Prospects for the development of alternative energy sources in the world energy

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Abstract. The article is devoted to the prospects for the development of alternative energy sources in the world energy. For this purpose, the article analyzes the modern generation structure in the developed EU countries. Based on this analysis, it was revealed that the share of renewable energy sources together with hydroelectric power plants is comparable to traditional sources of generation. In addition, the study outlines a trend in the development of the world energy sector, which is characterized by an increase in the use of alternative energy sources and a decrease in the use of hydrocarbon fuels. The paper considers the advantages of the development of alternative energy sources and the difficulties associated with their implementation.

1. Introduction

Global energy development trends are associated with three main areas: energy supply decentralization, decarburization and digitalization. The first direction is associated with the move away from centralized power supply to autonomous power supply through the construction of its own sources of generation [1]. The second direction is associated with a decrease in the share of hydrocarbon fuel in the structure of the fuel balance and an increase in the share of biogas, biofuel and hydrogen. These areas are directly related to the use of alternative energy sources.

Table 1 shows the generation structure of the EU member states in 2019 according to the official data of Eurostat.

Table 1 shows that the share of renewable energy sources together with hydroelectric power plants is comparable to traditional sources of generation.
If we talk about trends, just look at figure 1, which shows the projected balance of fuel and energy resources, developed by the International Energy Agency (IEA).

**Table 1.** Structure of installed generating capacity in EU member states in 2019.

| TPP  | NPP | SES | HPP | WPP |
|------|-----|-----|-----|-----|
| 45   | 13  | 11  | 15  | 16  |

**Figure 1.** Forecast balance of fuel and energy resources until 2050.

Figure 1 clearly shows the dynamic growth in the use of renewable energy sources (RES) by 2050. Renewable energy sources are those objects, the recovery of reserves of which is due to natural factors.

Alternative energy sources operate on installations that allow you to obtain electrical energy from solar and wind energy, using hydro resources and geothermal energy. They do not require the use of hydrocarbon fuels in the form of gas, oil and coal [2].

The countries of the European Union are leading in the development of alternative energy sources. They account for almost half of the world's renewable energy consumption.

This is because the European Union has developed a whole range of measures to stimulate the development of renewable energy sources, which include:

- **Preferential tariff** - a fixed guaranteed price at which electricity produced based on RES and supplied to the grid is purchased. The mechanism fully protects projects from the volatility of a competitive market and significantly reduces investment risks.
- **System of awards.** It is used for RES power plants participating in a competitive market and provides for a guaranteed premium payment in excess of the market price. Premiums provide additional income for producers, but at the same time do not remove the risk of price volatility and require regular revision, since they are based on forecasts of electricity production costs and average profit.
Obligations for quotas in the form of a constantly growing share of electricity from renewable energy sources that must be produced by energy companies or purchased by consumers. Failure to comply will result in fines. The quota system is combined with the issuance of tradable green ROC (renewable obligation certificate) certificates.

Investment guarantors from the state are used to stimulate only emerging or immature technologies.

Tax incentives - the most common tax incentives are related to investments (e.g., income tax cuts, accelerated depreciation) and production (income tax cuts or tax credits as a fixed share of RES-based electricity) [3-14].

This policy forms a trend in the development of the world energy sector associated with a significant change in the structure of the fuel and energy balance.

Analysis of the forecast of the World Energy Agency (IEA) [2-4] revealed the main global trends in energy development that meet the requirements of Industry 4.0. These requirements are associated with changes in energy policy, under the influence of which the development of alternative energy sources will take place, which will allow to provide up to 50% of the world's electricity production by 2040. Of the hydrocarbon fuels, according to experts, only gas will be able to increase its share in the world energy balance by this time by an average of 5%. Coal will reduce its share by an average of 10% [2].

2. Materials and methods

The purpose of this study is to analyze the prospects for the development of alternative energy sources in the world energy sector.

To achieve this goal, the following tasks are being solved:

- Study the state of renewable energy in the world
- Study the existing mechanisms for supporting renewable energy sources abroad
- Analyze the main reasons for the transition to the use of alternative energy sources;
- Explore the dynamics of the development of unconventional energy sources in the world;
- Determine the possibility of their further development in the global energy sector [15-19].

Within the framework of scientific research, methods of descriptive, statistical, comparative, economic analysis, the method of expert assessments are used.

The information base was the materials of various studies: the forecast of the Energy Center of the Moscow School of Management "Skolkovo", the forecast of the World Energy Agency, Eurostat data, the report on the international forum on energy efficiency and energy saving ENES.

3. Results

The study determined that the most common RES are wind and solar power plants. However, wind and solar power plants generate energy when there is wind and sunlight.

For example, the low intensity of solar radiation is a serious obstacle to the use of solar energy. Therefore, in order for solar collectors to collect energy in significant amounts per year, large-scale territories are required.

One of the breakthrough technologies that can circumvent this problem is to generate solar energy in space. This raises the need to place large solar structures in space. The area of one solar power plant can reach tens of square kilometers. The use of lightweight materials will also be critical, as the biggest expense will be the cost of launching a station in space.

One proposed solution is to launch small satellites into space, which will be brought together to create a single large solar generator.

The second major problem relates to the transfer of energy back to Earth.
This problem can be solved by the technology, which consists in the fact that solar screens will reflect the sun's rays onto solar collectors, and then the energy will be transmitted through microwave or laser beams back.

The leader in this area is China, whose researchers have developed a system called Omega, which they plan to be operational by 2050. This system should be capable of supplying 2000 MW of power to the Earth's electrical grid.

By comparison, it would take more than six million panels to generate so much energy from solar panels on Earth.

A second promising technology involves installing wind turbines high above the ground where they can use stronger wind currents.

Installing wind turbines in accessible locations with appropriate climatic parameters is one of the most widely used types of devices to ensure the production of clean energy [1].

However, antenna wind turbines have several limitations, for example, wind that is closer to the ground can have unstable speed values. In this case, the required wind speed must be more than 5 m/s for generating electricity.

It is clear that onshore wind turbines remain a hot technology for clean electricity today. However, the future of low-cost wind energy can be found in suspended wind turbines, the essence of which is the installation of airships with an integrated wind turbine, which is capable of generating twice the energy compared to traditional turbines [1].

In wind power, the United States is leading the way, where scientists have prepared a $1.3 million project called the Soaring Wind Turbine, which will operate 360 meters above the ground, providing constant cheap power to remote decentralized areas with no microgrids to the main electrical network. The supply of such areas is now completely dependent on expensive diesel generators.

This project is focused on the provision of facilities located on the island of Alaska, as well as for the supply of oil and gas companies, minerals, telecommunications companies, rescue organizations and military bases.

To climb to higher altitudes, where the wind force is significantly higher, the outboard turbines use a helium-filled, non-flammable inflatable shell. High-strength ropes provide the turbine with a stable lifting mechanism that is tailored to the specific application and is similar to the technology used in balloons, the industrial cousins of airships that have carried heavy communications equipment for decades. These ropes are able to withstand hurricane winds and are equipped with technologies that ensure a smooth landing in most difficult and even emergency situations [12-17].

This suggests that a new round of development can soon be observed in wind energy.

4. Discussion

It is obvious that the use of alternative energy sources has a number of material and non-material advantages:

- Feasibility of their use in areas where traditional energy is difficult to access. For example, in industrial enterprises, when it is more profitable to build your own energy source than to connect to centralized networks;
- Provision of reserve capacities for consumers requiring increased reliability and not allowing interruptions in the supply of energy in case of accidents in the zones of centralized power supply;
- Reducing anthropogenic impact on the environment.

However, along with these advantages, there are certain difficulties, which include the following:

- Significant costs for new technologies in the field of alternative energy sources;
- Long terms of transition to new technologies in the field of alternative energy sources;
- Availability of the necessary climatic conditions;
5. Conclusion

The study identified a global trend in the development of energy, which was formed under the influence of changes in energy policy, the development of new technologies and the transition to the 4th stage of the industrial revolution. The processes of decentralization, decarburization and digitalization characterize this stage.

This, in turn, leads to the rapid development of alternative energy sources, which in the long term will provide almost half of the world's electricity production. However, this does not mean giving up traditional energy. This means the emergence of structural shifts in the fuel balance, namely, only gas from fossil fuels will be able to increase its share in the global energy balance. At the same time, the share of coal will decrease, while the share of hydrogen and biofuel use will increase.

In the study, the main goal has been achieved, and, in fact, an analysis has been made of the prospects for the development of alternative energy sources in the world energy sector with a decrease in the consumption of hydrocarbon fuels [3].

However, one should not ignore the high cost of the latest technologies, which will slow down their rapid implementation.

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