

PROSPECTS OF WIND ENERGY DEVELOPMENT IN BELARUS

ПЕРСПЕКТИВЫ РАЗВИТИЯ ВЕТРЯНОЙ ЭНЕРГЕТИКИ В БЕЛАРУСИ

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Green energy obtained from renewable natural resources does not require the use of organic fuel. And so it is attractive and good. In the process of electricity production from the wind, inexhaustible energy is used for the movement of air masses, while no useful minerals are expended, no toxic substances are released. The cost of producing electricity is less than using fossil fuels.

The aim of this research is to determine the efficiency of wind energy using in Belarus. For achieving this aim the following tasks were highlighted:

- to determine the efficiency of the existing wind turbines,
- to identify features of the Belarusian landscape and climate,
- to show the prospect of wind energy development in Belarus.

The idea of using the power of the wind to produce electrical energy is not new. It was born back in the late 19th century when an American Charles F. Brush built a prototype of automatically controlled wind turbine for power generation. At that time it was gigantic - the diameter of the rotor was 17 meters, and consisted of 144 blades made of cedar.

In Europe, the first wind power station was launched in 1900, and at the beginning of the Second World War several millions of windmills were operating.

Currently, wind power is one of the most fast-growing sectors of electricity production. The wind turbine is expensive equipment, but the cost of its purchase will pay off within the first 7 years of operation. Estimated service life is 25 years.

The largest wind turbine in the world today is Enercon E-126 near Emden in Germany. Power plant capacity is 7.58 MW, the height is 141 m.

A modern windmill is a steel tower in height from 70 to 125 m, on top of which there is a generator and a rotor with blades. Wind power stations are located, as a rule, in regions where the average annual wind speed is 6 meters per second or higher and which are poor with other energy sources, as well as in areas where fuel delivery is very expensive.

Small wind turbines are usually designed for autonomous operation. The systems with which they produce energy are fastidious, they require energy of higher quality and do not allow interruptions in work, for example, during

periods of no wind. Therefore, they need an understudy that reserve energy sources, for example, diesel engines are the same as for wind turbines.

As for the more powerful wind turbines (over 100 kW), they are used as power plants and are usually included in the power system. Usually a sufficiently large number of wind turbines are installed on one site, forming a so-called wind power station.

Wind power depends on the vagaries of nature. Sometimes the wind speed is so low that the wind turbine cannot work at all, or so high that the wind turbine needs to be stopped and taken to protect it from destruction. If the wind speed exceeds the rated operating speed, some of the extracted mechanical wind energy is not used, so as not to exceed the nominal electric power of the generator. For efficient operation of wind turbines, they are placed in open spaces. In mountainous areas of the wind installations work effectively because of the natural features of these areas, where the movement of air masses predominates with great force and speed, besides, it gives energy to hard-to-reach areas.

Correct installation affects the efficiency of the wind aggregates, so the power utilization factor during the year is 15 - 30% of the wind energy or even less depending on location and installation parameters.

The leading countries in the use of wind energy are traditionally Germany, Spain, the USA, India and Denmark. In 2010 China was ahead of the United States (40.2 GW), Germany (27.2 GW) and other countries in terms of the total installed capacity of wind power plants (41.8 GW) for the first time.

In the same year, the amount of electric energy produced by all wind turbines in the world amounted to 430 million GW (2.5% of all electricity produced). There is an increase in the unit capacity of wind turbines in parallel, which makes it possible to reduce unit costs in their construction. At present it is proved that for the production of industrial volumes of electricity it is advisable to introduce units with a unit capacity of 1 MW or more according to the results of the world experience of operation of wind turbines.

In the Republic of Belarus until 2011 there was already some experience in operating of wind power equipment. In particular two 250 kW and 600 kW wind turbines are installed on the shore of Lake Naroch, respectively. This experience confirms that given the correct choice of the site for the deployment of wind turbines makes it possible to ensure the generation of electricity in conditions of our country.

In 2006 the issue of the possibility of the introduction of a wind turbine with capacity of 1-1.5 MW on the territory of the Grodno region began to be considered at RUE "Grodnoenergo" with its appearance on the market.

Analysis of the meteorological and geographical conditions of the region showed that it is the most suitable for the development of wind energy in terms of altitude above sea level, hills and the value of background velocities.

On April 29, 2011 the first industrial wind power plant with a capacity of 1.5 MW was commissioned as a result of a significant amount of work to survey this site, develop project documentation, select, supply, install and commission equipment in the Republic of Belarus.

The type of wind farm is HW82/1500. The wind turbine is a rather complex structure with a height of 82 meters, and weight of 208 tons, the length of each of the three blades is 42 meters, which is installed on a foundation support in the form of an octahedron with a diameter of 14 meters. The foundation weight is 1000 tons.

To ensure maximum power generation, as well as stable operation without maintenance of personnel, the wind power plant is equipped with an automatic control system that allows to determine the optimum position of the wind wheel relative to the wind. The initial wind speed for switching on the wind power plant is 3 m/s.

The wind speed allows to reach the rated power (1.5 MW) is 11 m/s. When the wind speed is 25 m/s (average value for 10 minutes) or 35 m/s (3 s with gusty wind) the installation is automatically switched off. Then, when the wind speed is reduced to 22 m/s, the installation is reactivated.

The wind speed is not constant during the year, therefore the wind power plant can operate both at rated power and in the mode of consumption from the network. Due to the high level of automation of the wind power installation of additional personnel for its operation and maintenance are not required. Operational control over the operation of the wind power plant is carried out by the operational-dispatching group of Novogrudok RES. Technical maintenance is carried out by specialists of the Lida High-Voltage District of Electric Networks, who have been specifically trained by the manufacturer.

As at 1 January 2017 the wind power plant produced 22.7 million kWh. The electric power consumption for own needs is 1.8%, the power utilization factor is 30-32%. The maximum power achieved was 1,617 kW. Due to the work of the wind farm of RUE "Grodnoenergo" for the years that have passed since the beginning of its work it economized imported types of fuel (natural gas) - 5.4 million m³, or 6,103 tons of fuel equivalent. The cost of electricity produced is 5.8 cents / kWh (the average tariff for the Republic of Belarus is 11.3 cents / kWh). On average the electricity generated in a year by the wind farm is sufficient for 2,000 houses.

Due to the fact that the wind power plant uses wind power for its work and does not use fuel, CO² emissions decrease in the order of 10 thousand tons per year, which will reduce the load on the climate of the region in the amount of

10.5 thousand tons of greenhouse gas CO² emissions. The experience of operating the first high-capacity wind power plant in the Republic of Belarus showed the possibility of using wind energy for electricity generation in our area and initiated the development of industrial use of this energy in Belarus.

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