POLITYKA ENERGETYCZNA – ENERGY POLICY JOURNAL

2022 ✦ Volume 25 ✦ Issue 4 ✦ 27–38

DOI: 10.33223/epj/154809

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Questions of cost and pricing in the conditions of the functioning of the electricity market of Kazakhstan

Abstract: The electric power sector is analyzed from the standpoint of well-being and a number of political priorities are considered that go beyond the traditional tasks of the so-called "energy trilemma", namely reliable, affordable and carbon-free energy. This shows the importance of solving the problem at different levels as it can help the Government of Kazakhstan more reliably achieve synergy between actions to combat climate change and other priorities and, consequently, achieve double harmonization. The purpose of the study is to consider the cost and pricing surveys in the conditions of the functioning of the electricity market of Kazakhstan. Electricity is of key importance for human well-being. Electricity is highly necessary for many basic services, infrastructure and eco-

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nomic activities. Despite the increase in energy efficiency, the global electricity demand increased by 115% between 1990 and 2020, which is significantly higher than the population growth rate over the same period. This trend will undoubtedly continue conditioned upon economic growth, increased access and the electrification of end users. The assessment of electricity generation technologies from the point of view of well-being requires the use of the full cost method, which includes all applicable external costs, risks and benefits to determine the low-carbon energy balance, which in the Republic of Kazakhstan, is compatible with sustainable development. This assessment clearly needs to go beyond the plant level to consider the network infrastructure and demand to get a holistic view of the social costs of electricity. The practical significance lies in the analysis of cost and pricing in the conditions of the functioning of the electricity market of Kazakhstan.

Keywords: electricity market, pricing, consumers, transportation, regional grid companies

Introduction

In 2019, electricity production in Kazakhstan at 128 power plants reached 102.3 TWh. At the end of 2019, the total installed capacity was 21.673 MW, and the actual available production capacity was 18.791 MW, where the difference between these two values is due to the age and dilapidation of some assets and losses associated with the transmission system. In the first half of 2018, electricity production reached 54.7 TWh, and consumption was 51.5 TWh. Exports account for about 5.7% of the total electricity production and are mainly intended for Russia, Uzbekistan and Kyrgyzstan. Because the electric power transportation and distribution network was integrated into the electric network of the former USSR, Kazakhstan should adapt and supplement its network to unite it throughout the country (Burns 2019). The country still imports electricity to power its western and southern regions. Kazakhstan's "thermal" power plants, especially the largest – Ekibastuz GRES-1, Ekibastuz GRES-2, Aksu GRES and Zhambyl GRES – are mainly coal fired. It forms the basis of the unified power grid of Kazakhstan and provides communication between different regions and with the electric power systems of neighboring countries, including the transmission of electricity between power plants and consumers in the wholesale market (Dahl and Kuralbayeva 2020; Arblaster and Hooper 2018).

Almaty University of Energy and Communications, named after G. Daukenov, has significant potential for conducting research and scientific work in the field of electrical and thermal power engineering. In the course of its activities, it successfully carries out work and cooperates with the Government of the Republic of Kazakhstan, in particular, with the Ministry of Energy, the Committee for Regulation of Natural Monopolies ("CREAM"), Samruk-Energo GC, the system operator of KEGOK JSC, the operator of the centralized trade market of KOREM JSC and many other entities in the electric power industry. The state-owned Kazakhstan Electric Grid Management Company KEGOC owns substations, switchgears, interregional and cross-border lines, and lines from power plants with a voltage of 220 kV and higher, which make up the national

electricity transmission network (Chao 2020). In accordance with the procedure established by the Agency for Natural Monopolies, the network operator KEGOC JSC, regional electric companies and other persons owning electric networks are obliged to guarantee all participants free access to the electric energy market. Wholesale market participants also have unlimited access to the national electricity transmission network for their activities (Arentsen and Kunneke 2019).

A message from the Head of State Kassym-Jomart Tokayev set a number of priority economic tasks arising from the need to attract investment in basic industries to increase labor productivity by at least 1.5 times and limit inflationary processes (Message of the… 2021). At a meeting of the Chambers of Parliament on August 28, 2020, it was noted that there was a need for a systematic approach to pricing and tariffs. Furthermore, the main task is to create and develop market institutions and mechanisms in the energy sector using its own potential and international experience for diversified investments in generating capacities and the completion of the reforms initiated with the stabilizing role of the state. In this direction, the main principles of building a system of electricity tariffs should be: compliance with strategic energy objectives; performance of economic, financial and political functions; calculation of the average price for electricity; ensuring the competitiveness of electricity compared to other types of energy carriers; state regulation; unification of the tariff across the country; differentiation or lack thereof across the country; regulation tariffs by hours of the day, season of the year; adjustment of the tariff level depending on external factors (Hage and Rufin 2019; Glachant and Perez 2020; Kozhageldi et al. 2022).

The purpose of this study is to consider the issues of cost and pricing in the conditions of the functioning of the electricity market of Kazakhstan.

1. Materials and methods

The basis of the methodology of this article are the following approaches to the study of this topic: monitoring, comparative and functional. The monitoring method is a systematic process of collecting, analyzing and using information to continuously determine the progress of Kazakhstan's electric power program in achieving its goals and for making management decisions. It usually focuses on processes, including when and where actions occur, who performs them, and how many people or organizations are covered by them. Monitoring is carried out from the moment of the start of implementation and continues throughout the entire period of performance assessment by justifying the dynamics of pricing and cost in the electricity market. It focuses on both expected and achieved achievements, and explores the chain of results and cause-and-effect relationships to understand achievements and the lack of achievements. Its assessment is aimed at determining the relevance, impact, effectiveness, effectiveness and sustainability of various interventions affecting the price, and should provide factual information that is reliable and useful.

The comparative approach helps to increase the competitiveness of various companies operating in the same energy sector, and gives an idea of maintaining quality and service, including various aspects that facilitate understanding of the strengths and weaknesses of the selling prices of the relevant organizations. This is a natural process that structures the most common categories of reasoning, and is also a means of scientific knowledge. Its main difficulty lies in the lack of consensus on the goals and methods of comparative analysis among the largest companies. Moreover, there are many typologies of comparison levels, and therefore, comparative comparison is only one strategy among others. Adherence to it implies certain methodological precautions for the comparability of cases. Comparative analysis can also be applied to the coefficients and balance sheets of the financial statements of energy companies represented on the market of Kazakhstan. Its comparison allows measuring of the financial performance of the company by comparing it with the performance of competitors, and analyzing the levels of investment during the study period by the subjects of the electricity market.

The functional method is carried out not only by energy suppliers, but also by companies and local authorities, including consumers who themselves become producers. It allows understanding and measuring changes in the market, supporting internal innovations in the context of the transition to energy consumption, evaluating and optimizing the quality of customer service in a multi-channel context, expecting efficiency, smoothness and simplicity. Thanks to the functional paradigm, the problems that suppliers may face in the current conditions of rising prices in the energy markets are also considered, which formulates certain ways to improve competition between suppliers in the interests of consumers. In the electricity market, the increase in prices for natural gas and coal mainly explains the current price increase and, to a lesser extent, the increase in the price of a ton of CO_2. Nevertheless, the price of CO_2 remains a structural factor contributing to the growth of electricity prices in the medium term. The functional analysis of components is a process in the field of information and documentation that allows looking at issues and problems related to the electricity market of Kazakhstan.

2. Results and discussion

Kazakhstan is assuming a transition to a “green” economy in the coming decades, which is a huge problem, since the country is heavily dependent on carbon resources for both its economy and its energy system. In this context, there is a lack of comprehensive and transparent planning tools to assess possible ways of sustainable development in terms of their technical, economic and environmental consequences (Hobman 2018). In general, the model can easily be used to analyse the least costly dispatching of the existing Kazakh electric power system and can be easily expanded to assess the development of the sector. Among other possible applications include investments in transmission lines and an aging fleet of power plants, scenarios and assessment of emission reduction policies, as well as issues of liberalization and market structure.

More than 70% of electricity in Kazakhstan is produced at coal-fired power plants, which consume a large amount of cheap coal mined in the north and east of the country. There are fewer deposits of the same type in the south of the country, so energy has to be imported there from neighboring countries and from the north of the country. Unfortunately, this happens with large losses of up to about 14% due to aging power lines. The policy of the Kazakh authorities is aimed at overcoming difficulties with electricity supply and reducing emissions of carbon dioxide. Conditioned upon its geographical location and climatic conditions, the state has the potential to be a developed energy country, since favorable climatic conditions and high demand for electricity prevail. Predominantly located cities have the potential for the development of hydropower along large rivers, in such regions as East Kazakhstan, Almaty, Zhambyl and South Kazakhstan. We are talking, in particular, about the Irtysh River basin and its largest tributaries: Bukhtarma, Uba, Ulba, Kurchum, Karjil, Syrdarya, Talas and Chu in the south. The steppes offer great opportunities for the development of wind farms in the country because 50% of the territory of Kazakhstan has an average wind speed of 4–6 m/s. The most attractive regions for wind power are the north, the center of the country and the regions on the Caspian Sea (Glas 2019; Lefouili 2020).

When planning any reforms related to the production, pricing and distribution of electricity in Kazakhstan, including from renewable energy sources, the authorities should consider the vast territory of the country and the vast distances for which energy is transmitted via high-voltage lines, and the differentiation of the economic activity of individual regions and the uneven distribution of the population across the country. In this context, it is necessary to point out the remoteness of the highly industrial western regions of Kazakhstan from the rest of the country. The next step for Kazakhstan should be the transition to the auction system, which is successfully used in many countries. This will help to choose and implement the most effective renewable energy projects using modern technologies. In 2017, Kazakhstan's electricity production was about 102.4 TWh (+8.8% per year), mainly provided by Soviet-era thermal power plants. Electricity is produced from 80.5% coal and 8.2% gas. The government introduced investment preferences for EnR projects, fixed preferential tariffs for fifteen years, and supplemented this system with the introduction of a partial indexation of the green tariff in the SLE and the creation of a reserve fund to cover short-term losses. An auction system for the purchase of electricity from renewable sources has been in operation since May 2018.

Industry and electricity transportation set tariffs and determine the tariff methodology. The committee does not have the right to authorize new facilities, but has the right to exercise control over purchases in limited circumstances. In cases of violation of the law, it issues mandatory regulations for market participants to eliminate such violations. If the actions of a regulated person cause damage to customers, activities related to the production, transmission and distribution of electricity, the operation of power plants, electrical networks and substations, and the purchase of electricity for resale, are subject to licensing (Hunt and Shuttleworth 2019; Kwon 2019). The daily schedules of the wholesale market, based on which the dispatching of loading management is carried out for the day ahead, work with regional dispatch centers for shipment to retail customers, and the state-owned KOREM manages the market for the day ahead, develops preliminary shipment schedules and implements the actual balances of supply and demand. The pool of the

reserve of electric power in Kazakhstan was created by the participants of the electricity market to provide a contractual reserve of power to ensure uninterrupted power supply to consumers in the event of accidents of generating capacities and power line outages. The LLP "Settlement and Financial Center for Support of Renewable Energy Sources" provides centralized purchase, sale and the supply of electricity produced by renewable energy facilities.

After the collapse of the Soviet Union, the Government of Kazakhstan was looking for an optimal pricing methodology that would be attractive enough for investors and fair enough for the end consumers of electricity. Since 2009, the methodology of charging in electricity supply has moved from costs to "marginal tariffs" (Yalcintas et al. 2020). In the period from 2009 to 2015, the program of the marginal tariff – the exchange rate for investments provided the necessary development of the power supply system. Power plants have reduced marginal costs after former president N. Nazarbayev instructed them to reduce electricity tariffs at the Security Council in November 2018 (Table 1).

Table 1. Marginal tariffs for electricity generation approved for the period from 2009 to 2015

Tabela 1. Taryfy krańcowe dla wytwarzania energii elektrycznej zatwierdzone na lata 2009–2015

Name by group	2009	2010	2011	2012	2013	2014	2015
Group 1 (EGRES-1.2. ECE)	3.60	4.68	5.60	6.50	7.30	8.00	8.80
Group 2 (ZHGRES)	5.90	6.50	6.90	7.90	8.30	8.50	8.70
Group 3 (Astana-Energy. Karenergocenter. PavlEnergo CHP-2.3. UKTEC. Ars Mitl)	4.30	4.94	5.40	5.90	6.40	6.90	7.50
Group 4 (Kar GRES-2. Al. Kazakhstan Balkhash CHP. Zhezk CHP)	3.50	3.80	4.10	4.55	5.10	5.50	6.00
Group 5 (Petrop CHP. Ridder CHP)	3.60	4.10	4.80	5.45	6.25	7.15	8.05
Group 6 (Sogrtets. KarGRES-1. Jet-7)	6.30	7.30	7.70	7.90	8.10	8.20	8.30
Group 7 (3-energoort. Atyrau CHP. Aktobe CHP. Tarazenergocenter)	4.90	5.40	5.90	6.30	6.70	7.00	7.30
Group 8 (Shakhtinskaya CHP. Tekeli CHPP. Kentausk. CHPP)	4.50	4.95	5.40	5.98	6.60	7.20	7.50
Group 9 (Arkalykskaya CHP. Ural thermal power plant. Cost. Fuel and energy complex)	5.28	5.56	5.88	6.28	6.70	7.12	7.60
Group 10 (AlES. CHP-1. CHP-2. CHP-3. Kapshag. Hydroelectric power station)	5.74	6.74	7.10	7.40	7.80	8.20	8.60
Group 11 (MAEK - Kazatomprom)	7.23	7.23	7.23	9.54	10.34	10.96	11.62
Group 12 (Zhanazhol. GTES. CHPP AZF)	5.30	5.80	6.40	7.00	7.70	8.40	8.80
Group 13 (Buh.HPP. UK HPP. Shard. HPP. Shulb. Hydroelectric power station. JSC "Moynakskaya HPP")	2.79	3.00	3.30	3.63	3.90	4.30	4.50

Despite this, many power plants have been allowed to increase their prices to cover the growing costs of transport, fuel, subsidies for renewable energy sources and other costs by approving new marginal electricity tariffs for a group of energy-producing organizations. The idea

of applying marginal tariffs was as follows: all electricity suppliers were divided into thirteen groups, and each group received its own tariff set for the next seven years, and the tariff for each group was independent of the other groups (Verschuren and Doorewaard 2020). The first seven years of application of marginal tariffs from 2009 to 2016 did not yield the expected results because no significant investments were made during this period. However, conditioned upon the lack of other alternatives in 2016, the application of marginal tariffs in Kazakhstan was extended until the end of 2025. From 2016 to 2018, energy supply organizations set marginal tariffs for electricity, and from 2019, the marginal tariffs were divided into two groups, the electricity tariff and the capacity tariff, defined for fifteen groups and valid until the end of 2025 (Wahyuda 2019). After 2015, the marginal tariffs were not approved, and their values did not change. In 2018, according to the Order of the Minister of Energy of the Republic of Kazakhstan (December 14, 2018, No. 514), the grouping of energy producing organizations (EPO) expanded and new marginal tariffs were approved from 2019 to 2025 (Table 2).

Table 2. Marginal tariffs for electric energy for 2019–2025

Tabela 2. Taryfy krańcowe dla energii elektrycznej na lata 2019–2025

Group of EPO implementing electric energy	Marginal tariffs for electric energy by year [tenge/kWh]						
	2019	2020	2021	2022	2023	2024	2025
1	2	3	4	5	6	7	8
2nd group	5.76	5.8	7.25	7.25	7.25	7.25	7.25
Group 2	4.5	5.55	6.94	6.94	6.94	6.94	6.94
Group 3	7.73	9.13	9.69	9.69	9.69	9.69	9.69
Group 4	5.83	7.5	9.21	9.21	9.21	9.21	9.21
Group 5	8.1	9.1	11.42	11.42	11.42	11.42	11.42
Group 6	–6.7	7.91	9.92	9.92	9.92	9.92	9.92
Group 7	6.44	7.72	9.68	9.68	9.68	9.68	9.68
Group 8	–6.7	8.38	10.09	10.09	10.09	10.09	10.09
Group 9	5.06	6.17	7.77	7.77	7.77	7.77	7.77
Group 10	6.6	8.29	10.24	10.24	10.24	10.24	10.24
Group 11	7	7	7	7	7	7	7
Group 12	4.03	4.8	6	6	6	6	6
Group 13	8.42	10.39	12.92	12.92	12.92	12.92	12.92
Group 14	7.8	10.1	13.13	13.13	13.13	13.13	13.13
Group 15	8.2	9.5	11.62	11.62	11.62	11.62	11.62
Group 16	7.57	8.86	11.88	11.88	11.88	11.88	11.88
Group 17	10.2	11.78	12.86	12.86	12.86	12.86	12.86
Group 18	8	9.95	12.73	12.73	12.73	12.73	12.73
Group 19	6.3	6.3	6.61	6.61	6.61	6.61	6.61

1	2	3	4	5	6	7	8
Group 20	6.82	8.48	13.99	13.99	13.99	13.99	13.99
Group 21	6.54	8.1	8.79	8.79	8.79	8.79	8.79
Group 22	7.3	7.3	7.3	7.3	7.3	7.3	7.3
Group 23	6.4	8.67	8.67	8.67	8.67	8.67	8.67
Group 24	6.33	7.61	8.43	8.43	8.43	8.43	8.43
Group 25	6.57	9.47	9.47	9.47	9.47	9.47	9.47
Group 26	8.7	10.3	11.01	11.01	11.01	11.01	11.01
Group 27	12.12	13.1	13.68	13.68	13.68	13.68	13.68
Group 28	8.95	10.02	12.47	12.47	12.47	12.47	12.47
Group 29	10.55	11.81	12.2	12.2	12.2	12.2	12.2
Group 30	7.6%	7.6%	7.6%	7.6%	7.6%	7.6%	7.6%
Group 31	8.94	10.4	13.39	13.39	13.39	13.39	13.39
Group 32	1.1	1.1	2.75	2.75	2.75	2.75	2.75
Group 33	2.43	3.44	4.15	4.15	4.15	4.15	4.15
Group 34	1.86	2.59	3.37	3.37	3.37	3.37	3.37
Group 35	8.72	8.1	9.74	9.74	9.74	9.74	9.74
Group 36	12.02	12.02	12.03	12.03	12.03	12.03	12.03
Group 37	8.78	10.8	13.5%	13.5%	13.5%	13.5%	13.5%
Group 38	13.68	15.46	15.47	15.47	15.47	15.47	15.47
Group 39	10.02	11.3%	13.73	13.73	13.73	13.73	13.73
Group 40	9.24	11.3%	12.54	12.54	12.54	12.54	12.54
Group 41	8.76	8.76	8.76	8.76	8.76	8.76	8.76
Group 42	11.38	12.78	12.8	12.8	12.8	12.8	12.8
Group 43	7	7	8.75	8.75	8.75	8.75	8.75
Group 44	7.39	7.39	7.39	7.39	7.39	7.39	7.39
Group 45	–	12.1	12.1	12.1	12.1	12.1	12.1
Group 46	–	–	17.5	17.5	17.5	17.5	17.5
Group 47	–	–	11.48	11.48	11.48	11.48	11.48

With the projected trend of growth in electricity consumption in the near future, it is necessary to build a significant amount of new energy capacity to meet the domestic demand for electricity (Satchwell and Cappers 2020; Varmaz 2019). To solve the problem of the aging of electric power capacities and ensure the number of generating power plants sufficient to meet the growing demand in the future, Kazakhstan today needs to attract foreign investors. To date, the electricity supply industry is highly dependent on external resources as there is not enough funding, available technologies or qualified specialists who could implement such complex projects as the construction of modern power plants (Varmaz 2019). Since the main

factor determining attractiveness for foreign investors is the tariff, which ultimately leads to income for the investor, it is very important to develop and implement an adequate methodology for charging in the electricity supply sector to attract external investment. Currently, the electricity supply in Kazakhstan is a strictly regulated industry in which the state plays a significant role in determining or limiting tariffs for energy-producing companies (Order of the… 2018; Law of the… 2012). The same conclusion may be relevant for other post-Soviet countries. Most of them, with the exception of those who have joined the European Union, face the same problems in the field of energy supply as Kazakhstan: a weak economy, a lack of financial and technological resources, and the need to attract foreign investors conditioned upon high tariffs and incomes. In most of these states, the energy supply sector is still tightly regulated by governments, as in Kazakhstan, and profitability rates and marginal prices are most often used.

Conclusions

Thus, the Republic of Kazakhstan is a developing country in which economic growth and social security are priorities. The state has a desire to become one of the thirty most developed countries in the world by 2050. It is known that one of the most important factors of economic growth, especially in developing regions, is reliable access to electricity at a reasonable price. From this standpoint, reliability is understood as a secured electric power system operating within the permissible level of system failures or power outages, access to electricity means no restrictions or prohibitions with regard to access to the electric grid and a reasonable price for electricity is a price that fairly represents the costs incurred for the production and transmission of electricity, providing the expected level of profits for the stakeholders involved. In this regard, the cost of electricity supply plays one of the main roles in the electric power industry and the country's economy. Therefore, it is extremely important that the pricing methodologies used are adequate, effective and considered transparent and fair. Based on the above, it can be stated that the tariff and investment policy ensures the timely solution of priority tasks for the development of the electric power industry, their solution together with the realization of the benefits of working together in the Unified Energy System of the Republic will provide the basis for the sustainable economic growth of the country.

Currently, Kazakhstan's electricity supply sector is facing a number of problems. One of the main tasks is to find the optimal pricing methodology that would correspond to the current economic situation in the country and stimulate investment in electricity supply, while keeping the cost of electricity for end users at the lowest possible level. If no action is taken today, the country may face the risk that in the future, the capacity for power generation will not be sufficient to cover the growing demand for electricity. Analysis of the theoretical aspect of regulatory tariff formation methodologies has shown that the most suitable strategies for solving the main

tasks in the electricity sector of Kazakhstan are the regulation of profit margins and price limits. However, both of these approaches require a higher level of transparency, confidence in future investments, and a higher monitoring and control function from the standpoint of the regulatory authority. Only under these conditions can the methodology of tariff formation based on the profit margin or marginal price will bring the expected results.

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Zagadnienia kosztów i cen w warunkach funkcjonowania rynku energii elektrycznej Kazachstanu

Streszczenie

Sektor elektroenergetyczny jest analizowany z punktu widzenia dobrostanu, w którym uwzględnia się szereg priorytetów politycznych, które wykraczają poza tradycyjne zadania tzw. trylematu energetycznego, a mianowicie niezawodną, przystępną cenowo i bezemisyjną energię. Pokazuje to wagę problemu na różnych poziomach, ponieważ może to pomóc rządowi Kazachstanu w bardziej niezawodnym osiągnięciu synergii między działaniami na rzecz przeciwdziałania zmianom klimatu a innymi priorytetami, a w konsekwencji osiągnąć podwójną harmonizację. Celem opracowania jest uwzględnienie badań dotyczących kosztów i cen w warunkach funkcjonowania rynku energii elektrycznej Kazachstanu. Energia elektryczna ma kluczowe znaczenie dla dobrobytu człowieka. Jest niezbędna dla realizacji wielu podstawowych usług, dla infrastruktury i działalności gospodarczej. Pomimo wzrostu efektywności energetycznej, światowe zapotrzebowanie na energię elektryczną wzrosło o 115% w latach 1990–2020, co jest znacznie wyższe niż tempo wzrostu populacji w tym samym okresie. Ten trend będzie niewątpliwie kontynuowany pod wpływem wzrostu gospodarczego, zwiększonego dostępu i elektryfikacji użytkowników końcowych. Ocena technologii wytwarzania energii elektrycznej z punktu widzenia dobrostanu wymaga zastosowania metody pełnego kosztu, która uwzględnia wszystkie mające zastosowanie koszty zewnętrzne, ryzyka i korzyści do określenia niskoemisyjnego bilansu energetycznego, co w Republice Kazachstanu jest zgodne ze zrównoważonym rozwojem. Ocena ta wyraźnie musi wykraczać poza poziom zakładu, aby uwzględnić infrastrukturę sieciową i wymaga całościowego spojrzenia na społeczne koszty energii elektrycznej. Praktyczne znaczenie tkwi w analizie kosztów i cen w warunkach funkcjonowania rynku energii elektrycznej Kazachstanu.

Słowa kluczowe: rynek energii elektrycznej, cennik, konsumenci, transport, regionalne firmy sieciowe