

Article

Assessment of Regional and Sectoral Parameters of Energy Supply in the Context of Effective Implementation of Kazakhstan's Energy Policy

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Abstract: The development of global and regional energy markets is one of the most important problems of the current state of global economic relations and is one of the highest-priority areas in the formation of national and regional strategies for the socio-economic development of any country. The role of energy supply is focused on monitoring and compliance with standards. However, in recent years, the importance of energy supply to the housing stock has increased significantly, which has led to an expansion of the role of management within the framework of the risk management function. Kazakhstan has a Unified electric power system, which is represented by a set of power stations, transmission lines, and substations that provide reliable and high-quality energy supply to consumers. Currently, the main task within the framework of the priority of the development of Kazakhstan's energy sector is to build up the energy base and provide the growing needs of the population and the economy with the necessary energy resources based on the development of modern energy complexes and alternative energy sources in conjunction with the implemented and planned macroprojects. Since the current economic development of Kazakhstan is closely interrelated with the realization of energy resources and their effective use, it acts as one of the fundamental levers for the development of the national economy. According to our research goal, it is necessary to consider sustainable energy supply in the country based on the analysis and assessment of energy consumption volumes and the impact of the country's regional and sectoral policies on their use. The author's approach to the distribution of countries by MNC has been developed and estimates of regression parameters, correlation coefficients, and elasticity coefficients. When constructing the author's approach, the countries of Europe and Central Asia were studied and a sample of estimates was carried out, which has statistically significant effects on the formation of energy consumption volumes in the Republic of Kazakhstan.

Keywords: energy supply; energy supply parameters; energy efficiency; energy policy; energy strategy; energy management; electric power industry; renewable energy sources; energy use; final energy consumption

1. Introduction

In the modern world, there is close attention being paid to the problem of energy supply, so it is explained not only by its importance in the world's economy but also by the fact that this issue is becoming global and ubiquitous. The energy supply of the global economy must be solved at the global level through the interaction of national economies, transnational, and multinational corporations and various international organizations.

Humanity's growing demand for energy contributes to a rapid increase in energy consumption, where emissions from fuel combustion are the main causes of global warming and climate change. What is energy saving? It is a key tool for training in the rational use of energy, advanced technologies, and renewable energy sources. An energy-saving building is classified as an energy-efficient building, a passive house, and a zero-energy house [1–12].

The consumption of electricity and other energy resources is low compared to conventional buildings, and the heat required is 70 kWh/m².

According to its design criteria, the building is based on three main factors: architectural design, construction technology, and technical design, which makes the building an energy-efficient object. Architectural design plays a big role in energy-efficient construction, as planned, and as such, it allows the house to accumulate up to 40% of its energy.

The assessment of energy parameters is a derivative indicator necessary for the analysis of situations occurring in the field of energy supply. The need to assess the sectoral and regional parameters of energy supply is important in the process of international negotiations regarding the definition of any general sets of rules (in the case of climate negotiations), as well as in the framework of government decisions or decisions of various international organizations (such as the question of the implementation of energy conservation programs), etc.

2. Materials and Methods

The theoretical and methodological basis of the research is based on an interdisciplinary approach using not only the methodological apparatuses of management theory, energy management theory, energy supply theory but also involving research results in the field of econometrics, higher mathematics, data analysis, and information technology. Currently, there are various ways and methods to identify the prospects for achieving sustainable energy supply in different countries based on determining the main directions for improving sustainable electricity supply and improving the energy efficiency of resources in the global economy. Nevertheless, economic and mathematical methods and models, in particular, methods of correlation and regression analysis, play important roles in conducting an effective assessment of the industry and regional parameters of the energy supply. Our use of the method of countries' distribution by MNC—estimates, regression parameters, correlation coefficients, and elasticity coefficients—allows us to evaluate statistically significant effects on the formation of energy consumption volumes in our country based on a sample of a special indicator. The advantage of the MNC assessment of regression parameters is that it is possible to conduct this assessment in both regional and sectoral aspects.

We conducted a review of the literature on the research topic: We conducted an analysis of the reliability of the power supply; References [4,7] reviewed the successful integration of energy efficiency for joint control; Reference [12] presented data for Italy, where the supply of housing stock is natural gas with an intensity of use of 54%; References [13,14] studied the systemic interactions between housing stock and energy

supply; scientist Heather [15] showed the reaction of the housing market to the change in consumer preferences; [13] examined the system of room heating and water heating; Reference [16] built an index using a process approach to budget allocation; Reference [17–19] assessment of the influence of storylines on the processes of reconversion is presented, and semi-structured interviews with key local players were used; and [20–25] provided an assessment of four scenarios for the transition to energy by taking into account the opinions of many stakeholders.

In the study of the aforementioned literature, we have identified promising areas on the problems of our article for future research.

The studied literature contains examples of practices in Europe, Africa, America, Australia, Asia, the Middle East, Central Asia, and Russia. The main studies on energy supply are presented in Table 1.

Table 1. Research in the field of energy supply by country. Note: developed by the authors.

Countries	Authors
Latvian	Aboltins, R., Blumberga, D. (2019), Key Factors for Successful Implementation of Energy Efficiency Policy Instruments: A Theoretical Study and the Case of Latvia. <i>Environmental and Climate Technologies</i> , 23(2). [1]
France	Alain Nadaï, Dan van der Horst (2010) Introduction: Landscapes of Energies, <i>Landscape Research</i> , 35:2, pp. 143–155. [2]
USA	Bartos, M. D. et al. Impacts of rising air temperatures on electric transmission ampacity and peak electricity load in the United States. <i>Environ. Res. Lett.</i> 11, 11 (2016). [3]
Italy	Claudio Daminato, Eugenio Diaz-Farina, Massimo Filippini, Noemi Padrón-Fumero, The impact of smart meters on residential water consumption: Evidence from a natural experiment in the Canary Islands, <i>Resource and Energy Economics</i> , Volume 64, 2021, 101221, ISSN 0928–7655. [6]
England	Elizabeth Shove (2018). What is wrong with energy efficiency?, <i>Building Research and Information</i> , 779–789, doi: 10.1080/09613218.2017.1361746. [9]
Italy	Filippini, M., Hunt, L. C., Zorić, J. (2014). Impact of energy policy instruments on the estimated level of underlying energy efficiency in the EU residential sector. <i>Energy policy</i> , 69, 73–81. [10]
Ghana	Gyamfi, Samuel, Krumdieck, Susan, Urme, Tania, 2013. “Residential peak electricity demand response—Highlights of some behavioural issues,” <i>Renewable and Sustainable Energy Reviews</i> , Elsevier, vol. 25(C), pages 71–77. [12]
USA	Jannik Heusinger, Ashley M. Broadbent, David J. Sailor, Matei Georgescu, Introduction, evaluation and application of an energy balance model for photovoltaic modules, <i>Solar Energy</i> , Volume 195, 2020, Pages 382–395, ISSN: 0038–092X. [5]
England	Jones, P., Patterson, J., Lannon, S. Modelling the built environment at an urban scale—energy and health impacts in relation to housing. <i>Urban Plan</i> 83, 39–49 (2007). doi: 10.1016/j.landurbplan.2007.05.015. [26]
USA	Jia Li, Just, R.E. Modeling household energy consumption and adoption of energy efficient technology. <i>Energy Economics</i> . [20]
USA	Reyna, J., Chester, M. Energy efficiency to reduce residential electricity and natural gas use under climate change. <i>Nat Commun</i> 8, 14916 (2017). https://doi.org/10.1038/ncomms14916 . [27]
China	Shen, L., He, B., Jiao, L., Song, X., Zhang, X. (2016). Research on the development of main policy instruments for improving building energy–efficiency. <i>Journal of Cleaner Production</i> , 112, 1789–1803. [28]
USA	Sailor, D. J. Pavlova, A. A. Air conditioning market saturation and long–term response of residential cooling energy demand to climate change. <i>Energy</i> 28, 941–951 (2003). [29]
Saudi Arabia	Tarek N. Atalla, Lester C. Hunt (2015). Modelling residential electricity demand in the GCC countries. <i>Energy Economics</i> . Volume 59, September 2016, Pages 149–158. [23]
Netherlands	Van Stiphout, Arne, Engels, Jonas (2015); Guldentops, Dries; Deconinck, Geert. Quantifying the Flexibility of Residential Electricity Demand in 2050: a Bottom–Up Approach. ISBN: 9781479976935. [30]
Japan	Yamaguchi, Y., Shimoda, Y., Mizuno, M. Proposal of a modeling approach considering urban form for evaluation of city level energy management. <i>Energy Build.</i> 39, 580–592. https://doi.org/10.1016/j.enbuild.2006.09.011 . [25]

As a result of the available literature review on the research topic, one can see the wide range it has in the regions and countries of the modern world. With the future directions of our research, the following can be noted: the introduction of priority “green” projects for the production of environmentally friendly products; features of the operation of environmentally friendly transport; the application of the principles of “green” construction; the use of environmentally efficient and adapted products of a waste-free economy; and more.

3. Results

The assessment of the impact of the global energy supply system on the energy consumption of individual countries is an urgent topic of study for ensuring the sustainable development and competitiveness of the national economy and improving the quality of life of the country’s population [9–12,15,26].

Due to the significant differences in the number of people, the size and scale of the economy, and social, financial, and transport structures and systems between countries, the subject of this task has a number of difficulties.

In this regard, the paper will attempt to identify hidden dependencies between the Republic of Kazakhstan and the countries of Europe and Central Asia to assess their statistically significant impact on the criterion of energy consumption per capita in tons of oil equivalent based on World Bank statistics. Next, we will consider the distribution of countries by OLS—which estimates regression parameters, correlation coefficients, and elasticity coefficients in accordance with the data in Table 2.

Table 2. Distribution of countries by MNC, estimates of regression parameters, correlation coefficients, and elasticity coefficients. Note: Compiled by the authors from a source of statistical data [31], via *, **, ***, designated, respectively, 10%, 5%, 1% level of errors of the OLS assessment.

N	E	Country, Code	R	Code	b_1	Code	b_1	Code
1	3.00	Poland, POL	1.00	KAZ	4.36 ***	POL	−7.31 **	POL
2	1.77	Russia, RUS	0.83	RUS	2.14 ***	LVA	−2.82 ***	RUS
3	1.20	Latvia, LVA	0.77	LVA	1.37 ***	RUS	−0.72	LVA
4	1.00	Kazakhstan, KAZ	0.69	BLR	1.11 ***	BLR	0.00 ***	KAZ
5	0.88	Belarus, BLR	0.63	TKM	1.00 ***	KAZ	0.43	BLR
6	0.87	Estonia, EST	0.62	EST	0.78 ***	EST	0.46	EST
7	0.72	Turkmenistan, TKM	0.60	POL	0.693 ***	TKM	1.02	TKM

Therefore, this work will use:

- Sample statistics use of energy in tons of oil equivalent per capita for 58 countries of Europe and Central Asia received from the open archive for the period from 1990 to 2014 from the web resource site [31], date of access 17 March 2021;
- OLS estimation (Greene, 2018) of parameters b_1 (KAZ; EGU) and b_0 (KAZ; EGU) (see Table 2, column 5 and 7) one-factor regression model $KAZ[t] = b_1 * EGU[t] + b_0 * EGU[t]$; r (KAZ; EGU) correlation coefficients (see Table 2, column 3); e (KAZ; EGU) averaged values of elasticity coefficients (see Table 2, column 1), where EGU = BLR, EST, LVA, POL, RUS, TKM is the country code of energy consumption (see Table 2, column 2), $t = 1990, 1991, \dots, 2014$ is the year of observation of the sample.

The consistent use of the OLS estimation model, elasticity filters, and correlation on the initial samples of the statistical data to build an empirical distribution of the countries of Europe and Central Asia and the choice of estimates that have a statistically significant impact on the formation of energy consumption volumes in the Republic of Kazakhstan will allow us to obtain the following classifications of the country’s development:

- Elastic energy consumption an increase in the volume of energy use per capita of Kazakhstan in tons of oil equivalent by a greater percentage ($>1.00\%$): e (KAZ; POL) = 3.00% (Poland), e (KAZ; RUS) = 1.77% (Russia) and e (KAZ; LVA) = 1.20% (Latvia) than an increase in the volume of energy consumption per capita in tons of oil equivalent by 1% for the countries of Poland, Russia, and Latvia, respectively (see Table 2, column 1–2, row 1–4; Figure 1);
- Inelastic energy consumption the growth of energy use per capita in Kazakhstan in tons of oil equivalent will be by a smaller percentage ($<1.00\%$): e (KAZ; BLR) = 0.88% (Belarus), e (KAZ; EST) = 0.87% (Estonia) and e (KAZ; TKM) = 0.72% (Turkmenistan) than the growth of energy consumption per capita in tons of oil equivalent by 1% for the countries of Belarus, Estonia, and Turkmenistan, respectively (see Table 2, column 1–2, row 4–7; Figure 1);
- Strong correlation—the change in the average values of energy use per capita in Kazakhstan in tons of oil equivalent: r (KAZ; RUS) = 0.8352 (Russia) and r (KAZ; LVA) = 0.7714 (Latvia) will be in the range greater than 0.70 and less than or equal to 1.00 when the energy consumption per capita in tons of oil equivalent changes for the countries of Russia and Latvia (see Table 2, column 3–4, row 1–3; Figure 2);
- Moderate correlation—the change in the average values of energy use per capita in Kazakhstan in tons of oil equivalent: r (KAZ; BLR) = 0.69 (Belarus), r (KAZ; TKM) = 0.62 (Turkmenistan) and r (KAZ; EST) = 0.62 (Estonia) will be in the range greater than 0.50 and less than or equal to 0.70 when the energy consumption per capita in tons of oil equivalent changes for the countries of Belarus, Turkmenistan, and Estonia (see Table 2, column 3–4, row 4–7; Figure 2);
- Increasing growth—an increase in the volume of energy consumption per capita by 1000 tons of oil equivalent, respectively, for the countries of Poland, Latvia, Russia, and Belarus increases by a growth (>1000) volume of the average value of energy use per capita in Kazakhstan: b_1 (KAZ; POL) = 4361 *** (Poland), b_1 (KAZ; LVA) = 2141 *** (Latvia), b_1 (KAZ; RUS) = 1379 *** (Russia) and b_1 (KAZ; BLR) = 1110 *** (Belarus) tons of oil equivalent (see Table 2, column 5–6, row 1–4; Figure 3), provided that other variables are constant;
- Decreasing growth increase in the volume of energy consumption per capita by 1000 tons of oil equivalent for the countries of Estonia and Turkmenistan; the average energy use per capita of Kazakhstan increases by decreasing (<1000) volume: b_1 (KAZ; EST) = 0.78 *** (Estonia) and b_1 (KAZ; TKM) = 0.69 *** (Turkmenistan) tons of oil equivalent (see Table 2, column 5–6, row 6–7; Figure 3), provided that other variables are constant;
- The level of underestimation—assessment of the average impact of unaccounted volumes of energy consumption per capita in tons of oil equivalent for the countries of Poland, Russia, and Latvia on the scarce use of energy per capita in Kazakhstan: b_0 (KAZ; POL) = -7316 ** (Poland), b_0 (KAZ; RUS) = -2820 *** (Russia) and b_0 (KAZ; LVA) = 0.72 (Latvia) tons of oil equivalent (see Table 2, column 7–8, row 1–3; Figure 4), provided other variables are constant;
- The level of revaluation estimate of the average impact of unaccounted volumes of energy consumption per capita in tons of oil equivalent for the countries of Poland, Russia, and Latvia on the excess use of energy per capita in Kazakhstan: b_0 (KAZ; TKM) = 1025 (Turkmenistan), b_0 (KAZ; EST) = 0.46 (Estonia) and b_0 (KAZ; BLR) = 0.43 (Belarus) tons of oil equivalent (see Table 2, column 7–8, row 5–7; Figure 4), provided that the other variables are constant, where *, **, and *** are designated as 10% , 5% , 1% , respectively, and the level of errors of the OLS assessment.

According to Figure 1, the distribution of countries by elasticity coefficients is clearly shown.

The data in Figure 2 clearly show the distribution of countries by correlation coefficients.

The distribution of countries by the slope and segment parameter is indicated in Figures 3 and 4.

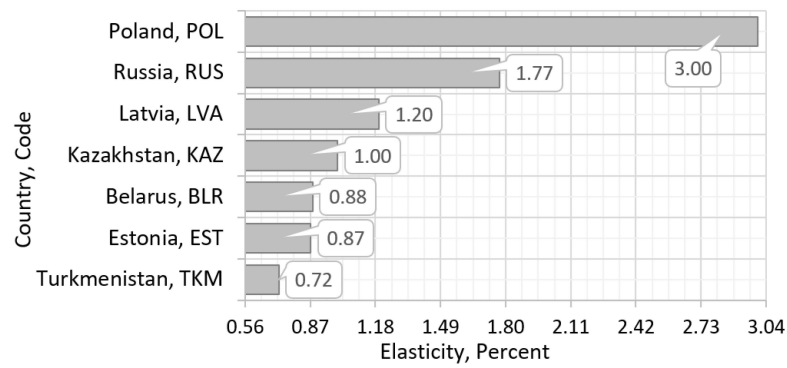


Figure 1. Distribution of countries by elasticity coefficients. Note: developed by the authors.

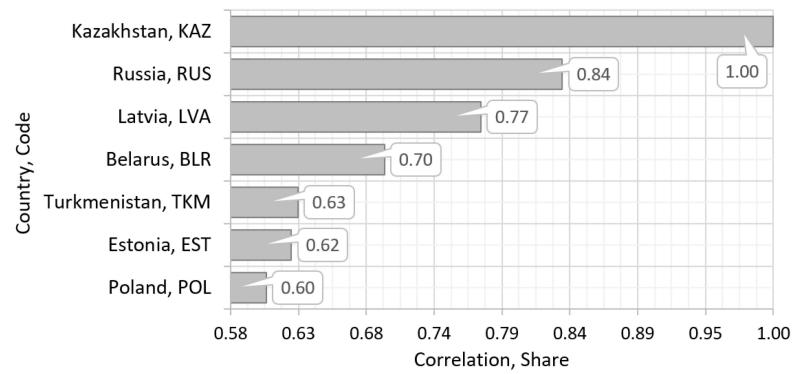


Figure 2. Distribution of countries by correlation coefficients. Note: developed by the authors.

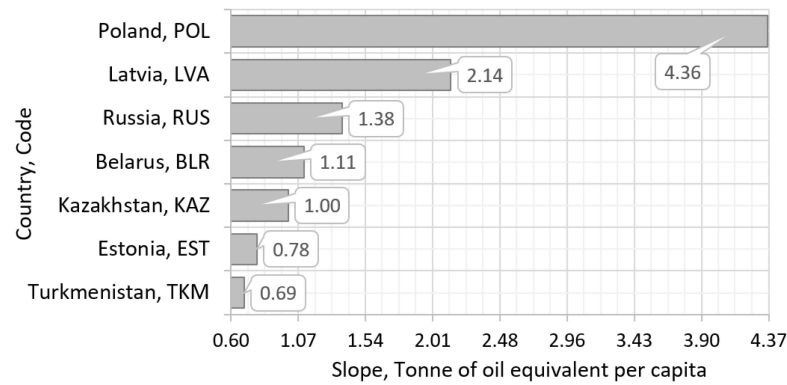


Figure 3. Distribution of countries by the slope parameter. Note: developed by the authors.

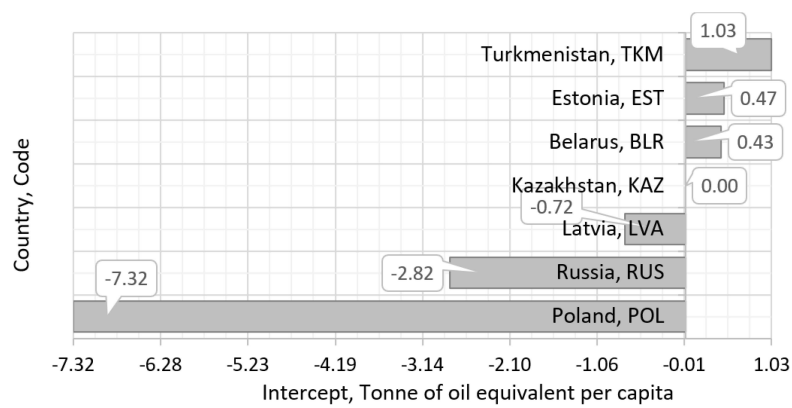


Figure 4. Distribution by segment parameter. Note: developed by the authors.

Thus, with the help of the Europe and Central Asia's empirical distribution by the values of the MNC estimation of the parameters of the regression equation, correlation coefficients, and elasticity the classification of the country's development and the assessment of the impact of energy consumption per capita of Kazakhstan in tons of oil equivalent is given.

We will analyze the data. The indicator is formed in accordance with the "Methodology for the formation of the fuel and energy balance and the calculation of individual statistical indicators characterizing the energy industry", approved by the order of the Chairman of the Statistics Committee of the Ministry of National Economy of the Republic of Kazakhstan No. 160, dated 11 August 2016 (Bureau for National Statistics of the Ministry of National Economy of the Republic of Kazakhstan, 2016).

The responsible state body for generating data on energy consumption is the Statistics Committee of the Ministry of National Economy. The information is generated based on the results of the national statistical observation in form 1-TEB (annual).

Units of measurement: Thousands of tons of oil equivalent to the total amount of primary energy and fuel supplied and the percentage of various types' shares of fuel in the overall amount of energy supplied. The total amount of primary energy supplied by the Republic of Kazakhstan for 2013–2019 is shown in Table 3.

The final energy consumption as an indicator characterizes the final consumption of energy supplied to the final consumer for use in all energy purposes, both in general and broken down by main consumers (industry, transport, households, services, and agriculture) in accordance with the international Standard Industrial Classification of Economic Activities (ISEA).

The final energy consumption includes fuel used for energy purposes, except for fuel consumed by energy enterprises for conversion into other types of energy (electricity, heat, gas) and equipment operation.

The following indicator is formed in accordance with the "Methodology for the formation of the fuel and energy balance and the calculation of individual statistical indicators characterizing the energy industry", approved by the order of the Chairman of the Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan No. 160, dated 11 August 2016.

The responsible state body for generating data on energy consumption is the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan.

Final energy consumption is the indicator of the driving forces that characterize the trend of changes in final energy consumption.

It is used for monitoring and evaluating the success of the implementation of energy policy directions designed to influence energy consumption and energy efficiency (Table 4).

Thus, Kazakhstan has adapted a new law on green tariffs "On support for the use of renewable energy sources", which will support renewable energy producers. The EBRD worked with the Ministry of Industry and New Technologies and the Ministry of Environmental Protection to help develop various aspects of the new legislation, starting with the model for determining green tariffs. The cost of the program is estimated at KZT 1100 billion (EUR 5.3 billion).

We have found that energy consumption is falling 30% faster than the GDP. Thus, CO₂ emissions are reducing 50% faster than energy consumption due to the stronger impact of the economic crisis on industries with a relatively high carbon factor (thermal energy production, transport).

* Including international air and sea transport (not included in the country data).

Note that the G20 countries account for 80% of global energy consumption.

The change was particularly sharp for coal, whose consumption declined sharply (−3.6% compared to +0.6% in 2018), while oil consumption increased (+1.2%), and gas consumption continued its upward trend (+3.2%) caused by a sharp increase in gas production in the United States.

Table 3. Total amount of primary energy supplied by the Republic of Kazakhstan for 2013–2019. Note: developed by the authors (Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, 2021).

N	Name	Unit	2013	2014	2015	2016	2017	2018	2019
1	Energy production	1000 t.n.e.	169.080	166.293	164.088	162.695	179.977	174.957	166.913
2	Energy import	1000 t.n.e.	15.342	7353	7519	8350	8090	11.023	15.592
3	Energy export	1000 t.n.e.	−100.789	−96.367	−94.025	−90.528	−103.419	−110.514	−108.832
4	International marine and aviation bunkers	1000 t.n.e.	−168	−232	−413	−462	−658	−635	−639
5	Inventory changes	1000 t.n.e.	−1914	−120	935	1578	997	395	114
6	Total amount of primary energy supplied	1000 t.n.e.	81.551	76.927	78.104	81.633	84.987	75.226	73.148
7	Coal	1000 t.n.e.	37.479	37.035	34.239	35.358	38.282	37.516	34.473
8	Coal	%	46%	48%	44%	43%	45%	50%	47%
9	Crude oil	1000 t.n.e.	22.117	18.748	18.059	18.624	19.371	22.563	22.729
10	Crude oil	%	27%	24%	23%	23%	23%	30%	31%
11	Petroleum products	1000 t.n.e.	−4119	−5701	−2546	−2107	−3187	−4213	−5177
12	Petroleum products	%	−5%	−7%	−3%	−3%	−4%	−6%	−7%
13	Natural gas	1000 t.n.e.	25.415	26.212	27.458	28.729	29.829	18.619	20.122
14	Natural gas	%	31%	34%	35%	35%	35%	25%	28%
15	Hydroelectric power	1000 t.n.e.	665	710	797	999	964	894	859
16	Hydropower	%	1%	1%	1%	1%	1%	1%	1%
17	Geothermal and solar energy, etc.	1000 t.n.e.	1	1	15	31	37	73	117
18	Geothermal and solar energy, etc.	%	0%	0%	0%	0%	0%	0.1%	0.2%
19	Biofuels and waste	1000 t.n.e.	66	22	80	107	66	76	65.8
20	Biofuels and waste	%	0.1%	0%	0.1%	0.1%	0.1%	0.1%	0.1%
21	Electric power	1000 t.n.e.	−73	−100	0	−10	−375	−299	−41.6
22	Electricity	%	−0.1%	0.1%	0%	−0.1%	−0.4%	−0.4%	−0.1%
23	Heat	1000 t.n.e.	...	...	0	...	...	...	...
24	Heat	%	...	...	...	...	...	...	...

The growth of electricity consumption, due to more sluggish economic conditions, slowed down (+0.7% overall) in most G20 countries and decreased in some.

According to the EBRD's financing, in addition to a comprehensive technical co-operation program that will support competitive bidding for wind energy projects, the development of the carbon market, and the promotion of gender integration in the renewable sector, the scheme is also supported by concessional financing from the Green Climate Fund [13,14,18,20–25,27–33].

The first stage helped to create 262 MW of renewable energy sources across the country, attracted four private international investors, and supported a project to strengthen the network.

The expansion of the program will help Kazakhstan achieve its goals for renewable energy sources: 3% of production by 2020 and 50% by 2050, as well as the fulfillment of its promises under the Paris Agreement. At the moment, the EBRD has allocated EUR 2 billion to finance projects in the field of renewable energy sources in Kazakhstan.

Table 4. Final energy consumption of the Republic of Kazakhstan for 2013–2019. Note: developed by the authors according to the data of the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. (Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, 2021).

N	Name	Unit	2013	2014	2015	2016	2017	2018	2019
1	Total final energy consumption	1000 t.n.e.	43.000	38.266	40.158	40.357	40.699	41.911	45.510
2	Industry	1000 t.n.e.	24.413	18.038	20.898	22.883	21.570	15.496	17.209
3	Industry	%	56.8%	47.1%	52%	56.7%	53%	37%	37.8%
4	Transport	1000 t.n.e.	4935	4883	5334	5469	5326	6277	5774
5	Transport	%	11.5%	12.8%	13.3%	13.6%	13.1%	15.0%	12.7%
6	Households	1000 t.n.e.	6695	8184	7409	5245	6559	11380	15132
7	Households	%	1.6%	21.4%	18.4%	13%	16.1%	27.2%	33.2%
8	Service sector	1000 t.n.e.	3746	3798	4310	4299	4905	5281	4599
9	Service sector	%	8.7%	9.9%	10.7%	10.7%	12.1%	12.6%	10.1%
10	Agriculture, forestry, and fisheries	1000 t.n.e.	786	896	730	732	799	1652	868
11	Agriculture, forestry, and fisheries	%	1.8%	2.3%	1.8%	1.8%	2%	4%	2%
12	Other activities	1000 t.n.e.	1496	1634	955	1213	1046	1504	1671
13	Other activities	%	3.5%	4.3%	2.4%	3%	2.6%	3.6%	3.7%
14	Non-energy use of energy	1000 t.n.e.	930	833	522	516	494	321	257
15	Non-energy use of energy	%	2.2%	2.2%	1.3%	1.3%	1.2%	0.8%	0.6%

4. Discussion

Thus, the problem of energy supply is becoming more acute every year. Human needs are constantly growing, as well as the number of people.

Exhausted resources will run out sooner or later, and the use of alternative sources and energy-saving technologies is not yet well established.

In such conditions, humanity is faced with a task of truly historical significance: switching to the use of reliable, completely safe energy sources for human life and the surrounding nature, its reasonable consumption, and a sustainable, economically efficient energy supply.

The problem can be attributed to the lack of investment in the development and modernization of energy production and transmission facilities [18,34].

There are different methods and solutions for a sustainable energy supply in the Republic of Kazakhstan in the context of globalization.

Energy efficiency refers to the rational and efficient use of not only fuel but also energy resources. In the Republic of Kazakhstan, the System Operator of the Unified Electric Power System and the manager of the National Electric Grid is JSC «KEGOC» (Kazakhstan Electricity Grid Operating Company).

One of the strengths of KEGOC JSC is the strategic role of the company in the economy of Kazakhstan. In 2014, KEGOC JSC received the status of a System Operator, which defined it as the owner and operator of the National Electric Grid (NES). This status gives the company exclusive rights to transmit electric energy through the NES networks, including inter-regional and interstate power transmission lines.

Now, the largest shareholder of KEGOC JSC is the Samruk-Kazyna National Welfare Fund, which owns 90% plus one share. The mission of the NWF is to increase the national welfare of Kazakhstan by increasing the long-term value of the companies included in the fund and the effective management of their assets. The Fund contributes to the implemen-

tation of the company’s investment programs, which improves and increases the efficiency of its operating activities by supporting relationships with leading industrial consumers of electricity and the export market.

To successfully improve the energy efficiency of an industrial enterprise, it is necessary to develop an energy strategy based on the cycle presented by (Figure 5).

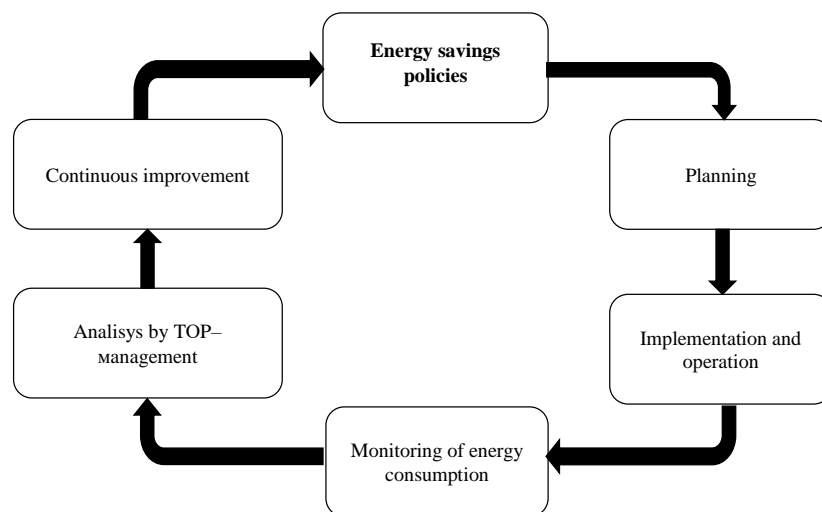


Figure 5. Industrial energy efficiency improvement strategy. Note: compiled by the authors.

The execution of such an algorithm for implementing an energy management system will allow for creating an enterprise of an energy efficiency management system; working out a strategy to provide energy resources linked to the company’s development strategy; ensuring the required energy efficiency by maintaining equipment in a safe and operable condition; implementing a system of operational improvements associated with relatively low investments; and developing a strategy for the introduction of alternative sources of energy supply by taking into account the territorial potential, the cost of energy resources, and the characteristics of production cycles.

In the field of the company’s capabilities, the main direction is innovative development through the use of advanced technologies and technological solutions by applying state financial support mechanisms. The use of advanced management technologies is an important factor to improve efficiency, which allows for reducing capital and operating costs and increases the competitiveness of the company.

Starting from January 2019, the electric power market will be organized, the main purpose of which is to ensure the balance and reliability of the power system of Kazakhstan.

The main benefits of this direction of economic development are shown in Table 5.

Table 5. Benefits of increasing the level of energy efficiency. Note: compiled by the authors according to the data UNEP «Green Energy Choices: The Benefits, Risks and Trade-Offs of Low-Carbon Technologies for Electricity Production; Summary for Policy Makers» [Report UNEP, p. 3].

For the Country’s Economy	For the Business Sector
Transition to a model of sustainable development that ensures economic growth and increased income and employment of the population; Reducing dependence on imports of fuel and energy resources and increasing the level of energy security of the state; Development of knowledge-intensive industries and improvement in the qualification level of the population.	Improving the profitability of the company and the competitiveness of its products; Solving a complex of environmental and social problems that are especially noticeable in energy-intensive sectors of the economy; Development of a socially oriented business model and demonstration of commitment to the concept of sustainable development.

Today, within the framework of the Concept for the Transition of the Republic of Kazakhstan to a “green economy”, approved on 30 May 2013, systemic transformations in energy conservation, energy efficiency improvement, and the development of the electric power industry are of great importance.

To successfully improve the energy efficiency of an industrial enterprise, it is necessary to develop an energy strategy, which, in our opinion, consists of five key areas, as presented in Figure 6.

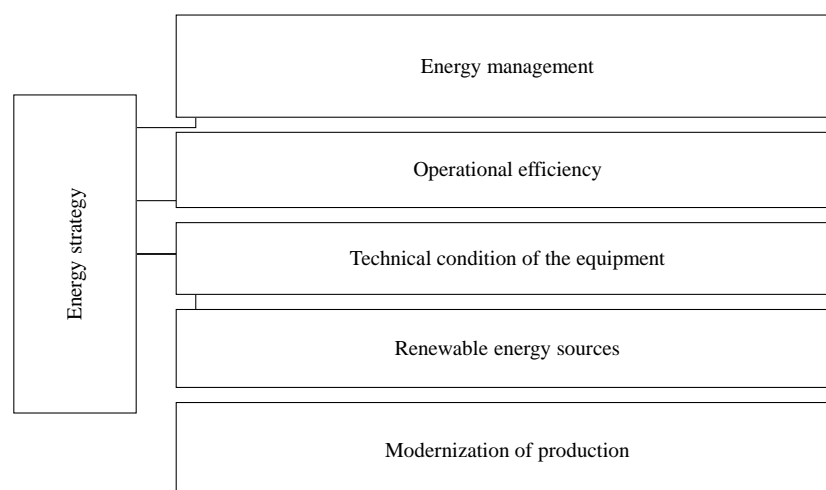


Figure 6. Key directions of the energy policy of industrial companies.

The implementation of the five strategic directions presented in Figure 6 will allow the following:

- The creation of an enterprise energy efficiency management system;
- The development of a strategy for providing energy resources linked to the company’s development strategy;
- Ensuring the required energy efficiency by maintaining the equipment in a safe and operable condition;
- The implementation of a system of operational improvements associated with relatively low investments;
- The development of a strategy for the introduction of alternative sources of energy supply by taking into account the territorial potential, the cost of energy resources, and the characteristics of production cycles.

In general, a comparative analysis of the production and consumption of energy resources in Kazakhstan with the countries of the near and far abroad showed that the production and consumption of energy resources in the countries has a general trend of growth, which slowed down in 2009, particularly in terms of the consumption of energy resources. In a number of countries, there is a decrease in the consumption of energy resources, including Kazakhstan, and there is a stabilization at the level of the previous year without a decrease in volumes. These circumstances are a consequence of the global decline in the pace of industrial production. The exceptions are countries characterized by intensive expansion of production (China and India).

As a result of the analysis, it was determined that having great potential, Kazakhstan faces difficulties in the implementation due to the existing problems in the energy sector, which were grouped into the following main blocks: the structure of raw materials’ orientation of the Republic’s economy; the shortage in providing the domestic market with products of the final consumption cycle; an undeveloped transport system; the absence of its own high-tech production of primary petrochemical products, as well as moral and physical wear of equipment in the republic.

Kazakhstan's institutional reforms include the formation of a modern, professional, and autonomous state apparatus, ensuring the rule of law, industrialization, and economic growth based on diversification, a nation of a single future, as well as a transparent and accountable state.

5. Conclusions

We will note the main prospects of the energy industry of Kazakhstan. In the field of the company's capabilities, the main direction is innovative development through the use of advanced technologies and technological solutions by applying state financial support mechanisms. The use of advanced management technologies is an important factor to improve efficiency, which allows for reducing capital and operating costs and increases the competitiveness of the company.

To determine the role of the energy sector in the development of the economy of Kazakhstan, a method was used to define the relationship between the indicators of energy resources and that of economic development, for which a correlation analysis was used.

The analysis of the results of the analysis showed that there is a close relationship between the considered indicators of economic development and that of the volume of energy resources, which indicates a significant role of the energy industry in the development of the economy and improvement of the welfare of the country. The exceptions were a number of indicators reflecting the relationship with the import of energy resources.

The prospects of the energy industry are closely related to the resolution of the main problems and the realization of the inherent potential. As a result, the prospects for the development of the energy industry are associated with the following main aspects: changing the structure and scale of production; implementing the path for innovative development; and integrating into the global energy system.

An important contribution to the prospects for further development of the energy industry is played by the processes of "greening" industries and sectors of the economy, particularly the financial system. Currently, the "greening" of the financial system in our country is associated with the introduction of "green" sources of financing ("green" loans, "green" bonds, etc.). In Russia, at the end of 2018, the company "KhMAO Resource Saving" LLC carried out the first issue of "green" bonds in accordance with the principles of the International Capital Markets Association (ICMA). Kazakhstan has already issued the first "green" loan in the field of energy supply, in particular, street lighting in the city of Atyrau. These measures will certainly allow the accelerated transition of energy to the principles of "greening", that is, the activation of the use of renewable energy sources. It should be noted here some advantages of issuing "green" bonds for the issuer: assistance in implementing the requirements of environmental legislation, improving business reputation, expanding the investment base, and compliance with international standards.

Accordingly, there are benefits for investors: transparency and accountability of investments, greening of the investment portfolio, financial profitability along with environmental impact, and the implementation of regional sectoral, national, and global environmental policies.

In order to improve the energy supply in Kazakhstan, the following recommendations are suggested:

- Introduction of indicators on renewable sources through the use of forms of accounting for electric and (or) thermal energy produced by qualified energy-producing organizations and a report on the production of electric and (or) thermal energy produced by qualified energy-producing organizations, which are defined in the Rules for Monitoring the Use of Renewable Energy Sources;
- Determination of energy-efficiency indicators by taking into account the review of the energy policy of the IEA countries (Energypoliciesofieacountries) and the experience of individual states;
- The use of statistical data on energy indicators at the sector level in accordance with the collection "Energy Indicators of Stable Development: Guidance and methodology",

which was developed jointly by a number of international organizations (including the IEA and Eurostat).

To minimize the risks associated with the disruption of transit, we consider it appropriate to offer implementation of the following measures:

- The implementation of constant monitoring of funds' receipt for the payment of contracts for the of electric energy transit's provision to the energy systems of Central Asian countries;
- The implementation of claim and contract management aimed at the proper protection of the company's interests and rights when interacting with counterparties;
- The development of an emergency plan for the separation of the work of the UES of Kazakhstan from the energy systems of Central Asian countries in cases of a sharp deterioration due to the socio-economic situation.

For further improvement of energy supply, there are criteria for acceptable "green" projects. We will highlight the criteria for acceptable "green" projects: renewable energy sources, energy efficiency, pollution prevention and control, sustainable management of water resources and wastewater, environmentally efficient and adapted products of a waste-free economy, production technologies and processes, environmentally sustainable management of living natural resources and land use, conservation of terrestrial and aquatic biodiversity, environmentally friendly products, adaptation to climate change, and "green" construction.

Therefore, the attention to the problem of improving energy efficiency is explained not only by its importance in the global economy but also by the fact that this issue is becoming global and comprehensive.

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