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ALTERNATIVE RESOURCES IN THE ENERGY INDUSTRY: RENEWABLE ENERGY SOURCES AND FACTORS FOR THEIR DEVELOPMENT

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At the present stage of development of the world economy, one of the most pressing problems is the disruption of the global ecological and energy balance. This situation is primarily explained by the constantly growing demand for energy resources as a result of the expansion of industrialization processes and increased economic activity. At the same time, the limited nature of traditional energy sources such as oil, gas, and coal, as well as the increased costs of their extraction, are becoming one of the factors threatening stability in the global energy system.

These trends make the issue of efficient use of alternative resources in the energy industry even more relevant. In particular, renewable energy resources such as solar, wind, hydropower, biomass, and geothermal sources are considered as an important instrument for ensuring energy security, reducing carbon emissions, and achieving long-term economic stability. In this regard, an in-depth study of institutional, technological, and investment factors influencing the development of renewable energy sources in the energy sector is one of the priority areas of modern economic research.

Without the development of energy and electrification, it is impossible to achieve scientific and technological progress. Humanity needs energy, and the need for it is growing every year. At the same time, the reserves of traditional natural fuel



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(oil, coal, gas, etc.) are unlimited, nuclear fuel - uranium and thorium reserves, from which plutonium can be obtained in selective reactors. Therefore, today it is important to find useful alternative energy sources, taking into account not only the cost of fuel and materials, but also the construction, ease of use, and durability necessary for the construction of the station [1].

Traditional sources include, first of all, heat, nuclear energy, and water flow energy.

It is known that the expansion of traditional energy production creates two main global problems. Firstly, the waste from traditional energy production enterprises leads to a negative change in the world's climate, and secondly, the depletion of natural resources (coal, gas, oil, etc.) used by traditional energy production enterprises. The solution to these problems is the use and development of renewable energy sources.

Renewable energy sources are solar, wind energy, ground temperature (geothermal), natural movement of water flows, biomass energy, which are naturally renewed in the environment [2].

Alternative energy is a set of promising methods of obtaining energy, which are not as widespread as traditional ones, but due to the profitability of their use, the risk of environmental damage is low[3].

The relevance of using alternative energy sources, including renewable ones, and energy carriers is also reflected in the global environmental problems that have arisen on our planet over the past decade. These include climate change, ozone depletion, and other factors.

The world community has long been discussing the expansion and development of the use of alternative energy sources. However, although there are many types of alternative energy sources today, their use is still not widespread. Although alternative energy sources are not as widespread as traditional ones, they have



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been proven to be a promising method of energy production [4].

One of the important trends observed in the global energy system in the context of modern economic development is the intensification of the process of gradual transition to alternative sources against the backdrop of increased energy demand. The expansion of economic activity, the modernization of industrial sectors, and the growth of the population's standard of living are further increasing energy consumption. Therefore, in order to reduce dependence on traditional resources in the energy sector and form a stable and long-term energy supply, the use of renewable energy sources is becoming an urgent strategic direction.

In particular, the development of "green energy," formed on the basis of natural energy resources, such as solar radiation, wind currents, hydropower resources, geothermal sources, and biomass, is becoming an important component of modern energy policy. The main advantage of these sources is that they are practically a renewable and continuous energy reserve, creating the possibility of energy production while minimizing the negative impact on the environment. At the same time, the introduction of renewable energy technologies will expand the possibilities of achieving relatively inexpensive and environmentally safe energy production, reducing carbon emissions, and preserving natural resources such as oil, gas, and coal for future generations.

From this point of view, the formation of mechanisms for the effective use of alternative resources in the energy industry, the study of economic, institutional, and technological factors influencing the development of renewable energy sources is one of the important scientific and practical tasks of ensuring a stable energy system.

However, green energy is developing only in most leading countries of the world. In essence, today a new paradigm of world energy is being formed, which provides for a decisive contribution of renewable energy sources to overall energy



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consumption and the phased replacement of traditional fossil energy resources. One-fifth of the primary energy consumed by the world's population comes from renewable sources such as wind, solar, hydro, and geothermal. It is expected that this sector will continue to grow by 2.6 percent annually until 2040.

Until recently, the main source of renewable energy was hydroelectric power. Currently, wind and solar energy are also developing rapidly. In many countries, scientists, leading specialists in the field, and researchers are conducting research on new photovoltaic cells that can be printed on flexible panels, which leads to a reduction in solar energy costs [5].

Wind and solar energy are highly dependent on weather and daylight hours, and in sunny conditions, they do not need to produce the main part of electricity during periods of high demand. Currently, many countries are fighting this by storing more reliable sources of energy production. This means that power plants running on atomic, gas, and even coal are not operating or are operating at a low level, but production is at a high level when there is wind or when the sun is below the horizon. [6].

Alternative energy sources refer to renewable energy sources that produce the absolute majority (85%) of the energy used in world energy and can replace traditional energy sources - thermal and nuclear power plants.

Thus, the energy of the future must solve three main tasks in its further development [7]:

- economical use of non-renewable energy resources (saving energy resources);
- efficient use of energy (reduction of losses in the process of production, transformation, transmission and consumption);
- increasing the use of renewable (alternative) energy sources and stimulating the search for new energy sources (development of research on hydrogen energy, etc.).



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Addressing these global challenges entails three main goals of the new energy policy:

- risk minimization;
- climate protection;
- sustainable development.

Based on this, it can be said that the goal of the energy policy of any state is the most effective use of the potential of natural energy resources and the energy sector to promote sustainable economic growth, improve the quality of life of the country's population, and strengthen its foreign economic position.

Political factors

- Striving to ensure the energy independence and security of states
- Reduction of dependence on a single energy source and imported energy sources

Economic factors

- Increase in the cost of fuel and energy resources
- Reducing the cost of renewable energy technologies

Environmental factors

- Combating climate change through the use of renewable energy technologies
- The depletion of fossil energy resources, preservation for future generations

Technological factors

- Improvement of renewable energy technologies, an innovative development method
- Reduction of technological losses through the use of renewable energy sources

Figure 1. Main factors in the development of the global renewable energy market [8]

By the late 70s and early 80s of the last century, many countries began to adopt state-funded special programs for the development of energy based on renewable sources.

Central Asia is rich in renewable energy sources and has significant potential for increasing energy efficiency, as well as opportunities for expanding regional



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cooperation in the energy sector. USAID's "Central Asia Energy" project (implementation period: October 2020 - September 2025, budget: 39 million US dollars). USAID will help five Central Asian countries - Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan - in achieving national and regional security priorities and obtaining economic benefits from regional electricity trade. The project will work closely with national governments and key stakeholders to address the three key issues.

Reforms for the liberalization of the national market. USAID's "Central Asia Energy" project offers Central Asian countries areas of cooperation in updating their national energy strategy and developing optimal market structures, including legal, institutional, regulatory, and technical frameworks. USAID will also support the development of cost-reflecting pricing methodologies, business modernization, and cybersecurity.

Clean energy. USAID's Central Asia Energy Project supports the efforts of Central Asian governments to develop renewable energy by conducting research on the integration of renewable energy sources into a unified energy system and developing strategies for the future. USAID promotes private sector investment in renewable energy.

Regional electricity market. The project is based on USAID's support for regional cooperation in the energy sector, ensuring cross-border electricity trade and open access to production and transmission networks. USAID's "Central Asia Energy" project will also work on developing a regional model of the electricity market, combining technical and market foundations.

Through these projects, USAID provides technical assistance to national governments, businesses, and other stakeholders, including international development agencies and organizations, system operators, local and international investors, and energy companies. USAID will promote reforms in



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the national and regional energy markets and promote the widespread adoption of clean technologies to strengthen the regional electricity market and promote renewable energy sources.

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