EXPO-2017: engine of alternative types of energy of the future

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Abstract. The relevance of the topic is the development of alternative energy and search for new sources of energy as the main world trend of the twenty-first century. Using the energy of earth, wind, water and sun, humanity will stop polluting the environment and save valuable fossil resources. The Republic of Kazakhstan is well known with its stability and successful development. It is quite important not only for the country, but for the whole Central Asian region. Nowadays it is necessary to improve the energy returned on investment, and to make producing it cheaper. Wind power will be nearly very important in coming years. Probably the most established renewable energy source, besides hydro, becomes as cheap as fossil fuels in many markets around the world. The different types of the renewable energy were examined in this article.

1 Introduction

In the modern world the energy power is the basis of the development of the key branches of the national economy, defining progress of social production. Many years of the development of the energy power, based on the combustion of organic fuels, revealed the following basic shortcomings: unevenness of distribution of the fields of energy carriers, formation of huge freight traffics of power, inadmissible scales of influence on ecosystem of the Earth, exhaustion of stocks of power sources, transition to other ecologically cleaner and renewable power sources. According to the Concept of Development of Fuel and Energy Complex of the Republic of Kazakhstan on 2014–2030, the hydro capacity of the average and large rivers is 55 billion kWh, the small rivers – 7.6 billion kWh per year. Potential of solar energy is about 2.5 billion kWh per year. Wind potential reaches 1820 billion kWh per year [1].

Traditional energy sources: oil, gas, coal over time will run low. By some estimates, this will happen in the coming decades. Except that traditional sources are depleted, there is also an environmental problem, as the burning of hydrocarbon fuel leads to harmful emissions into the atmosphere, deteriorating the human habitat, creating ecological problems.

2 Methods

For research of a subject of alternative types of energy of the future and renewables general scientific methods, methods of the analysis, synthesis and abstraction and also comparison of the obtained information were used. The methodological basis is the use of solar energy and its conversion to electricity and heat, as well as the basis of wind power is the conversion of wind energy to electricity, through wind plants and wind farms. At the same time, hydropower is converting water energy into electricity. In turn, geothermal energy uses the heat of the Earth 's subsoil. Bioenergy allows different types of biofuels to produce energy and heat. The essence of thunderstorm power is to capture and redirect it to the lightning grid. Hydrogen power uses hydrogen as the most common element on Earth, to accumulate and transport energy.

3 Results

On July 4, 2009 in the Republic of Kazakhstan was adopted the Law “About support of use of renewables” [2]. In accordance with this law, the financial settlement of imbalances of electric energy for use the renewable sources are carried out by the financial center. Global demand for renewables constantly grows. By 2050 increase in their share in global power balance is predicted already up to 35%. Practically in all developed countries the programs of development of the renewables are formed and implemented today. The appeal of this energy is connected with inexhaustibility of the resources, independence of price situation in the world markets of energy carriers and also ecological purity. In the modern world the damage caused by exhaust gases from vehicles is most felt. Therefore, we want to show, how in the metropolis vehicles partially switch to use of the alternative sources of the energy. Figure 1 shows the type of alternative and transitional energy sources on urban transport.

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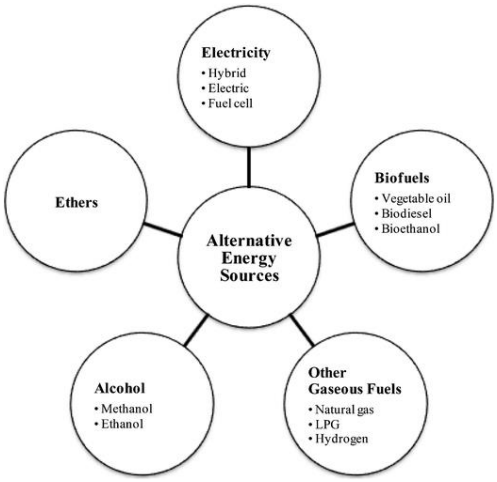

Fig. 1. Type of alternative and transitional energy sources on urban transport.

It is well known that the Resolution of the Government of the Republic of Kazakhstan No. 827 adopted on December 12, 2017 approved the State Program "Digital Kazakhstan". It was developed by the Ministry of Information and Communications of the Republic of Kazakhstan, according to the Message of the President of the Republic of Kazakhstan "The Third Modernization of Kazakhstan: Global Competitiveness" of January 31, 2017. This program is directed to accelerating rates of development of economy of the republic and to improve quality of life of the population, due to use of digital technologies in the medium term and also to provide creation of digital economy of the future of the country. Terms of implementation of the program are planned for 2018–2022 [3].

Assessing the practical significance of this program, Kushzhanov N.V. and Aliev U.Zh. wrote: "The purpose of the program is acceleration of rates of development of the economy of the republic and improvement of quality of life of the population due to use of digital technologies in the medium term and also creation of conditions for transition of economy of Kazakhstan to essentially new trajectory of development providing creation of digital economy of the future in the long term" [4]. In the program it is mentioned also development of "the smart cities", their number in 2022 is planned to increase to five: Astana, Almaty, Shymkent, Karaganda, Aktobe.

Kazakhstan developed the mechanism of support of use of RES, following the schemes of the "fixed" tariffs, which are carried out in the EU, and other countries of the world. The Kazakhstan mechanism of support is based on purchase of electric energy at the support price for the 15-year period. The Kazakhstan Law on support of RES provides the high level of stability for investors, providing long-term price guarantees, limiting at the same time the right of the government to make changes to the promised support level: correction of tariffs can be made only once in three years and only for new projects.

Below we will give Table 1 Conventional energy sources consumed for different purposes, which shows, how the Central Asian region uses traditional energy sources consumed for various purposes: wind energy, solar energy, thermal energy, biofuels, and battery energy.

As G. Alibekova and M. Bapiyeva stressed: "The trajectory on two vectors of development is supposed: "digitalization of the existing economy" and "creation of the digital industry of the future", with consecutive development of the human capital, creation of institutes of innovative development and a digital ecosystem" [5]. By and large, digitalization of the industry, power industry, transport, logistics, agriculture, trade, financial technologies, non-cash payments, and internal activity of public authorities is supposed. And, at last, creation of the "smart" cities.

Today RES acts as the necessary direction of the development of power of the future. Kazakhstan in this plan possesses all necessary resources for use of this energy. Considering power shortage in the country, especially in the southern regions, the question of expansion of application of RES is relatively new.

4 Discussion

Elena G. Popkova, Yulia V. Ragulina and Aleksei V. Bogoviz insisted, that "practice of development of the advanced countries with developed economy shows that the financial sector is the most important element of stable economy, and the speed and quality of the happening changes depend on its state. In modern economy of Kazakhstan electronic payments and electronic trading became an integral part of the financial sector" [6]. The financial industry traditionally everywhere is in the lead in introduction and use of innovative technologies and digital services for interaction with clients.

The renewable power can promote elimination of historical interrelation between the carbon intensive economic development and corresponding growth of

Table 1. Conventional energy sources consumed for different purposes.

	Electricity	**Heating**	**Motor fuel**
Kazakhstan	Coal, natural gas, oil	Coal, natural gas, oil	Natural gas, oil
Uzbekistan	Natural gas, coal, diesel fuel, fuel oil	Natural gas, coal, black mineral oil	Oil and gas condensate
Kyrgyzstan	Water	Coal	Imported fuels (oil and gas)
Turkmenistan	Natural gas	Natural gas	Oil products
Tajikistan	Water	Insufficient coal and gas	Imported liquefied gas

volumes of the emissions of greenhouse gases, promoting the achievement of sustainable development. Now practically all banks provide services by means of remote channels. 70% of banks render services to natural persons by means of the Internet and mobile banking, 55% of banks provide the services on the basis of mobile applications. The volume of payments of natural persons with use the Internet and mobile banking in 2016 in comparison with 2015 increased by 2.6 times. For investors the order of rendering electronic services by brokers, including carrying out trade operations on the basis of the digital signature of the client and rendering electronic services through a private office was simplified [7]. The renewable power also serves further diversification of primary power sources and ensuring access to power services in remote regions. Now in the second table we want to indicate, how the additional renewables look like.

The current expenses and problems of integration into network of rather large volumes of the electric power made with use of renewable sources, as a matter of experience in other countries of the world. RES has appeared in the Republic of Kazakhstan recently and meets similar difficulties. Abramov N.F., Bezrukov A.V., Vol'pyan O.D. and Obod, Y.A. paid attention, that "these short stories significantly simplified access to the market of regional investors and allowed investors to carry out trade in financial instruments in the Kazakhstan stock market from any point of the world" [8].

Two years ago, in 2017, in the capital of the Republic of Kazakhstan, Astana – was held International Exhibition named "Energy of the Future": EXPO-2017, in order to demonstrate alternative sources of energy in the world. EXPO-2017 in Astana has presented thousands of exhibitions. The international exhibitions created the conditions for the system shifts. This largest achievement of the Republic of Kazakhstan in the international level was the driver of the development of national economy.

But the most important factor of success of our exhibition is its subject – "Energy of the Future": EXPO-2017, which became the most ecological exhibition in the history.

Sharma S.S. explained the relationships between the energy and economic growth. She wrote: "The power transferring organizations are obliged to provide free access to transfer on networks to the power making organizations" [9]. Below we will provide in the third table the benefits of using major renewable energy sources.

According to the legislation of the Republic of Kazakhstan using renewables, the power making organizations, using renewables by delivery of electric energy, are exempted from fee of the power transferring organizations on transfer of electric energy.

EXPO-2017 Exhibition in Astana became an integration platform of the initiatives of Kazakhstan and the UN of the 21-st century. The subject of the Energy of the Future exhibition was directed to the solution of the major problems of mankind on stabilization of climate and access to the energy. EXPO-2017 became the bases of synergy of the global initiatives of Kazakhstan, such as "World anti-crisis plan, "G-Global", Program of partnership "Green Bridge".

There was a special pavilion "Zone of Best Practices". In this pavilion the best practices in the different areas of steady power sources have represented new technologies. EXPO-2017 became a new paradigm of the development of science and technology. The exhibition became an incentive of the development of alternative and renewables. Innovative "green" technologies gradually became mass and reduce the prime cost. The exhibition almost helped to Kazakhstan to develop new power on the basis of biogas, pure coal and petro chemistry, coal liquefaction. Development of the legislation on alternative renewables will contribute to the development of "green" power as one of the main results of the EXPO-2017 Astana exhibition.

Table 2. Additional energy sources from renewables to diverse energy generation.

	Electricity	**Heating**	**Motor fuel**
Kazakhstan	Wind energy, solar PV	Solar power, thermal heat	Natural gas + biomass
Uzbekistan	Small HPP, solar energy	Natural gas + solar power	Altered natural gas, biofuel, battery accumulated energy
Kyrgyzstan	Water, solar PV	Biomass, solar, geo- thermal	Biomass + fuels
Turkmenistan	Solar PV	Solar thermal + natural gas	Natural gas
Tajikistan	Middle and small HPP, solar PV	Solar thermal and PV	Wind and solar accumulated batteries

Table 3. Advantages of main renewable energy sources utilization.

Advantage	Short characteristics
Inexhaustibility	It is impossible to finish sun, wind or water while using energy from these sources
No additional CO2 emission	Energy produced from sun, wind or water doesn't emit any negative gases causing air pollution
Availability	Solar, hydro or wind power can be found on any territory in accordance with environmental conditions
Low water demands	Solar or wind installations don't need additional water resources to generate energy (comparing with oil or gas extraction when big amounts of water are necessary)
Small risk of catastrophes	RES installations exclude possible big man-caused disasters since generated power is directly transformed into necessary energy (electric or thermal); there is no need to extract, refine and transport these resources

EXPO-2017 has showed to the world the volume of scientific ecological development, opened the new page in the development of humanity, "green" economy and available energy. EXPO-2017 became the great platform for demonstration of the achievements of the different countries all over the world in this area, the powerful impulse for its further development.

Murzakulov G.T., Alipbeki O.A., Nurguzhin M.R., Dyusenev C.T. and Dyusenbekov Z.D. accented the attention of the readers on the peculiarities of EXPO-2017. They wrote: "EXPO-2017 is the formation of intellectual heritage and consists from the number of the programs and recommendations, submitted on the solution of the global problems in the sphere of power" [10].

Altinay G., Karagol E. insisted, that "the European Union has the purpose in 2020 to receive the energy for 20% from renewable sources. Energy is planned to be received through the following: roof energy, facades of houses, cellar, garbage, etc. It is well-known that energy needs to be preserved. Internet revolution has created the general infrastructure, so called "smart power network". "Smart building" supposes automatic adjustment of ventilation, conditioning, lighting, etc." [11].

Moreover, four Nobel Prize laureates, eight winners of the International Award "Global Energy", foreign scientists, engineers and representatives of public sector took an active part in "Energy of the future: innovative scenarios and methods of their realization".

Apergis N., Payne J.E. are sure that "now the society needs the implementation of the new principles of energy consumption and energy efficiency in order to increase the living standard and welfare of the citizens of the Republic of Kazakhstan" [12].

The famous specialists in this field Bildirici M.E. and Kayikci F. wrote: "Destruction of the system stereotypes in the field of traditional energy has received by the means of combustion of hydrocarbon fuel. Implementation of the technology of thermal energy is quite necessary" [13].

The research scholars Finon D. and Locatelli C. noted, that "In Sayram District, in Southern Kazakhstan area, were created mini-solar and hydroelectric power stations. In the territory of the EXPO-2017 the corner of Silicon Valley was opened in order to demonstrate the decisions of Zerde partners in the field of digitalization of the economy" [14].

Aashish Mehta, H. Satish Rao and Anil Terway wrote: "We examine the paths to structural reform of the electricity sectors in six former communist Central Asian countries, present data on progress towards solving identified problems, and develop economic hypotheses linking the structural changes with progress identified. This analysis is used to derive suggestions for the further structural reforms of the sectors. The experiences documented make a strong case for improving the transparency of operations of Central Asia's power utilities, beginning with the transactions between subsidiaries; and improving incentives for distribution companies to perform their billing and cash collection responsibilities, both through improved accountability, and, in the countries studied, some privatization of these commercial services" [15].

The reform in the Republic of Kazakhstan in the field of power engineering systems and complexes will allow to create "Smart Energy Systems". It is not succeeded in rationalizing tariffs or balancing supply and demand. Electricity market reform in our country has not increased access levels, and the rise of captive power generation is likely to have an adverse impact upon the natural environment. Actually, in Central Asian region, the states play dominant and very visible role in the energy sector, leading structural reforms and improvements. Unfortunately, electricity utilities in this region remain very weak today.

5 Conclusion

In the conclusion we would like to point out that it takes a long time to find the ways to move to new sources of energy. The Republic of Kazakhstan has a real opportunity to provide the growing needs of the economy with the sources of higher ecological quality: hydraulic power, solar energy, wind and biomass. Therefore, despite the availability of raw materials and energy (oil, gas, coal, uranium), Kazakhstan emphasizes the prospects of renewable energy sources, related to their inexhaustibility and the forthcoming fuel deficit in traditional energy. It is clear that the main subject of the International Exhibition "EXPO-2017" is the renewable

energy sources of the future. Humanity is constantly opening up new sources of energy and inventing new ways of its generating. People have learned to extract energy with ocean waves and currents, warm underground sources, sunlight, gusts of wind. Energy is produced from rice husk, chicken litter, and banana peel. There can be no doubt that in the future our descendants will completely switch to alternative sources of energy. The future of energy is the clean energy of renewable natural resources.

References

[1] Concept of Development of Fuel and Energy Complex on 2014-2030. Adopted by the Resolution of the Government of the Republic of Kazakhstan. **827,** (2017)

[2] Law of the Republic of Kazakhstan "About Support of Use of Renewables", **165-IV,** (2009)

[3] IGI Global. "Definition of Digitalization". (2017)

[4] N.V. Kushzhanov, U.Zh. Aliev, Digital transformation of economy in EEU Reports of National Academy of Sciences **1,** 42-47 (2018)

[5] G. Alibekova, M. Bapiyeva, Digitalization processes and their impact on the development of the Republic of Kazakhstan Bulletin of National Academy of Science **4,** 217-225 (2019)

[6] E.G. Popkova, Y.V. Ragulina, A.V. Bogoviz, Industry 4.0: Industrial revolution of the 21st century. Studies in systems, decision and control **169**, 253 (2018)

[7] Digital Single Market Strategy for Europe: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Brussels, the European Commission COM **192**, 20 (2015)

[8] N.F. Abramov, A.V. Bezrukov, O.D. Vol'pyan, Y.A. Obod, The Influence of the power supply of a magnetron sputtering system on the properties of the deposited TiO2 Films Inorganic Materials **54,** 1491-1497 (2018)

[9] S.S. Sharma, The relationship between energy and economic growth: Empirical evidence from 66 countries Applied Energy **3,** 665-674 (2010)

[10] G.T. Murzakulov, O.A. Alipbeki, M.R. Nurguzhin, C.T. Dyusenev, Z.D. Dyusenbekov, *The Concept of Creation and Development of National Spatial* Data Infrastructure of the Republic of Kazakhstan till Astana Ltd. Dame 39 (2013)

[11] G. Altinay, E. Karagol, Electricity consumption and economic growth: Evidence from Turkey Energy Economics **27,** 849-856 (2005)

[12] N. Apergis, J.E. Payne, Energy consumption and economic growth: Evidence from CIS 2009 Energy Economics **31,** 641-647

[13] M.E. Bildirici, F. Kayikci, Economic growth and electricity consumption in former Soviet Republics Energy Economics **34,** 747-753 (2012)

[14] D. Finon, C. Locatelli, Russian and European gas interdependence: Could contractual trade channel geopolitics. Energy Economics **36,** 423-442 (2008)

[15] A. Mehta, H.S. Rao, A. Terway, Power sector reform in Central Asia: observations on the diverse experiences of some formerly Soviet Republics and Mongolia Journal of Cleaner Production **35,** 218-234 (2007)