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Specific Aspects of Using Wind Energy

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Abstract: This article examines the advantages of wind energy and the experience of wind energy in developed countries such as China, the USA, and Germany. The article analyzes the possibilities of using wind energy in the Republic of Uzbekistan, its existing resources, and development prospects. It also analyzes the technology of building wind power plants, and major projects being implemented in Uzbekistan, including wind power plants in the Republic of Karakalpakstan, Navoi, and Bukhara regions.

Keywords: Wind power plant (WPP), modernization, "green" energy, European Bank for Reconstruction and Development (EBRD), operation, investment.

Introduction: In recent years, interest in the use of environmentally friendly, renewable energy sources in the energy sector has been growing all over the world. Traditional energy sources - oil, gas and coal - are distinguished by their negative impact on human health, environmental damage and limited reserves. That is why many countries, including Uzbekistan, are paying great attention to renewable energy sources, in particular wind energy.

The geographical location of the Republic of Uzbekistan, climatic conditions and high wind speeds in some regions indicate that the country has potential for the development of wind energy. In particular, in the Karakalpakstan, Navoi, Bukhara regions, the average annual wind speed is around 5–7 m/s, which allows for

the effective use of wind power plants. At a time when the country's energy needs are increasing year by year, the development of wind resources is an important factor not only in ensuring energy security, but also in maintaining environmental sustainability [1].

Main part. Wind energy has advantages over other types of alternative energy sources, which can be analyzed in the following areas:

The main advantages of wind are that it is an inexhaustible resource.

It can be available in any season, at any time of the day. As long as there is atmosphere and solar heat, there will be wind. As a result of using wind resources, humanity will not be dependent on limited and fossil resources. Wind power plants do not pollute. The most important advantage is that the electricity generated by wind does not emit any harmful and toxic gases (carbon dioxide (CO_2), nitrogen oxides (NO_x) and other harmful gases) into the environment. Wind power plants do not pollute water resources and have minimal impact on natural ecosystems. [2. 23-p.].

Although the construction of wind power plants initially requires large investments, later operating costs are low. Since wind is a free resource, the price of electricity produced is stable and economically profitable. In addition, there is an opportunity to save natural gas for use in other areas than electricity generation. In addition, the development of wind energy creates new jobs in the construction, operation and service sectors (almost 150 thousand people work in the wind industry in all 50 states of the USA, and this number is constantly growing). This gives an impetus to increase local human resources and introduce new technologies. In addition, wind power plants can operate in a variety of conditions, without being connected to large central systems, and can be installed on a small scale even in remote and mountainous areas. This helps to electrify remote areas that are not provided with electricity [4].

The experience of a number of developed countries in obtaining wind energy was studied. In particular, China is currently the world leader in the field of wind energy, and in 2023 the total capacity of wind power plants will exceed 282.0 GW. China will receive 71.67 GW of wind energy annually. This energy is mainly obtained through strong and stable wind resources in the regions of Inner Mongolia, Xinjiang and Shanxi. China's main strategy is to expand the sector by developing its own technologies, using large land areas and providing tax incentives to foreign investors. The low-cost policy of domestic enterprises, the systematic study of foreign advanced technologies and their practical application have significantly increased the technical level. In the United States, the capacity of wind energy has reached 117.7 GW, and more than 434.8 billion kilowatt-hours of energy are obtained from wind annually. Wind energy in this country accounts for about 10% of total electricity. The main wind resources are located in the states of Texas, Iowa, Oklahoma and Kansas. In the United States, wind farms are mainly operated by the private sector. At the same time, the state pays special attention to the modernization of the energy sector by financing scientific research.

In Germany, wind power capacity is 70 gigawatts and 222 MW of energy is produced annually. In this country, 25 percent of electricity is generated from wind. Germany mainly uses strong winds located along the North Sea coast, in particular in the Schleswig-Holstein and Brandenburg regions. The construction of offshore wind farms, digitalization of energy networks, and creation of opportunities for direct investment by citizens play an important role in the country's strategy [5].

Uzbekistan, due to its geographical location and natural and climatic conditions, is a potential country for the development of renewable energy, including wind resources. In recent years, large-scale research and investment projects have been launched in the country to study and implement wind energy.

High wind speed areas: In some areas of the republic, wind speeds are high enough for energy purposes, making it economically feasible to build wind power plants there. (According to UZGIDROMED, in any region of our republic at any time of the year it is around 5-10 m/s. In particular: The Republic of Karakalpakstan is one of the regions with the highest wind resources, where there is a stable wind flow throughout the year. The wind speed is around 6.5–7.2 m/s throughout the year. It is planned to build several large wind power plants (wind power plants) in this region by 2030. The wind speed is especially high in the Tomdi district and its surroundings, where the wind speed is around 5.8–6.4 m/s throughout the year. The Gijduvan and Peshku districts of Bukhara region are also favorable zones for wind energy, where the wind speed in this region is around 5.5–6.0 m/s throughout the year.

Today, several projects have been launched in Uzbekistan to build wind power plants. In particular:

The UAE's Masdar and China's Goldwind companies have signed agreements to build a 500 MW wind power plant worth $600 million in the Tomdi district of Navoi region. When fully commissioned in 2024, the plant will generate 1.8 billion kWh of electricity per year and save 546 million cubic meters of natural gas per year.

The Chinese company Liaoning Leader has signed an agreement to build two 1,000 MW wind power plants

worth $1.3 billion in the Gijduvan and Peshku districts of Bukhara region. When these plants are commissioned in 2023, they will supply 3.6 billion kWh of electricity per year and save 1.1 billion cubic meters of natural gas per year.

A 200 MW wind power plant worth $250 million in the Beruni and Karaozak districts of the Republic of Karakalpakstan A tender was held jointly with the European Bank for Reconstruction and Development to build a wind power plant with a capacity of 10.3 gigawatts. The winner of the tender was the company ACWA Power with a tariff proposal of 2.57 US cents per 1 kWh of electricity. By 2030, it is planned to build 10 large wind power plants with a total capacity of 10.3 gigawatts in Karakalpakstan at the expense of direct investments of 11 billion dollars. When these projects are fully operational, 35 billion kilowatt hours of "green" energy will be generated annually [6].

Studies show that the Ministry of Energy is implementing the plans set out in the concept for the development of wind energy ahead of schedule. As a result, by 2030, the total capacity of wind power plants in the country is expected to reach 5,000 MW. Most of them are planned to be built in the Republic of Karakalpakstan.

During the implementation of wind power projects, measures are also being taken to safely integrate them into a single energy system.

The construction of a wind power plant (WPP) is carried out in several stages. First, an investor is found. For example, the European Bank for Reconstruction and Development (EBRD) has allocated investment for the WPP being built in Karakalpakstan. Then, an area with strong winds is selected and wind power is measured there for 1–2 years. After that, the project is calculated and permits are obtained. Construction work lasts 1.5–2 years. Finally, the plant is commissioned and operates under control.

CONCLUSION

Uzbekistan is one of the countries with great potential for wind energy. The existing natural and climatic conditions, especially the stable wind speed throughout the year in some regions, allow for the effective use of wind energy.

The development of wind energy plays an important role in ensuring the environmental sustainability of Uzbekistan, as it reduces dependence on traditional fuel sources and significantly reduces emissions of harmful gases into the atmosphere. In addition, the commissioning of wind power plants creates jobs. This, in turn, creates beautiful landscapes and increases the number of tourists visiting the country.

In conclusion, the development of wind energy in Uzbekistan will not only ensure stable energy supply and economic independence, but also ensure the country's active participation in global environmental initiatives. Therefore, one of the urgent tasks is to develop comprehensive and long-term strategies in this area, study international experience and implement it in practice.

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