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## **Assessment of the role of fuel and energy resources in ensuring the energy security of Kazakhstan**

This article is devoted to the assessment of the role of fuel and energy resources of energy security in Kazakhstan. At the same time, the definitions of «energy security» are considered, the structure of the fuel and energy resources of the country, which are important for the state, is evaluated by various indicators that are strategically important for the development of the state's economy. Promotion of the country's economy is impossible without modernization of the existing technology, which allows to increase the efficiency of fuel and energy resources not by percent, but by several times due to utilization of losses and involvement of renewable energy sources in the turnover. The main problem is that the concept of its provision goes beyond the uninterrupted supply of energy resources for the needs of the economy, the world community has faced fundamentally new problems that require a change in traditional approaches to ensuring the energy security of the country.

*Keywords:* energy security, fuel and energy resources, balance of resources and distribution of crude oil, power plants.

In the Strategy «Kazakhstan–2050» the first President of the Republic of Kazakhstan drew attention to the fact that «... Kazakhstan is one of the key elements of global energy security. Our country, which has large reserves of world-class oil and gas, will not deviate from its policy of reliable strategic partnership and mutually beneficial international cooperation in the energy sector» [1]. In this regard, it is required from the public authorities of a reasonable, rational and effective implementation of long-term activities aimed at ensuring the energy security of the country

Every year there is an increase in energy consumption and meeting demand is a priority. We can say that at the moment ensuring energy security is an urgent direction, which has increased significantly in recent years due to the action of both internal and external factors.

In Western literature, many researchers in this area of the 2000s [2] have formulated energy security as «4As»:

- availability (availability of resources in a geological sense);
- accessibility (the ability to access resources in a geopolitical sense);
- affordability (acceptability of supply in the financial and economic sense);
- acceptability (acceptable terms of delivery in a social and environmental sense).

Meanwhile, there are some doubts that the 4As formula is unlikely to help conceptualize the «new» paradigm of energy security, since it is generally believed that energy security means different things in different situations for different people.

This observation has a logical explanation.

Firstly, the energy system of one country is different from another; accordingly, there are different problems and different tasks to solve them.

Vo-the second, the concept of energy security applies to other issues in the field of energy, since energy poverty and ending with climate change issues.

In this regard, energy security depends, first of all, on the degree of provision of countries with energy resources. It can be distinguished:

- countries with small own stocks;
- countries with an average supply of energy resources;
- countries rich in their own resources.

In the first case, countries are heavily dependent on imports and energy security is often understood to a greater extent as «security of supply» — the creation of guaranteed internal and external energy sources in order to overcome external energy dependence, that is, «4As» mentioned above. This is confirmed by the wording of the name of the EU energy strategy, which sounds like «Strategy for ensuring the security of energy supply». This approach reflects the vision of the problem of energy security solely on the part of importing countries [2].

For the second category of countries with medium energy reserves, the ability to meet energy needs on their own is of great importance. In the case of a relatively rich own resource base, the main emphasis is on maintaining the so-called «demand stability» [3, 4].

Thus, energy security is classified into «security of supply», «the possibility of providing own energy resources» and «stability of demand».

A definition is widespread in the world community, which is presented by the World Energy Council: energy security is the belief that energy will be available in the quantity and quality that is required under given economic conditions [5]. That is, the ability of the state's fuel and energy complex to meet the energy needs of its economy through the production of fuel and electricity of the required quantity and quality, delivering at an affordable price to ensure the normal functioning of the economy and its development, the existence of the nation and the protection of its interests.

An analysis of the definitions of the concept of «energy security», which are presented in various sources, allows us to talk about its multifaceted nature, since energy security:

1) is an integral part of economic security, as well as the entire national security system. Therefore, the state implements tactical and strategic measures of influence on energy security with the help of economic, organizational and legal mechanisms and their tools (investment, tax, price, licensing, monetary, regulatory and others);

2) depends primarily on the degree of provision of countries with energy resources. Therefore, the key role in energy relations is assigned to the interests of states seeking to ensure maximum access to energy resources, or the most favorable conditions for the sale of their energy resources on world markets;

3) is defined as the state of protection of an object from internal and external threats, in which the state is able to ensure energy independence and sustainable development to meet the needs of society and the state in energy resources;

4) involves ensuring the sustainable functioning of the fuel and energy complex. Damage to fuel and energy facilities (nuclear and hydroelectric power stations, oil platforms, gas and oil pipelines, hydrocarbon storage, power lines and others) can lead to emergencies and significant losses for the national economy.

At the present stage of development, the fuel and energy complex (FEC) management system in Kazakhstan is undergoing active transformations. One of the elements of the program of broad socio-economic modernization of the economy is to increase the level of energy security. This problem is considered as the primary problem that predetermines a long-term state development strategy. The resolution of energy security management issues as one of the most important links in the economically sustainable development of the fuel and energy complex is caused by the ever-increasing threats to national economic security, due to the increased influence of the energy factor.

Consider the structure of the fuel and energy balance of the Republic of Kazakhstan for 2012–2016 (Table 1).

Compared to last year, the extraction (production) of fuel and energy resources (hereinafter referred to as FER) increased by 4.8 %, the share of which in the resource part amounted to 75 %.

In 2017, 298.3 million tons of standard fuel or 74.3 % of the total fuel and energy resources were consumed in the domestic market of the republic, of which 16.1 % was spent on conversion to other types of energy and 34.7 % was spent on production and technological and other needs.

Due to the significant reserves of fossil fuels, according to the World Bank (hereinafter referred to as the World Bank), Kazakhstan is one of the twenty world leaders in the production of primary energy resources with a total annual volume of about 160 million tons of oil equivalent [6]. According to the IEA and the World Bank, in terms of the level of consumption of primary energy resources, the republic, in view of the relatively low population and the corresponding scale of the economy, is in the world ranking at 28th place, which corresponds to 0.6 % of the total primary resources consumed in the world. At the same time, British Petroleum (hereinafter — BP) estimates the volume of domestic consumption of primary energy resources in Kazakhstan at the level of 60 million tons of oil equivalent, which corresponds to 34th place in the world.

According to the IEA, the largest share of primary resource consumption in Kazakhstan is accounted for by coal (more than 34 million tons of oil equivalent), which is the main type of fuel in Kazakhstan's energy sector. Significant volumes of gas consumption (about 28 million toe) are largely due to its active use (up to 67 %) in the oil and gas sector. The consumption of petroleum products is at the level of 12 million tons of oil equivalent. More than a third of the primary resources consumed in the Republic

of Kazakhstan are in the energy sector, a quarter in industry, while other categories (transport, agricultural, population) consume about 35 %.

The oil and gas industry is the «locomotive» of the economy of Kazakhstan, provides the largest influx of foreign investment and technology into the country, and allows accumulating financial reserves for the development of non-resource sectors and overcoming periods unfavorable for the economy.

Table 1

**The structure of the fuel and energy balance of the Republic of Kazakhstan for 2013–2017**

Indicator	Thousand tons. with fuel					Percentage of total				
	year									
	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Resources — total	347 342	349,660	383 601	377,404	401 578	100.0	100.0	100.0	100.0	100.0
Balances at the beginning of the year	17,400	19 912	18 952	17,546	15 389	5.0	5.7	4.9	4.6	3.8
Looted (produced)	301 112	295 729	287 174	286 645	300,460	86.7	84.6	74.9	76.0	74.8
Received from all sources	12 551	24,039	66,373	60 988	73,860	3.6	6.9	17.3	16.2	18.4
Import	16,280	9 981	11 102	12 225	11 870	4.7	2.9	2.9	3.2	3.0
Distribution — total	347 342	349,660	383 601	377,404	401 578	100.0	100.0	100.0	100.0	100.0
Consumed within the republic	139 572	147 543	149,619	146 806	236 395	40.2	42.2	39.0	38.9	58.9
– for the production of electric and thermal energy	55 311	62 144	43,599	44 127	48 113	15.9	17.8	11.4	11.7	12.0
– on production technology and other needs	84,260	85 399	106 020	102 679	103 413	24.3	24.4	27.6	27.2	25.8
Losses	9 806	8 339	6,707	7,788	5,798	2.8	2.4	1.7	2.1	15.4
Other consumption	21,492	21,068	51 957	55,025	61 853	6.2	6.0	13.5	14.5	5.7
Released to other enterprises and the public	16 387	21,877	23,291	23,484	23 016	4.7	6.3	6.1	6.2	1.4
Export	139 960	130,088	134 339	128,684	145,312	40.3	37.2	35.0	34.1	36.2
Bunkering	8	85	142	235.4	245	0.002	0.02	0.04	0.1	0.06
Balances at the end of the year	20 118	20 661	17,546	15 389	13,827	5.8	5.9	4.6	4.1	3.4

Note. Compiled by the author of the source [7].

In Kazakhstan, to one degree or another, all the redistribution of the oil industry is present, but the most developed sector is the extraction of hydrocarbons. Crude oil in 2017 amounted to 87 million tons, including 72.9 million tons of production in the republic and 0.02 million tons of imports. Of the total resources on the internal eat Debt E intake was about 16.3 Mill. Tons and released on the export of 67.8 Mill. Tons (Table 2).

Table 2

**Analysis of resource balances and crude oil distribution**

Indicator	2013 y.	2014 y.	2015 y.	2016 y.	2017 y.	2017/2016, %
1	2	3	4	5	6	7
Resources, thousand tons	79 962.7	71 996.3	80 593.2	80,039.9	86 997.2	108.6
Remaining fuel at the beginning of the year	3 217.4	3,292	2 743.5	2 161.1	2,435.8	112.7
Production (mining)	69 483.6	67 908	66 520.6	65,569.6	72 924.9	111.2
Other income	-	624.5	11,278.1	12 302.2	11 613.4	94.4
Import	7 261.7	171.8	51.1	7.0	23	3 times
Distribution	79 962.7	71 996.3	80 593.2	80,039.9	86 997.2	108.7

1	2	3	4	5	6	7
Used up — total	19 216.5	16 503	15 705.8	16,270.7	16,276.6	100.3
for the production of electric and thermal energy	98.1	eleven	11.7	13	eleven	84.6
for production and technological and other needs	16 567.9	16,492	15 694.1	16 257.8	16 265.5	100.1
Other consumption	2 550.5	-	-	-	-	-
Released to the public	-	-	-	-	-	-
Losses	577.4	553	346.1	364.1	388.1	106.6
Export	56 884.5	52 008.7	62,380.3	60 969.3	67 839.4	111.3
Remaining fuel at the end of the year	3 284.2	2 931	2 161,1	2 435.8	2 493.1	102.4

*Note.* Compiled by the author of the source [7].

Currently, most of the fields developed in the Republic of Kazakhstan are characterized by a low oil recovery ratio (CIF). Moreover, in the period since 1995, there has been a decrease in the average CIN for the country from 42 to 25 %.

The volume of oil production (including gas condensate) in Kazakhstan in 2017 increased by almost three times: in 1991 26.6 million .T onn to 73 million tons. In terms of oil production, Kazakhstan ranks 17th in the ranking of oil producing states and 2nd place among the CIS countries, second only to Russia.

The share of the oil and gas sector in the structure of Kazakhstan's GDP is more than 20 %, including all types of activities (production, processing, transportation and related services). Oil accounts for more than 65 % of the country's total export revenue, half of total government revenue is oil revenue. Demand for petroleum products is partially filled by their imports (Table 3).

Table 3

**The production of petroleum products in Kazakhstan for 2013–2017 yy.**

Indicator	2014 y.	2015 y.	2016 y.	2017 y.	2017/2016, %
Gasoline, thousand tons	3 023	2 864.1	2 938.9	3 054.7	103.9
Kerosene	113,828	33,400	1,700	600	64.7
Gasols (diesel)	5,039	4,488	4,652	4 352	94.6
Fuel oil	3,877	3 899, 4	3 101	3 36 4,5	109.7
Oil and shale bitumen	602,2	599.9	604.6	809.4	109.7

*Note.* Compiled by the author of the source [7].

In 2017 compared to 2016 production of heating oil increased by 8.5 %, motor gasoline by 3.9 %, oil and shale bitumen by 9.7 %, gas oil production decreased by 6.4 %, as well as kerosene by 35.3 %.

Due to insufficient refining infrastructure and relatively low market capacity, Kazakhstan is noticeably behind the majority of oil producing countries in terms of the share of crude oil consumed in the domestic market. At present, the main consumers of oil in the republic are three large oil refineries — Atyrau (Atyrau Refinery), Pavlodar (Petroleum Refinery) and Shymkent (PKOP). The total capacity of all primary processing plants in Kazakhstan is 15 million tons per year. Although these plants are capable of providing deep oil refining, relatively simple technologies are generally applied to them. As a result, in the oil refining industry of Kazakhstan there is a pronounced bias towards the production of fuel oil (residual oil fuel), which does not correspond to the structure of domestic demand for oil products. Kazakhstan's oil refineries currently collectively cover only about 87 % of domestic demand; the remaining 13 % is accounted for by imports (Table 4 ).

Table 4

**Consumption, export, import of motor gasoline by region of Kazakhstan for 2017**

	Domestic consumption	Export	Import
Akmola	185.2		9.8
Aktobe	148.4	2,3	19.9
Almaty	559.6		21,4
Atyrau	647.1		1.8
West Kazakhstan	368.7		37.0
Zhambyl	433.8		17.4
Karaganda	246.8		
Kostanay	167.3		10,4
Kyzylorda	162.5		
Mangystau	69.1		
South Kazakhstan	1,030.2		
Pavlodar	1 306,2		
North Kazakhstan	174.5		166.6
East Kazakhstan	338.8		
Nur-Sultan city	393.0		70.8
Almaty city	724.9		717.7
The Republic of Kazakhstan	6956.1		1072.8

*Note.* Compiled by the author of the source [7].

A major refinery modernization program is currently being implemented, after completion, by which the range of products will change significantly — a larger share in it will belong to light oil products (motor fuel).

As of January 1, 2018, according to the assessment of the State Commission on Mineral Reserves of Kazakhstan (GKZ), gas reserves in the country (state balance) were estimated at 4 trillion. m<sup>3</sup> (this indicator has remained at approximately the same level over the past few years). A distinctive feature of natural gas reserves in Kazakhstan is the fact that they are mainly represented by associated gas; therefore, gas production is carried out mainly simultaneously with the production of liquid hydrocarbons.

According to the results of 2017, the volume of gas production in the Republic of Kazakhstan amounted to 46.4 billion m<sup>3</sup>. At the same time, the main gas producing companies in Kazakhstan are Karachaganak Petroleum Operating (hereinafter — KPO) and Tengizchevroil LLP (hereinafter — TCO), whose gas production accounts for more than 75 %. Almost half of the gas produced in Kazakhstan is used for re-injection into the reservoir, consumed by subsoil users to meet other own needs, or burned. At the same time, the commercial production volumes at the field in 2017 as a whole remained at the same level (about 9.6 billion m<sup>3</sup>). As a result, Kazakhstan ranks 29th in the world ranking of commercial gas producers with a 0.6 % share in world production.

Unlike the export-oriented oil transportation system, the gas transmission system of Kazakhstan was created during the Soviet era for the transit of Central Asian gas. As a result, the share of transit in the total volume of gas transportation in Kazakhstan currently reaches about 80 %. For several years (until 2008), more than 100 billion m<sup>3</sup> of transit gas were pumped through the gas pipeline system per year.

The total length of gas pipelines is 15,265 km and a throughput of up to 180 billion m<sup>3</sup> / year. The main gas pipeline system of Kazakhstan includes 28 compressor stations with a total capacity of more than 2,000 MW.

There are three large gas processing plants in Kazakhstan (Kazakh, Tengiz and Zhanazholsky), and there is a gas processing scheme from the Karachaganak field outside the country at the Orenburg gas processing plant in Russia. The total capacity of the three above-mentioned plants is about 20 billion m<sup>3</sup> / year. Unlike other CIS countries with large volumes of energy consumption, the share of gas in the total structure of final consumption in Kazakhstan is not so significant and amounts to just over 13 billion m<sup>3</sup>.

With proven coal reserves of 33.6 billion tons (the balance sheet value is 34.1 billion tons), which is 4 % of the global total, Kazakhstan is one of the world leaders in coal production and consumption. The country ranks eighth in the world in terms of coal reserves, which are sufficient to maintain the cur-

rent production rate for at least 300 years. Kazakhstan ranks tenth in the world among the largest coal-mining countries; in 2015, the total volume of coal production amounted to 96.4 million tons [8].

Coal can literally, without exaggeration, be called the fuel of the Kazakh economy, since the share of coal in the country's fuel and energy balance is the highest among other former republics of the USSR. After 1990, the share of coal in the balance of total primary energy consumption was 50–60 %, exceeding 66 % in some years. Coal is widely used in the economy of Kazakhstan, especially in the electric power industry, heavy and mining industries, in other sectors related to mining, and in the municipal sector.

Power plants are the largest consumers of coal, which account for more than half of total consumption (68 % in 2017). The shares of metallurgy and other industries in the overall structure of coal consumption are comparable with the indicator characteristic of the municipal sector (approximately 17–18 % of the total consumption). More than 25 % of the coal mined in Kazakhstan is exported (in 2016, net exports amounted to about 34.2 million tons). Obviously, Kazakhstan could supply abroad large volumes of coal, if not for remoteness from the largest export markets and, accordingly, high transport costs.

The electric power industry includes the production, transmission and supply of electric and thermal energy and is the basis for the functioning of the economy and the country's livelihoods. The Unified Electric Power System of Kazakhstan (UES) works in parallel with the UES of Russia and the unified energy system of Central Asia. Electricity production in Kazakhstan is carried out by 69 power plants of various ownership forms. The total installed capacity of Kazakhstan's power plants as of January 1, 2018 is 21.3 GW; available power — 17.5 GW. Gaps and power limitations amounted to 3800 MW. In 2017, electricity generation amounted to about 94 billion kWh, its consumption — 92.3 billion kWh.

Kazakhstan has 8 power plants of national importance, 15 — industrial power plants, and 46 — regional power plants. Electric networks include: power lines with a voltage of 0.4 — 1150 kV; electrical substations 0.4 — 1150 kV.

Electricity production in 2016 amounted to 82.7 billion kWh, 2017. — 91.5 billion kWh. In 2017, exports amounted to 5.7 billion kWh of electricity to Russia. Electricity is supplied from Russia, mainly, Western Kazakhstan consumers and Central Asia — the consumers of South Kazakhstan. Thus, 1.3 billion kWh of electricity was imported, of which 1 % from Kyrgyzstan, 99 % from Russia. Electricity consumed in the domestic market of the republic in 2017 city — 86 Bln. KW. ch that was from. Total resources — 87.7 %. Losses of electricity in 2017 amounted to 6.5 %.

Based on the current state of the fuel and energy complex in ensuring energy security, it is possible to determine whether the fuel and energy complex has internal forces and resources to realize the existing capabilities and counter threats, and which internal shortcomings need to be addressed as soon as possible.

Firstly, given the strategic importance of energy for the economy of Kazakhstan as a whole, it is not surprising that the energy sector is heavily influenced by the state.

Secondly, a consistent policy in the energy sector allowed Kazakhstan to create a National Fund for managing the country's oil wealth.

Thirdly, despite the increase in production of basic hydrocarbons, a sufficient influx of investments, the implementation of various projects, as well as the improvement of a number of indicators, the industry has systemic problems associated with high costs of transporting energy resources and a high level of depreciation of fixed assets.

Fourth, public administration is aimed at a «multi-vector» approach to the energy development strategy, however, regulatory documents with the EAEU countries are not well developed.

Fifth, despite the identified weaknesses and threats, the fuel and energy complex of Kazakhstan has enormous opportunities for the use of natural gas in the transport sector, the development of a large petrochemical industry based on gas, the alternative use of coal as fuel (coal chemistry) and the development of the nuclear industry.

The above factors suggest that despite the existing pros and cons, further advancement is impossible without modernizing the existing technology, which allows increasing the efficiency of the use of fuel and energy resources not by percent, but several times due to the utilization of losses and the involvement of renewable energy sources in the turnover.

From the point of view of public administration, energy security should be ensured in conjunction with economic, environmental and social factors, since energy security determines the degree of protection of the fuel and energy complex and energy systems from threats that can destabilize the uninterrupted supply of fuel and energy resources to the population and the economic complex. And, and thereby undermine its economic and social development.

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### **Қазақстанның энергетикалық қауіпсіздігін қамтамасыз етудегі отын-энергетикалық ресурстардың рөлін бағалау**

Мақала Қазақстандағы энергетикалық қауіпсіздік үшін отын-энергетикалық ресурстардың рөлін бағалауға арналған. Сонымен бірге «энергетикалық қауіпсіздік» анықтамалары қарастырылған, мемлекет үшін негіз болып табылатын отын-энергетикалық ресурстар элементтерінің құрылымын мемлекет экономикасын дамыту үшін стратегиялық маңызды әртүрлі көрсеткіштер бойынша бағалау берілген. Қолда бар технологияны жетілдірусіз ел экономикасын алға жылжыту мүмкін емес, бұл отын-энергетикалық ресурстарды пайдалану тиімділігін пайыздық емес, бірнеше есе арттыруға, шығындарды жоюға, сонымен қатар жаңартылатын энергия көздерін айналымға тартуға мүмкіндік береді. Негізгі проблема — экономиканың қажеттіліктері үшін энергия ресурстарын үздіксіз жеткізумен ғана шектелмей, әлемдік қоғамдастық алдында елдің энергетикалық қауіпсіздігін қамтамасыз етудің дәстүрлі тәсілдерін өзгертуді қажет ететін түбегейлі жаңа проблемалар пайда болуды қамтамасыз ету тұжырымдамасы болып табылады.

*Кілт сөздер:* энергетикалық қауіпсіздік, отын-энергетикалық ресурстар, ресурстар теңгерімі және шикі мұнайды бөлу, электр станциялары.

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### **Оценка роли топливно-энергетических ресурсов в обеспечении энергетической безопасности Казахстана**

Статья посвящена оценке роли топливно-энергетических ресурсов энергетической безопасности в Казахстане. При этом рассмотрен термин «энергетическая безопасность», приведена оценка структуры основополагающих для государства элементов топливно-энергетических ресурсов страны различными показателями, которые являются стратегически важными для развития экономики государства. Продвижение экономики страны невозможно без модернизации существующей технологии, позволяющей повысить эффективность использования топливно-энергетических ресурсов не на проценты, а в несколько раз, за счет утилизации потерь и вовлечения в оборот возобновляемых источников энергии. Основная проблема заключается в том, что концепция ее обеспечения выходит за рамки бесперебойной поставки энергоресурсов для нужд экономики, перед мировым сообществом возникли принципиально новые проблемы, требующие смены традиционных подходов к вопросу обеспечения энергетической безопасности страны.

*Ключевые слова:* энергетическая безопасность, топливно-энергетические ресурсы, баланс ресурсов и распределения сырой нефти, электростанции.

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