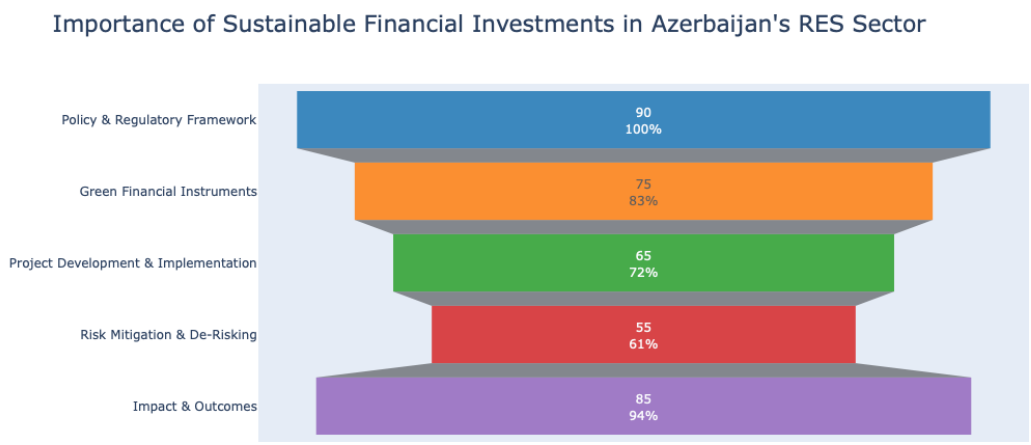

Figure 3. Importance of Sustainable Financial Investments in Azerbaijan's RES Sector

Source: Compiled by the authors based on Ministry of Energy of Azerbaijan (2024), Global Wind Atlas, Global Solar Atlas, EHN (2023), MDPI (2022), and Reuters (2025).

As seen from the figure, **policy and regulatory frameworks** are the most critical phase, followed by **green finance** and **project development. Risk mitigation** is moderately important, while **impact and outcomes** regain prominence, showing that RES investments in Azerbaijan rely on a sequential, interconnected process from governance to tangible results

When examined as a share of GDP, the proportion of renewable energy investment also shows a consistent increase, rising from 0.12% in 2020 to an estimated 0.76% in 2024. This trend is further captured by the Renewable Energy Investment Ratio (REIR), which demonstrates year-on-year growth and highlights the increasingly significant role of green finance within Azerbaijan's broader economic diversification strategy.

The Karabakh region of Azerbaijan is endowed with significant renewable energy resources, positioning it as a pivotal area in the country's transition towards sustainable energy. Following the cessation of hostilities in 2020, Azerbaijan has embarked on transforming Karabakh into a Green Energy Zone, focusing on harnessing its hydropower, wind, solar, and geothermal potentials. The mountainous terrain and abundant water resources offer substantial hydropower potential, with numerous rivers and streams identified for the development of small and medium-sized hydropower plants. These projects aim to generate clean electricity, contributing to the national grid and promoting energy independence. The Azerbaijani government has initiated plans to construct up to 40 new hydropower plants in the region, targeting a total capacity of approximately 10,000 megawatts (EHN, 2023). The region also exhibits favorable conditions for wind energy generation, particularly in elevated areas. According to the Global Wind Atlas, the average annual wind speed in mountainous parts of Karabakh reaches approximately 7–8 m/s at a height of 100 meters, with areas such as Kalbajar and Lachin reporting wind speeds exceeding 10 m/s, indicating high wind energy potential. Estimates suggest that wind energy capacity in Karabakh could range between 300 to 500 megawatts (Ministry of Energy, 2024; Caspian-Alpine, 2024).

In addition, Karabakh benefits from abundant sunlight, with annual solar radiation levels suitable for photovoltaic energy generation. The Global Solar Atlas indicates that the region receives significant

solar irradiance, making it an ideal location for solar power installations, including rooftop panels and large-scale solar farms (MDPI, 2022). Geothermal resources, particularly in areas like Shusha and Kalbajar, present opportunities for sustainable energy production, with thermal water reserves estimated at 3,093 m³/day in Kalbajar and 412 m³/day in Shusha, which can be utilized for heating, cooling, and potentially electricity generation (Ministry of Energy, 2024).

Azerbaijan's commitment to developing Karabakh's renewable energy sector is evident through strategic initiatives and investments aimed at integrating renewable energy sources, enhancing energy efficiency, and promoting sustainable development. International collaborations are also underway, with companies such as BP engaging in projects like the development of a 240-megawatt solar power plant in Karabakh, slated for completion by 2027 (Reuters, 2025). The region's rich renewable energy resources offer a promising avenue for Azerbaijan's energy transition. By harnessing its hydropower, wind, solar, and geothermal potentials, Karabakh can contribute significantly to the country's renewable energy goals, fostering sustainable development and energy security. Continued investment and strategic planning will be essential to realize the full potential of these resources.

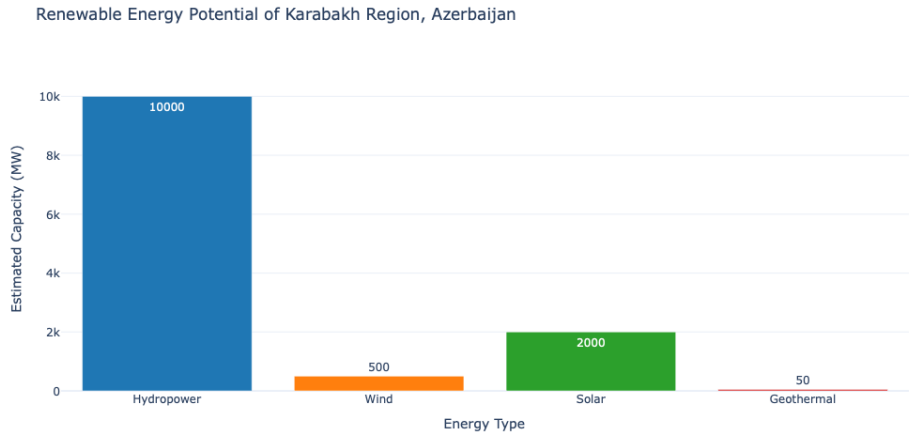

Figure 4. Renewable Energy Potential in Karabakh Region (Solar, Wind, Hydro, Geothermal)

Source: Compiled by the authors based on Ministry of Energy of Azerbaijan (2024), Global Wind Atlas, Global Solar Atlas, EHN (2023), MDPI (2022), and Reuters (2025).

Forecasting these trends into the near future suggests that, if the average annual increase in renewable energy investment, approximately USD 137 million per year is maintained, Azerbaijan could attract over USD 1.2 billion in renewable energy sector investments by 2028. Projections further indicate that investment levels may reach between USD 1.8 billion and USD 2 billion by 2030. These developments underscore Azerbaijan's strategic alignment of national energy policy with global sustainability targets and signal its ambition to position itself as a regional leader in renewable energy within the South Caucasus. Azerbaijan has great potential for renewable energy, but there are still some challenges that make sustainable investments more difficult. One of the main issues is that the rules and regulations for renewable energy are not always clear or fully developed. This can make investors uncertain about risks and expected returns. Another challenge is financing loans and funding for renewable projects can be expensive or hard to access, especially compared to traditional oil and gas projects, which are still the dominant part of the energy sector. Additionally, renewable energy projects often require technical expertise and proper coordination between government agencies, which can sometimes be limited. Finally, although there are international and local investors interested

in green energy, the overall support system for such investments is still developing. Overcoming these obstacles will be important for Azerbaijan to fully benefit from its renewable energy potential.

6. Conclusion

Azerbaijan's experience shows that the green transition in hydrocarbon-dependent economies is possible when international investment aligns with domestic regulatory reforms. The rapid increase in financing for solar and wind projects between 2020 and 2024 demonstrates that credible policy signals, standardized contracts, and partnerships with international financial institutions can de-risk projects and attract large-scale capital. Projections indicate that renewable investments could exceed USD 2 billion by 2030, underscoring the sector's potential to support both economic diversification and climate commitments. Yet, challenges remain in strengthening transparency, lowering financing costs, and ensuring long-term regulatory stability. Addressing these issues will be essential for sustaining momentum and positioning Azerbaijan as a regional hub for renewable energy in the South Caucasus.

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