

## DRIVING "GREEN GROWTH" IN AZERBAIJAN: EXPANDING INVESTMENT OPPORTUNITIES IN THE RENEWABLE ENERGY SECTOR

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**Abstract.** This study employs a dual scientific approach, integrating both theoretical analysis and experimental investigation, to explore public perception of RE (RE) in Azerbaijan. Focusing specifically on Azerbaijan's unique RE potential and ongoing "Green Growth" initiatives, this article offers a distinct perspective by integrating original local public opinion data. The research specifically investigates interest in installing RE systems (RES) and the perceived importance of government promotion of RE.

A primary survey was conducted (n=31) and analyzed using regression analysis via IBM SPSS. The findings revealed a moderate level of interest in installing RES, with a significant portion of respondents leaning towards being somewhat interested. However, the analysis did not detect a statistically significant relationship between interest in installing RES and the perceived importance of government promotion of RE.

The study underscores the complexity of factors influencing public interest in RES. While government promotion can play a role, other factors such as financial incentives, installation ease, and public awareness of the benefits and challenges associated with RES also warrant consideration. Policymakers and stakeholders in the Azerbaijani RE sector can leverage these insights to develop targeted strategies that stimulate "green growth" through enhanced RE investment.

**Keywords:** *green energy, Paris Climate Agreement, Third Energy Package, installing of RES, SDG.*

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### 1. Introduction.

Energy markets are rapidly changing, and renewable sources are replacing conventional ones making electrification one of the most viable solution for the decarbonization [15]. The switch from fossil to RE sources is made possible by technological progress and a societal push towards sustainability.

The global transition towards clean energy presents a significant challenge: securing sufficient investment to develop RE sources. While the number of renewable projects is rapidly increasing due to decarbonization efforts, the technical equipment required remains expensive. This high upfront cost creates significant hesitation among potential investors, including financial institutions seeking large-scale projects and individual consumers who want to participate actively in the energy market. Their primary goal is to maximize returns on investment, and the perceived risks associated with renewables can be a deterrent.

Consequently, the burden of deploying RE sources often falls on governments committed to environmental sustainability. These governments are forced to shoulder the financial risks and potential losses associated with RE projects, diverting funds from other crucial areas like social welfare programs or national defense [11, p.57-58]. This situation creates a trade-off, limiting resources available for essential public services while attempting to meet critical energy goals.

However, a potential solution exists: liberalizing the electricity market to increase efficiency and competition. This model allows private entities to participate more actively in energy generation and distribution, fostering innovation and potentially attracting more investment [6, p.3-5]. The success of this approach is exemplified by the case of Turkey, demonstrating how market liberalization can incentivize private investment in RE [21, p.18], [8, p.61].

Electricity market liberalization is a double-edged sword. Proponents argue it fosters competition, driving down prices and spurring innovation in renewables. Consumers gain choice and potentially lower costs. However, this competition can also lead to price volatility and require a complex regulatory framework to prevent monopolies [18]. Ensuring affordability for all during this transition is another key consideration.

This article will examine the key considerations that legislators should take into account when creating a framework for open market competition in the electricity sector. This framework should

facilitate unrestricted market access and allow all electricity producers to participate in the broader energy market without being limited to the domestic.

## 2. Azerbaijan: Unveiling the Immense Potential of RE.

Azerbaijan, a nation strategically located at the crossroads of Europe and Asia, possesses significant potential for RE development. The Republic of Azerbaijan's economy has traditionally been reliant on its substantial hydrocarbon reserves. However, the global energy landscape is undergoing a transformative shift towards cleaner and more sustainable solutions. This necessitates a strategic diversification of Azerbaijan's energy mix, mitigating dependence on fossil fuels and ensuring long-term energy security. Embracing RE offers a potent solution, fostering environmental stewardship, economic growth, and reduced vulnerability to price fluctuations in the global energy market.

Azerbaijan boasts a diverse RE portfolio, with each resource holding immense potential:

- **Solar Power:** Characterized by abundant sunshine exceeding is in the range of 1 387 to 1 534 kWh/m<sup>2</sup> for most of the territory, Azerbaijan is primed for large-scale solar photovoltaic (PV) farms in arid lowlands. Additionally, rooftop solar installations in urban centers can significantly contribute to distributed generation [12, p.19].
- **Wind Power:** The Caspian Sea coast and mountain ranges experience consistent, strong winds, presenting an ideal opportunity for wind farm development. Strategic placement of these farms can harness this kinetic energy to generate clean electricity.
- **Hydropower:** Azerbaijan's abundant rivers feeding into the Caspian Sea offer tremendous potential for hydropower generation. However, meticulous planning is vital to ensure ecological sustainability and minimize disruption to surrounding ecosystems.
- **Geothermal Energy:** The presence of hot springs across the nation indicates the existence of untapped geothermal resources. Utilizing these resources for electricity generation or direct heating applications presents a promising avenue for further exploration.
- **Bioenergy:** Agricultural residues and dedicated energy crops can be valorized into biogas or biofuels. These sustainable alternatives can potentially displace conventional fossil fuels in the transportation sector.

Totally the potential of Azerbaijan RE sources, which are technically feasible and economically viable, is estimated at 27 000 MW. Share of wind energy is 3 000 MW, solar energy is 23 000 MW, bioenergy potential is 380 MW, and 520 MW of mountain rivers [1].

### *Electricity production by renewable sources in 2023.*

Azerbaijan's energy sector is undergoing a gradual shift towards renewable sources. In 2023, renewables accounted for a promising 20.3% of the nation's overall energy mix, with fossil fuels making up the remaining 79.7%. This signifies a growing focus on clean energy alternatives, even though fossil fuels continue to be the dominant source [1].

- **Hydropower:** Hydropower remains the leading source of RE in Azerbaijan, contributing a significant 1,757 million kWh in 2023. The country possesses abundant hydroelectric potential due to its mountainous regions and rivers.
- **Wind and Solar Power:** While still in their initial stages of development, wind and solar energy are demonstrating promising growth. Wind power generation reached 56.6 million kWh in 2023, and solar power production reached 79.4 million kWh. These sectors are poised for further expansion as Azerbaijan implements plans to diversify its energy sources.
- **Bioenergy:** Bioenergy also plays a role in Azerbaijan's RE mix, with a 223 million kWh contribution in 2023. This sector utilizes organic materials like biomass for energy generation.

Azerbaijan's commitment to RE is further evidenced by its target of achieving a 30% share of renewables in the energy balance by 2030 [2]. The significant increase in installed RE capacity in 2023, reaching 20.3% of the total grid capacity, reflects this ongoing effort.

### ***A Glimpse of Progress: Existing Initiatives and Future Directions***

Azerbaijan has embarked on its journey towards a RE future with several key initiatives:

- **State Strategy:** The “Azerbaijan 2030: National Priorities for socio-economic development” where Priority 5 is “CLEAN ENVIRONMENT AND “GREEN GROWTH” COUNTRY”, “Socio-economic development strategy of Azerbaijan Republic in 2022–2026”, sets the strategic framework for RE development within the country.
- **Pilot Projects:** Azerbaijan is soaring towards a cleaner energy future with a series of groundbreaking pilot projects exploring the potential of solar, wind, and biomass power. These initiatives not only demonstrate the feasibility of RE in the region, but also pave the way for large-scale deployments in the years to come.
  - **Pioneering Solar:** Launched in 2023, Masdar's impressive 230 MW solar plant is already generating clean electricity, proving the viability of solar power in Azerbaijan's energy mix [4].
  - **Harnessing the Wind:** ACWA Power's 240 MW wind farm, currently under construction, will tap into the country's wind resources. This project represents a significant step towards diversifying the energy mix and reducing reliance on fossil fuels [5].
  - **Renewables Take Root in Liberated Lands:** Currently, Azerbaijan are actively developing hydropower potential in the territories of Karabakh and Eastern Zangezur, which were liberated from occupation three years ago. It was already commissioned 170 megawatts of hydropower plants, and by the end of this year it will reach 270 megawatts. In two to three years, the capacity of hydroelectric power stations will be 500 megawatts. Besides that bp's 240 MW solar project in the recently liberated Jabrayil city holds immense symbolic value. This will be another important contribution to the process of transition to green energy [4,19].
- **Legal Framework:** In 2021 the Law “On the use of RE sources in the production of electricity” was adopted [3]. The government is actively developing a robust legal and regulatory framework to foster a more conducive environment for attracting investments in the RE sector.

### **3. Barriers to RE penetration**

A report by the IEA shows a dramatic increase in RE production in 2023. Global capacity additions are estimated to jump nearly 50% to 507 GW, thanks in large part to supportive policies in over 130 countries. This reverses a previous slowdown and is driven by a surge in China's solar and wind power markets, which grew by 116% and 66% respectively compared to 2022. The trend is expected to continue for the next five years, with solar and wind making up a record 96% of new capacity. This is fueled by the fact that RE is now cheaper than most traditional fossil fuels and other alternatives in most countries, along with ongoing government support (Pic. 1) [10].

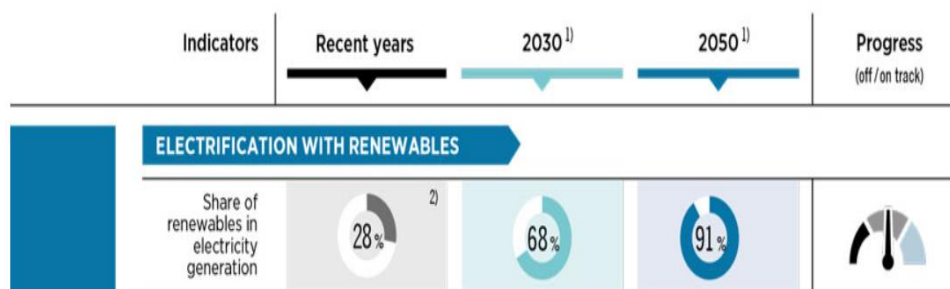


Pic. 1. Renewable electricity capacity additions by technology and segment, 2016-2028

In 2015, the United Nations set out 17 sustainable development goals (SDGs), and many countries have followed suit and SDG 7 aims to increase shares of RE among energy sources globally, expand the adoption of related technologies to protect the environment from climate changes that result from fossil fuel emissions and preserve non-RE sources from depletion.

Due to the fact that the transition to RE sources is inevitable and important, countries and the world community are faced with the question of how to do this? One of the key aspects of the complexity of the situation is that the transition to a sustainable future requires significant changes in our electricity landscape. RE sources such as solar, wind, geothermal and hydropower offer clean and abundant alternatives to fossil fuels. However, despite their enormous potential, RE sources face a number of obstacles that prevent their widespread adoption in the electricity market.

On the other hand, despite the support, RE is not widely used and only a small percentage of energy produced comes from renewable sources [13] (Pic. 2).



Pic. 2. Share of renewables in electricity generation, IRENA World Energy Transition Outlook 2023

The reason for this lies in the numerous barriers preventing the spread of RE. These barriers prevent it from competing with traditional energy sources and slow its widespread adoption.

Although the outlook for the deployment of RE Sources is positive, it faces many obstacles that can be divided into the following categories:

- **Policy and Regulation:** Lack of supportive policies, complex permitting processes, and regulations favoring traditional energy sources.
- **Market Barriers:** Inconsistent pricing structures, lack of financing mechanisms for renewables [16], and dominance of established fossil fuel companies [17].
- **Technological Barriers:** Intermittency of some renewable sources (solar, wind), energy storage limitations, and grid integration challenges.
- **Social and Environmental Barriers:** Public perception issues (e.g., wind turbine noise) [22], land-use concerns for solar farms, and potential environmental impacts of some renewable technologies [20].

This article examines the key barriers to the penetration of RE and explores potential solutions to create a more favorable environment for investment.

#### 4. The study of public opinion

To gain a deeper understanding of potential investor sentiment towards Azerbaijan's "Green Growth" strategy in the RE sector, a survey was conducted with 31 participants. This primary data collection effort provides crucial insights directly from stakeholders. By analyzing both survey findings and secondary data, this study aims to comprehensively assess investment opportunities within Azerbaijan's burgeoning RE market. Detailed information about the survey is presented in Appendix 1.

This survey was designed to gather public opinion on "Driving Green Growth" in Azerbaijan through RE. By analyzing the responses, we can expect to find results in several key areas:

**Public awareness and interest in renewables:** The survey gauges how familiar people are with RE sources and their interest in adopting them at home or in businesses. This reveals the existing knowledge base and potential market for RE solutions.

**Factors influencing adoption:** The survey explores the factors that would most influence people's decisions to use RE, such as cost concerns, visual impact, and government incentives. This helps identify areas where policies and programs can be tailored to address specific concerns.

**Government's role:** The survey assesses public opinion on the importance of government involvement in promoting RE. This indicates the level of public support for government initiatives like subsidies or infrastructure development.

**Information needs:** The survey identifies the type of information most helpful for people considering RE. This helps tailor future outreach and education campaigns to address knowledge gaps.

**Community support:** The survey explores people's perception of community receptiveness to large-scale renewable projects and the importance of being part of a community committed to RE. This helps assess potential social acceptance of such projects.

Overall, the survey results provided valuable insights into public understanding, concerns, and support for the development of a RE sector in Azerbaijan. This information can be used to inform policy decisions, design targeted incentive programs, and develop effective public education campaigns to drive "green growth" through RE investment.

Based on the results of the survey, the two questions presented to the respondents and their answers were subjected to regression analysis using IBM ISPS application. These questions are: "Would you be interested in installing RES" and "Importance of government role in promoting RE."

25 (80,6%) of respondents interested in installing RES, 5 (16,1%) unsure, 1 (3,2%) not interested. And 25 (80,6%) think that government play a major role in promoting RES, 5 (16,1%) respondents say that its somewhat important and 1 (3,2%) say not important at all.

## 5. Conclusion

This study investigated public perception of RE (RE) in Azerbaijan, focusing on interest in installing RE systems (RES) and the perceived importance of government promotion of RE. A survey was conducted (n=31) and analyzed using regression analysis via IBM SPSS. The findings revealed a moderate level of interest in installing RES, with a significant portion of respondents leaning towards being somewhat interested. However, the analysis did not detect a statistically significant relationship between interest in installing RES and the perceived importance of government promotion of RE.

The study underscores the complexity of factors influencing public interest in RES. While government promotion can play a role, other factors such as financial incentives, installation ease, and public awareness of the benefits and challenges associated with RES also warrant consideration. Policymakers and stakeholders in the Azerbaijani RE sector can leverage these insights to develop targeted strategies that stimulate "green growth" through enhanced RE investment.

## 6. Key findings:

- Moderate interest in installing RES among respondents.
- The majority of respondents lean towards being somewhat interested in RES.
- No statistically significant relationship between interest in installing RES and the perceived importance of government promotion of RE.
- Government promotion of RE is a statistically significant predictor of interest in installing RES.
- The linear regression model is a reasonable fit for the data, but with some variability in the residuals.



## 7. Limitations:

- Small sample size (n=31) limits the generalizability of the findings.
- The cross-sectional nature of the survey prevents the establishment of causality.
- The survey may not fully capture all factors influencing interest in RES.

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