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PERSPECTIVES OF WIND ENERGY UTILIZATION IN THE TERNOPIL REGION

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Since the beginning of the full-scale military invasion of the territory of Ukraine, the problem of preservation and production of electric power has become acute throughout the country.

This problem became particularly significant after the attacks in October-November 2022 on the energy facilities of Ukraine. At that time, each region found itself in a state of blackout with prolonged power outages.

The Ternopil region was no exception. Let's consider the prospects of using wind energy in this region, as alternative sources of electricity can partially address the overall issue during massive attacks on energy infrastructure.

In the Ternopil region, more than 60 days per year are marked by strong winds exceeding 15 m/s, especially in the southern part of the region. According to meteorologists, the highest number of such days is observed in the south, while in the west and central areas, this phenomenon is less common. During the summer months from June to August, only 0-1 day is typically characterized by strong winds over most of the region [1].

The highest wind gusts exceeding 15 m/s are observed in March and November. Despite powerful winds, storms, and gusts in spring and autumn, February is more frequently marked by severe frosts and snowstorms [1].

For instance, the city of Berezhany, located in the western part of the region, practically has no days with strong winds, while in the southern region, this phenomenon is observed more than 25 times per year [2].

There is also a trend of increasing wind gust speeds, particularly those exceeding 20 m/s, observed in the region. In the 1990s, the average wind gust speed was 20-21 m/s, but after 2010, this value has reached 26-27 m/s. This indicates an increased risk of occurrence of meteorological phenomena such as hurricanes, tornadoes, storms, squalls, snowstorms, and others. Changes in air circulation in the atmospheric surface layer, air mass flows, and temperature regime have led to an increased frequency of hazardous meteorological events, affecting the territory of the Ternopil region as well [3].

In Ukraine, the wind potential of different regions is determined using the National Wind Energy Cadastre [4]. This database contains information on average annual and monthly wind speeds obtained from long-term scientific observations. It also takes into account the frequency of wind directions throughout the year, month, day, and other periods [5].

The average wind speed at the Earth's surface in Ukraine is generally quite low, at 4.3 m/s [6].

The Ternopil region is traditionally classified as an area with an average wind speed of less than 4 m/s [7].

However, as of 2023, there is an increase in the average wind speed at specific monitoring points in the region, with an increase of at least 1 m/s.

This information is confirmed by official meteorological data, including for cities such as Ternopil (≥ 4 -5 m/s), Kremenets (4 m/s), Berezhany (4 m/s), Chortkiv (≤ 3 m/s), and Zalishchyky (≥ 4 m/s).

Local residents also confirm these changes; for example, residents of the village of Rudky in Chortkiv district report a change in wind direction approximately twice a day when the wind shifts from north to south and vice versa, less frequently from west to east.

Taking into account the trend of increasing average wind speed in the region, the installation of wind turbines can become an effective solution for providing energy to agricultural lands [6].

Examining the optimal wind turbine model based on the Onipko rotor suggests the potential for electricity generation at low wind speeds, allowing the use of this type of equipment in various territorial conditions [8].

These wind generators, on average, produce approximately 300 kilowatt-hours of electricity per month. One such wind generator can power all household appliances in most homes, excluding the heating system. Two or three of these rotors can also provide energy for heating a house during the winter period [8].

During times of military action, it is crucial for the residents of the region and the entire country to have continuous electricity supply and heating in their homes. Unfortunately, it is impossible to predict with certainty potential attacks by Russia on the country's energy system, but the presence of additional energy sources for

residential buildings becomes an important backup option for overcoming potential difficulties.

The results of the analysis of climate change impact on the Ternopil region, along with the study of technical aspects of wind energy utilization, confirm the necessity to rethink the energy strategy of the region. The increase in wind speed and its unpredictability open up new opportunities for the application of wind turbines in electricity production.

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