

**NEWS**

**OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN  
SERIES OF SOCIAL AND HUMAN SCIENCES**

ISSN 2224-5294

Volume 4, Number 320 (2018), 112 – 119

JEL 338.242.2

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**USE OF RENEWABLES AS FACTOR OF DEVELOPMENT OF  
NATIONAL ECONOMY OF THE REPUBLIC OF KAZAKHSTAN**

**Abstract.** The paper represents the analysis of modern data and information of the development of renewable energy sources (RES) and energy efficiency in the Republic of Kazakhstan. The purpose of this article is to identify trends in the development of alternative energy sources that are economically feasible at the current stage of the development of the energy complex and allow providing sustained growth in the national economy of the Republic of Kazakhstan. Analytical publications, interviews with experts, and other open sources of information were used as sources of secondary data. The conducted research allows formulating a number of conclusions. The Republic of Kazakhstan has a significant potential for the development of alternative energy. However, it is shares in total energy production, remains rather low and the available capacities of the RES facilities are not fully utilized. In the context of aggravation of global environmental problems, depletion of traditional types of energy and raw material resources; it has proved necessary to create new energy system, based on RES. The Government of the Republic of Kazakhstan needs to develop a long-term concept of rendering sustainable energy services. In addition, it is necessary to implement a set of measures to strengthen the enabling environment, including higher investments into renewable facilities. One of the most promising mechanisms for supporting the RES sector is the introduction of an auction system for selecting RES projects, which will help solve problems with planning and control of the budget to support RES.

**Key words:** energy efficiency, energy saving, gross domestic product, energy intensity, renewable energy sources (RES), alternative energy, solar energy, wind power, biofuels, eenergy potential.

It is impossible to create steady model of economic development without solution of questions of energy efficiency. According to the Government of the Republic of Kazakhstan, the policy of the effective and balanced consumption of energy contains growth of consumption and significantly reduces impact on the environment. Any efforts in this area will promote modernization of manufacturing sector, power industry, housing and communal services, and the transport sector by encouragement of introduction of new technologies and innovations. In this regard the government of Kazakhstan has chosen energy saving and energy efficiency as the main priorities of national power policy, in spite of the fact of the considerable energy country resources and developed power infrastructure. The government has set a goal to reduce power consumption of GDP non less than by 40% by 2020 (The Decree of the President of the Republic of Kazakhstan, May 30, 2013, No. 577).

In November, 2011 Kazakhstan has suggested in the agenda of UN conference on sustainable development discussion of global power ecological strategy of sustainable development in the 21-st century. The eponymous book, written by the President of Kazakhstan Nursultan Nazarbayev, offers an explanation to strategy and describes practical ways of its realization (Nazarbayev 2011). The ultimate goal of this strategy is to reach optimum level of satisfaction of needs of all countries in energy and other natural resources due to complex improvement of use of the renewable energy sources in the middle of the 21-st century (RES).

Now in the Republic of Kazakhstan was adopted several programs, directed to increase the renewables (R) in electricity generation. In 2013 the Concept of transition to “green economy”, which has been fixed by the strategic development plan till 2020 subsequently, has been accepted. According to this document, the share of RES in electric power total production by 2020 has to be increased up to 3%, and by 2030 the share of RES has to make 30%.

However, despite a number of legislative initiatives and measures of the general policy of increase in energy efficiency of the Republic of Kazakhstan needs further improvement, according to the best international practice.

Despite rather high stock of traditional types of fuel, creation of the new power system, based on renewables, is quite important. Kazakhstan, owing to natural data, has enormous potential on introduction RES, whether it be the solar power stations (SPS), hydroelectric power stations (HPS), or the wind power stations (WPS).

Experts allocate two main reasons for the accelerated development of renewables in the Republic of Kazakhstan. First, there is an urgent need of reduction of emissions of greenhouse gases and other pollutants, which main producer is fuel and energy complex of Kazakhstan, generally burned fossil fuel, coal, oil and gas. Secondly, the deficiency of energy grows that can become the limiting factor for further economic growth. The relevance of development of alternative power engineering on the basis of renewables is caused by complexity of the current situation in power branch of the country, including extremely high wear of infrastructure: 70% - the generating capacities, 65% - electrical networks, 80% - thermal networks (The review of state policy of the Republic of Kazakhstan in the field of energy saving and increase in energy efficiency) (The review of state policy of the Republic of Kazakhstan in the field of energy, saving and increase in energy efficiency). Access to power supply still is a problem for more than 8 million residents of the Republic of Kazakhstan. At the same time with growth of economic activity also electricity consumption growth is observed, and certain regions of RK still remain power scarce.

T.L. Afonso and other authors wrote: “The understanding of fragility and non-environmental friendliness of the traditional resources and also conjuncture of their pricing became an initial incentive of development of RES” [1]. The review of literature on problems of use of renewables has shown disappearance of very different power sources under the general term RES [2].

From one hand, long ago large hydropower was successfully operated; from the other hand, rather new types, such as solar power, wind, geothermal sources and even absolutely exotic energy of waves of the ocean [3]. The most common forms of use of renewables are energy of the sun, wind, biomass, hydraulic power, geothermal energy and biofuel [4]. A rich source of renewable energy is wind power. The movements of wind rotation of the earth, generally due to Coriolis’s effect are carried out due to heat from the sun, and [4]. The solar power is the excellent choice in the growing market of RES, environmentally friendly source, doesn’t produce greenhouse gases [5]. As a renewable source of energy, solar technologies are used in power production (solar batteries) or in production of heat and heating of water (solar thermal) [5]. J. Freeman notes: “Energy of biomass is renewable and steady power source, received from organic substances, which can be used for power production and other types of energy” [6]. Through photosynthesis process, the chlorophyll, which is present at plants, absorbs energy from the sun by transformation present carbon dioxide in the atmosphere and waters in carbohydrates. When these plants are burned, the same energy is released in air; they have taken from the sun. For production of fuel from biomass such materials as manure, forest blockages, scrap of timber, mulch, sewage, the separate cultures and some types of waste are used [7]. The hydropower uses water flow for electricity generation. By one of forms of hydroelectric power station it is created due to the movement of water via turbines in a dam.

N. Kelsey has stressed: “The geo power is power source, that doesn’t emit greenhouse gases, which are dangerous to the person and the environment. The term “geothermal” means the earth and heat” [8]. This conclusion quickly indicates definition of geothermal energy, which uses heat from under the Earth’s surface to generate energy. Energy in the earth was formed at disintegration of minerals and the woods many years ago. One of the main advantages of use of renewables is demand smaller costs of service, than traditional generators of energy [9]. Energy production with use of renewable sources makes the minimum impact on the environment as there is practically no release of pollutants, such as, for example carbon dioxide [10]. Enough researches are devoted to questions of justification of economic feasibility of

introduction of RES. Many experts agree in opinion that projects in the field of renewables can bring economic benefits for many regions as the majority of projects far away from the large city centers and suburbs of the capital [11].

Besides the listed advantages of development of RES, experts allocate also the number of shortcomings. The first lack of renewables is difficult for generate and make a large number of the electric power in comparison with traditional generators of fossil fuel [12]. It means that society has to reduce energy consumption, or just build more power objects of RES. Many experts note that for the solution of power problems it is necessary to observe balance of various power sources [13].

Other lack of renewables is reliability of deliveries. Renewables often depends on weather conditions (Banshwar at al. 2017b) [3]. So, for example, for hydro generators the rain is necessary to fill dams for providing with flowing water, wind generators need wind to rotate blades, solar collectors need the clear sky and the sun to accumulate heat and the electric power.

Despite such rough rates of development of RES, remain very many skeptics doubting stability of this trend. The main argument consists that energy of RES is commercially noncompetitive, and projects with its use are unstable in the long term (Saavedra at al. 2018). That the “green” energy is too expensive in comparison with traditional, also develops it only thanks to the state support (Parida at al. 2016) [13].

The power consumption of GDP is the most widespread indicator of economic efficiency of use of energy. It pays off as the relation of primary consumption of energy (coal, oil, gas and other energy resources) to real GDP of the country.

The Republic of Kazakhstan is included into ten countries with the highest rates of power consumption of economy (figure 1).

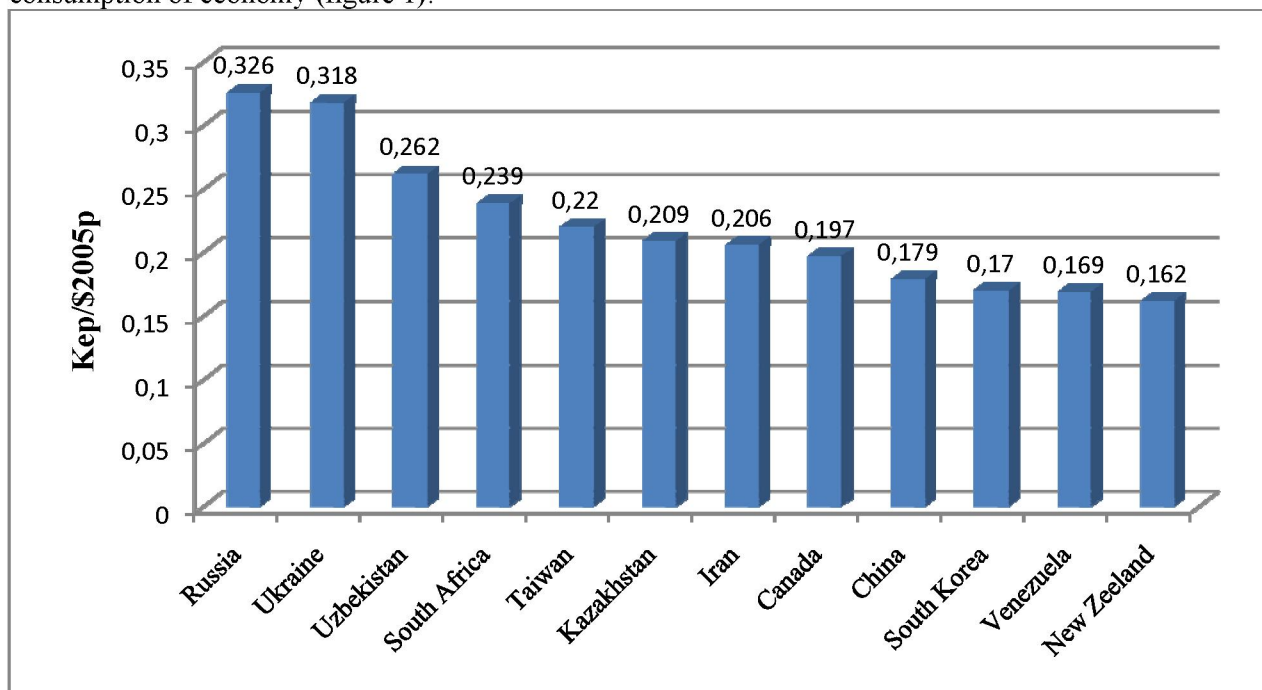


Figure 1 - Indicators of power consumption of GDP, kep/of \$2005 p (Statistical year-book of world power of 2017)

In general, the power consumption of GDP of the country shows the tendency to decrease energy consumption per capita grows. High power consumption of GDP in Kazakhstan we can explain by the number of the natural reasons:

- severe sharply continental climate, long and cold winter;
- prevalence of power-intensive sectors of economy in structure of GDP;
- extensive populated areas;
- considerable extent of transport infrastructure (oil and gas pipelines, power lines, line water).

According to expected balances of electric energy and power for 2017-2023, the deficiency of the electric power in the Republic of Kazakhstan will be 13,7 billion kWh. Access to clean types of fuel and

technologies for household heating, lighting and cooking is still the problem for inhabitants of the region. Many villagers still show high dependence on solid fuel in houses as other types of fuel are remote.

The government of the Republic of Kazakhstan and the international donors continue to advance decisions in the field of renewables by means of initiatives of improvement of quality of access to energy. Transition from the pilot projects financed by donors to large-scale introduction of renewables for improvement of quality of access to energy to RK remains difficult. Despite 100% coefficient of electrification of the country, quality of power supply from the point of view of reliability, availability and stability remains one of the main problems of access to energy. The leadership of the Republic of Kazakhstan pursues active state policy on development of the renewables (R), which is directed to acceptance of system measures and existing strategic interests of Kazakhstan. Renewables are positioned in recent years by the country as one of priority vectors of development of power complex.

By expert estimates, the Republic of Kazakhstan has the essential potential of development of alternative power engineering. So, the potential of wind power is estimated at 920 billion kWh per year that 10 times exceeds the current consumption of electric energy in the country. Hydro capacity of Kazakhstan is estimated at 62 billion kW, 70% of the current consumption in the country.

As for the potential of solar energy in the southern regions of the country, it is about 2500-3000 thousand sundial per year. In January 1, 2017 50 enterprises, using RES with a total power of 295,7 MW work in the country (hydroelectric power station - 139,8; VES - 98,2; SES - 57,3; biogas installation - 0,35). For 2016 rated capacities of renewable sources in Kazakhstan have increased by 18%.

In 2016 4 RES projects with a total power of 50,39 MW were realized; in 2017 was planned to put into operation 12 objects of RES with the rated volume of 114,25 MW. Rated capacity of wind station has increased from 37% to 98,2 MW, solar stations from 0,4% to 57,3 MW, the thermal power plant on biomass was left without changes - 0,4 MW, and the power of small hydroelectric power stations has grown from 14% up to 139,9 MW.

For the last five years the share of RES in the total amount of generation has increased from 0,5% to 0,98% (figure 2).

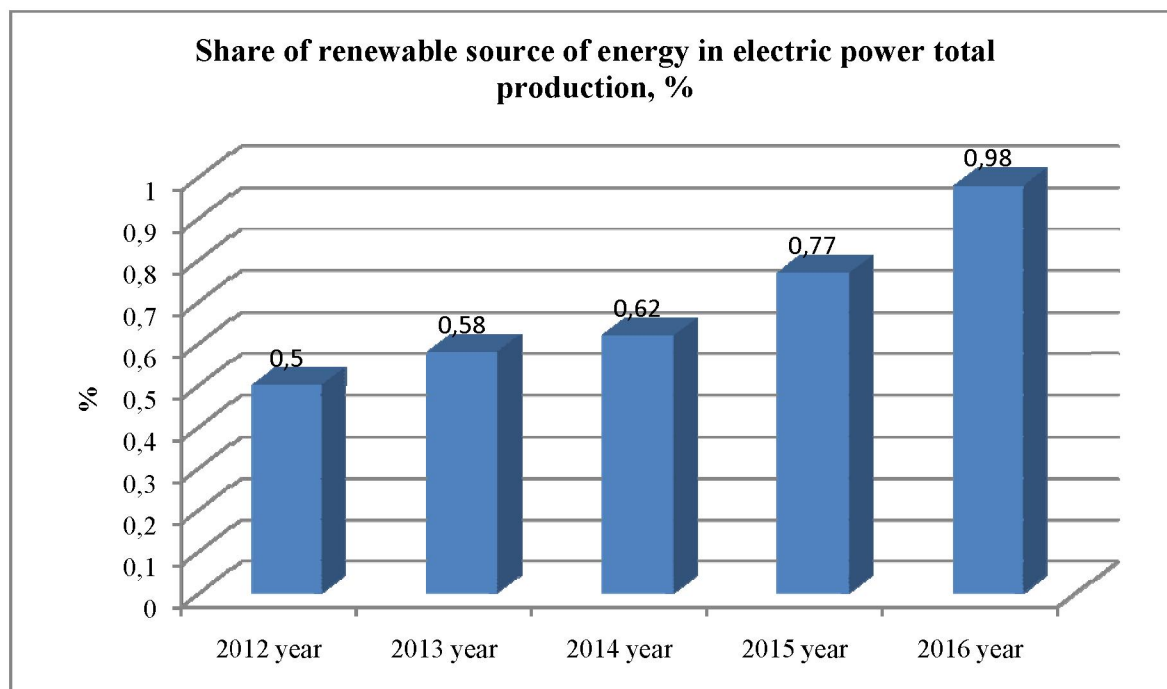


Figure 2 - Share of renewable source of energy in electric power total production in the Republic of Kazakhstan, %

In five years the electric power volume developed by RES has increased by 2,4 times (figure 3).



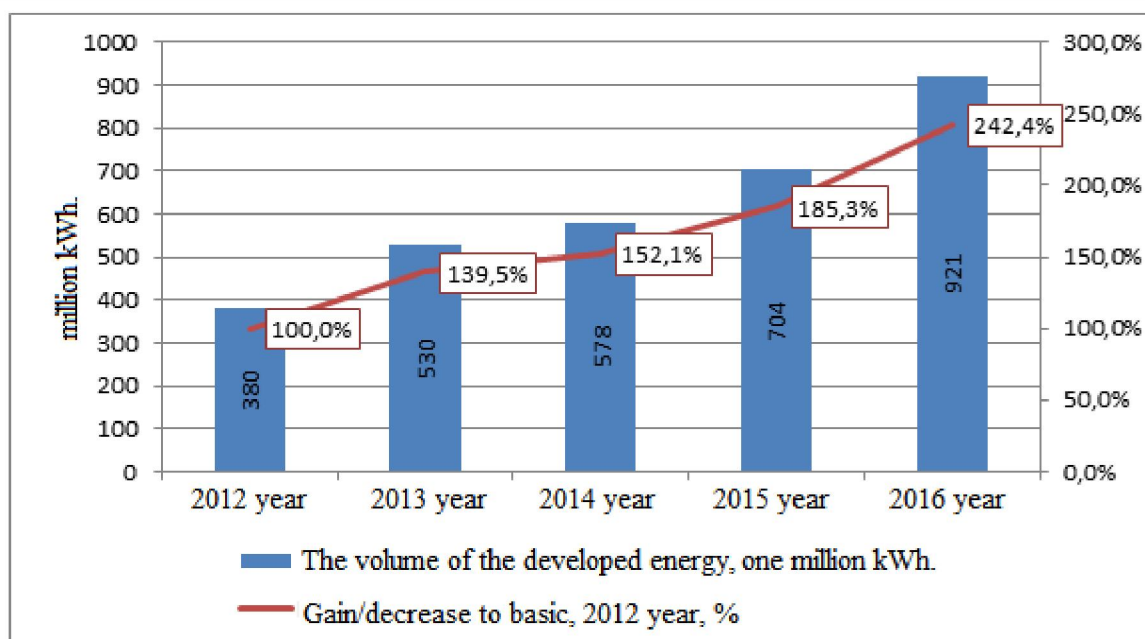


Figure 3 - Dynamics of volumes of the developed electric power of renewable source of energy in RK in 2012-2016 years

Kazakhstan receives other 99% of the electric power from traditional sources: 79% - fuel power plants, 8% gas-pipe and 12% of hydroelectric power station. By the estimates given by the program of partnership "Green Bridge" theoretically the power of all water resources of the country make 170 billion kWh a year from which only 7149, 4 million kWh – only insignificant part now used. Recently in Kazakhstan there are three large hydroelectric power stations: Bukhtarminsky, Ust-Kamenogorsk and Shulbinsky work. Besides, the 300 MW Moynaksky hydroelectric power station – the first station since independence of the country.

Along with large hydroelectric power stations, such as Bukhtarminsky, Ust-Kamenogorsk and Shulbinsky, in the Republic of Kazakhstan small hydroelectric power stations which in 2016 have developed 577,2 million kWh - 10% more intensively develop, than in 2015.

During 2012-2016 production of wind energy has increased more than 100 times. In 2016 wind power stations have developed 275 million kWh, that is twice more than production in 2015 (table 1).

Table 1 - Indicators of electricity generation of RES of RK in 2012-2016.

Indicator	2012 year	2013 year	2014 year	2015 year	2016 year
The electric power made by wind power stations, one thousand KWh	2665	4546,9	13300,8	131722,3	274982,8
The electric power made by solar power stations, one thousand KWh	21	775,8	1268,3	46171	88403,1
The electric power made by hydroelectric power stations one thousand KWh	763726,6	773073,6	826283,1	926919,0	11620764

According to the plan by 2020 there were planned to start 13 objects of VES of the general power 793 MW in the following cities: Almaty, Zhambyl, Kostanay, North Kazakhstan, Akmola, Karaganda and Aktyubinsk regions. The largest object of VES with power of 300 MW is planned to start in the village of Badamsha of Kargalinsky district of the Aktyubinsk region. Implementation of large-scale projects on construction of wind station of new generation needs to introduce the latest construction technologies in order to create the new markets. The Republic of Kazakhstan, realizing the RES small projects, loses these advantages. In 2016 solar power stations have increased development for 92% - to 88,4 million kWh, bio power plants have increased energy production by 4 times, having generated 1,9 million kWh. For the last 10 years the cost of solar energy fell from 1,0 to 0,025 US dollars. It has been reached at the expense of economy of scale, reduction in cost of technologies and transition to market the mechanism.

By 2020 it is planned to put into operation only 4 objects of SES with a general power of 77 MW. The service projects connected with production of the equipment for solar power, the national plan of action for sustainable development of power aren't provided. Experts consider that green power sources become more and more competitive, and soon in power branch there will come the turning point. The existing electro generating capacities – state district power plant, combined heat and power plant – have physically and morally become outdated [14].

One of the central moments in consecutive transition to green economy is the energy efficiency. Now on an indicator of power consumption of GDP Kazakhstan is in number of the countries with the highest values [15].

Experts in power at Stanford University notes, that use of wind power, solar, geothermal and water (hydropower, tidal and wave) energy for electrization of all sectors of economy - considerably will reduce energy consumption, mortality from air pollution, will create millions of jobs (Shakeel et al. 2017) [16], stabilizes energy costs and will keep trillions of dollars on health care. For sustainable development of RK it is necessary to provide access to inexpensive, reliable, steady and modern power sources and to reduce the volume of emissions of greenhouse gases in the energy sector. Increase in efficiency and reduction of emissions will be important for achievement of the ecological purposes.

Experts emphasize importance of creation of new power system, which will be based on renewables, though the economy of Kazakhstan has sufficient stock of traditional types of fuel. There are two main reasons.

First, there is an urgent need of reduction of emissions of greenhouse gases and other pollutants, which main producer is fuel and energy complex of Kazakhstan, which is generally burned fossil fuel, namely coal, oil and gas. Secondly, the deficiency of energy grows and that can be the limiting factor for further economic growth.

Creation of the new energy market assumes development and acceptance of full range of normative documents, including national norms in the field of interaction and trade, and also use of the advanced foreign practice. It will allow adjusting and supporting open dialogue on energy security, introduction of technologies and realization of effective policy between the manufacturing countries, transitors and consumers of energy resources.

As relevant problems of further development of RES in the Republic of Kazakhstan is possible to allocate:

1. To choose and realize the RES effective projects and to attract the best investors with advanced technologies;
2. To lower load from RES of national economy.

Kazakhstan should increase investments into the projects of creation of power infrastructure for increase in energy efficiency and integration of renewables. For creating favorable conditions for investments the Government of RK should develop the long-term concept of rendering steady power services supporting use of the norms, which are based on the principles of rationality and allowing producers and consumers to react to the changing energy market [17].

Future power system demands new technologies and new professional skills. Research and development, commercial introduction of new technologies, attraction of the capital and also management skills are important during transition period. It demands expansion of the international cooperation and exchange of experience.

The role of the international cooperation, strategic partnership and effective functioning of the energy markets and regional corridors is very essential. Exchange of experience and technologies, increase in cross-border investments will accelerate transition.

Introduction of the auction mechanism of support of the sector can become the effective tool of the solution of tasks at implementation of the RES projects. The difference of this mechanism from the mechanism on the basis of the fixed tariffs and green certificates is that: first support only to the suppliers of the electric power selected on competitive basis from RES is carried out. Secondly, the level of tariff is defined not administratively [18].

It is necessary to study the international experience of holding auctions on RES, particularly, to investigate types of contracts and types of auctions on RES, to define characteristics of demand (an

auction product), to study staging and frequency of holding auctions, qualification requirements to participants of an auction [19].

Use of auctions will allow exercising control of rates of development of RES, to plan the budget for its support and also to define tariff for purchase of the electric power from RES on competitive basis [20].

In the conclusion it should be noted, that the conducted research of tendencies of the development of renewables in the Republic of Kazakhstan allows to formulate the following. The high power consumption of GDP of RK, exhaustion of renewable power sources dictates need of development and use of renewables. The Republic of Kazakhstan has the essential potential of development of alternative power engineering. However, their share in the general energy production is still insignificant, and the available capacities of objects of RES are used not rather full.

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### ЖАҢАРТЫЛАТЫН ЭНЕРГИЯНЫҢ КӨЗДЕРІН ПАЙДАЛАНУ ҚАЗАҚСТАН РЕСПУБЛИКАСЫНЫҢ ҰЛТТЫҚ ЭКОНОМИКАСЫН ДАМУДЫҢ ФАКТОРЫ РЕТІНДЕ

**Аннотация.** Жұмыста Қазақстан Республикасындағы жаңартылатын энергия көздері мен энергиялық тиімділіктің жағдайы туралы ақпараттар мен заманауи деректер талдауы келтірілген. Бұл зерттеу жұмысы өз алдына ҚР ұлттық экономикасында тұрақты өсуге мүмкіндік беретін және энергетикалық кешенді дамытудың қазіргі кезеңінде экономикалық тұрғыдан мүмкін болатын баламалы энергия көздерін дамытудың бағыттарын анықтау мақсатын қояды. Қосымша ақпараттар ретінде сараптамалық, аналитикалық басылымдар мен материалдар және басқа да ашық ақпарат көздері пайдаланылды. Жүргізілген зерттеу жұмыстары келесі қорытындыларды жасауға мүмкіндік береді: Қазақстан Республикасы баламалы энергетиканы дамыту үшін айтарлықтай әлеуетке ие. Дегенмен, олардың жалпы энергия өндірісіндегі үлесі өте төмен болып қалып отыр, ал жаңартылатын энергия көздерінің қол жетімді қуаты толық пайдаланылмайды. Қазіргі кезде ЖЭК-не негізделген жаңа энергетикалық жүйені құру қажеттігі туындап отыр. Қазақстан Республикасының Үкіметі тұрақты энергетикалық қызметтерді ұсыну үшін ұзақ мерзімді тұжырымдаманы әзірлеуі қажет. Бұдан басқа, қолайлы ортаны нығайту бойынша шаралар кешенін іске асыру қажет, оның ішінде, жаңартылатын энергия көздеріне белсенді инвестициялар. ЖЭК секторын қолдаудың перспективалық тетіктерінің бірі - ЖЭК-ны қолдау үшін бюджетті жоспарлау және бақылау мәселелерін шешуге көмектесетін ЖЭК жобаларын таңдау үшін аукциондық жүйені енгізу.

**Түпін сөздер:** энергиялық тиімділік, энергияны үнемдеу, ЖІӨ, энергиялық сыйымдылығы, жаңартылатын энергия көздері (ЭКЖ), баламалы энергия, күн энергиясы, жел энергиясы, биоотын, энергетический потенциал.

УДК 338.242.2

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### ИСПОЛЬЗОВАНИЕ ВОЗОБНОВЛЯЕМЫХ ИСТОЧНИКОВ ЭНЕРГИИ КАК ФАКТОРА РАЗВИТИЯ НАЦИОНАЛЬНОЙ ЭКОНОМИКИ РЕСПУБЛИКИ КАЗАХСТАН

**Аннотация.** В статье представлен анализ современных данных и информация о состоянии возобновляемых источников энергии и энергоэффективности в Республике Казахстан. Настоящее исследование ставит своей целью выявить направления развития альтернативных источников энергии, экономически оправданных на современном этапе развития энергетического комплекса и позволяющих обеспечить устойчивый рост национальной экономики РК. В качестве источников вторичной информации были использованы экспертные и аналитические публикации, экспертные материалы и иные открытые источники информации. Проведенное исследование позволяет сформулировать следующие выводы. Республика Казахстан обладает существенным потенциалом развития альтернативной энергетики. Однако, их доля в общем производстве энергии остается достаточно низкой, а имеющиеся мощности объектов ВИЭ используются не в полной мере. В настоящее время возникла необходимость в создании новой энергетической системы, базирующейся на ВИЭ. Правительству РК необходимо выработать долгосрочную концепцию оказания устойчивых энергетических услуг. Кроме того, необходимо реализовать комплекс мер по укреплению благоприятной среды, в т.ч. более активного инвестирования в объекты ВИЭ. Одним из перспективных механизмов поддержки сектора ВИЭ являются внедрение аукционной системы отбора проектов ВИЭ, которая будет способствовать решению проблем с планированием и контролем бюджета на поддержку ВИЭ.

**Ключевые слова:** энергоэффективность, энергосбережение, энергоёмкость, ВВП, возобновляемые источники энергии (ВИЭ), альтернативная энергетика, солнечная энергия, ветроэнергетика, биотопливо, энергетический потенциал.

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