«ЖАҺАНДЫҚ ӨЗГЕРІСТЕР ЖАҒДАЙЫНДАҒЫ ТҰРАҚТЫ ЭКОНОМИКАЛЫҚ ДАМУ ПАРАДИГМАСЫ: СЫН-ҚАТЕРЛЕР, САЛДАР, МҮМКІНДІКТЕР»

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«ПАРАДИГМА УСТОЙЧИВОГО ЭКОНОМИЧЕСКОГО РАЗВИТИЯ В УСЛОВИЯХ ГЛОБАЛЬНЫХ ПЕРЕМЕН: ВЫЗОВЫ, ПОСЛЕДСТВИЯ, ВОЗМОЖНОСТИ»

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“THE PARADIGM OF SUSTAINABLE ECONOMIC DEVELOPMENT IN THE CONTEXT OF GLOBAL CHANGE: CHALLENGES, CONSEQUENCES, OPPORTUNITIES”

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МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ
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В сборнике рассматриваются актуальные вопросы современной экономики: бизнес-технологии в контексте устойчивого развития, цифровая трансформация финансово-учетной системы, новые тренды управления в турбулентных условиях, стратегические приоритеты развития экономики.

Рассчитан на широкий круг читателей, руководителей, преподавателей и обучающихся.

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Development of renewable energy in Kazakhstan based on global trends

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Abstract

Kazakhstan has unique opportunities and prerequisites for a "green" economy. A large territory, an advantageous geopolitical position, available natural resources, world experience and the growth of offers in the field of green technologies and other factors should contribute to the successful implementation of these opportunities. The purpose of the study is to analyze the current state and trends in the use of renewable energy sources in the world to develop proposals for improving the efficiency of clean "green energy" in Kazakhstan.The methods used in this article include the method of comparative system analysis, causal analysis. The methodological basis consists of general scientific and special methods of cognition of social phenomena and processes, as well as comparative analysis, comparative functional, system-structural, the method of expert assessments and other methods. Based on the study of the experience of the leading countries in this field (USA, Germany, China), proposals are made to improve the efficiency of renewable energy use in Kazakhstan.

Keywords: CO_2 emissions, renewable energy, incentive measures.

JEL codes: Q42

1 Introduction

The energy crisis in many European countries is associated with the beginning of Russia's "special operation" in Ukraine, since it is no secret that Russia is the main supplier of oil and gas to the countries of the European Union. In addition, the Covid-19 pandemic has had a great impact on the global economy.

In 2021, the share of alternative energy in the global energy sector was 38% (including nuclear energy). At the same time, the high share of coal in electricity production leads to significant CO_2 emissions, which reached a historical maximum in 2021 (36.6 Мт). This process leads to global warming and climate change, which are expressed in sea level rise and natural disasters.

Kazakhstan is one of the largest sources of greenhouse gas emissions in the world - the country. Therefore, Kazakhstan is actively engaged in attracting investments in the construction of renewable energy facilities.

In this regard, the study of issues related to global trends in the use of alternative energy sources, analysis of factors that affect their development to develop proposals to improve the use of renewable energy in Kazakhstan.

2 Literature review

The study was based on the legal acts of the Republic of Kazakhstan, the sources of the country's official governing bodies (Ministry of Energy, etc.), reflecting the state policy aimed at fulfilling the country's obligations to reduce CO_2 emissions, the introduction of renewable energy.

The study pays much attention to global trends in the field of renewable energy based on open foreign sources (International Energy Agency, Renewables 2022, Global Status Report, etc.).

The opinions of various authors on the advantages and disadvantages of alternative energy sources for their use in further research are of interest (Kerry Thoubboron, 2022), (Hossein Karami Lakeh,2021).

Widespread use of renewable energy is impossible without government support measures. The study examined the experience of Germany (Gilles Lepesant, 2023), the USA (Inflation Reduction Act of 2022) and China (Hu Min, 2022 and others) for use in Kazakhstan, taking into account territorial, climatic and other features.

3 Methodology

The methods used in this article include the method of comparative system analysis, causal analysis.

The methodological basis consists of general scientific and special methods of cognition of social phenomena and processes, as well as comparative analysis, comparative functional, system-structural and other methods.

To ensure a comprehensive study, the article used such methods of analysis as generalization, comparison and differentiation, the method of expert assessments.

4 Results and Discussion

Kazakhstan has unique opportunities and prerequisites for a "green" economy. A large territory, an advantageous geopolitical position, available financial and natural resources, world experience and the growth of offers in the field of green technologies and other factors will contribute to the successful implementation of these opportunities.

Renewable energy sources (RES) include solar radiation, wind energy, hydrodynamic water energy, as well as biomass, biogas and other fuels from organic waste that are used to produce electrical and thermal energy.

At the initiative of the First President of the Republic of Kazakhstan N.A. Nazarbayev, a Concept for the transition to a "green economy" was developed, which presents a list of priority tasks aimed at reforming certain sectors of the economy [1].

The main tasks of the country's transition to a "green economy" are: improving the efficiency of the use of resources (water, land, biological, etc.) and their management: modernization of existing and construction of new infrastructure, improving the well-being of the population and the quality of the environment, improving national security, including energy, water.

The concept of Kazakhstan's transition to a "green economy" will be implemented in three stages:

Stage 1 (2013 - 2020) – the main priority of the state will be to optimize the use of resources and increase the efficiency of environmental protection activities, as well as the creation of a "green" infrastructure.

Stage 2 (2020 – 2030) – on the basis of the formed "green" infrastructure, it is planned to begin the transformation of the national economy focused on the careful use of water, the promotion and widespread introduction of renewable energy technologies, as well as the construction of structures based on energy efficiency standards.

Stage 3 (2030 – 2050) – the transition of the national economy to the principles of the so-called "third industrial revolution" will be implemented, requiring the use of natural resources provided that they are renewable and sustainable.

Seven key directions of development of the "green economy" in Kazakhstan have been identified:

1. Introduction of renewable energy sources.
2. Energy efficiency in housing and communal services.
3. Organic farming in agriculture.
4. Improvement of the waste management system.
5. Improvement of the water resources management system.
6. Development of "clean" transport.
7. Conservation and effective management of ecosystems.

Kazakhstan has achieved the planned goals: in 2020, the share of renewable energy was 3%, in 2022 – 4.53%. In the future, renewable energy production should be: 6% in 2025, 10% in 2030, and by 2050, renewable energy should account for at least 50% of the total energy consumption of the country. President of the Republic of Kazakhstan K.Tokayev sets a goal of

achieving 15% of the share of renewable energy in 2030 instead of the planned 10%.

In 2016, Kazakhstan signed the Paris Agreement on Climate Change and committed to achieving carbon neutrality by 2060 [2]. To do this, it is necessary to reduce the share of coal in the total energy balance of the country, which is about 70%.

The global trend of reducing CO_2 emissions is also determined by a decrease in the share of coal. At the same time coal consumption grew over 6% in 2021 to 160 EJ, slightly above 2019 levels and its highest level since 2014. Emissions from energy rebounded strongly in 2021 back to around 2019 levels. The sharp rebound in emissions in 2021 was explained by economic growth. As economic activity recovered from lockdowns and other COVID-19 related measures, energy consumption increased sharply. China and India accounted for over 70% of the growth in coal demand in 2021, increasing by 3.7 and 2.7 EJ, respectively. In 2021, the largest volume of CO_2 emissions from the world level was in China -33.1%, as well as the United States (US) -12.6%, India -6.7%.Thus, the three countries account for more than half of CO_2 emissions [3,4].

The share of renewable energy is increasing due to climatic changes in the Earth (greenhouse effect). Rising temperatures on Earth are leading to record storms, droughts, floods and fires.

The energy crisis in many European countries is associated with the beginning of Russia's "special operation" in Ukraine, since it is no secret that Russia is the main supplier of oil and gas to the countries of the European Union.

In many countries (Belgium, Bulgaria, Czech Republic, Finland, Hungary, Netherlands, Romania, Spain, Mexico, Brazil, etc.), the level of nuclear energy consumption has not changed in 10 years (from 2011 to 2021).

In the leading European and Asian countries (France, Germany, Switzerland, United Kingdom, Japan, South Korea), it decreased over the same period. This is due to the fact that after the accident at the “Fukushima – 1” Nuclear Power Plant (Japan) on March 11, 2011, a number of countries decided to gradually reduce the share of nuclear energy in the country's energy balance [3].

All of the above factors, in our opinion, influenced the trend of increasing RES in the overall energy balance on a global scale (Table 1).

According to Table 1, over 10 years, the increase in wind and solar energy was 8%, in bioenergy and geothermal sources – 1%.

During 2021, China became the first country to exceed 1 terawatt (TW) of installed renewable energy capacity. Its total installed capacity increased 136 GW during the year, accounting for around 43% of the total global additions.

China showed a notable surge in solar power, representing around 31% of global solar PV additions, although the country also dominated in capacity additions of other technologies.

Table 1. Share of Renewable Energy in Electricity Generation, 2011 and 2021, %

Electricity Generation	2011	2021	Deviation (+,-)
Fossil fuels	68	62	- 6
Nuclear power	12	10	-2
Hydropower	16	15	-1
Solar and wind power	2	10	+8
Bioenergy and geothermal power	2	3	+1
TOTAL	100	100	
Compiled by the author based on the source [5]			

China accounted for nearly 80% of global hydropower additions and an estimated 14.5 GW of offshore wind power additions, more than half of its total previously installed offshore wind capacity. Overall, China led global markets for bio-power, hydropower, solar PV and wind power [5].

A rapid increase in solar energy generation is becoming possible, first of all, due to the development in China of production technologies key to solar energy generation – polysilicon, silicon wafers, solar elements and modules. Thanks to this development, during the 13th five-year plan, the price of polysilicon plates fell by almost 25%, the prices of silicon plates, elements and modules fell by 50%, which is a strong support for a breakthrough during the 14th five-year plan. According to expert estimates, during the 14th five-year plan, the average annual internal installed capacity of solar power plants can grow to 90 GW [6,7].

The key volume of wind power generation is associated with the marine electric power industry and is provided in the coastal provinces of Guangdong, Jiangsu, Zhejiang. The plans of these provinces for the 14th five-year plan emphasize the sustainable and large-scale development of offshore wind energy [6, 8].

The insufficient pace of development of the "green economy" is due to the fact that, along with the advantages of renewable energy, they have a number of disadvantages (Table 2).

Let's consider at some of the most important *advantages* of renewable energy.

Renewable energy has lower maintenance cost. In most cases, renewable energy systems require less overall maintenance than generators that use traditional fuel sources. Fewer maintenance requirements translate to more time and money saved.

Table 2. Advantages and disadvantages of renewable energy [9,10]

Advantages of renewable energy	**Disadvantages of renewable energy**
Renewable energy won't run out. Renewable energy is reliable	Renewable energy has high upfront costs
Renewable energy has lower maintenance cost	The efficiency of renewable technologies is low.
Renewable energy can increase public health	Renewable energy is intermittent. Renewable energy is not available round the clock
Renewables save money	Renewables have storage capabilities
Renewable energy has numerous environmental benefits	Renewable energy sources have geographic limitations
Renewables lower reliance on foreign energy sources and can increase countries' economic independence	Renewables aren't 100% carbon-free
Renewable energy can reduce turmoil in energy prices	Renewable energy sites require a lot of space
Renewable energy leads to cleaner water and air	Renewable energy devices need recycling
Renewable energy creates jobs	
Renewable energy can cut down on waste	

Renewable energy can increase public health. By reducing greenhouse emissions and other polluting substances, we'll have healthier air and soil. Moreover, having a healthier population will cause a significant reduction in the health budget people and governments should set aside each year.

Renewables save money. Using renewable energy can help you save money long term. Not only will you save on maintenance costs, but on operating costs as well.

Renewable energy has numerous environmental benefits. Renewable energy generation sources lead to low to zero greenhouse gas emissions compared to traditional fuel sources like natural gas. This means a smaller carbon footprint and an overall positive impact on the natural environment.

Renewables lower reliance on foreign energy sources and can increase countries' economic independence. With renewable energy technologies, a country can produce energy locally. The higher the amount of our energy use is renewable, the less dependence on energy imports.

Renewable energy leads to cleaner water and air. When you burn fossil fuels to generate electricity, it contaminate the air and water we use. For example, coal power stations release high volumes of carbon dioxide and nitrous oxide, as well as harmful toxins like mercury, lead, and sulfur dioxide. Health problems from ingesting these elements can be dangerous, and even fatal in some cases.

Renewable energy creates jobs. For example, currently in the U.S. the renewable energy sector employs three times as many people as fossil fuels do. That number is expected to rise over the next few years - and as a plus, these jobs tend to pay above average wages, making it a very attractive career option and an overall economic boom.

According to the International Labor Organization, in 2021 the number of workers in the renewable energy industry amounted to 12.7 million, of which about 2/3 are in Asia (China accounts for 42%).

China is followed by the EU and Brazil (10% each), then followed by the USA and India (7% each). In addition to workers directly employed in the renewable energy industry, the demand for data processing specialists is increasing.

Renewable energy can cut down on waste. Specifically, biomass energy can offer a big benefit in this way. Biomass generators consume used organic products like vegetable oil, corn and soybean byproducts, and even algae to generate energy. Therefore, using biomass as an energy source can reduce the amount of waste.

Among the main *disadvantages* are:

Renewable energy has high upfront costs. While you can save money by using renewable energy, the technologies are typically more expensive upfront than traditional energy generators.

The efficiency of renewable technologies is low. Each type of energy requires a specific technology so that we can convert it into electricity. For example, solar panel efficiency, that are available in the market, is between 15% and 20%. On the other hand, traditional technologies that use coal or natural gas can respectively reach efficiency levels of up to 40% and 60%.

Renewable energy is intermittent. Some days may be windier than others, the sun doesn't shine at night, and droughts may occur for periods of time. There can be unpredictable weather events that disrupt these technologies, and the amount of energy we can get from renewable power sources can be inconsistent.

Renewables have storage capabilities. Because of the intermittency of some renewable energy sources, there's a high need for energy storage. While there are storage technologies available today, they can be expensive, especially for large-scale renewable energy plants. But, with the development of technology, the capacity of energy storage is increasing, and batteries will become more affordable.

Despite the shortcomings, there are undoubtedly more positive aspects of the use of renewable energy sources.

Kazakhstan is one of the largest sources of greenhouse gas emissions in the world - the country is in the top 30 countries in terms of their emissions, 82% of which are related to energy production. Therefore, Kazakhstan is actively engaged in attracting investments in the construction of renewable energy facilities.

Kazakhstan has favorable natural development conditions for wind and solar energy. In addition, Kazakhstan differs from European and other states in its large territory (2.7 million km^2) and low density (6.6 people/km^2).

Therefore, no electricity tariffs can compensate for the costs associated with the power supply of remote villages. In this regard, it is most cost-effective to use alternative sources there, primarily wind and solar energy.

Within the framework of the project of the United Nations Development Program (UNDP) "Kazakhstan – Wind Energy Market Development Initiative", certain work is being carried out to study wind potential in various regions, regions of the country. In particular, a lightweight web version of the Wind Atlas of Kazakhstan has been developed, with which the user can determine the average annual wind speed at a selected point, the distance to the nearest power line, the distance to other objects, and also select the desired map layers. Thus, the wind atlas contains complete cartographic information, including wind maps of long-term wind speed on the territory of Kazakhstan, administrative maps of the Republic of Kazakhstan with the distribution of long-term wind speed, as well as maps of the energy infrastructure of the Republic of Kazakhstan (Figure 1).

The wind Atlas will contribute to the application of a systematic approach to the study of wind resources in the country to develop sound recommendations for the placement of wind farms in certain regions of the country.

According to experts, the Almaty region has the most unique sites in the world for the construction of wind farms (Dzungarian Gate, Erementau and Shelek corridor).

For example, in the Dzungarian Gate, the average annual wind speed at an altitude of 50 m is 9.7 m/s, the flow density is 1050 W/m^2, the number of hours of operation of the wind farm with full load is 4,400 hours/year; in the Shelek corridor, these indicators are respectively: 7.7 m/s, 310 W/m^2, 3,100 hours/year. Western Kazakhstan also has a high wind potential. Until recently, it could not be used, since this region remained locked.

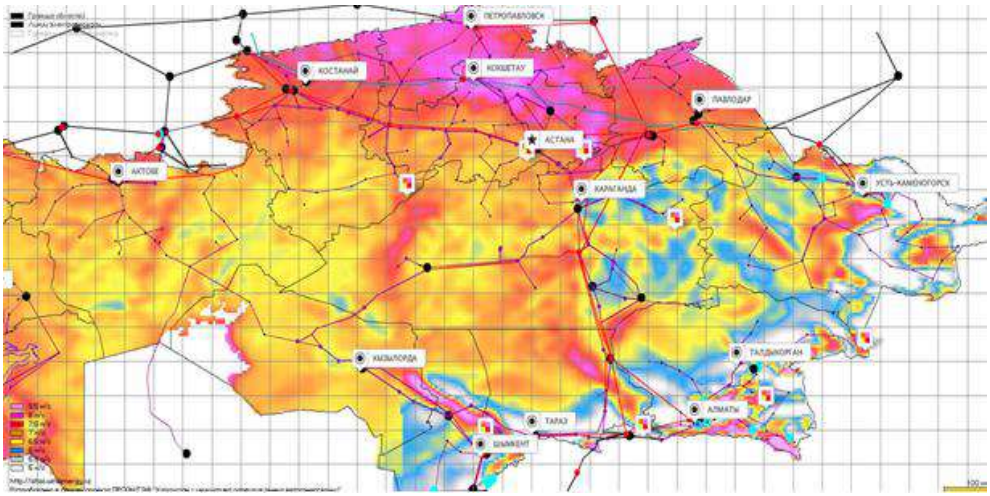

Figure 1. Wind Atlas of Kazakhstan [11].

In 2022, Kazakhstan has developed and approved the Energy Balance until 2035. The modernization of the National Electric Grid is underway, including the connection of the electric networks of Western Kazakhstan to the Unified Electric Power System, as well as the strengthening of the electric networks of the Western and Southern energy zones. Strengthening of the Western energy zone is planned in the current 2023 [12].

The adoption of relevant legislative and regulatory acts also contributes to the successful implementation of the tasks set. The law on Renewable Energy support in Kazakhstan was published in 2009, but the active development of renewable energy began in 2013-2017on the basis of improvements the country's legislation. For example, in 2013, Kazakhstan adopted a Concept for the transition to a "green economy", the main direction of which is to achieve the share of renewable energy in 2020 -3%, in 2030 – 10%, in 2050 - 50%. In 2016, the Republic of Kazakhstan signed the Paris

Agreement on Climate Change, which provides for the country's commitment to reduce greenhouse gas emissions by 15% by 2030 relative to 1990 emissions. In December 2020, at the summit on climate ambitions, Kazakhstan pledged to achieve carbon neutrality by 2060.

The state provides measures to support renewable energy through subsidies, special tariffs, free priority allocation of land plots, as well as providing tax benefits, benefits for transportation and dispatching of electricity. A great impetus to the development of green energy was given by the conducting in Kazakhstan (Astana) the World Exhibition EXPO-2017 under the slogan "Energy of the Future", which was attended by 115 countries, 22 international organizations. During the exhibition, 220 official events were organized with the participation of heads of state and government, 39 agreements were signed by the participating states with representatives of business, scientific and educational circles of Kazakhstan [13].

Since 2018, UNDP in Kazakhstan, together with the Ministry of Energy of the Republic of Kazakhstan, has been implementing a project aimed at reducing the risks of investing in renewable energy sources with the financial support of the Global Environment Facility. This is a joint initiative, the main task of which is to support the government in developing and amending the country's legislation on renewable energy, as well as the introduction of pilot mechanisms for small and medium-sized businesses interested in using renewable energy. Kazakhstan needs to attract private investment to expand the use of renewable energy.

Tariffs play an important role in the use of energy. In Kazakhstan, renewable energy tariffs are much higher compared to traditional energy sources. In this regard, according to the legislation of the Republic of Kazakhstan, electricity produced from renewable energy sources is purchased by a Financial Settlement Center of RE (FSC) created under a system operator. In the future, FSC redistributes the purchased electricity to all electricity consumers included in the Unified Electric Power System of the Republic of Kazakhstan, which will contribute to the equalization of electricity tariffs, as well as its uniform use in various regions of the country.

The law provided for a fixed tariff for electricity from renewable energy sources for a long-term period (15 years). According to these prices, FSC purchased electricity from suppliers, while the difference in tariffs for consumers is subsidized by the state.

These tariffs exceed the tariffs of traditional types of energy.

Since 2018, in order to improve the investment climate and attract external and internal investments, the mechanism of international electronic auctions has been introduced. At the same time, the Ministry of Energy of the

Republic of Kazakhstan approves the schedule of auctions, broken down by types, capacities and regions of Kazakhstan, which is published on its official website. In the same place, a potential investor can get acquainted with the Investor's Guide.

In 2021, the following maximum starting auction prices were set for auctions [14]:

- 21.53 tenge /kWh – for wind installations (WI);
- 16.96 tenge/kWh – for solar installations (SI);
- 32.15 tenge/kWh – for bioenergy installations (bioenergy);
- 15.2 tenge/kWh – for hydropower (HP).

In total, 5 auctions were planned: 2 for small projects, 3 for large projects. 24 Kazakhstani companies participated in the auctions. The greatest interest from investors was in WI, as the volume of demand exceeded the volume of supply by 10 times. According to the results of auctions in 2021, the maximum reduction in the auction price for wind farm projects is 34.6%, SI- 24.11%, small hydroelectric power plants -1.31%, bioelectric power plants – 0.03%. Thus, auctions help to reduce prices and establish market prices for renewable energy.

In order to prevent the risks of imbalances in the energy system and the impact of high tariffs from newly introduced new energy sources, norms were worked out for the transition to a new target model of the electricity market, which provides for centralized purchase of electric energy and the introduction of a balancing market [14]. In 2022, 12 renewable energy facilities with a total capacity of 385 MW with a total investment of 180 billion tenge were put into operation.

In 2022, 130 renewable energy facilities with an installed capacity of 2,400 MW are operating in Kazakhstan (Table 3).

Table 3. Renewable energy sources in the Republic of Kazakhstan

Renewable energy sources	Number of installations	2022	
		capacity, MW	the volume of energy production, million kWh
Wind installations	46	958	2 411
Solar installations	44	1 148	1 763
Hydropower	37	280	934
Bioenergy	3	1,77	
Total:	130	2400	5 108

Compiled by the authors based on the source [14]

Thus, by the end of 2022, the volume of renewable energy generation in Kazakhstan amounted to 5.11 billion. kWh or 4.53% of the total electricity. In 2023, it is planned to achieve the share of RES – 5%. In order to achieve the set goals for the development of renewable energy, it is certainly necessary to support the state on a larger scale than it is currently being implemented. Let's turn to the experience of countries with great achievements in the use of renewable energy. For example, in Germany, energy production is increasing from year to year, mainly solar and wind. In 2022, renewable energy accounts for 47% of the country's energy consumption, compared with 41% in 2021. With the goal of becoming carbon neutral by 2045, Berlin this year raised its renewable energy targets and passed several bills aimed at easing restrictions and accelerating the introduction of wind and solar energy, declaring the expansion an "outstanding public interest." The need for renewable energy sources has become even more acute due to the reduction of Russian imports of fossil fuels into Europe's largest economy after the conflict between Russia and Ukraine. Only around 0.8% of land in Germany is currently designated for onshore wind power. Berlin earlier this year drafted a bill setting out a minimum percentage of land in each of the 16 federal states that must be available for wind farms [15].

A solar cluster emerged in the south of the former GDR (German Democratic Republic) against the backdrop of generous support schemes, a supportive industrial legacy in the silicon sector as well as the support of R&D institutions (such as the Fraunhofer-Center für Silizium-Photovoltaik CSP in Halle). Overall, financial support to solar R&D has increased in past years to reach about 90 million EUR, notably under public-private support schemes [16].

Let's consider the measures taken recently by the state to support renewable energy in the United States. The United States has adopted the Inflation Reduction Act (IRA) of 2022, which is the largest investment in clean energy and tax breaks in American history, consolidating America's position as a world leader in the production of clean energy and setting a goal of achieving carbon neutrality by 2050. Some $10 billion is available for qualifying projects, which could include crypto data centers. Crypto data centers can lead on clean energy and efficiency to contribute to the energy transition [17].

China released its 14th five -year plan (FYP) for renewable energy on 1 June, outlining the country‘s renewable energy roadmap for the five years 2021-2025.

China’s climate pledge aimed for 1,200 gigawatts (GW) of wind and solar power capacity by 2030, and for 25% of energy consumption to be met by non-fossil fuels by 2030. Achieving these goals is expected to ensure China’s carbon dioxide (CO_2) emissions peak before 2030, but to fall short of a pathway towards carbon neutrality.

The 14th FYP for renewable energy sticks with the previously announced vision of 25% of China’s energy coming from non-fossil sources by 2030.

In 2021, China’s investment in clean energy took up more than 30% of the total global investment, according to the International Energy Agency, and this trend will continue. Having dominated the solar panel market, China’s companies are now leading the global markets for electric vehicles (EVs) and batteries. Chinese companies CATL and BYD are responsible for producing the batteries for 39% of the world’s EV fleet.

A report from the Global Wind Energy Council for 2022 indicates that China has recently surpassed the UK and Germany in the field of offshore wind energy, becoming the largest offshore wind energy market in the world, accounting for 40% of the total installed capacity in the world.

According to the new 14th Renewable Energy Financial Plan, China has committed to building offshore energy “bases” in five regions. The energy development plans of the six coastal provinces indicate an increase in the capacity of offshore wind power by a total of 32 GW during the 14th fiscal year 2021-2025, which will represent an increase of more than 60% compared to the level of 2020 [18].

Thus, investments in renewable energy in Kazakhstan are associated with investment and currency risks. Nothing is actually produced in the country, so turbines and solar panels are imported, the payback period of projects is high. In addition, the exchange rate is unstable, taking into account the current geopolitical situation.

In this regard, according to the authors, it is necessary to create clusters in Kazakhstan along the entire renewable energy production chain, starting from research and ending with the manufacture of necessary installations. Clusters can be located at the venue of the EXPO-2017 World Exhibition in Astana.

It is necessary to train personnel in the electrical industry. Only in this case, renewable energy projects will pay off faster, and renewable energy will be available to residents of remote villages. The territory and weather

conditions of Kazakhstan are the most attractive for wind turbines and solar panels. It is necessary to create the appropriate infrastructure.

5 Conclusion

Kazakhstan is one of the largest sources of greenhouse gas emissions in the world - the country is in the top 30 countries in terms of their emissions, 82% of which are related to energy production. Therefore, Kazakhstan is actively engaged in attracting investments in the construction of renewable energy facilities. The state provides measures to support renewable energy at the legislative level, but they are insufficient. The use of renewable energy is associated with high investment and currency risks. In this regard, the study examines the experience of foreign countries in state support of renewable energy development programs (Germany, US, China).

In this regard, in accordance with the opinion of the authors, it is necessary to create Clusters in Kazakhstan along the entire renewable energy production chain, starting from research and ending with the manufacture of necessary installations. This will speed up the process of replacing coal with "green energy", significantly reduce tariffs for renewable energy for the population.

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СОДЕРЖАНИЕ

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