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GREEN ENERGY IN UZBEKISTAN: USE AND PROSPECTS

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Abstract
This paper analyzes information on the state of electricity supply in Uzbekistan and explores new prospects for harnessing the potential of alternative energy sources. It examines the state of energy security in Central Asian countries and presents the aspects and economic prerequisites for using renewable energy sources to cover electricity consumption in various sectors.

Keywords: Alternative energy, electricity supply, distribution network, renewable energy sources, areas of renewable energy use.

Introduction

The economic well-being of any country can be directly linked to the state of its electricity generation sector, which is a vital component. This sector ensures the sustainable prosperity of the real sectors of the economy and creates the necessary conditions for the smooth operation of such important social sectors as education, social security, healthcare, and utilities. Moreover, it is this sector that ensures a comfortable life for citizens [5] . By 2025, our country plans to generate 84 billion kilowatt-hours of electricity, which is 25 billion kilowatt-hours, or 1.5 times, more than in 2016.

Discussion

Green energy, or renewable energy, is an important component of the sustainable development of the modern economy. In recent decades, it has become increasingly relevant due to global challenges such as climate change, depletion of traditional energy resources, and environmental degradation. The use of renewable energy sources (RES) can significantly reduce dependence on fossil fuels, improve the environment, and contribute to the sustainable development of global economies. The main types of green energy include solar energy, wind energy, hydropower, biomass, and geothermal energy. The last two are almost always involved in the overall process of electricity generation. Each of these sources has its own advantages and disadvantages depending on geographical and climatic conditions.

Since 2000, there has been significant growth in installed renewable energy capacity worldwide. According to a report by the International Energy Agency, in 2020, renewable energy accounted for approximately 29% of global energy consumption. The leading countries installing solar and wind power plants are China, the United States, and Germany. At the same time, the cost of renewable energy technologies continues to decline, spurring increased investment in this sector. It is projected that by 2030, the share of renewable energy in the global energy mix could reach 50%, assuming current trends in technology cost reductions and support from national and international programs continue.

The average annual solar radiation in Uzbekistan is approximately 1,700 kWh per square meter, significantly higher than the global average. The country also has good potential for wind energy

development, particularly in the southwest and in the foothills of the Tien Shan. Potential for biomass and geothermal energy also exists, albeit in smaller quantities.

A look at the structure of electricity consumption in the republic across various economic sectors and populations in 2021 is sufficient to confirm this: industry accounts for 35.9%, the population for 27.7%, villages and households for 16.6%, utilities for 4%, budgetary organizations for 2.4%, transport for 1.5%, construction for 1%, and other sectors for 10.8%. Regarding energy use, since 2019, annual demand has exceeded supply by an average of 3%. Electricity imports from neighboring countries such as Turkmenistan (64%), Tajikistan (20.3%), Kazakhstan (11.3%) and Kyrgyzstan (4.4%) helped to fill the electricity shortage in 2021. Notably, in 2021, due to its good price position in the energy supply market, Afghanistan was able to offset approximately 31.3% of the costs associated with electricity imports by selling electricity exported from Afghanistan [3,4].

The "Concept for Providing the Republic of Uzbekistan with Electricity for 2020-2030" projects that annual electricity consumption growth rates will reach 6-7% by 2030, reaching approximately 120.8 billion kWh. In Uzbekistan, energy is distributed and supplied to consumers through distribution networks with a capacity of 0.4 to 110 kW. These networks are responsible for distributing electricity. There are 1,626 substations with a voltage range of 35 to 110 kV, with a total capacity of 20,421 MW-amperes. Transmission lines with a voltage range of 35 to 110 kV have a total length of 28,642 km, and there are 75,534 transformer substations. The basis of reliable power supply is made up of power transmission lines with a total capacity of 0.4 10 kV, a current of 13,933 MW, which is equal to 223,987 km, with a total capacity of 223,987 km [5] .

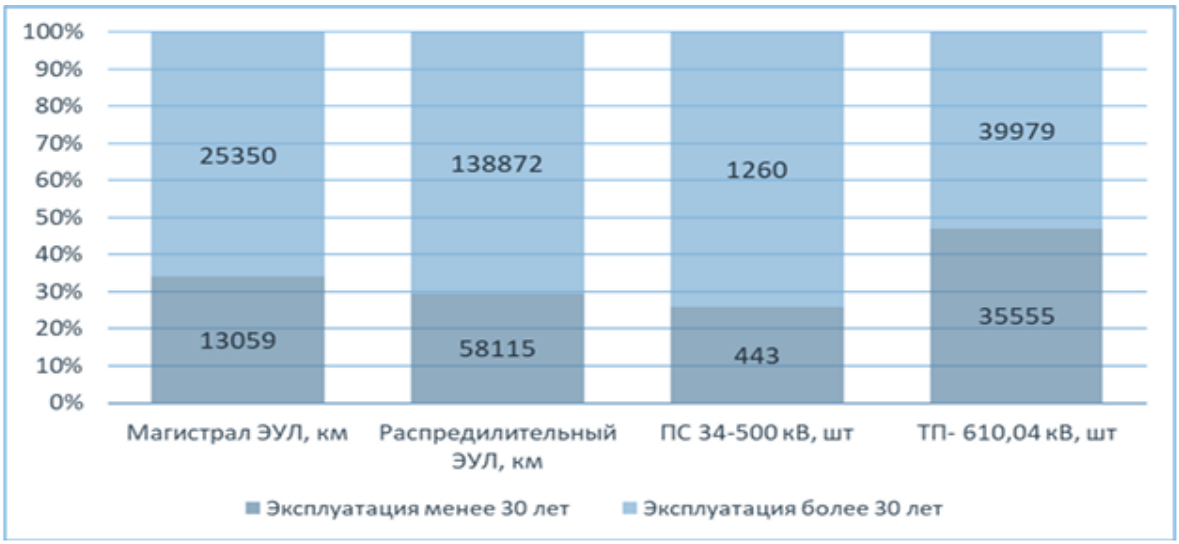

Fig . 1. Current state of all electricity transmission networks in Uzbekistan (as of the end of 2022).

The total volume of technological and physical electricity losses in the country, as part of primary production, averages 2.7% of the total, while losses in distribution networks account for approximately 12.5% of the total. From the perspective of the country's main energy system, Uzbekistan's energy infrastructure is divided into five distinct geographic regions:

1. North-West (Republic of Karakalpakstan and Khorezm region);
2. Southwest (Kashkadarya, Samarkand, Bukhara and Navoi regions);

3. South (Surkhandarya region);
4.Eastern (Andijan, Namangan and Fergana regions);
5. Central (Jizzakh, Syrdarya, Tashkent regions and the city of Tashkent).

Key drivers of this growth include improved solar panel efficiency, the development of grid-tied energy storage solutions, and the introduction of new wind turbine and geothermal technologies.

Uzbekistan, like many other countries, faces challenges with environmental pollution, growing energy consumption, and dependence on traditional energy sources such as coal and gas. Amid the global transformation of energy markets, concerns about climate change, and the need to improve the resilience of the country's energy system, Uzbekistan is actively investing in the development of green energy. In recent years, the country has significantly stepped up its efforts to transition to renewable energy sources (RES), opening up new prospects for its economy and improving the environmental situation. The country has significant potential for developing various types of RES. Its location in the sunny zone of Central Asia makes it an ideal location for harnessing solar energy.

Despite significant achievements, renewable energy development in Uzbekistan faces a number of challenges. First, significant capital investment is required in infrastructure to connect solar and wind power plants to the national grid. Second, a lack of qualified personnel requires investment in education and training of specialists in renewable energy sources. Third, energy storage is a challenge, as renewable energy sources are intermittent and require storage solutions for efficient use.

Fig. 2. Dynamics of electricity consumption in Uzbekistan in the period 2005-2020 (billion kW/h) [2] .

Hydroelectric power plants operate by converting water energy into electrical energy using turbines. Water at elevated altitudes, containing potential energy, is directed through a turbine, where its kinetic energy is converted into mechanical energy. This mechanical energy is then transferred to a generator, which produces electricity. Types of hydroelectric power plants:

•Large hydroelectric power plants are large structures that include reservoirs and can produce huge amounts of electricity.
They often require significant infrastructure changes and can have significant impacts on the ecosystem.
•Small hydroelectric power plants – characterized by smaller size and power output. These plants are often installed on rivers that are unsuitable for the construction of large hydroelectric power plants and do not require such significant environmental and social changes.
Pumped storage stations (PSS) use two reservoirs at different levels to store energy. During periods of low energy demand, water is pumped from the lower reservoir to the upper one, and during peak demand, the water is released back, driving turbines. [1] .
Social issues:
• Displacement: The construction of large hydroelectric power plants often requires the relocation of local residents, which can cause social and economic problems.
• Conflicts with local communities: Poor project management can lead to protests and conflicts with local communities, especially if they have not been properly informed about the consequences of the hydroelectric power plant's construction.
Modern technologies and development prospects With the development of hydropower technologies, new opportunities are emerging for increasing the efficiency of hydroelectric power plants and minimizing their impact on the environment.
1. Small hydropower plants and microhydropower: The development of small hydropower plants allows for the use of energy from rivers and reservoirs with minimal environmental impact. Such plants can be installed even in remote and inaccessible areas.
2. Innovative hydro turbines: Modern hydro turbines have higher efficiency and can operate at lower water flow rates, making it possible to use hydropower technologies even in regions with fewer water resources.
3. Hybrid systems: Combining hydropower with other renewable energy sources such as solar or wind power plants opens new horizons for sustainable energy production [1].
Thus, the development of green energy in Uzbekistan represents an important step toward ensuring a sustainable energy future for the country. Despite existing challenges, such as high initial investment and the need for infrastructure modernization, the country has significant potential for the successful implementation of solar and wind energy projects.

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