Sciental Journal of Education Humanities and Social Sciences, Vol. 3. 2, (2024)
ISSN Online: 2961-0389
***Website**: https://scientaljournals.com/index.php/SJEHSS/index*

Submitted: December 29, 2024/ Accepted February 19, 2025/ Published February 27, 2025

PROBLEMS AND PROSPECTS FOR THE DEVELOPMENT OF WIND ENERGY IN THE REPUBLIC OF UZBEKISTAN

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Abstract
The article examines the key aspects of wind energy development in the Republic of Uzbekistan, including its potential, existing challenges, and possible solutions. It highlights the main barriers to the implementation of wind power plants, such as infrastructural constraints, financial difficulties, technological challenges, workforce shortages, and regulatory obstacles. Recommendations are proposed to overcome these barriers, including infrastructure modernization, attracting investments, localizing equipment production, training qualified specialists, and improving the regulatory framework. Wind energy development is considered a strategically important direction for enhancing the country's energy security and reducing greenhouse gas emissions.

Keywords: Wind, wind energy, renewable energy sources, Uzbekistan, development, investments, technology, infrastructure, legislation, human resources.

Introduction

In recent years, Uzbekistan has actively developed renewable energy sources (RES) as part of its strategy to transition to a cleaner and more sustainable energy sector. Wind energy is one of the most promising sources of "green" electricity from renewable resources. Many countries are increasingly adopting this environmentally friendly technology to reduce greenhouse gas emissions and address energy security issues. Wind energy has become highly competitive with traditional energy sources worldwide. Its main advantages are renewability, availability of natural resources, and the absence of harmful emissions into the atmosphere.

In 2020, the leading countries in installed wind power capacity were China (281 GW), the USA (122 GW), Germany (62 GW), India (38 GW), and Spain (27 GW). Currently, China is the

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world leader in wind energy, with wind turbine capacity reaching 441,895 MW, almost three times more than the USA, which is in second place.

METHODS

Among various types of renewable energy, wind energy holds significant potential in Uzbekistan. According to international energy organizations, Uzbekistan has substantial wind energy resources, particularly in Karakalpakstan, Navoi, and Jizzakh regions, where average wind speeds reach 7–9 m/s, making them suitable for wind power plants (WPPs).

The government of Uzbekistan has developed a renewable energy program until 2030, which aims to install over 5 GW of wind power capacity. This initiative will significantly reduce carbon dioxide emissions and decrease dependence on traditional energy sources, such as natural gas and coal.

President Shavkat Mirziyoyev participated in the ceremony for two wind power plants and a manufacturing facility for wind turbine components and heating radiators. By 2030, ten power plants with a total capacity of 10.3 GW are planned in Karakalpakstan. In recent years, ten solar and wind power plants with a capacity of 2.6 GW were commissioned with $2 billion in investments. An additional 1.5 GW will be added by the end of the year, increasing the share of "green" energy to 15%.

Thirty-two "green" projects totaling 18.6 GW, with an investment of $19 billion, are planned. Karakalpakstan has the potential to produce 680 GW of solar and 120 GW of wind energy, according to research institutes.

RESULTS

Through direct investments of $11 billion, ten large wind power plants with a total capacity of 10.3 GW are planned to be built in Karakalpakstan by 2030. Once these projects are fully operational, they are expected to generate 35 billion kilowatt-hours of "green" energy annually. Three energy storage systems with a total capacity of 400 MW will be constructed in the Kungrad, Beruni, and Karaozak districts to ensure stable electricity transmission. In the near future, they plan to generate 4.2 billion kilowatt-hours of "green" energy per year, which is equivalent to the annual consumption of 1.76 million households. This will save approximately 1.3 billion cubic meters of natural gas and reduce emissions by about 2 million tons.

DISCUSSION

Despite its high potential, the development of wind energy in Uzbekistan faces several challenges:

- **Infrastructural Constraints:** The lack of developed energy infrastructure in remote regions of the country slows down the construction and connection of new WPPs.

- **Financial Barriers:** Implementing projects requires significant investments, and access to financing is limited. Foreign investors are often hesitant due to insufficient legal protection and lack of guarantees for returns on investments.

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- **Technological Challenges:** The country currently lacks local production of equipment for WPPs, and dependence on imported technologies increases project costs.

- **Workforce Shortage:** A shortage of specialists experienced in renewable energy slows down the deployment of new technologies and the maintenance of existing plants.

- **Regulatory Restrictions:** Inflexible legislation and a lack of incentives for investors and consumers hinder the industry's growth.

To effectively develop wind energy in Uzbekistan, the following steps are necessary:
-Infrastructure Development: Construct new power transmission lines and modernize existing networks to integrate WPPs into the national energy system.
-Investment Attraction: Introduce government subsidies and tax incentives for investors, as well as create a favourable investment environment.
-Technology Transfer and Localization**:** Establish agreements with international companies for technology transfer and develop local production of WPP components.
-Training Qualified Specialists: Create educational programs and conduct training sessions to prepare specialists in renewable energy
-Legislative Improvement: Develop incentives for using renewable energy sources and introduce mechanisms for the guaranteed purchase of electricity from WPP producers.

CONCLUSION

Wind energy development in Uzbekistan is a strategically important direction for ensuring energy security, reducing greenhouse gas emissions, and creating new jobs. However, achieving a real **"Energy Transition"** will require significant investments and innovative solutions to overcome the limitations of this technology. By addressing current challenges and implementing the proposed measures, Uzbekistan can become a leader in renewable energy use in Central Asia.

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