

Applying wind energy for alternative energy efficiency

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Abstract. This article looks at one way of harnessing inexhaustible energy - wind power. The relevance of the use of wind farms has been considered, which is due to many factors. The most important advantage of wind farms is the use of an inexhaustible source of energy, namely air currents, which are the result of pressure differences in the atmosphere. Although the modern energy industry is mainly based on non-renewable energy sources (oil, gas and hard coal account for about 80% of the global energy balance), interest in renewable energy sources (RES) is growing steadily. The main arguments for using RES are the high price of conventional fuels, energy security for the countries.

1 Introduction

Energy consumption in the world is growing, due to increased production, population increase despite energy efficiency. Today, the question of the world's transition to alternative energy is becoming acute. In today's world, one of the alternative forms of energy refers to wind power, which specializes in converting kinetic energy from air masses in the atmosphere into any other form of energy - electrical, mechanical, thermal - favorable to use in the national economy. Wind power is one of the fastest growing alternative energy sectors [2].

Wind power has all the advantages of alternative energy in general (environmental friendliness, renewability, low-operating costs) [1, 5]. The development of wind power around the world has been going very quickly in recent years. China and the US are leading the way now, but the rest of the world is also gradually developing this promising area of clean energy based on an inexhaustible natural resource - wind power [12]. Every year, more and more wind turbines are being installed around the world, and the trend is towards further expansion of the technology. Wind power is playing an increasing role worldwide as a renewable energy resource. Countries such as Spain, Germany and Denmark are close to reaching their goal of generating 30% of their electricity needs from wind power. Although the United States currently generates only about 5% of its electricity from wind power, in terms of total installed capacity, it ranks first in the world, recently surpassing

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Germany. Scientists predict that wind will cover more than 1/3 of the world's electricity needs by 2050. The wind power resources are so enormous that they cannot be fully exploited even in the long term. On the quantitative side, there can only be a question of the possible degree of concentration of wind power plants in a particular limited area [17].

The best places to locate a wind turbine are atop rounded hills, open plains (or open water for coastal wind) and mountain passes, through which the wind passes naturally (creating regular high wind speeds). Generally, the higher the altitude, the better, as higher areas tend to have stronger winds. Predicting wind energy is important for choosing where to install a wind turbine. There are many wind speed maps and data from different organizations [4].

The site should then be surveyed in order to assess the local winds and determine the best direction to place the wind turbines with maximum efficiency. Wind speed, turbulence and onshore wind direction as well as air temperature and humidity are projected for at least one year. Once this information is determined, the turbines can be installed. Wind is not the only factor for turbine placement. Wind farm developers must consider how close the wind farm is to power lines (and to towns that could use the electricity); possible interference with airports and aircraft; rocks and faults; flight patterns of birds and bats; and impacts on the local community (noise and other impacts) [8].

Most large wind power projects have duration of at least 20 years, so these factors must be considered in the long term.

2 Materials and methods

The article uses methodological and statistical data to analyse wind power in the world. In addition to the traditional, most common ways of generating electricity, there are other, less used, but quite efficient means. These include solar power, tidal power plants, nuclear power plants, and other power units capable of generating electricity on an industrial scale or for the needs of the individual home. But there is one method that has many advantages over the others, wind power, an efficient and rapidly growing energy industry [10].

3 Results

Wind turbines transform wind power. The task of all types of wind turbines is the same - to convert wind energy into electricity. But, this task can be carried out in different ways. There are horizontal and vertical axis wind turbines. Operation of the first type is the most common. Such wind turbines have many disadvantages: they create a lot of noise, ultrasound, vibration, and small animals leave areas near the installations next in figure 1 we will look at the common vertical wind turbines, which are used all over the world [6].

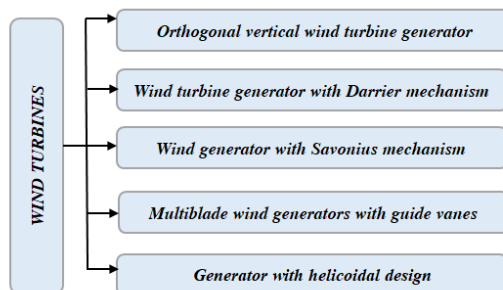


Fig. 1. Types of common vertical wind turbines in the world.

Looking at each type of vertical wind turbine, consider their disadvantages and advantages in Table 1.

Table 1. Disadvantages and advantages of a wind turbine.

No.	Type of wind turbine	Benefits	Minuses
1	Orthogonal vertical wind turbine generator	works independently of the wind direction and can be positioned at ground level	short service life of support assemblies due to high loads on the wind turbine rotor.
2	Wind turbine generator with Darrier mechanism	no wind orientation, easy to assemble and install yourself for household use	low blade efficiency, high dynamic loads
3	Wind generator with Savonius mechanism	operation at relatively low speeds and high technology in energy production	high material intensity
4	Multiblade wind generators with guide vanes	high efficiency compared to other vertical wind turbines, works in low winds.	high cost and expensive maintenance due to the number of blades.
5	Generator with helicoidal design	longer service life than other orthogonal rotors.	high cost

Table 1 shows that each installation has both advantages and disadvantages. Therefore, a given economic operator will choose the most efficient plant for energy production based on these indicators [11].

Among the types of wind turbines listed above, the most promising direction is that of balloons. Flying generators have plenty of advantages: they are environmentally friendly, practical and economical. Airborne units, most often similar to kites or balloons. They are safe for birds, do not interfere with radio waves, do not make loud noises and can work in any weather. Researchers are now actively developing this air technology, which is sure to carve a niche for itself in the energy market of the future [14].

The use of wind energy is particularly attractive in high-rise buildings. Powerful wind turbines are installed inside the building itself, usually on technical floors. They allow the wind to blow through the building without creating draughts and air pockets. Due to the streamlined shape of the building, the air masses entering the special wind turbine channels will act on the installed wind generators. In this way, all the necessary energy will be generated from the generators, which will significantly reduce the cost of other types of electricity. In addition, such installations will control the level of cooling of the building, thus preventing it from overheating [13].

Among the developed and developing countries, the top five countries that have installed new capacity stand out according to the statistics. Figure 2 below shows the leading countries in terms of electricity generation [15].

Based on Graph 3, we see that the top five countries are China with 56% wind power, the US with 18%, Brazil with 3% and the Netherlands and Germany with 2% each. Based on these statistics, in total among the leading countries in wind energy are 80.1 %. The outlook for wind power worldwide remains positive. Average growth for the next 5 years is 4%.

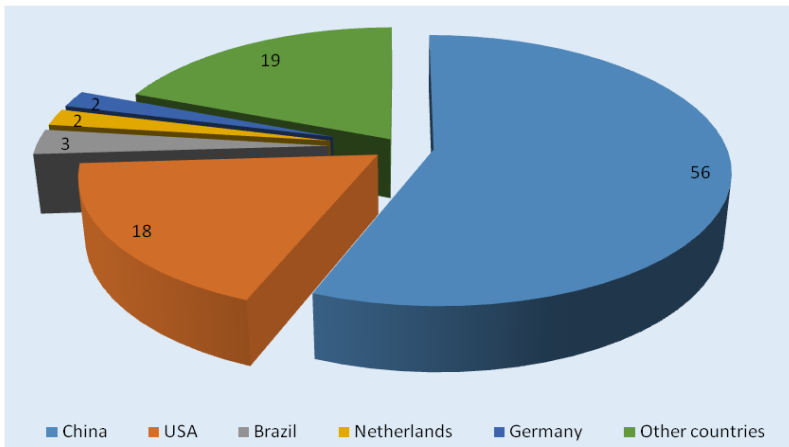


Fig. 2. Share of countries in new installed capacity (%).

4 Discussion

Wind energy is one of the fastest-growing renewable energy technologies. Nevertheless, given the growing demand for wind power, it is important to note that current wind energy technology is still far from optimal [16].

Because of its intermittent nature, wind power poses serious new challenges before it becomes a fully reliable technology. For example, on average, modern wind power plants operate at only 35% of their capacity. They also operate at full capacity less than 10% of the time.

This is partly due to wind variability, but also to economic factors affecting the aerodynamic design of the wind turbine. Although it is possible to increase the capture of wind energy by increasing the rotor diameter this approach has economic limitations.

The intermittent and unpredictable nature of wind energy makes energy storage systems a key element in renewable energy [3].

A renewable energy source like wind is poised to play an important role in the world's energy future. New generation wind turbines should improve their efficiency, reduce their acquisition costs, improve the reliability and cost of electricity generated and increase their competitiveness compared to the use of traditional fossil fuels.

Each year the growth of wind power is increasing worldwide, consider this growth in Figure 3

Based on Figure 3, we can see that every year since 2017 there has been significant growth in wind power.

Thus, we can say, based on statistics that wind energy technology has improved dramatically over the past decade, as wind turbines have become giant engineering achievements towering above the landscape or floating in the sea.

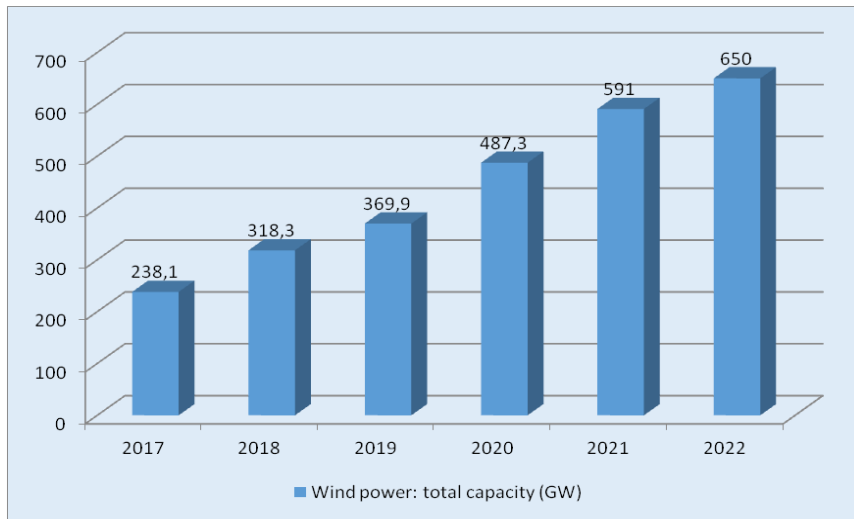


Fig. 3. Growth of wind power in recent years.

5 Conclusion

Global experience shows that, thanks to state support, wind power has received a strong impetus for development and has taken a leading position in the economies of developed countries. The analysis of wind energy application shows that this type of energy is environmentally friendly and inexhaustible. Summing up, we can say that wind energy is currently the most promising and fastest in terms of energy production. Consequently, wind power will provide enough energy for the world community.

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