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Research Original Article

Role of Renewable Energy Sources in the World

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Abstract
The severe climate crisis on the planet has led to the need to quickly abandon fossil fuels and switch to alternative energy, "green" energy sources. This article discusses the main types of alternative energy. It is shown that new types of energy play an important role in the energy supply systems of most countries of the world, and in the future they can become the main sources of energy to meet the growing needs of the world economy. The main reasons for the growing interest in RES are revealed. Their advantages and disadvantages are considered, on the basis of which you can find out which one is the most profitable. The ways and purposes of using solar energy and wind energy are given. The advantages of renewable energy sources in comparison with traditional energy sources are considered.
Keywords: RES; "green energy"; alternative energy; electrical energy; energy; advantages and disadvantages; environment; fuel;

Introduction
RES (renewable energy sources) - natural resources or processes from which energy is obtained and which, by human standards, are inexhaustible or renewable faster than they are consumed. RES is considered as an alternative to fossil fuels (coal, peat, oil, natural gas, uranium ore). The latter are also renewable, but it takes much more time and, according to forecasts, they can be exhausted fairly soon. In addition, when burned, they release carbon dioxide into the atmosphere, which contributes to the growth of the greenhouse effect and global warming (Boyle & Redgwell, 2021). In contrast, most renewable energy sources are classified as so-called green energy - that is, environmentally friendly, non-polluting. In addition to inexhaustibility/ renewability and environmental friendliness, the following advantages of RES are distinguished:

a) availability of resources, providing territories (regions, countries) independence from imports;
b) the ability to use land unsuitable for economic activity;
c) safety — minimizing the risk of man-made disasters;
d) development of technologies and creation of new jobs.

Alternative energy is a set of promising methods of obtaining, transmitting and using energy (often from renewable sources), which are not as widespread as traditional ones, but are of interest because of the profitability of their use with, as a rule, a low risk of harm to the environment (Grigorash et al., 2013). They are practically inexhaustible, while fossil fuels will run out sooner or later. Renewable sources do not include nuclear power and natural gas, since the reserves of these resources are limited. There are different types of energy and ways to extract it. Based on our interpretation, the following types of alternative sources can be distinguished: solar energy, wind energy, hydropower, wave energy, tidal energy, hydrothermal energy, fluid diffusion energy, geothermal energy and biofuels. The methods of extraction and use of energy differ depending on the type of alternative sources. What unites them is that today they are all used much less frequently than fossil fuels, but at the same time they have great potential for development (Новокрещенов et al., 2017).

Wind power, Wind energy is a type of renewable energy obtained from the kinetic energy of air flows. For their part, winds arise on the planet due to pressure and temperature gradients, which are in any case caused by the indirect influence of the Sun on the earth (Putri et al., 2022). The development of wind energy around the world, in recent years, is very fast. The leaders at the moment are China and the United States, however, the rest of the world is gradually developing this promising area of "clean" energy, based on an inexhaustible natural resource - wind energy. Every year more and more wind turbines are installed in the world (figure 1), and there is a tendency for the technology to spread further. Wind energy is playing an ever-increasing role worldwide as a renewable energy resource. Countries such as Spain, Germany and Denmark are close to meeting their goal of generating 30% of their electricity needs from wind power (Mahmood et al., 2017). Although the United States currently only generates about 5% of its electricity from wind power, relative to its total installed capacity, it ranks first in the world, recently overtaking Germany. According to scientists, by 2050, the wind

will cover more than 1/3 of the world's electricity needs (Wikipedia, n.d.).

Figure 1. Wind turbines

Consider the advantages and disadvantages of using wind turbines.

Advantages:

1) Completely renewable energy source is used. As a result of the action of the sun, air currents are constantly moving in the atmosphere, for the creation of which it is not necessary to extract, transport, and burn any fuel. The source is fundamentally inexhaustible (wind is a free and easily accessible renewable energy source).
2) There are no harmful emissions during the operation of the wind power plant. This means that there are no greenhouse gases or any production waste whatsoever. That is, the technology is environmentally friendly.
3) The wind farm does not use water for its operation.
4) The wind turbine and the main working parts of such generators are located at a considerable height above the ground. The mast on which the wind turbine is installed occupies a small area on the ground, so the surrounding space can be successfully used for household needs, various buildings and structures can be placed there, for example, for agriculture.
5) There is no need to prepare areas for the installation of installations.
6) Wind energy is cost-effective in many regions of the world.
7) Electricity transmission losses are much lower due to the proximity to consumers, since wind turbines can be installed as early as 300 meters from settlements.
8) The use of wind turbines is especially justified for isolated areas where electricity cannot be delivered by conventional means, and autonomous provision for such areas is perhaps the only way out.
9) Maintenance during operation is minimal. Repair and maintenance of wind farms is much cheaper than other stations.

Flaws:

1) Dependence on external conditions at a particular moment. The wind may be strong, or it may not be at all. To ensure a continuous supply of electricity to the consumer in such intermittent conditions, a large-capacity energy storage system is needed. In addition, infrastructure is required to transfer this energy.
2) The construction of a wind turbine requires material costs (high investment cost). In some cases, regional investments are attracted, which is not always easy to secure. It is the starting stage, the construction of the project itself, which is a very expensive undertaking.
3) Wind turbines produce aerodynamic noise that can cause discomfort to people. For this reason, in some European countries, a law has been passed according to which the distance from a windmill to residential buildings should not be less than 300 meters, and the noise level should not exceed 45 dB during the day and 35 dB at night. The intermittent and unpredictable nature of wind power makes energy storage systems a key element in renewable energy.

A renewable energy source like wind is poised to play an important role in the global energy future. New generation wind turbines should increase their efficiency, reduce their acquisition cost, improve the reliability and cost of the electricity generated, and increase their competitiveness compared to traditional fossil fuels. The advantages of wind power far outweigh the disadvantages. Gradually, the myths around wind generation are being destroyed and, in general, a bright future can be predicted for wind energy (Кириченко, n.d.).

Solar energy, Solar energy is a direction of alternative energy based on the direct use of solar radiation to produce energy in any form. Now solar energy (or photovoltaics) is considered one of the most dynamically developing industry sectors. Quite optimistic statements are not uncommon, such as the fact that all energy in the coming times will, no less, be based on solar energy. From an environmental point of view, the use of solar energy is also very beneficial, since it does not produce any waste, and when using it, the air is not polluted with harmful emissions. When using solar panels (figure 2), the energy of the sun is directly converted into electrical energy (Mahmood et al., 2017). This process is called the photoelectric effect. For the first time, photovoltaic batteries were used in space on satellites. Today, solar electricity is widely used in many areas (Lukman et al., 2020). In remote areas where there is no centralized power supply, solar panels are used to power individual houses, to raise water and cool medicines. These systems often use batteries to store the

electricity generated during the day (Muller et al., 2016)

Figure 2. Solar panels

Advantages.

The strengths of solar energy are obvious to everyone and do not need lengthy explanations. Firstly, the resources of the Sun will last for a long time - the duration of the existence of a star is estimated by scientists at about 5 billion years. Secondly, the use of solar energy does not threaten greenhouse gas emissions, global warming and general environmental pollution, i.e. does not affect the ecological balance of the planet. A photovoltaic plant with a capacity of 1 MW produces about 2 million kWh per year. This prevents the emission of carbon dioxide compared to a fuel power plant in the following volumes: about 11 thousand tons on gas, 1.1-1.5 thousand tons on oil products, 1.7-2.3 thousand tons on coal (Nasution et al., 2020).

Flaws.

The bottlenecks of solar energy include, firstly, still insufficiently high efficiency, and secondly, insufficiently low cost per kilowatt-hour - something that raises questions in connection with the widespread use of any renewable energy source. Added to this is the fact that a fair amount of solar radiation near the surface of the Earth is scattered uncontrollably.

Environmental safety is also, strictly speaking, in question - after all, it is still unclear what to do with the disposal of used elements. And, finally, the degree of knowledge of solar energy - no matter what they say - is still far from perfect. The weakest link in solar energy is the low efficiency of batteries, the solution to this problem is only a matter of time.

Today, solar energy is most actively used for three purposes:

a) heating and hot water supply, as well as air conditioning;
b) conversion into electrical energy using solar photovoltaic converters;
c) large-scale production of electricity based on the thermal cycle.

Solar energy does not have to be converted into electricity, but it can be used as heat. For example, for heating and hot water supply of residential and industrial facilities. The principle of operation of the design of solar heating systems is based on the heating of antifreeze. Then the heat is transferred to the storage tanks, usually located in the basement, and is consumed from there. One of the largest potential consumers of PV is the agricultural sector, which alone is capable of consuming hundreds of megawatts of peak PV energy per year. To this we can add navigation support, power supply of telecommunications systems, systems for the resort, health and tourism business, as well as cottages, street solar lamps, etc. Today, the possibility of absolutely fantastic, from the point of view of the layman, ways of using solar energy is seriously considered. In space, the concentration of solar energy is much higher compared to our blue planet. Energy transfer to the Earth is possible with the help of directed light (laser) or microwave (microwave) radiation.

Hydropower, Hydropower, hydraulic energy, hydrokinetic energy, hydroelectric power is the energy obtained from the energy of falling water, which is then used for useful purposes. Hydroelectricity is a renewable energy that converts the movement of large bodies of water into electricity (Nasir, 2014). The gravitational energy of these large masses is converted into kinetic energy when falling from a great height or under the influence of the force of the water flow itself. To increase this potential, dams, reservoirs and conduits are being built along the rivers. The resulting kinetic energy is then converted into electrical energy using a complex system of turbines and alternators. Hydroelectric power plants (figure 3) allow you to produce energy quickly and at low cost, since the raw material for them, that is, water, is practically free.

Figure 3. Hydroelectric power plant

At the same time, the equipment that allows the production of hydroelectric power actually requires few resources for its operation. In addition to power supply, hydropower can offer many very important services to the power system, helping to maintain system stability and power supply reliability by providing frequency control, voltage support, contingency reserves, load monitoring, and blackout capability. Hydropower is also playing an increasingly important role for grid-scale energy storage, balancing services for other intermittent renewables such as wind and solar and reservoir water management services such as flood control, water supply, irrigation and transportation.

Advantages:

1) Most hydroelectric power plants - storing large amounts of water in tanks - almost always have a supply from which energy can be extracted. In this sense, hydroelectric power plants are a more reliable and stable source of energy than wind and solar energy.
2) Storage hydroelectric power plants are able to generate electricity on demand, which allows hydroelectric power plants to replace traditional dispatch generators such as coal and gas plants.

Flaws:

1) Accumulative hydropower installations interrupt the natural flow of the river system. This leads to disruption of animal migration routes and water quality problems.
2) Hydroelectric power plants are large infrastructure projects, including the construction of a dam, a reservoir and power generating turbines, which require significant financial investments.

There is still great potential for further development, as less than 25% of its technical potential has been used. Hydropower is very cost-competitive compared to other renewable energy sources, and compared to thermal energy has a very high energy payback ratio and very low greenhouse gas emissions.

Materials and Methods

The objects of study in this work are mainly wind power stations, solar stations, hydroelectric power stations. Research in America, Germany, China shows that in the next 30 years the role of wind power installations in the world will be huge. For this, various thyristor systems for switching the stator winding are being developed, and the use of a two-speed asynchronous generator is being developed for wind turbine operation at low wind speeds. Studies also show that solar energy, like wind energy, will play an important role in the world's energy. Research method. It is necessary to investigate at what wind speeds a wind turbine can generate a high amount of energy, in what places it is necessary to install wind turbines. And also explores the role of solar panels today. We determine, according to the values of the installations of the various countries, which of the installations are the most favorable for suitability at the present time. Research in different areas of the world, characteristics, advantages and disadvantages established by us show that renewable energy sources have a huge advantage over traditional energy sources.

Conclusions

The use of renewable energy sources provides a number of undeniable advantages:

- Creation of new jobs in enterprises;
- Reducing air pollution at the local level;
- Reducing water consumption;
- Positive impact on the economy of individual countries (since the technologies for generating energy in such ways are mostly built on the exploitation of exclusively local resources, this will help to keep it resilient during external shocks related to electrical security).

Renewable energy sources help fight climate change, which is becoming more destructive. The use of renewable energy sources prevents environmental pollution, helps reduce greenhouse gas emissions into the atmosphere, and reduce the effects of climate change. Thanks to all the advantages of renewable energy, which we have considered, we can say that the use of these sources is the most reliable, safe, and profitable at the present time.

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