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WIND, SUN, AND HYDROENERGY: A LOOK INTO AZERBAIJAN'S GREEN ENERGY FUTURE

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Introduction

Azerbaijan is a country rich in natural resources within the energy sector. Traditionally, oil and natural gas production have been among the main pillars of the country's economy, generating significant export revenue. However, global climate change, the depletion of fossil fuels, and pressures toward the sustainable use of energy highlight the need for innovations in Azerbaijan's energy policy. For this reason, Azerbaijan has prioritized the transition to green energy as one of its key issues.

Green energy aims to ensure the production of clean and sustainable energy by utilizing renewable energy sources. In Azerbaijan, renewable energy sources such as wind, solar, and hydroelectric power perfectly align with the country's geographical location and climatic conditions.

This article will examine Azerbaijan's green energy potential, the challenges it faces, and the development trends in this field.

Azerbaijan's geographical and climatic potential

Azerbaijan's geography and climate create an ideal environment for green energy production. Situated along the Caspian Sea, the country is a favorable region for wind energy production. Particularly, the Absheron Peninsula and Gobustan region are known for their high-speed wind fields. Research indicates that in these areas, the annual average wind speed reaches 5.5-7.0 meters per second, creating ideal conditions for wind energy production.

Azerbaijan also has great potential for solar energy. The country receives an average of 2200-2400 hours of sunlight annually, providing a favorable environment for the installation of solar energy systems. In particular, the southern regions experience high levels of solar radiation, which increases the efficiency of photovoltaic panels. By utilizing solar energy, the country can diversify its energy portfolio and reduce its dependence on fossil fuels.

Hydroelectric energy also plays a significant role in Azerbaijan's energy potential. The country's numerous rivers and mountainous areas enable the production of hydroelectric energy. The Mingachevir Energy Center, with a capacity of 400 MW, is the largest hydroelectric station in Azerbaijan and plays a crucial role in the country's energy security. Additionally, other rivers in Azerbaijan provide opportunities for the construction of small hydroelectric plants, contributing to more sustainable energy supply.

Figure 1 presents data showing how the structure of Azerbaijan's energy production will change from 2020 to 2030. According to the diagram, in 2020, renewable energy accounted for only 10% of the total energy production, while fossil fuels made up 90%. However, by 2030, the share of renewable energy is expected to increase to 30%, while fossil fuels will decrease to 70%.

Figure 1 visually illustrates the progress made in diversifying Azerbaijan's energy portfolio and transitioning to green energy.

Benefits of the transition to green energy

The green energy sector could reduce Azerbaijan's dependency on oil and gas, leading to a more diversified and sustainable economic structure. This transition offers several significant benefits.

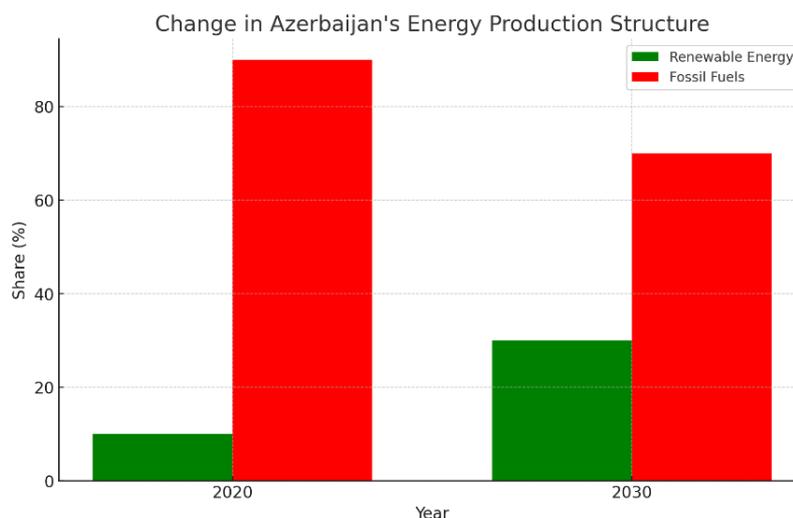


Fig. 1. Change in the structure of Azerbaijan's energy production

섹션 12.

ECOLOGY AND ENVIRONMENTAL PROTECTION TECHNOLOGIES

1. Economic diversification and job creation.

The green energy sector helps create new jobs and strengthens the local economy. The establishment and management of wind, solar, and hydroelectric energy projects generate job opportunities across various fields (see Table 1). This is particularly beneficial for reducing unemployment and poverty in rural areas. According to calculations by the International Renewable Energy Agency (IRENA), the renewable energy sector could create tens of thousands of new jobs in Azerbaijan. These jobs require various skills in fields such as engineering, construction, technical services, and management, thereby stimulating the local labor market. This transition will also have a positive impact on the country's economic development and social welfare.

Table 1

Jobs to be created in the green energy sector

Sector	Jobs to be created	Importance
Wind Energy	2000	Production and installation of wind turbines
Solar Energy	1500	Production and installation of photovoltaic panels
Hydroelectric	1200	Management of hydroelectric stations
Total	5700	-

2. Energy security and independence

The transition to green energy strengthens Azerbaijan's energy security. Reducing dependence on fossil fuels decreases the country's reliance on foreign energy suppliers and makes it more resilient to price fluctuations in the global energy markets. The use of renewable energy sources, especially energy production based on local resources, makes the country more independent. This shields Azerbaijan's energy market from external influences and ensures a more stable energy supply in the future. At the same time, the increase in local energy production helps make the country's economy more stable and self-sufficient. Investing in green energy sources reduces the impact of fluctuations in Azerbaijan's oil and gas markets and provides a boost to the diversification of the economy.

3. **Environmental protection and combatting climate change**

Renewable energy sources reduce the negative environmental impacts associated with the consumption of fossil fuels. Wind, solar, and hydroelectric energy significantly decrease greenhouse gas emissions, helping to prevent global warming. In line with Azerbaijan's climate policy, this transition also aligns with the country's commitments under the Paris Agreement. The significant increase in renewable energy production reduces the country's carbon footprint and supports

the protection of ecosystems. Clean energy sources such as wind, solar, and hydroelectric energy prevent air pollution and safeguard human health. In addition to the social benefits, this transition helps Azerbaijan meet its obligations under international environmental agreements.

Figure 2 shows how wind energy, solar energy, and hydroelectric energy reduce CO₂ emissions. The figure visually demonstrates how each energy source contributes to combating climate change. Wind energy reduces CO₂ emissions by 20%, solar energy by 25%, and hydroelectric energy by 15%.

The transition to green energy will contribute to reducing the environmental damage caused by Azerbaijan and help build a more sustainable future. This shift will not only focus on energy supply but also represent a significant step toward protecting the environment and ensuring social welfare.

Azerbaijan's green energy future: next steps

Azerbaijan's green energy sector has significant development potential, but this growth can only be realized with the right policies and support mechanisms. The steps taken in this direction are crucial for enhancing the country's energy security, diversifying its economy, and contributing to environmental protection.

CO₂ Emission Reduction by Renewable Energy Sources

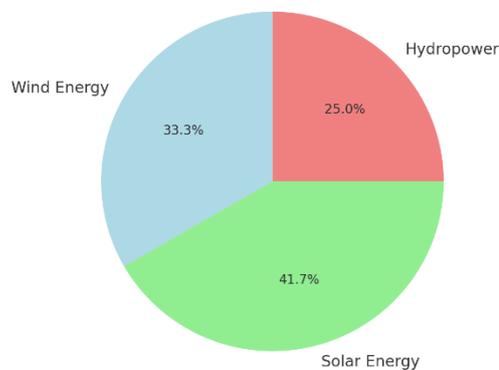


Fig. 2. **CO₂ emission reduction indicators of renewable energy sources**

1. Role of the Government and Private Sector

The development of the green energy sector requires active participation from both the government and the private sector. The government must implement a range of incentive policies that support the growth of renewable energy. These policies could include tax breaks, subsidies, and financial incentives to attract investment in renewable energy sources. The government should also take measures to encourage private sector involvement in this field and create a regulatory framework for the projects being launched.

섹션 12.

ECOLOGY AND ENVIRONMENTAL PROTECTION TECHNOLOGIES

The role of the private sector is indispensable for accelerating this process. Private enterprises can provide the necessary resources for the application of innovative technologies and the implementation of projects. The rapid development and application of modern energy technologies will facilitate the expansion of the renewable energy sector. Additionally, the private sector plays a key role in competing in international markets and bringing new investments to the country's economy.

Figure 3 shows the increase in Azerbaijan's energy independence and the reduction in foreign energy dependence from 2020 to 2030. The graph illustrates that the share of renewable energy will increase over time, while foreign energy dependence will decrease. In 2020, renewable energy accounted for 10%, while foreign energy dependence was 90%. By 2030, these figures are expected to be 30% and 70%, respectively. This graph demonstrates Azerbaijan's progress toward energy independence.

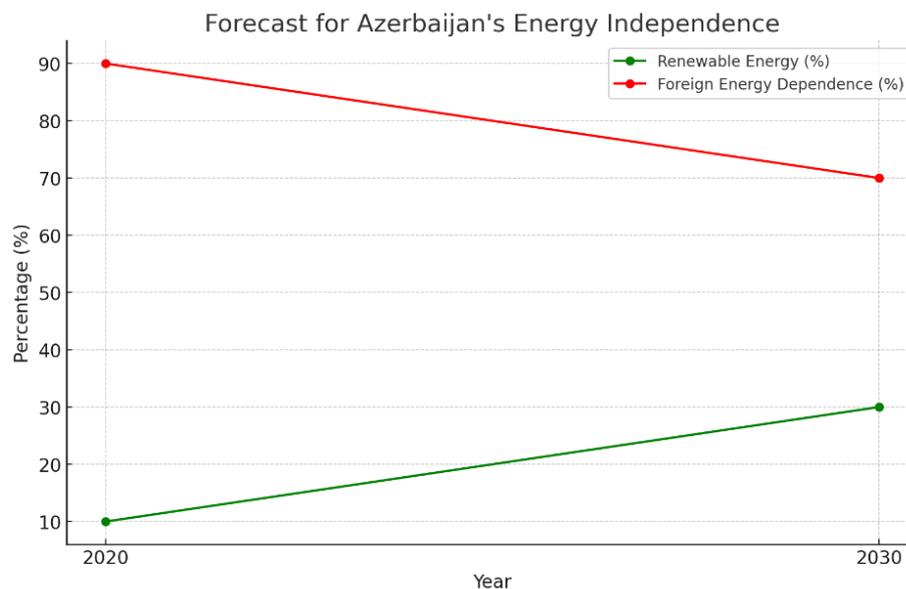


Fig. 3. Projections for Azerbaijan's energy independence (2020-2030)

2. International cooperation and technology exchange

Azerbaijan should collaborate with developed countries to benefit from international experiences and apply positive practices in the green energy sector. These collaborations are essential for facilitating technology exchange, ensuring access to financial resources, and developing local potential. International organizations, including the European Union and the United Nations, implement policies that support sustainable development goals and offer financial and

technical support to achieve these goals. Through cooperation with these organizations, Azerbaijan can acquire positive practices in the green energy sector and adapt them to its local conditions.

International cooperation is crucial for Azerbaijan to overcome existing energy challenges and accelerate the development of renewable energy. Furthermore, the application of new technologies and innovative approaches can modernize infrastructure in this sector.

3. Engaging local communities and social impacts

The success of green energy projects depends not only on the initiatives of the government and private sector but also on the active participation of local communities. Community-based energy projects are essential for improving energy accessibility in rural areas and supporting socio-economic development. These initiatives can also contribute to environmental protection and the efficient use of natural resources.

Local populations can benefit from green energy projects by achieving energy independence and taking advantage of the job opportunities created during the implementation of these projects. In rural areas, energy projects equipped with renewable energy systems can positively impact the local economy and improve the quality of life. This approach also promotes the efficient use of natural resources, directed toward environmental protection.

Moreover, the active involvement of local communities in green energy projects can help ensure social justice. This participation lays the foundation for more successful and long-term sustainable projects. To encourage community participation, the government must engage in discussions with the local population and consider their needs.

Conclusion

Azerbaijan, with its rich natural resources and geographical advantages, possesses great potential for the development of the green energy sector. Harnessing renewable sources such as wind, solar, and hydroelectric energy is crucial for strengthening the country's energy security, diversifying its economy, and contributing to environmental protection. However, the challenges faced can only be overcome through the joint efforts of the government and the private sector.

By focusing on international cooperation, local community involvement, and technological innovation, Azerbaijan has the potential to become a leader in the green energy sector.

The transition to green energy could become a key part of Azerbaijan's sustainable development strategy and help the country achieve its future economic, social, and environmental goals.

섹션 12.

ECOLOGY AND ENVIRONMENTAL PROTECTION TECHNOLOGIES

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섹션 12.

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