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IMPROVING ENERGY EFFICIENCY IN AN AUTONOMOUS POWER SYSTEM USING RENEWABLE ENERGY SOURCES.

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Abstract This article will analyze and control optimal energy consumption of autonomous energy system of Kashkadarya region based on renewable energy sources. The goal set in the work is solved by mathematical modeling of linear programming methods, production rules and energy consumption modes through the production of consumers' living conditions. It is anticipated that energy consumers in the area under review will be able to independently cover the energy shortage by installing additional generating energy sources. The goal function is to minimize the financial costs for their energy consumption and maximize them from the export and redistribution of energy streams. Depending on the season in this study,

The optimal ratio of electricity generation by alternative sources of daily energy consumption is hydroelectric power plants (94.8%), wind power plants (3.8%), solar photovoltaic power plants (0.5%) and energy storage (0.8%); Water is not required by power plants in the summer due to the possibility of maintaining an energy balance. As a result, each producing consumer can independently minimize his own energy consumption and receive maximum benefits from the energy exchange with other consumers depending on the selected energy sources, which turns out to be a good example of the use of carbon-free energy at the micro and mini-grid level.

Keywords: Renewable energy; solar photovoltaic plant; a productive energy consumer; hydroelectric power plant; optimal power consumption; a wind farm; heat; heat balance; energy; energy storage.

Introduction; At present, the dwindling of fossil fuel reserves and the increasing demand for energy have been the most important issues in the global context. Nevertheless, modern energy systems in Uzbekistan are also experiencing a period of significant changes in 2008 and 2023 related to the transition from centralized, top-down structures dependent on fuels to distributed, decentralized, environmentally friendly energy solutions aimed at combating climate change and depletion of natural resources, as well as ensuring energy security at the national and scale. Therefore, the use of renewable energy sources (REM) as an alternative to traditional energy sources is becoming an energy policy priority in most countries of the world [1,2]

By making "green" decisions about electricity generation with the goal of developing renewable energy sources, researchers are doing everything to get the most reliable and efficient way to generate energy using RES. Therefore, the increased focus on technologies applicable to RES on such a large scale has led to a decrease in the ongoing cost of distributed technologies for the generation, storage, and conversion of renewable energy [2,3]. The use of WPP is suitable from a technical and economic point of view to provide electricity to remote areas operating in autonomous mode. For example, the introduction of renewable energy technologies with their rational use will provide electricity to areas with weak fuel base and poor transport conditions, as well as the efficient use of consumed resources and attract previously unused energy sources and resources to the energy balance of regions, solving the problems of improving the environmental situation at places of heat and energy production. Consequently, these measures and measures contribute to the accelerated economic development of these regions and the improvement of social and living conditions of their populations, based on the creation of autonomous, low-voltage, low-inertia local networks to ensure

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universal sustainable access to reliable energy sources of settlements located far from national networks, based on energy sources, processing.[2,4,5].

The use of such systems will prevent energy shortages, while mass adoption reached 3.4 GW in 2013 and is expected to increase to 11.8 GW by 2026 [6]. Such great interest is due to their potential advantages in terms of facilitating the integration of RES into existing and new energy systems. For example, microgrid multi-energy carrier dal ava refers to an interconnected energy system that provides a platform to connect different energy vectors from different sources to meet different energy needs in desert areas, and is used in a variety of industries, including commercial, industrial, and military, taking into account the set goals, load types, geographic, and climatic conditions. The model expands on the concept of original electricity demand-oriented microgrids, with a desire to leverage the interaction between different energy vectors to virtually meet all energy needs of communities while increasing the stability, reliability, efficiency, and availability of RES [1].

2 Relevancy and mission

Increase energy production and efficiency based on renewable energy sources.

The issue of effective management of energy production consumption is becoming relevant. In addition, the performance of autonomous power systems with a high proportion of RES can create serious problems in balancing the system. The decentralized integration of RES based on a smart energy system has been presented as the most promising way to increase the stability and reliability of the latter in a cost-effective way [7,8], especially since it is autonomous, smart and integrated renewable energy systems, aimed at providing modern energy services to all. It increases energy stability in mountainous and desert areas and, more broadly, rural/remote areas. [9]. Hybrid Renewable Energy Systems (HRES) can vary significantly in terms of the type and number of sources of production, consumers, installed capacity, operating conditions, and many other factors. Currently, conditions and opportunities have been created for energy consumers to independently choose the sources of production whose renewable energy sources, combined with energy storage units, can serve for both autonomous and local energy systems. Such systems are characterized by the absence of centralized energy sources and high uncertainty of renewable and alternative energy sources, which implies that each producer will independently solve the problem of optimizing the most profitable combination of renewable and alternative energy sources in order to minimize the material, technical and financial costs of the electricity consumer. [10].

3 Information and materials

3.1 Estimation of energy resources of the Kashkadarya region of the Republic of Uzbekistan, Kashkadarya is one of the richest southern sunny regions of Uzbekistan in terms of hydropower reserves. Energy reserves are concentrated in this region, they are estimated at 37.2 billion kWh. However, about 11% of this capacity is currently being utilized. The low level of development indicates a weak level of economic development and great potential for future growth of the region. The open hydropower resources of small rivers and watercourses of the region are so large that their utilization rate reaches 21%, the hydroelectric potential of the Kashkadarya represents the cost efficiency of its use and the commercial benefit to justify the construction of small hydroelectric power plants. Key factors deferring the use of energy resources include: environmental impact assessment of hydropower construction, the complex nature of wastewater use, and the energy market in Central Asia. It is important to note that even medium-sized Kashkadarya rivers are being adequately studied for their energy potential [11,12,13].

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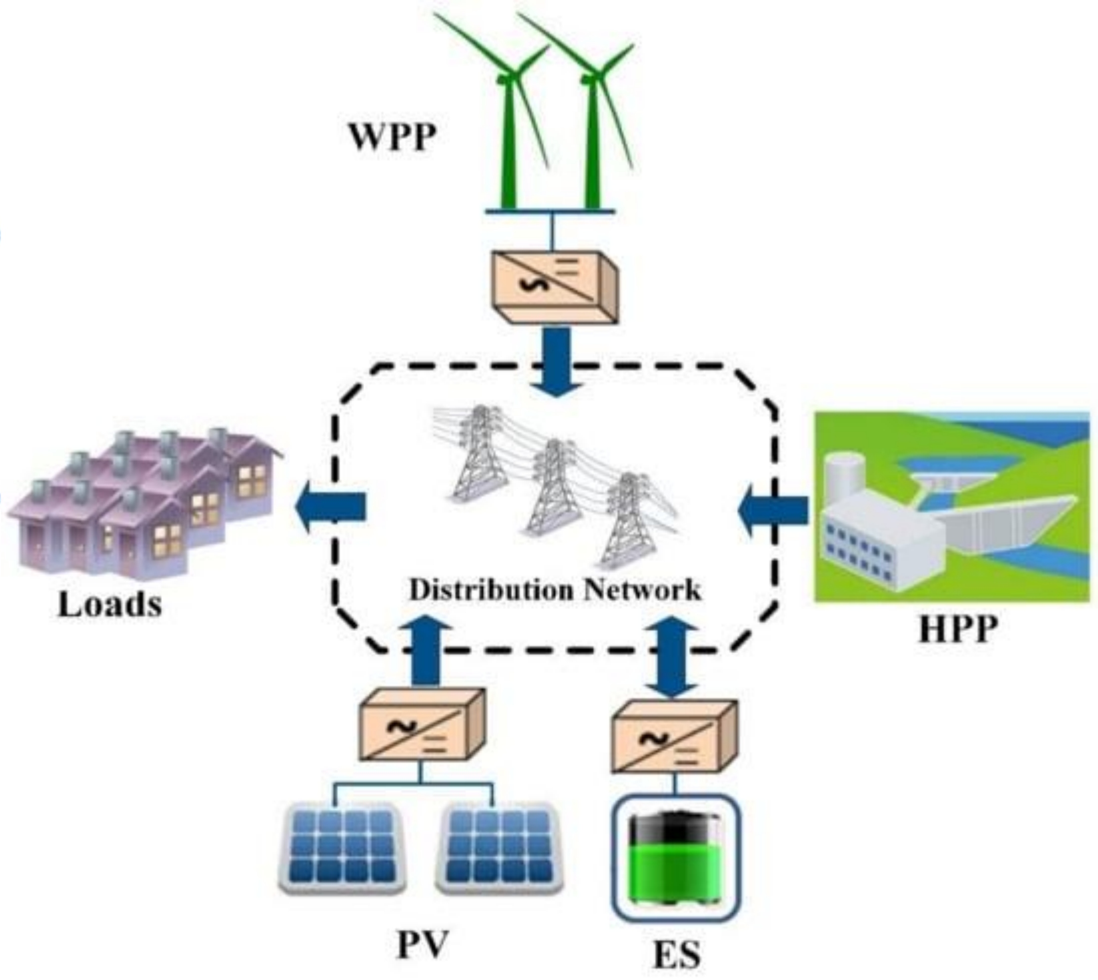


Figure 1. Overview of the proposed hybrid power system.

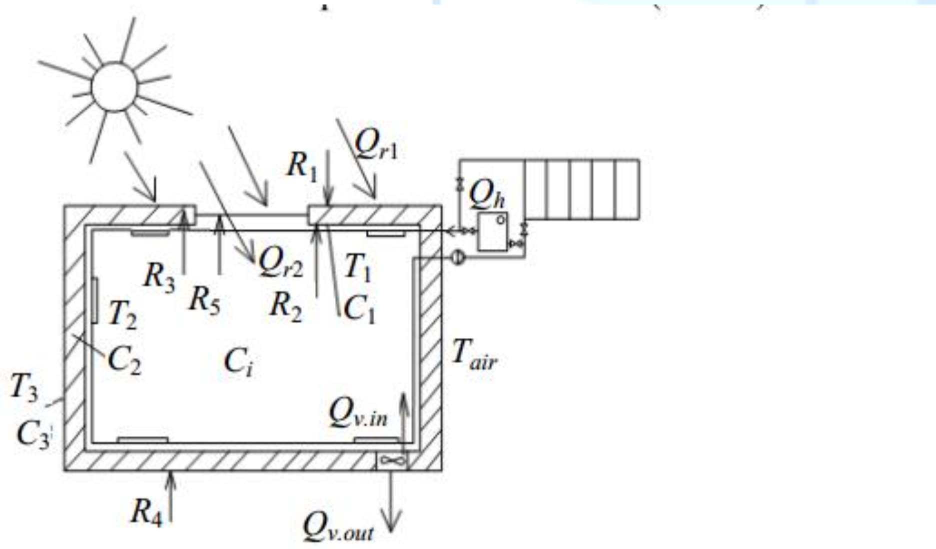
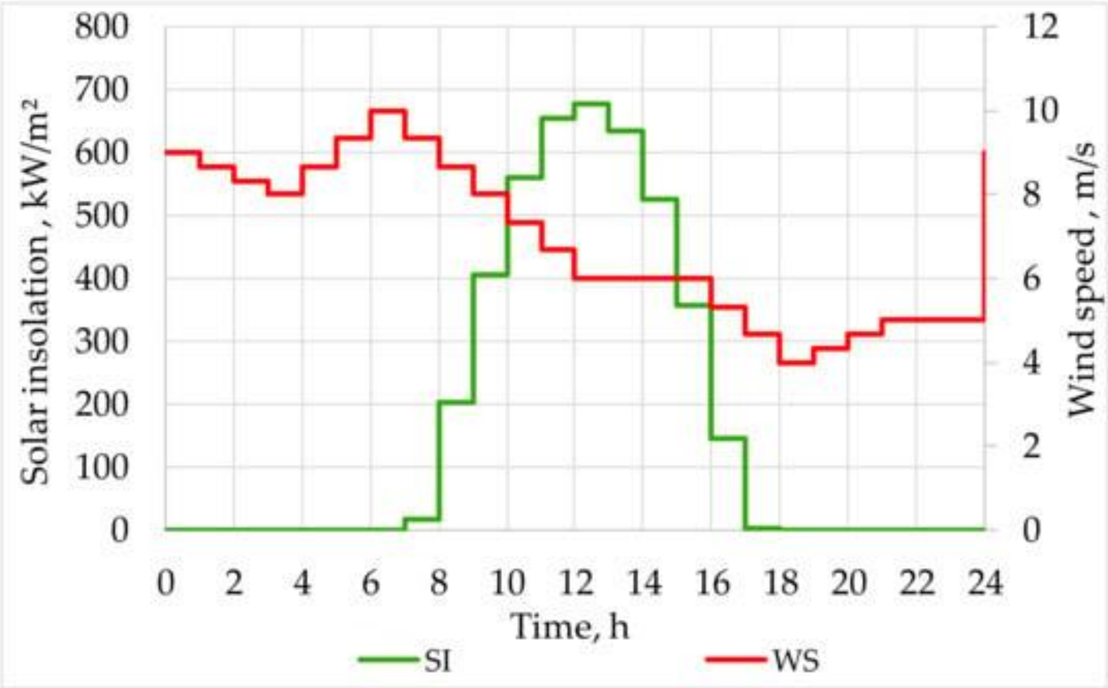


Fig. 2. Scheme of the heat balance of a solar house with autonomous heat supply

3.2 Assessment of energy balance in Kashkadarya region

In order to assess the energy potential of the autonomous energy system under consideration in Uzbekistan, it is necessary to assess the possibility of using alternative energy sources at daily intervals. At the same time, the main difference between the modes of this system is that it is a lack of energy in winter and an excess energy in summer. On this connection, the most characteristic days are chosen for the winter and summer period. Two modes are chosen to describe the extreme points. In summer, when the maximum energy of small rivers is available, hydroresources are sufficient to fully cover the load, especially during the hot period of summer. It can also create good conditions for the export of electricity. In winter, the consumption of electricity for heating increases, and for the activation of reservoirs water energy can be used only by 30 - 40%. On these characteristic days, energy shortages occur in the peak modes of electricity consumption, exports are significantly restricted, and energy storage is fully utilized. Ideally, it would be desirable to build a pump-assisted storage station, a continuation of all of these works. To optimize energy consumption modes, statistical data of wind speed, solar radiation, electricity generated by GES at the expense of water resources, and daily load schedule were used [14].

Table 1. Wind speed and solar irradiation data are displayed for a typical winter day in the area being investigated. Peak wind speed values coincide with the morning peak of the day, which leads to the use of wind energy in the morning. As it turns out, the greatest power can be obtained at the expense of solar energy in a daily profile of 8 to 18 hours. This roughly corresponds to the duration of the electric load during the working day. The total capacity of the solar panels was selected as 5 MW with an efficiency of 22.5%.



Conclusion;

According to the results of the study, the following conclusions were reached: based on the available resources of renewable energy, a combined system of providing sources (solar and biomass energy) in the southern climate, energy (heat and electricity) to rural households, the schemes of which are operating, was developed and recommended on the basis of renewable energy sources. This energy-saving system runs on 100% solar energy all year round in the heat, water and provide up to 400 liters of hot water per day at a temperature of not less than 50 0C As well as in centralized energy supply districts, the use of local autonomous energy sources will create a competitive environment in the energy market.

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