Designing a wind farm for individual energy consumers

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ABSTRACT *an Wind resource assessment can assess wind energy potential globally, by country or region, or for a specific area. The potential of wind resources in our region has been studied in detail, precautions and possibilities of wind power plants that produce electricity from low-speed wind have been studied. Current wind power plants that work even at low wind speeds have been analyzed and comments on their achievements and existing shortcomings have been made. Also, the article recommends some projects on the design of wind power devices operating at low wind speed. The characteristics of devices operating at low wind speed were studied through the conducted experiment.*

Key words: *Wind power, wind, potential, power, small turbines , towers, dry turbines, blade length, pole location, analysis of wind power plants that generate electricity from low-speed wind.*

We know that even low-power turbines are usually designed for relatively high wind speeds, usually 10-15 m/ s. At the low wind speeds typical of many inland areas in Central Asia, commercially available wind power systems do not generate significant power. This prevents them from being used or causes them to be very inefficiently powered in areas with lower wind speeds. At lower turbine and generator wind speeds, more power can be produced than commercial turbines.

This allows wind energy to be used in remote areas of Central Asia and around the world where wind speeds are low. This includes remote meteorological telemetry stations, radio receivers, power for rural homes and schools, as well as applications requiring non-sparking power sources, such as oil production, refining, fueling and transportation sites, and power near military posts. Researches and experiments with significant results in the design of turbine systems with low wind speed are the most important today. For this we need to focus on smaller turbines in the range of less than 1 kW as the available wind power is significantly lower at low wind speeds. For wind sites near sea level the atmospheric pressure is about 1.18 kg/m3 and decreases with height. . The coefficient of performance is related to the design of the turbine and has a theoretical upper limit of 0.593, called the Betz limit. Most 10 kW wind turbines have speeds between 8 and 12 m/s. The coefficient of performance of small commercial turbines is usually between 0.25 and 0.45 based on manufacturers' rated capacities, speeds, and diameters . The power of the turbine is directly proportional to the swept area , so it is proportional to the square of the length of the blade. The factor that has the greatest effect on turbine output is wind speed.

From the turbine cutting speed to the rated speed, the power of the turbine is proportional to the cube of the wind speed. This means that a 10 m/s wind produces eight times more force than a 5 m/s wind. Therefore, many turbines have very high wind speeds: this is also the easiest way to achieve high power production. A practical experiment was carried out on the heat of wind power devices operating at the speed of

Small turbines have a limited variety of designs due to cost and performance constraints. The most common design is the variable speed, horizontal axis, fixed pitch blade, direct drive permanent magnet machine with stall control. will be, so the blades are heavily pitched and optimized to produce power at rated speed. This

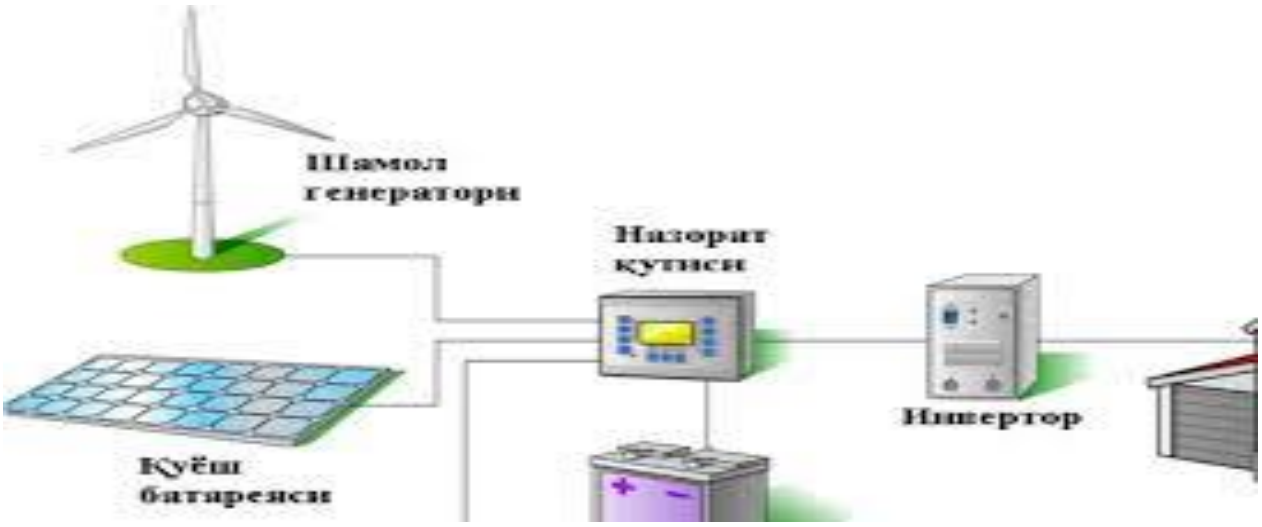
results in poorer performance at low speeds than a turbine with active pitch control . The maximum speed of the turbine is determined by the wind speed and the applied load. A power controller is usually required to prevent over-speeding of the turbine and over-charging of the batteries. This power controller may also include a power matching circuit that allows for optimized power extraction from the wind turbine at different wind speeds . Turbine overspeed is prevented by applying a low resistance load to the generator, increasing the load torque on the turbine, slowing down the blades and resulting in an aerodynamic stall.

Wind and Low Wind Speed Normalized Probability of Wind Power from the Test Site At very low wind speeds, the turbine produces too little torque to overcome friction. When the wind speed is sufficient to keep the turbine spinning, the power output is roughly proportional to the cube of the wind speed. This corresponds to the nominal speed . Above this speed, power output levels decrease, and stall-regulated turbines actually decrease as wind speed increases. Finally, at even higher wind speeds, fur speed, the turbine is turned off to prevent damage to the machine. The stress on the turbine is related to the wind load , which causes the blade to bend in the direction of the wind, centrifugal forces, pull the blades radially outward, and various paints. Dynamic stresses. Centrifugal forces are proportional to blade weight, blade length , and the square of the turbine speed, limiting the maximum speed of the turbine. Assuming similar materials and blade design, a larger and heavier blade will need to rotate at a lower speed than a smaller blade to achieve the same level of tension. The maximum speed of the turbine becomes one of the limiting factors in the wind turbine, which requires a very robust design or an active speed control system. Stall control systems are mechanically simple to implement and are therefore common in small turbine systems. In order to improve the production of electricity, the wind turbine requires a radical reconstruction. For a given wind speed, it remains to change the area of the turbine and optimize the

performance coefficient . However, this increases the load on the turbine and causes the rotation speed to slow down. the electricity production from the generator is proportional to the square of the rotation speed, so it can be useful to adjust the pitch angle to maximize TRS and thereby increase the speed of the generator. For low wind speeds, both the turbine hub and the generator will need re-optimization for larger blades to achieve an acceptable level of power production.

Wind energy. Humanity has been using wind energy long before water power and steam engines. In England, Germany, France, Denmark, Holland, the USA and other countries, wind energy has been used on a very large scale in industry and agriculture. Current work on the use of wind energy consists in the creation of individual wind power generators and their energy is connected to the existing power grids and used as the main grid. Wind is the movement of air masses as a result of changes in pressure due to the intensity of sunlight. The conversion of mechanical energy generated by air flow into electrical energy is carried out with the help of wind power plants. A combination of several wind turbines makes up a wind power plant. The circulation of air mass around the earth's atmosphere has been evaluated differently by experts. The annual theoretical reserve of wind is 100 times more than all the energy reserves on earth and is 3300 x 1012 kWh. But only 10-12% of this energy can be used. For example, in 1987, all wind turbines on earth produced 10 x 1012 kWh of energy, that is, about 0.3% of the annual reserve was used. 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. Most wind generators operate using wind speeds above 3-4 m/s. Wind generators get maximum power using wind blowing at a speed of 8-25 m/s. Usually, the maximum operating speed of wind generators is 25-

30 m/s. Wind energy is an environmentally clean source of energy . But for wind power plants, very large areas are needed (wind energy devices should be located far from each other and the distance between them should be 6-18 times the diameter of the impeller). For example, the impeller D = 100 m 5-7 km2 area is needed for a wind power plant. For a full-scale wind power plant, an area of tens of km2 is needed. Another disadvantage is that the working wheel produces noise and vibrates the air, which interferes with TV and radio broadcasts. Germany ranks first in the use of wind energy. The production of wind energy in this country is increasing by 500-1500 MW per year , currently the amount of energy produced has exceeded 2 million kWh. Wind generators are devices that convert the kinetic energy of the wind into electrical energy. There are two types of wind generators: industrial and home. Wind generators for industry are built by the state or large energy corporations. The energy of these devices is collected in one place, and as a result, wind power plants are created. Its main difference is that it does not require raw materials for its operation and does not produce any waste. One of its main requirements is high annual average wind speed . Every industrial power plant has a transmission system, a telecommunications system that provides information about the operation of the wind generator, and a lightning protection system. The capacity of modern wind generators reaches 6 MW (6000 kW). Types of wind generator. There are two main types of wind turbines: vertical and horizontal axis of rotation. Vertical axis turbines work in low-speed winds, so they are less efficient. Therefore, vertical axis turbines are rarely used. Mostly they are installed for home. The use of wind turbines for the home is developing rapidly. Typically, for a small house , around 1 kW of electricity can be obtained from wind energy blowing at a speed of 9 m/s. Currently, 1-3 kW/h wind turbines are installed and used in the regions of our country by Dialog LLC.



It should be remembered that the wind flow received by the wind wheel is determined by the diameter of the wind wheel, the number of blades in it is not important. Currently, there are wind turbines with an impeller diameter of 1.0 +64

m. Most wind generators operate with wind speeds above 3-4 m/s. Wind generators achieve maximum power with wind speeds of 8-25 m/s. Usually, the maximum operating speed of wind generators is 25-30 m/s. Wind energy is an environmentally friendly energy source. But for wind power plants, very large areas are needed (wind energy devices should be located far from each other and the distance between them should be equal to 6-18 times the diameter of the impeller). For example, the impeller Z)= 100m 5-7 km2 area is needed for a wind power plant. And for a full-scale wind power plant, tens of km2 are needed. Another disadvantage is that the working wheel makes noise and vibrates the air, which interferes with TV and radio broadcasts. Economically, if the wind speed at the site is less than 5 m/s, it is reasonable to use wind generators. Wind power generators are 2-4 times more expensive than conventional generators. But in some regions where wind energy is constantly abundant, it is considered an important source of energy. Usually, wind energy is determined by the effect of a certain area perpendicular to the wind, i.e.

N(candle current) =Q< V*F.

Here: q - air density (in relation to temperature and atmospheric pressure) , kg /m3;

V - speed of air flow, m/s;

F - area surface, m2.

The amount of energy transmitted by a wind energy device is fundamentally different from the amount of energy generated by air flow. 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 outlook for wind energy production is promising and has huge potential for the future. Wind power generation has grown in popularity over the years as an alternative and renewable source of energy. Several factors

have contributed to this growth, including technological advancements, policy support, and increasing demand for sustainable energy. One of the main advantages of wind energy is its ability to generate electricity without emitting any greenhouse gases or harmful pollutants. This makes it an environmentally friendly energy source that can significantly contribute to reducing global carbon emissions and mitigating climate change. In addition, wind energy is abundant, renewable and widespread, making it a reliable and sustainable source of energy. makes the source. Unlike fossil fuels, which are limited and can cause environmental damage, wind energy is constantly replenished with solar energy and can be used without significant impact on the natural environment. Another advantage of wind energy is its economic efficiency. Advances in wind turbine technology have dramatically reduced the cost of generating wind energy, making it more competitive with traditional sources of electricity. In addition, government support, tax breaks and subsidies have helped reduce the overall cost of wind energy, making it an attractive investment for small and large energy projects.

REFERENCES.

1. Yulchiev M.E., & Odilov.S. (2024). DESIGN ISSUES OF AUTOMATION SYSTEMS AND THEIR FUNCTION. Лучшие интеллектуальные исследования, 21(2), 160–164. Retrieved from https://web-journal.ru/index.php/journal/article/view/5372

2. Yulchiev M.E., & Odilov.S. (2024). ANALYSIS OF THE AUTOMATION PROCESS OF TWO-RATE CONSUMERS. Лучшие интеллектуальные исследования, 21(2), 171–174. Retrieved from https://web-journal.ru/index.php/journal/article/view/5374

3. Yulchiev M.E., & Odilov.S. (2024). ANALYSIS OF THE AUTOMATION PROCESS OF TWO-RATE CONSUMERS IN ELECTRICITY SUPPLY.

Лучшие интеллектуальные исследования, 21(2), 165–170. Retrieved from https://web-journal.ru/index.php/journal/article/view/5373

4. Yulchiyev Mash'albek Erkinovich, & Yusupov Asadbek G`ulom o`g`li. (2024). LIGHTING IN PRODUCTION AND ITS STANDARDS. NATURAL AND ARTIFICIAL LIGHTING. Лучшие интеллектуальные исследования, 14(2), 110–115. Retrieved from https://web-journal.ru/index.php/journal/article/view/2898

5. Muhtorovich, K. M., & Abdulhamid o'g'li, T. N. DETERMINING THE TIME DEPENDENCE OF THE CURRENT POWER AND STRENGTH OF SOLAR PANELS BASED ON THE EDIBON SCADA DEVICE.

6. Abdulhamid o'g'li, T. N., & Sharipov, M. Z. (2023). ENERGY DEVELOPMENT PROCESSES IN UZBEKISTAN. Science Promotion, 1 (1), 177–179.

7. Abdulhamid o'g'li, T. N. Raxmonov Azizbek Botirjon o'g'li, & Musiddinov Otabek Ulug'bek o'g'li.(2022). STIRLING ENERGY GENERATOR. E Conference Zone, 13–16.

8. Topvoldiyev Nodirbek Abdulhamid o'g'li, & Komilov Murodjon Muhtorovich. (2022). Stirling's Engine. Texas Journal of Multidisciplinary Studies, 9, 95–97. Retrieved from https://zienjournals.com/index.php/tjm/article/view/1932

9. Abdulhamid o'g'li, T. N. Davronov Akmaljon Abdug 'ani o'g'li.(2022). Stirling Engine and Principle of Operation. Global Scientific Review, 4, 9–13.

10. Erkinovich, Y. M. A., & Asadbek Gulom og, Y. (2024). LIGHTING IN PRODUCTION AND ITS STANDARDS. NATURAL AND ARTIFICIAL LIGHTING. Лучшие интеллектуальные исследования, 14(2), 110-115.

11. Erkinovich, Y. M. A. (2024). PROBLEMS OF EFFECTIVE USE OF ELECTRICAL ENERGY IN AGRICULTURE AND WATER MANAGEMENT. Лучшие интеллектуальные исследования, 14(2), 72-78.

12. Erkinovich, Y. M. A., & Sirojiddin, X. (2024). AUTOMATION OF ELECTRICITY CONSUMERS. Лучшие интеллектуальные исследования, 14(2), 86-92.

13. Erkinovich, Y. M. A., & Sirojiddin, X. (2024). WHAT DOES IT DEPEND ON TO ENSURE THE CONTINUITY OF ELECTRICITY CONSUMPTION. Лучшие интеллектуальные исследования, 14(2), 100-104.

14. Erkinovich, Y. M. A., & Umurzoqbek, D. (2024). APPLICATION OF HYBRID SYSTEM IN MULTIFUNCTIONAL DEVICES USING BOTH RENEWABLE AND CONVENTIONAL ENERGY RESOURCES. Лучшие интеллектуальные исследования, 14(2), 226-233.

15. Erkinovich, Y. M. (2024). TYPES OF LIGHTING LAMPS AND THEIR CHARACTERISTICS. Лучшие интеллектуальные исследования, 14(2), 28-34.

16. Topvoldiyev Nodirbek Abdulhamid o‘g‘li, & Soliyev Muzaffar Mominjan’s son. (2024). WASTE OF ELECTRICAL ENERGY IN LINES AND TRANSFORMERS. Лучшие интеллектуальные исследования, 21(2), 153–159. Retrieved from https://web-journal.ru/index.php/journal/article/view/5345

17. Abdulhamid o‘g‘li, T. N., & Husanboy, S. (2024). SMALL FROM HYDROELECTRIC POWER STATIONS IN USE THE WORLD EXPERIENCE. Лучшие интеллектуальные исследования, 21(1), 110-114.

18. Topvoldiyev Nodirbek Abdulhamid o‘g‘li, & Shavkatbekov Husanboy. (2024). VILLAGE HOUSEHOLD FOR SMALL HPPS CURRENT TO DO CONDITION IN UZBEKISTAN. Лучшие интеллектуальные исследования, 21(1), 115–119. Retrieved from https://web-journal.ru/index.php/journal/article/view/5284

19. Topvoldiyev Nodirbek Abdulhamid o`g`li, Utkirbek Akramjonovich Axmadaliyev, & Karimberdiyev Khikmatillo Qahramonjon ugli. (2024). DEVELOPMENT AND APPLICATION OF 3rd GENERATION SOLAR

ELEMENTS. Лучшие интеллектуальные исследования, 14(2), 219–225. Retrieved from https://web-journal.ru/index.php/journal/article/view/2916

20. Topvoldiyev Nodirbek Abdulhamid o`g`li, & Shavkatbekov Husanbor Azamjon o`g`li. (2024). IMPLEMENTATION OF SMALL HYDROPOWER PLANTS IN AGRICULTURE. Лучшие интеллектуальные исследования, 14(2), 182–186. Retrieved from https://web-journal.ru/index.php/journal/article/view/2910

21. Topvoldiyev Nodirbek Abdulhamid o`g`li, Utkirbek Akramjonovich Axmadaliyev, & Abdullajonov Muhammadqodir Botirjon o`g`li. (2024). A GUIDE TO SELECTING INVERTERS AND CONTROLLERS FOR SOLAR ENERGY DEVICES. Лучшие интеллектуальные исследования, 14(2), 142–148. Retrieved from https://web-journal.ru/index.php/journal/article/view/2903

22. Topvoldiyev Nodirbek Abdulhamid o`g`li, Xolmirzayev Jasurbek Yuldashboyevich, & Xabibulayev Iqboljon Axmadjon ugli. (2024). SOLAR PANEL INSTALLATION REQUIREMENTS AND INSTALLATION PROCESS. Лучшие интеллектуальные исследования, 14(2), 135–141. Retrieved from https://web-journal.ru/index.php/journal/article/view/2902

23. Topvoldiyev Nodirbek Abdulhamid o`g`li, Xolmirzayev Jasurbek Yuldashboyevich, & Tursunov Ro'zimuhammad Muhammadyunus ugli. (2024). ENERGY-EFFICIENT HIGH-RISE RESIDENTIAL BUILDINGS. Лучшие интеллектуальные исследования, 14(2), 93–99. Retrieved from https://web-journal.ru/index.php/journal/article/view/2895

24. Topvoldiyev Nodirbek Abdulhamid o`g`li, Xolmirzayev Jasurbek Yuldashboyevich, & Obidov Shaxzod Ozodjon ugli. (2024). SOLAR PANEL INSTALLATION REQUIREMENTS AND INSTALLATION PROCESS. Лучшие интеллектуальные исследования, 14(2), 48–54. Retrieved from https://web-journal.ru/index.php/journal/article/view/2888

25. Topvoldiyev Nodirbek Abdulhamid o`g`li, Xolmirzayev Jasurbek Yuldashboyevich, & Najimov Abbosbek Mominjon ugli. (2024). SOLAR PANEL INSTALLATION REQUIREMENTS AND INSTALLATION PROCESS. Лучшие интеллектуальные исследования, 14(2), 40–47. Retrieved from https://web-journal.ru/index.php/journal/article/view/2887