

# Energy potential of sustainable development of the region

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**Abstract.** At the present stage, the whole world is facing serious energy challenges, including the rapid growth of energy consumption, the inevitable exhaustion of energy resources with an extremely uneven distribution, a large environmental burden on nature, and the globalization of energy. The electric power industry harms the environment with its excessive emissions of pollutants, which is reflected globally. The article first of all offers a literary review of studies on this topic. A comparative description of the achievements of countries in the field of emission schedules is proposed, as well as the prospects for drawing up a schedule of emission intensity for the period up to 2030 in comparison with countries. In addition, this paper presents unresolved problems that impede sustainable development, which guarantees the stability of the future existence of mankind. These challenges hamper the sustainable development of the energy industry in the long term and the global sustainable development and prospects for green economic growth of the country. Thus, the relevance of the subject of the study is due to the lack of resources, reflecting the relationship of trends in reducing pollution from the activities of industry with the conditions of economic growth.

## 1 Introduction

Kazakhstan is one of the world leaders in terms of diversity and quantity of mineral resources. As oil, gas, coal and other minerals are the most important components of the state's economy and regulation in these areas is well developed, the government has historically paid less attention to the development of alternative energy sources. For example, most power plants in Kazakhstan currently operate on natural gas, coal and petroleum products.

According to the Strategic Development Plan of the Republic of Kazakhstan until 2020, the share of RES in the total electricity consumption should be 1.5% by 2015 and more than 3% by 2020. The share of alternative energy sources in the total electricity production is less than 1%. Taking into account the need to address environmental issues, one of the priority areas for the development of the electric power industry will be the use of

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renewable energy resources (hydropower, wind and solar energy), the unused potential of which is quite large in Kazakhstan (strategic plan for the development of the Republic of Kazakhstan until 2020, 2010).

Significant investments in the electricity sector by 2030 amounted to about US\$50 billion by 2050, which will create employment opportunities for people with disabilities. A significant proportion of these investments will fall to 50% on alternative energy sources, so new jobs will be created in the region. The potential of hydropower in Kazakhstan is about 30 billion kwh/year. This is the direction that is currently most actively developing in our country. The reason, except for the natural potential, is the relatively low cost of electricity generated by the hydroelectric power plant. it is about 11-14 tenge/kw. Speaking of the natural potential of hydropower, one can say that the most favorable conditions for the construction of a hydropower plant may be on the rivers of southern Kazakhstan. However, out of 2000 rivers of the republic about 5%, i.e. about 100 rivers are suitable for construction of small hydroelectric power plants. The natural and geographical location of Kazakhstan provides ample opportunities for the generation of solar energy. Solar potential energy is approaching approximately 2500-3000 sundial per year, with solar irradiation energy equal to 1,300-1,800 kw / m<sup>2</sup>/year. The aim of the study is to study the legal aspects of the use and development of renewable energy sources in the republic of Kazakhstan and to determine their place and role in the legal system. Through the study of the shortcomings of the legal provision of conceptual conclusions for the improvement and elimination of barriers in the area will be carried out the development of "green energy".

80% of all electricity is generated in the industrial north by power plants located near coal mines. Electricity transmission networks across the country are inefficient with transmission and distribution losses estimated at about 15% of the energy produced, although the actual value may be higher. The electricity transmission and distribution system is divided into three networks, two of which are connected to Russia in the north and one in the south to the unified energy system of central Asia [1]. Given the rapid economic development of Kazakhstan and the associated increase in demand for electricity, the significant Modernization of existing power facilities in addition to 2020 requires the construction of new power plants with a capacity of ~20 gw [2]. Improving energy efficiency is also important; a recent study has shown that improving the efficiency of electricity and heat supply systems can reduce almost a third of Kazakhstan's electricity and heat consumption in the residential and commercial sectors at an average cost to end-users of about \$1/gj [3]. The industrial sector currently accounts for about 70% of total final electricity consumption, the residential sector-10%, the commercial and service sector-9%, transport 6% and agriculture 2% [4]. To promote efficiency improvements and to cope with the challenges of the demand and supply situation, the government of Kazakhstan adopted an efficiency law in 2012 and in 2013 launched the energy efficiency program 2020 aimed at reducing the energy intensity of the national economy by 10% by 2015 and 25% by 2020. Kazakhstan's energy sector is responsible for carbon dioxide emissions in the amount of 275 million tons of co<sub>2</sub> in 2011, with 80% of the energy sector derivatives from heat and power generation due to low efficiency and aging generation and grid assets [5]. To reduce emissions and meet the growing demand for electricity, a decentralized, efficient and urgent need for an environmentally friendly energy supply system based on a variety of renewable resources [6].

Renewable energy sources are an important mechanism for achieving sustainable development and Kazakhstan has abundant resources (solar radiation, wind energy, hydropower, biomass and organic waste and evaporation), suggesting that adequate use of these resources could complement the country's energy portfolio. Renewable energy also contributes to a significant reduction in greenhouse gas emissions, local pollution air and

minimize the impact on the landscape and the physical, geographical and natural environment [7,8].

## 2 Literature review

Mukhtarova K.S. et al wrote about the present research which was enabled of identifying and analysing problems of formation and development of Kazakhstan's industrial and innovative economy, namely the lack of application of research results in business, inadequate and ineffective funding (both public and private) of innovation activities, as well as little support and encouragement for scientists as major participants in innovation activities. [9]

In order to meet its obligations under the Kyoto Protocol, Kazakhstan agreed to reduce its carbon dioxide emissions by 15% by 2020 and by 25% by 2050 compared to the 1992 level. The National Concept of Transition to Green Color 2013 The economy until 2050 focuses on the transition of the economy and the energy sector to sustainable development and seeks to increase the share of renewable energy in electricity production to 3% by 2020, increasing to 30% by 2030 and 50% by 2050.

T.Srebotnik said that while the government is adopting a new legal framework to encourage the transition to renewable energy, there are still significant barriers to addressing, including a lack of awareness of the associated renewable energy opportunities, lack of technical expertise and capacity, insufficient government support to overcome the high initial financial and capital requirements and investment incentives resulting from the subsidy of other sources [10]. M.Bilgin argues that financial barriers, including low electricity prices in the country, uncertainty with long-term electricity purchase tariffs, difficulties in attracting foreign investment and lack of access to credit for both consumers and investors are currently opposed to rapid adoption [11]. Institutional barriers include the lack of a clear national program for the development of renewable energy sources, the absence of specific action plans and the absence of specific competition laws and regulations relating to the newly developed renewable energy market. Given the growing success of the oil and gas sector, Kazakhstan will need significant government leadership to achieve its vision for 2050. The future development of the domestic oil sector depends on the development of the Kazakhstani sector of the Caspian Sea, where projected reserves are expected to last for more than 50-60 years," Abdurahmanov said [12]. Adding renewable energy sources to the global energy balance has become one of the most important changes in the energy sector over the past decade. Today, renewable energy sources in the form of wind, solar, hydropower, geothermal energy and biomass provide a significant amount of energy, namely electricity and heat," said W.Hirsman [13].

According to L.Junfeng, renewable energy systems have the potential to play an important role in a low-carbon future, since they produce energy with very low greenhouse gas emissions and global dependence on fossil resources [14].

K.Jorde argues that demand for energy, and renewable energy in particular, is expected to increase in the future, a study of "aluminium and renewable energy systems - prospects for sustainable electricity and heat production" was commissioned by the International Aluminium Institute [15]. This was done to provide information on the current and future potential use of aluminium in selected renewable energy systems, as well as on the energy and environmental benefits, namely the energy generated and the potential for reducing CO<sub>2</sub> emissions, for the base years 2020, 2030 and 2050.

Regional sustainability is defined as the "continuous support of the quality of human life in the region, ecological carrying capacity" of M.Wackernagel[16].

Sustainable development is understood in the category of economic development subject to the availability of certain natural resources in the region, but economic

development should remain at a level not exceeding the environmental potential of the region, - said K.Malik [17].

K. Jorde said there are two product and process oriented approaches to sustainable development in the region. The first approach is the value that the region provides to its users, while the second approach focuses on the fundamental processes taking place in the region. The process approach is closely linked to the process of formulating the region's development strategy and the broader concept of regional planning.

Traditional energy resources of Kazakhstan

Kazakhstan has significant oil, gas, coal and uranium reserves. These resources are unevenly distributed across the country and their production, transportation and use have been difficult to connect to networks, the environment and regional geopolitics.

Kazakhstan has proven onshore oil reserves in the west of the country, which will allow oil production for more than 30 years, estimated at 30.0 billion barrels (3.9 billion tons) of oil, representing 1.8% of the world's reserves. Currently, Kazakhstan has 172 oil fields and 42 gas condensate fields across the Caspian Sea. production in 2013 amounted to 81.8 million tons. In Pavlodar, Atyrau and Shymkent there are three large oil refineries operating mainly in oil processing [18, 19]. More than 50% of oil production is accounted for by large Tengiz, Kashagan and Karachaganak fields and about 85% of all oil produced in Kazakhstan are intended for export [20].

A. J. Bradbrook said that scientific problems of state and legal regulation of renewable energy sources are considered by scientists from various sectors of the Republic of Kazakhstan and foreign countries. One of the active researchers is a Western scientist [21].

According for the kazakh researchers especially were appreciated S. Ziyadin and Veynberg R.R., Titov V.A. et al. Veynberg R.R., wrote about specific business processes in the media industry, described in BPMN notation and appear as part of media workflow management. [22]

S. Ziyadin and Yessenova G. described the process of diversification as a matter of aggregate socio-economic and administrative relations that arise between the subjects of a region, including industrial enterprises on the one hand and regional consumers on the other as well as the participation of authorities and entities of the institutional environment. [23]

Ziyadin, S., Suieubayeva, S., et al considered the current economic potential of China, which is one of the largest recipients of foreign direct investments in the world and plays a leading role in the world trade.

Veynberg, R.R., et al researched presents prospects of the development the principles of the operation business development methods and business development principles and its application in the real economic sector.

Uranus

Kazakhstan is the world's leading uranium producer. It contains 15% of the world's uranium reserves, with current production at 22,550 tons per year (2013), accounting for 38% of global production; 90% of total uranium production is currently exported. Kazakhstan's only 90 MW Mangyshlak HPP at Aktau was shut down in April 1999 after 27 years of operation, but a cooperation agreement with Russia on commissioning a new nuclear power plant was signed in May 2014 [9].

### **3 Data and methodology**

#### **3.1 Data descriptions and analysis**

The environmental management system includes:

1. detailed development and adoption of the company's mission aimed at environmental protection;
2. analysis of the external and internal environment of the enterprise to clarify the environmental potential;
3. development of the company's goals and strategies to achieve its environmental mission.

### 3.2 Methodology

SWOT analysis is an effective method of strategic planning. It addresses weaknesses, strengths, opportunities and threats.

## 4 Results and discussion

From the experience of these countries, it can be safely concluded that a national innovation system will undoubtedly be effective and sustainable if countries allocate sufficient resources, modernize services, manufacturing sectors and other subsectors of the economy and develop a positive perception. Given their indispensability, these innovative developments are increasingly becoming the object of close attention not only at the government level, but also at the level of regions and individual economic entities. Taking into account the above mentioned problems of the energy industry, a SWOT analysis is compiled.

**Table 1.** SWOT - analysis of energy management development on the market.

Strengths		Weaknesses	
1.	Territorial proximity to the main energy supplier	1.	High dependence on energy imports
2.	Geographical position as a transit country	2.	Infrastructure wear and tear
3.	favourable level of investment activity	3.	Limited commercialization of business activities
4.	Export opportunities and transit potential	4.	Insufficient budget financing of projects
5.	Established regulatory framework for efficient functioning of the market	5.	Low share of national companies in the development process
6.	Advanced power transmission circuitry	6.	Lack of construction of new power plants
7.	Advanced power transmission circuitry		
8.	Sufficient stock of natural resources		
Opportunities		Threats	
1.	Involvement of the private sector in the sector	1.	Prices for imported energy carriers are increasing
2.	Enhancing attractiveness of the market to attract investment	2.	Depreciation of infrastructure in future
3.	Introduction of energy security in selected regions	3.	Deterioration of quality
		4.	Lack of personnel, engineers
		5.	Risks of man-made accidents
		6.	Restrictions on deliveries from neighbouring countries
		7.	

The development of any country is determined by solving the problems associated with the formation of effective territorial strategies aimed at accelerating economic growth, which is a necessary condition that requires extensive investment activity. Forming the

production potential of the territories on a new scientific and technical basis in the process of innovation, investment projects predetermine the competitiveness of the regions of the country and, consequently, the country as a whole.

A multidisciplinary approach to the definition of the term energy security is very important for the formation of an adequate policy in the public sector.

(b) The use of the Internet as a medium of communication, and/or at the regional level, as allows to take into account its various aspects - economic, social, environmental, technical, political, political and others.

However, despite the sophistication of modern energy security monitoring methodologies, it is increasingly subject to stringent criticism. The fact is that most of the "classical" indicators and indicators of energy security are developed in relation to the realities of industrialized countries and use Different ways of measuring the amount of electricity, nuclear fuel and motor fuel produced and consumed. Such indicators are as follows are often completely unsuitable for measuring energy security in countries with fundamentally different energy systems (e.g. most African countries), (e) with limited access to central power grids, few nuclear power plants and non-motorized transport.

The hierarchy of metrics is conditioned by the need to have at the disposal of persons accepting Solutions, specific computable indicators various aspects of energy security, without which it is impossible to monitor the state of the energy system, targeting and develop of her development scenarios. In addition, the use of of algorithms that allow large Data sets into recognizable patterns, allowing energy policy makers to more freely and easily analyze the state of energy systems in different groups of countries, to identify best practices, make decisions, close to optimal, reducing the level of information asymmetry of the global energy market.

It should be noted that in today's realities, the requirements for the quality of electricity in terms of physical properties are constantly increasing. The reason for this is the automation of production processes and the penetration of ICTs into almost all spheres of modern business.

However, as long as the marginal benefits of investment in further improvements are not lost the processes of creation and distribution of electricity remains above the marginal costs for investors, investments in improving the quality of systems the power supply will increase. Process of standardization of energy supply quality parameters fixes a point of equilibrium between the marginal benefits and costs to society, while the interests of private investors in this area may differ significantly from the needs of the macro system in ensuring the quality of electricity supply.

Thus, the consistent expansion of the concept of quality of energy supply allows include some aspects that have traditionally been considered as energy security issues. As a result, we obtain the hierarchy of concepts presented in Figure 1.

Proposed approach to determining the quality of energy supply systems as one of the most important components of energy supply security allows for a significant expansion of the range of use of quality management methods, as in the development of energy production (municipal, regional, federal), as well as in the implementation of specific measures aimed at improving energy efficiency.

In any case, all contemporary work on energy security underscores the multidimensional nature of the concept, including not only economic, but also other aspects (environmental, social, etc.) In addition, the majority of authors consider energy security along the entire chain of energy services creation - from generation to final use.

**Table 2.** Simple, medium and complex metrics to measure energy security.

Energy aspect safety	Simple indicators (quantitative)	Average indicators (qualitative)	Complex indicators (conceptual)
Energy Import	Share of imported energy in total consumption (possibly broken down by fuels)	Type of imported energy, mode of transport	Geopolitical significance of energy imports for of a particular country or regions
Energy production and infrastructure	Diversification energy production by sources	Local energy resources, utilization rate	Manufacturing Features energies in a certain country
	National capacity of the generating system	Investments in the development of the national energy system	Energy independence
Vulnerability to interruptions and power outages	Power consumption on per capita	The ratio of the cost of import of energy and revenues from energy exports	The industry's vulnerability (transport, agriculture, industry, residential sector)
	VVP's energy intensity	Energy intensity by economic sector or fuel type	
	Motor consumption of fuel per unit of conversion carriage	Fuel consumption by mode of transport	
Fairness of distribution and availability of energy services	Percentage of households with reliable access to the electricity grid	Household expenditure on power supply	Gini coefficient of energy consumption
Greenhouse gas emissions	Total greenhouse gas emissions per capita	Greenhouse gas emissions by industry	Carbon intensity of individual transport systems

In addition to addressing global challenges related to economic and social progress, one of the most important aspects of the innovation and investment concept of regional development is to minimize the severity of environmental problems and focus on the international doctrine of sustainable development. In this regard, consideration of environmental factors has become an integral part of the assessment of energy problems of projects.

The study also assessed the effectiveness of the organization in the field of energy conservation and energy efficiency, based on the compliance of organizations with the criteria for the functioning of the energy management system in accordance with the requirements of standard 50001.

According to the results of the study, it can be concluded that the surveyed organizations are at different stages of energy efficiency management in accordance with the developed multi-stage model of the energy efficiency management process and adapted carbon Trust energy management matrix:

1. Energy survey, determination of further goals and objectives in the field of energy saving and energy efficiency, monitoring;
2. Identification of those responsible for energy saving and energy efficiency improvement, introduction of key performance indicators in this area, training of personnel,

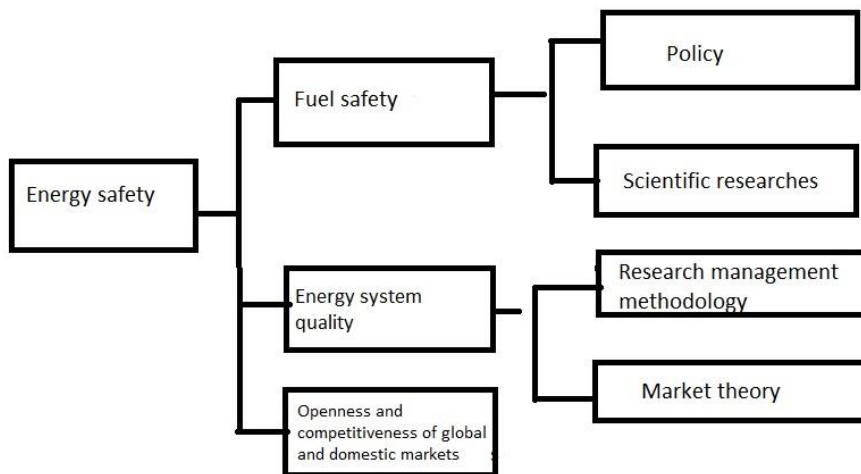


promotion of energy saving, implementation of medium-term measures, the main effect of which is to increase energy efficiency;

**Table 3.** Simple and complex energy security indicators and indicators.

Economic accessibility/price attractiveness		
Price stability	End-use prices by fuel type End-user prices by sector Regional price differences (average price in the most expensive / cheapest deciles) Electricity and gasoline price volatility (annual fluctuations, %) % of demand covered by long-term contracts Fuel price volatility Carbon price volatility Currency exchange rate volatility	Price of macro-economic the shocks caused by the volatility
Availability and equality.	Percentage of households connected to the electricity grid Electrification level (number of new connections per year) Percentage of the population using charcoal/diesel/biomass for the use of charcoal/diesel/biomass for the purposes of the food preparation Percentage of the population using mechanical energy for non-industrial purposes (e.g. water abstraction, agricultural work, grinding, milling) Electrification expansion level (annual change, %) Annual number of new electricity consumers Income lost from energy theft Average number of household appliances in households Distribution of energy-related revenues (the lowest in the world quantile) Average household energy expenditure Annual electricity consumption by households (in kWh) Average mileage of a private car per capita % of air-conditioned living quarters Annual sales volume of new ACs Number of vehicles/TVs/Computers/Coolers/Lamps per capita Car occupancy rate Average income of motorists Percentage of reliable mass transit systems Ratio of net fuel imports to PBR	Upper household energy expenditure threshold (products and services) GINI energy efficiency factor
Decentralization	Percentage of required energy covered by distributed energy (less than 1 MW) Number of households covered without network connection Number of households served by micro-networks Average construction time of new energy infrastructure % of electricity generation through cogeneration Installed capacity of residential photovoltaic systems/fuel cells/microturbines/wind turbines in the residential sector/biogas plants	
Economic availability	Share of household income spent on fuel and electricity Government expenditure on subsidies, as a percentage of BBP Energy prices for industry/population Retail gasoline prices Price 1 kg of wood/charcoal; price 1 l of kerosene Market prices for coal/uranium/oil/natural gas Average cost of electricity in the residential sector at BBP Energy intensity of industry Inflation caused by import duties Retail prices of final energy consumers by fuel type/sector Alternative energy generation costs Marginal costs of electricity generation Fuel cost for electricity generation Tariffs for electricity transmission and distribution Cost of carbon emissions Wholesale electricity price	Daytime ratio Net income and energy consumption Equal access to the network / transmission system Power consumption on household needs for each population group and the corresponding fuel balance





**Fig. 1.** Quality of energy supply systems as a component of energy security [made by author].

3. Implementation of the energy management system, linking the strategic goals of the company, energy audit, training of personnel on energy saving and energy efficiency, energy accounting system, formation, implementation and monitoring of the energy saving program, as well as automation of activities in this area.

## 5 Conclusion

Kazakhstan's domestic energy sector is heavily dependent on fossil fuels (coal, oil and gas) and large hydropower plants to supply its power and electricity needs. The increase in electricity demand is linked to rapid economic growth, combined with concerns about environmental pollution, stimulating new interest in alternative energy sources. It has been argued that Kazakhstan has the necessary natural, climatic and economic conditions for sustainable development, bioenergy solutions, but broad and flexible regulatory support mechanisms and investment incentives are required to stimulate the introduction of these technologies in light of the success of the oil and gas export industry. Wind energy, small and medium hydropower and solar technologies also have significant potential and, given that 47% of the population is in rural areas, small-scale renewable decentralized energy systems offer good opportunities to move away from dependence on fossil fuels and ensure further economic growth. Renewable energy also offers Kazakhstan to increase energy security in the complex interdependencies and geopolitics of the 'Energy Game of Central Asia'.

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