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### **Wind Energy Efficiency in Belarus**

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It is a well-known fact that sooner or later, people will face a shortage of raw carbon materials: reserves of gas, coal and oil will be exhausted. Taking in consideration current volume of coal production, it will last for 400-500 years; and oil and gas – for almost a century. This is the reason why the analysis of the efficient usage of renewable energy sources is carried out all over the world. Scientists and governments of various countries, including Belarus, are working on the development of renewable, also called non-traditional, energy sources. For example, one of the inexhaustible sources is wind energy. Therefore, in the last two decades, interest in the use of wind energy has begun to grow [1].

Only 15% of our country's needs are covered by its own fuel and energy resources. The remaining 85% is imported (mainly from Russia). At the same time, in recent years there has been a constant increase in prices for imported electricity and fuel. This growth will only continue in the future, eventually reaching a very high level.

According to calculations, a wind turbine with a capacity of 1 MW can replace approximately 29 thousand tons of coal for 20 years. Using that type of energy will also lower the amount of carbon dioxide and other substances released in the atmosphere. Therefore, it is necessary to develop wind power industry of our country, and Belarus should master the production of its own wind power equipment based on modern technologies. Our

country independence should start with us developing local energy sources and preferably renewable ones. On average, Belarus energy sector may become fully independent by 2050 [2]. If we look at the national program of local and renewable sources development for years 2011-2015, we will see that 1,840 sites have been identified as those that can potentially accommodate single wind turbines and wind farms. The identified sites are mainly hills that are 20 to 80 meters high, with a background wind speed of 5 meters per second or more. In a spot like that, we can build 5 to 20 wind turbines.

At the moment, there are 23 wind turbines operating on the territory of our republic. They are installed in Minsk, Grodno, Mogilev and Vitebsk regions. The largest wind power plant in Belarus operates in the village of Grabniki, Novogrudok district, Grodno region, its capacity is 1.5 MW. That windmill is still the most powerful and largest one in Belarus. It is also the only one owned by the state. According to experts, the wind turbines will pay off within 5 years at an average annual speed of 6-8 m/s [3].

1) The average annual background wind speed at an altitude of ten meters

2) The average annual estimated wind speed at an altitude of one hundred meters (taking into account the data of monitoring wind parameters)

3) Map-diagram of the wind energy potential on the territory of Belarus at the height of the wind turbine installation one hundred meters from the ground surface (for wind turbines with an installed capacity of 2.5 MW) [4].

According to the forecasts provided by power engineers, Belarus can cover up to 50% of its energy needs by using only 10% of the territory suitable for wind energy purposes.

One of the reasons for the skeptical attitude towards wind energy is that it is not cheap. Here is an approximate cost of a serial wind turbine with different capacities:

- 6 kW is 7.2 thousand USD

- 60 kW is 60 thousand USD

Marketing research conducted by the specialists of the International Academy of Ecology showed that the payback period of wind power equipment is comparable to the payback period of small hydroelectric power plants, combined-cycle and gas-fuel power plants. However, it is significantly lower than the payback period of coal, nuclear and diesel power plants. At the same time, the cost of operating wind turbines is lower than the cost of operating power plants running on gaseous, liquid, solid or nuclear fuel. The large-scale development of Belarusian wind power industry will require appropriate marketing research, installation, construction work and creating a unique service sector. This will lead to creation of new jobs, more or less evenly distributed across the country. Overall, wind energy sector, like everything new, will require considerable effort and costs. And, of course, the activities of enthusiasts alone are not enough here. There is also a need for adequate and wise action by public authorities.

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