Researching localization of vertical axis wind generators

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Abstract. The paper analyses the economic efficiency of using wind power plants in mountainous areas and small residential areas as well as the results of using vertical axis wind devices in areas with low-speed winds. So it became possible to obtain the necessary electrical energy in the less windy regions of Uzbekistan by using vertical axis wind generators. In recent years the demand for electricity is increasing gradually as a result of the sharp growth of direct production enterprises and population consumption. This demand can be compensated by using not only traditional energy sources but also non-traditional energy sources. The use of wind energy is to a certain extent the basis of energy production. Nurato district of Navoi region of Uzbekistan was selected as an object. The problems of saving and shortage of electric energy will be avoided by using the vertical axis wind generator in the regions. By moving the rotor of the wind generator the wind energy is converted into mechanical energy, which generates electrical energy through the generator. Electric power from the generator is provided by a controller that serves to monitor the charge level of the accumulator and is sent to the accumulator through the controller.

1 Introduction

Currently, in many countries, it is necessary to switch to the use of non-traditional energy sources in order to save electricity and prevent its shortage. For this purpose, it is appropriate to build vertical axis wind power plants in areas with high wind speed in our Republic. When building vertical axis wind power plants, it is necessary to choose the right installation facility for wind generators. Today, with the increasingly serious energy crisis, the production and use of energy is becoming an important issue, and saving electricity is becoming more and more important. Energy production and consumption are directly related to the daily life of most consumers, and energy research issues are very important. Aware of global issues, people are becoming more realistic about renewable energy (RE). Wind turbines with horizontal and vertical axis of rotation Design of wind turbines with horizontal axis of rotation is as follows: the generator and the rotor axis are placed vertically on the mast, the rotor blades are directed into the wind, and small wind turbines can be operated using weather systems or and controller systems are used to turn the axis of rotation into the wind to direct

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the devices. This type of wind turbine has a classic appearance and fully reflects the project described above.

Rotors of propeller-type horizontal-axis wind generators have one, two, three, and many blades. "In order to obtain the highest possible wind speed, it is recommended to install the wind turbine higher and further away from natural and man-made obstacles [1]. The main disadvantage of such wind generators is the high rate of breakdown, as well as vibration and high noise during operation. At this stage, we can see that horizontal wind turbines are the most common. They are parallel to the axis of rotation of the windmill, and their blades rotate against the wind and are parallel to the ground. Such wind generators are popularly called "windmills". Horizontal axis wind turbines are characterized by high efficiency (40-50%). Therefore, we can usually use such a variety of wind farms to create systems. The actuation of wind turbines is usually described by the drag coefficient. Drag coefficient is a dimensionless value that describes the force exerted by the turbine in the direction perpendicular to the incoming momentum of the wind flow. In the case of a wind turbine with a high drag coefficient, the wake becomes turbulent very close to the rotor and the recovery increases. In this work, we study wind turbine motion under high thrust coefficients using large-eddy simulations and propose a model consisting of a simple generator to progress the motion deficit of a high thrust coefficient wind turbine. Many of the most important aerodynamic research topics in the field of wind energy are reviewed from vertical and horizontal generators in another research report [2]. Wind turbine aerodynamics is concerned with the modeling and analysis of aerodynamic forces, such as predicting the performance of wind farms, as well as the design of specific components of wind turbines, such as rotor blade geometry. Basics of blade-element momentum theory are presented along with instructions for constructing airspeed data. Various theories of aerodynamically optimal rotors are discussed and recent results on classical models are presented. State-of-the-art numerical simulation tools for wind turbine rotors and wakes are reviewed, including rotor predictions, as well as model data for simulating wind turbine wakes and flows in wind farms. On power density and its relationship with wind speed, the report in [3] presented wind power distribution characteristics derived analytically from wind distribution functions. Simple equations are derived that establish the relationship between average power density and wind speed for a given location and wind turbine. When choosing a wind generator model, we will have to accept certain criteria:

- The first criterion is to determine the average annual wind speed at the site of installation.
- The second criterion is the amount of electricity produced.
- The third is the value of the initial wind speed, which varies from 2 to 4 m / sec for different models.
- The fourth is the nominal wind speed, usually 8 - 15 m / sec.

The average annual wind speed is determined using the Beaufort scale and the data obtained from observing the visible effect. How the wind blows during the year in the planned place for installing a wind generator is the most important criterion. We select the power of the generator through the approximate measurement scale of wind power. Regardless of where a wind turbine is placed on, the closer it is to the ground, the lower the wind speed. From the Bernoulli equation and the mass and momentum balance equations for the analysis of the extended wind turbine in this part of the paper used [4]. The power coefficient and drag coefficients are obtained only taking into account energy losses, as in the case of a turbine casing. The efficiency of a wind turbine can be defined as the ratio of the net power output to the energy input to the system. The experimental and numerical results provided useful information on the flow mechanism behind a flanged diffuser wind turbine.

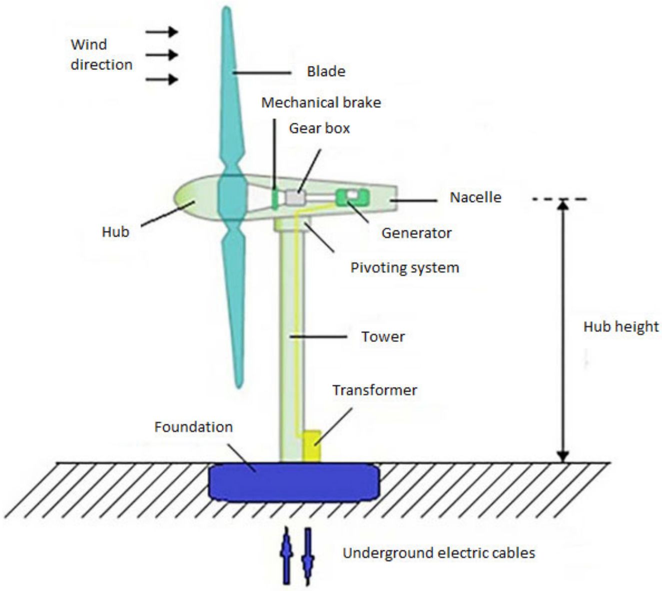

Fig. 1. Components of wind generators.

Therefore, even small changes in wind speed can cause significant changes in electricity. When the wind speed is doubled, the output power increases several times. Obviously, even small changes in the wind have significant changes in the efficiency of the wind turbine. When installing on the ground, the properties of the soil where the wind generator is located are also taken into account [5]. This is a result of the friction force on the surface and the presence of obstacles on the surface of the earth. These obstacles create turbulences that reduce the efficiency of any wind. Therefore, it is better to place the wind in a place where there is as little interference as possible. That is, it is better to place wind turbines on the hill". The modification of the internal structure of the diffuser occurred by changing the shape of the air flow optimized as the internal profile of the diffuser. Compared to the original diffuser with a flat interior, the speed can be increased by about 66% with the optimized profile [6].

Fig. 2. Scheme of the Savonius-Orthogonal wind generator.

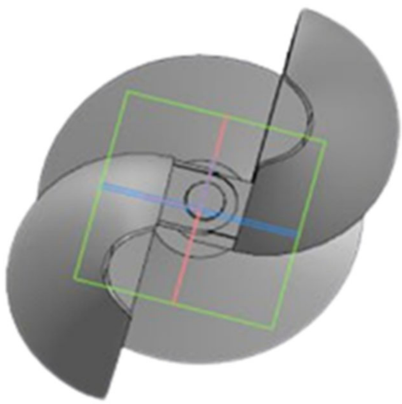

Fig. 3. Scheme of the foundation for the column and collection wires.

2 Materials and methods

The kinetic energy of the wind is usually divided into two parts: useful and unnecessary. According to it, 60% of the energy is used for the production of electricity, and the rest is the part that is not useful for us. On the other hand, real wind turbines extract about 40% of the electricity and the rest is wasted. These identified data (61.8% and 38.2%) are visible. The installation of wind turbines on the roofs of buildings in the Navoi area allows to receive and use electricity without connecting to the main supply [7].

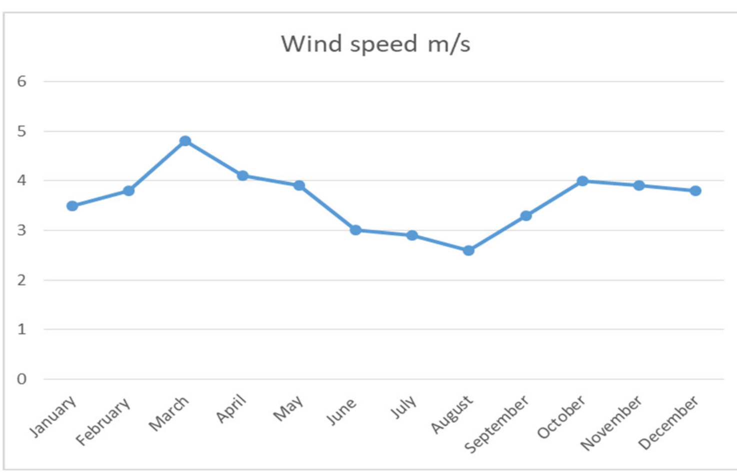

Fig. 4. Average annual wind speed.

Loose sandy soil, soils that change easily with weather conditions, are not suitable for wind turbine installation, such as piles, unless measures are taken to strengthen the foundation. During the operation of the wind generator, there are significant vibrations and loosening of the supporting elements. The distance between the wind turbine and additional electrical equipment should be taken into account when choosing the installation location. The shorter this distance, the shorter the cable length. As a result, energy loss during transmission is less. If this distance is long, it is better to use a cable with a larger section for transmission.

In areas where the speed of the wind is determined, the energy of the wind flows at a certain height above the earth's surface. In particular, it can be observed in the Nurota mountain ranges, in the Tashkent region, in the southern part of the Republic. Therefore, energy wind properties are presented as random probability descriptions [8, 9]. The main approach probability is the discretization of the time process, the parameters in the sampling interval that allow us to consider independent and constant as fixed. As a time interval, stationary is usually used hour, day, season, year "

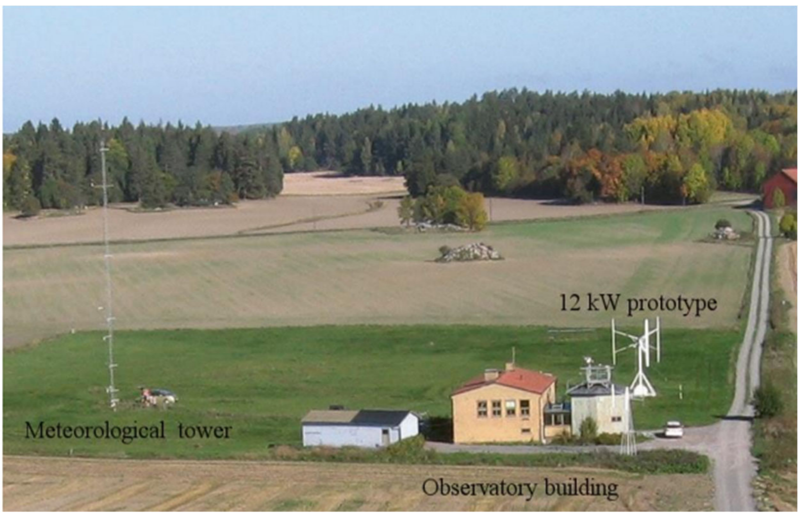

Fig. 5. Location of the vertical axis wind power plant.

We directly determine the land area occupied by the wind generator. This is the sum of the area occupied by the cross sections of the lower base of the column S_m and S_r wires [10]. From the technical specifications of the wind generator (Table 2), we get the values for the calculation:

Table 1. Specifications of WH6.4-5000W wind turbine.

Rated power	5000W
Maximum output power	7500 W
Charging voltage	180 V in constant current
Output voltage	180 V in alternating current
The number of blades	2
The material of the blades	Fiberglass reinforced plastic
The diameter of the main rotor blades	6,4 m
Initial wind speed	4-4.5 m/c
Nominal wind speed	10 m/c
Nominal rotation speed	240

3 Results

Increasing energy efficiency in economic sectors and the social sphere, introducing innovation technologies, scientific and technical developments and increasing energy efficiency in the introduction of priority directions for the further development of renewable energy, creation and localization energy-saving devices, including innovative techniques and methods of technology transfer and engineering centers that use renewable and alternative energy sources energy utilization of secondary energy resources, electricity generation, fuel by attracting business entities to create energy production capacities based on proven technologies of using wind energy power plants e-energy balance diversification. modernization of existing production facilities based on modern energy-efficient and energy-saving technologies, technical and technological re-equipment and reduction of the energy capacity of manufactured products by creating new ones [11].

Houses located in mountainous areas use electricity for household appliances, lighting, heating and cooling systems. The average monthly consumption of energy is 350-400 kW. In such houses, the height of the wind tower, energy consumption is not large, and the main part of the energy consumption is spent on heating and cooling the house [12, 13]. Whenever we choose a wind generator, it is necessary to consider the wind speed in the selected mountain systems. Since the speed of the wind varies over time, we measure its speed several times at different times. For example, measurements are made at different times of the day, month, and year, and the average wind speed is found, and the power of the wind generator is selected accordingly. For example, in the form of the following table. Here are the daily checks for the first 5 months of the year and the last selected average speed [14]. To estimate the direction of the wind, a wind rose is drawn, which is a vector diagram, in which the length of rays radiating from the center of the diagram in different directions is proportional to the frequency of winds in this direction [14, 15].

Thus, the results of the wind energy study indicate the following characteristics of the potential at the proposed location of the wind farm:

- Determination of average daily, average monthly and average annual wind speeds;
- Wind speed according to meteorological observations for 5-10 years;
- Determining the average monthly wind’s speed from the approximate height of the wind turbine tower;
- Distribution of gradations of wind speed for each month of the year along the height of the axis of the wind generator.

Obtained wind energy characteristics to optimize the selection of wind energy equipment and its integration into the enterprise's power supply system.

$$K=K_{average}+K_{project}+K_{slope} \quad (1)$$

where; $K_{average}$ - price of all installed equipment, sums;

$K_{project}$ - the cost of project work to determine the place of installation on the ground, sums;

K_{slope} - the cost of construction and assembly works for the installation of a wind power plant, sums;

$$E_n=\frac{1}{T} \quad \textit{standard rate of efficiency;} \quad (2)$$

T - economic service life of the equipment, years;
C - annual operating costs, sums;

$$C = C_f + C_r \quad (3)$$

C_f - annual electricity supply system costs, sums;
C_r - annual expenses for planned maintenance, sums.

Economic analysis of autonomous electricity supply, taking into account the current economic conditions in this area, can lead to a decrease in budget subsidies in most cases. Accordingly, it is often not necessary to talk about the profitability of electricity generation in isolated power supply system’s [16]. In such cases, it is appropriate to choose a normal rate of return depending on the life of the equipment E_n=0,05.

4 Conclusion

In the electrical part of this project, information is provided about the kinematic and electrical diagrams of the Orthogonal-Savonius wind generator, the necessary calculations were made, and this allows the selection of electrical generators. Also, the use of wind turbines in urban environments provides an efficient and aesthetically pleasing landscape.

Currently, Savonius-orthogonal vertical axis wind generators are distinguished from other wind turbines by their ability to operate even at low wind speeds of 1m/sec. That is, the speed that is sufficient for the rotation of the blades, and 3 m/sec is sufficient for the operation of the generator. Sections that allow to supply the specified area with electricity and provide economic freedom by using them in small objects and production enterprises were considered.

In order to ensure the feasibility of the installation in the economic part, the selection of a place for the installation of a wind power plant should be made in favorable conditions with high wind potential. At the same time, we have the opportunity to use this project in the middle part of the roads, that is, according to this, the wings will move from the speed of the cars.

In the process of working on the technological part of my prepared article, I learned and analyzed a computer technique for projecting a part. We have selected the necessary equipment and accessories for all processes, and I can clearly say that the vertical axis wind turbines built in the Russia city of Tomsk provide an opportunity to produce electricity from them in the territories of our Republic. As a result, the electricity saved theoretically allows to save 87811175 sums per year.

According to the results of the work in financial management, it can be said that this development is competitive and economically efficient.

According to the result of work in financial management, it can be said that this development is competitive and cost-effective, a work schedule for the manufacture of one product was compiled, and the price of development was calculated.

Designs have been developed for the implementation of a projected wind generator in the cities: the nomenclature of structures is capable of providing energy to various spheres of city life such as: lighting of park areas and city streets; supply of energy to traffic lights, small trading pavilions, local lighting of residential areas of the city.

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