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**DEVELOPMENT OF THE USE OF LOW-POWER WIND ENERGY  
GENERATORS IN THE CREATION OF RENEWABLE ENERGY IN  
UZBEKISTAN**

***Abstract:** This article covers problems in the field of energy. Wind energy and the problems of its use, the research conducted on them, the opinions of scientists are highlighted. Proposals and recommendations for the development of wind energy sources in Uzbekistan are given.*

***Key words:** solar energy, wind energy, power plant, energy network, investment.*

Introduction. One of the biggest problems facing humanity today is the energy problem. The increase in the number of people in the whole world, the development of industry causes an increase in the demand for fuel and energy. In our country, especially in the autumn-winter season, the demand for fuel and heat increases. The decrease in fuel (oil, gas, coal...) reserves and the increase in environmental problems caused by them, as well as the increase in the load on the power grids, lead to the use of environmentally clean renewable energy (biofuel, solar energy, wind energy,...) requires a transition.

Wind energy reserves in Uzbekistan. One of the types of renewable energy is wind energy. Wind is the movement of air masses resulting from uneven heating of the earth's surface and changes in air pressure. Wind energy has been used since ancient times. Wind energy reserves are 100 times more than the hydropower of rivers. But today, very little is produced.

The German companies Geo-Net and Intec Sora conducted research in cooperation with JSC "Uzbekenergo" to study the energy potential, distribution and power of wind resources in Uzbekistan, and a map of wind resources of Uzbekistan was created by Geo-Net. is based on

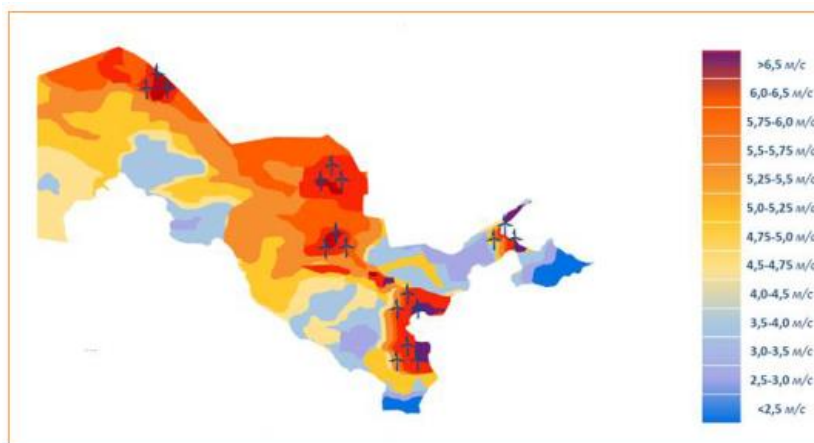


Figure 1. Optimum places for construction of wind power stations in the territories of Uzbekistan.

According to the data, the areas with wind speed of 5.0 m/sec to 6.5 m/sec and more are 70-75 percent of the total area of the country of Uzbekistan, and the areas with wind speed from 3.0 m/sec to 5.0 m/sec 20 -25 percent, and areas with wind speed less than 2.5 m/sec occupy about 5 percent. These figures indicate that wind energy can be used in 95 percent of the republic. In the information in the picture, the qualitative distribution of wind speed at a height of 80-85 meters above the ground was studied, and it was determined that the Republic of Uzbekistan has a huge potential for the development of wind energy. For the construction of wind stations, good results will be achieved if windmills are placed in Moynaq district of Karakalpakstan, Konimekh and Tamdi districts of Navoi region, Kashkadarya, Surkhandarya, Jizzakh, and Tashkent regions.

Wind energy production. Wind is an eternal source of energy generated by the activity of the sun, moving at 7-12 km above the surface of the earth. Its widespread use is the most advantageous aspect of its use, whether it is in the desert, in the foothills, or in places where electric wires do not reach.

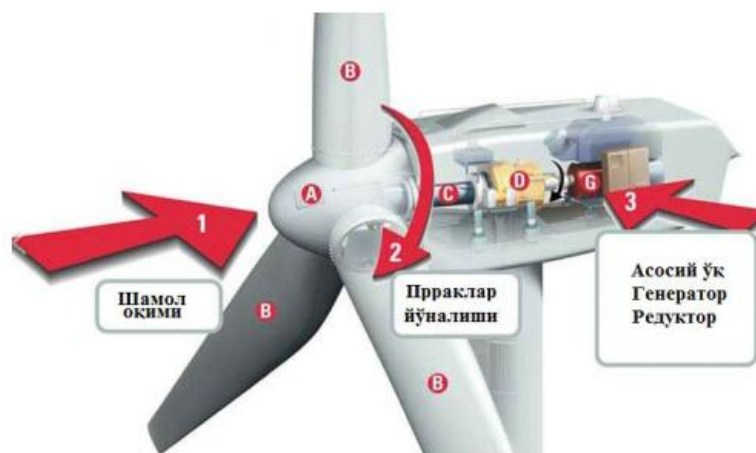


Figure 2. The device that converts wind mechanical energy into electrical energy.



Figure 3. Wind power plant complex

Economically, it is advisable to use wind generators if the wind speed at the site is not less than 5 m/s. Wind power generators are 2-4 times more expensive than conventional generators. But in some regions where wind energy is constant, it is an important source of energy. Usually, wind energy is determined by the effect of a certain area perpendicular to the wind,

$$H_{wind\ current} = 0,0049 \times \rho \times v \times \Phi$$

where:  $\rho$  is air density (relative to temperature and atmospheric pressure)  $\text{kg/m}^3$ ;  $v$ —speed of air flow,  $\text{m/s}$ ;  $\Phi$  is the surface area,  $\text{m}^2$ .

The amount of energy transmitted by a wind energy device is fundamentally different from the amount of energy generated by air currents. Because part of the energy of the air flow is wasted in the blades of the wind wheel, reducers and generators. The amount of wasted energy is accounted for by the coefficient of wind energy utilization. The power of the wind energy device can be calculated from the following formula by defining the surface of the field perpendicular to the wind with the diameter of the wind wheel.

$$H_{wind\ power\ device} = 0,00386 \times \rho \times B \times D^2 \times \xi_{blades} \times \eta_{red.} \times \eta_{gen.}$$

Here: D is the diameter of the working wheel, m;  $\eta_{red.}$  and  $\eta_{gen.}$  - useful work coefficients of reducer and generator,  $\xi_{blades}$  - air flow energy wasted in the wings.

According to calculations, wind energy efficiency of wind turbines can be as high as 48%, while the overall efficiency of wind turbines is even lower. Perpendicular to the wind, mainly the blades of wind turbines are located. The power of the wind turbine is determined not by the number of blades, but by the diameter of the impeller.

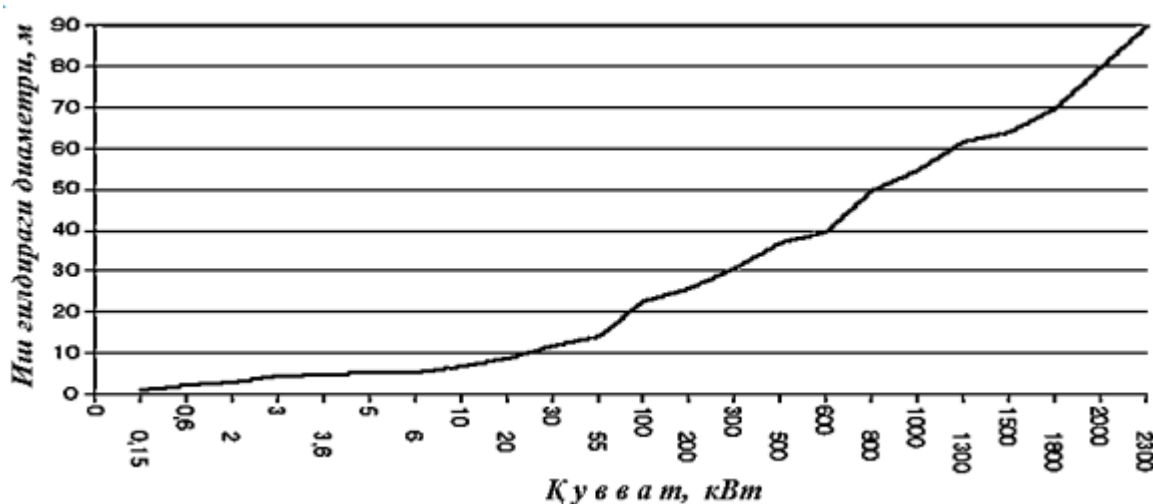


Figure 4. A plot of the relationship between the diameter of the impeller of a wind turbine and its power is shown.

Problems in the use of wind energy. The disadvantage of wind energy is that its speed is constantly and seasonally changing, which causes many

inconveniences in wind generators. The noise that wind generators make when they work is also one of its disadvantages.

Wind power generators are 2-4 times more expensive than conventional generators. But in some regions where wind energy is constant, it is an important source of energy. Currently, there is no easy way to store electricity generated by wind or solar energy for a certain period of time. technologies such as capacitors and flywheels can provide stored power for minutes or hours. But the adjustment of electrical networks is of particular importance, they work only when the amount of energy input is the same. However, connecting these new energy producers to existing grids will not be easy. One of the biggest problems with using continuous renewable sources like wind and solar is the impact on the system.

Focus on wind energy production. The annual theoretical reserve of the wind is 100 times more than all the energy reserves on earth and is 3300 trillion kWh. However, only 10-12 percent of this energy can be used now. Many countries have begun to pay attention to the wider use of wind energy. increased its power by 66%. Today, 15-22% of the electricity in the USA, Denmark, Portugal, Ireland, Spain and Germany is produced by wind energy. Work has been carried out since 2015 on reports on renewable energy in our country. In 2015, solar power stations produced 0.003 million kWh of electricity, and in 2019, this figure was 0.1 million kWh. In 2019, 15.5 million kWh of electricity was generated from wind power plants.

According to scientists, 1 kW of wind energy can save 1.5 tons of coal for a year and reduce the emission of carbon dioxide gas by 1.8 tons, sulfur oxide by 9 kg, and nitrogen oxide by 4 kg. It can be seen that the use of wind energy has both economic and environmental advantages.

In 2017-2021, approved by the Decree of the President of the Republic of Uzbekistan Shavkat Mirziyoev "On the Strategy of Actions for the Further Development of the Republic of Uzbekistan" No. PF-4947, special attention is paid to this issue and the production of new electricity tasks have been defined in connection with the implementation of measures to improve the supply of

electricity and other fuel-energy resources to the population based on the construction and modernization of the existing ones, the renewal of low-voltage power networks and transformer points, as well as the expansion of the use of renewable energy sources.

According to the legislation of the country, citizens who use alternative energy sources are given tax benefits. That is, there is a privilege in the form of exemption from property tax and land tax for individuals who use alternative energy sources in their homes, completely disconnected from the current energy resource networks. The privilege is provided for a period of 3 years from the month of installation of alternative energy sources. The relevant certificate of energy supply organizations is the basis for applying the privilege. As a result of the conditions created in the country of Uzbekistan, there is an increasing interest among the population in the use of small power wind generators for supplying electricity to houses and offices. This shows the need to increase the number of enterprises that produce convenient, cheap and simply structured options of small-power wind generators from local raw materials and helps to popularize them.

In order to eliminate the above-mentioned energy problems and to find new energy sources, to expand the scope of renewable energy in the energy system, large-scale projects have been implemented in Uzbekistan with the support of the Asian Development Bank, the World Bank and the European Bank for Reconstruction and Development. is being increased. In particular, cooperation relations have been established with the subsidiaries of the Saudi Arabian company "ACVA Power", the French company "Tota Eren", the company "Masdar" of the United Arab Emirates, and the investment holding "Mubadala Investment Company" in Abu Dhabi. Specific projects for 10 years have been developed by expanding the scope of work on the production of alternative energy sources. During this period, it is planned to build solar power plants with a total capacity of 5 thousand MW and wind power plants with a total capacity of 3 thousand MW.

**CONCLUSIONS AND SUGGESTIONS.** In our country, the demand for electricity is increasing as a result of the growth of the population, new

construction, and the increase of production enterprises. Since most of the thermal power stations are outdated, it is necessary to use renewable energy sources to prevent losses in the supply of electricity and to provide the population with natural clean electricity. It would be appropriate to apply the following suggestions for solving problems in our country after studying renewable energy sources in foreign countries in depth:

- attracting investors for renewable energy installations, investment;
  - expanding the use of renewable energy sources;
  - training centers to increase the level of competence in the energy sector expansion and opening of new ones, development of employee retraining programs
- output, including experts in renewable energy technology
- it is necessary to expand training programs;
- import and deployment of equipment and technologies of different countries;
  - not only the equipment of renewable energy sources in our country;
  - implementation of work on the organization of production enterprises;
  - production of low-power wind generators in our country from local raw materials
- has the ability to generate, using this "the most efficient wind generator"
- wide application to production by supporting project selections;
- Windmills, solar panels and boilers for residents in their homes
- to carry out promotion and propaganda work for the use of collectors.

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