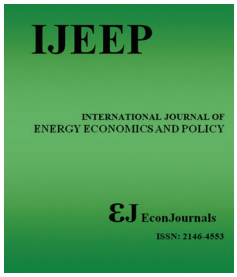

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Energy Consumption and Economic Growth in Kazakhstan: A Causality Analysis Using Time Series Methods

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ABSTRACT

This study examines the relationship between economic growth and energy consumption in Kazakhstan. Using data from 1995 to 2023, we analyze the relationship between GDP, total final energy consumption (TFEC), electricity use, and the share of renewable energy sources. The results of the analysis show that all variables are non-stationary over time, but only their changes are stable. This allowed us to test the long-term relationship. The Johansen cointegration test proved that there is a long-term equality between GDP and energy consumption in Kazakhstan: that is, as the economy grows, energy demand also increases. Electricity and the share of renewable energy are also related to GDP in the long run, but since the share of renewable energy is too small, its impact is not yet clear. Granger causality analysis showed that there is a bidirectional relationship between energy consumption and GDP. As the economy grows, energy consumption increases, and energy availability increases economic activity. This reflects Kazakhstan's dependence on fossil fuels. The relationship between renewable energy and GDP is one-sided: GDP growth contributes to the development of renewable energy, but the reverse effect is not yet observed. Overall, the study highlights the energy dependence of the Kazakhstani economy and the need for policy to focus on energy efficiency and diversification of energy sources. This is an important step for the country's sustainable and environmentally friendly development.

Keywords: Kazakhstan, Energy Consumption, Economic Growth, TFEC, Electricity, Renewable Energy, Cointegration, Causality.
JEL Classifications: C32, O13, Q43, Q48

1. INTRODUCTION

Energy is considered one of the main factors of production in economics. Although in classical and neoclassical growth theories the balance of labor and capital is considered the main driver of economic development, since the end of the 20th century the relationship between energy consumption and economic growth has attracted the attention of scientists (Stern, 2011; Ozturk, 2010). Energy is the basis for the continuous operation of production processes, and increased economic activity, in turn, increases the demand for energy (Baimaganbetov et al., 2019). For this reason, the study of the energy-economic growth relationship provides a scientific basis for explaining structural changes in the world economy and for formulating sustainable development strategies for countries (Apergis and Payne, 2010).

Kazakhstan is a country rich in natural resources. The country's energy structure is mainly based on traditional sources such as oil, gas and coal (Baimaganbetov et al., 2021). Although Kazakhstan is a major exporter of oil and gas, coal and natural gas dominate domestic energy consumption (IEA, 2023). On the one hand, this provides certain advantages in terms of energy security, on the other hand, it makes the economy dependent on carbon. Although government programs aimed at developing renewable energy

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sources have been implemented in recent years, their share in the overall energy balance is still limited (World Bank, 2022). Thus, the situation of Kazakhstan is a unique example of a country that is an energy exporter but dependent on traditional sources for domestic consumption.

In this context, the study of the causality between energy consumption and economic growth is of great importance. If economic growth stimulates energy consumption, then economic policy should prioritize the expansion of the country's energy infrastructure and increasing energy efficiency (Sadorsky, 2011). And if energy consumption is the main driver of economic growth, then any disruption in energy production and supply poses a direct threat to the national economy (Narayan and Doytch, 2017). Therefore, a comprehensive study of this issue based on time series is relevant not only for Kazakhstan, but also for countries with developing and resource economies in general.

In this regard, the article seeks answers to the following scientific questions:

- Is there a long-term relationship (cointegration) between energy consumption and economic growth in Kazakhstan?
- In which direction does the causality between energy consumption and GDP growth run: energy → GDP or GDP → energy?
- What are the features of this relationship in the short and long term?
- How can the results of causality in the case of Kazakhstan affect energy policy decisions?
- To answer these research questions, the main objectives of the work were defined as follows:
- Comprehensive analysis of the relationship between energy consumption and economic growth in Kazakhstan using econometric methods.
- Determination of the presence of a long-term cointegration relationship based on time series.
- Clarification of the energy-GDP causality direction using Granger and Toda-Yamamoto causality tests.
- Application of the error correction model (VECM) to assess short-term dynamics.
- Based on the results obtained, recommendations are made to improve energy policy for Kazakhstan.

2. LITERATURE REVIEW

The relationship between energy consumption and economic growth has been an important area of economic research for several decades. Although energy was not considered a key factor of production in classical growth theories (the Solow model and its extensions), later studies have recognized energy as a key determinant of economic development, along with capital and labor (Dai et al., 2022). In addition, the relationship between energy consumption and economic growth has long been central in energy economics. Global analyses confirm that renewable and non-renewable energy dynamics are key determinants of sustainable development. A recent international meta-review shows that renewable energy capacity has doubled since 2010, driven by technological advances, cost reductions, and policy support mechanisms such as feed-in tariffs and tax incentives (Hassan et al., 2024). However, the transition is still uneven. Sharma et al. (2025) review emphasizes that despite significant progress in green technologies, developing economies continue to face barriers related to cost, intermittency, and limited infrastructure.

There is a wealth of empirical research in the international literature on the energy-economic growth relationship. Naidu et al. (2024) found long-run cointegration between renewable energy consumption and GDP in OECD countries, while Saqib (2021) found multivariate Granger causality between exports, electricity consumption and GDP in Middle Eastern countries. Halilbegović et al. (2023) examined the complex interlinkages between renewable and non-renewable energy consumption and economic growth in nine Southeastern European (SEE) countries using advanced panel econometric techniques. Their work builds upon the classical energy-growth nexus theories, notably the four hypotheses-neutrality, conservation, growth, and feedback-which explain different causal directions between energy use and GDP growth.

Studies on emerging economies highlight that government policy, financing, and institutional quality remain decisive. Elavarasan et al. (2020) review on India demonstrates how coherent renewable-energy policies-feed-in tariffs, hybrid systems, and long-term targets-accelerate transition by integrating solar, wind, and biomass capacities, and by aligning with the Sustainable Development Goals. The paper also shows that most developing nations share similar challenges: regulatory instability, lack of investment incentives, and weak coordination between national and regional authorities.

In Central Asia, renewable resources are abundant but underutilized. A regional overview identifies substantial untapped potential: solar (up to 3.76 million MW), wind (354 000 MW), and hydro (30 000 MW) resources remain largely undeveloped. Kazakhstan leads with more than 800 MW of solar and 300 MW of wind capacity, yet deployment in other republics is minimal (Laldjebaev et al., 2021). Barriers are interrelated-regulatory gaps, limited financing, a shortage of technical expertise, and unreliable data-requiring cross-sectoral governance reforms.

Complementing this, Taguchi and Asomiddin (2022) analyzed the energy-use inefficiency of Central Asian countries through the energy-environmental Kuznets curve (EEKC). Kazakhstan, Uzbekistan, and Turkmenistan were identified as inefficient energy users, where weak policy governance and dependence on natural resources drive excessive consumption relative to income growth. The study recommends strengthening institutional quality and regulatory performance to achieve efficiency gains.

Research on Kazakhstan is still limited, but in recent years, attention has been increasing on this topic. Some studies have noted the high dependence of the Kazakh economy on energy, especially the dominance of coal and gas in domestic consumption (Baimukhamedova, 2022). According to Kazstat and IEA, the country's GDP growth largely depends on energy production and exports, which ties the economy to the raw material nature.

In addition, domestic research often highlights Kazakhstan's potential for developing renewable energy sources. For example, solar and wind energy have significant regional potential, but the development of this sector is slow due to investment and technological barriers (Mukhtarova et al., 2021).

In general, foreign studies have shown that the energy-growth nexus is multifaceted for different countries. That is, international studies show that the relationship between energy and economic growth takes on different characteristics in each country. In some countries, energy consumption is the main driver of economic growth, while in others, economic growth increases energy demand. The economic structure, institutional environment, and level of technological development affect the nature of this relationship.

Recent econometric evidence has deepened understanding of Kazakhstan's energy-growth linkages. Zhai et al. (2024) applied time-series data (1992-2023) and found a long-run positive relationship between GDP and total energy consumption, with a 0.3972 elasticity coefficient - that is, a 1% increase in GDP raises energy use by 0.397%. This suggests moderate decoupling potential but continued structural dependence on fossil fuels. Earlier asymmetric causality testing by Tuna and Tuna (2020) revealed neutrality under symmetric shocks but growth causality under positive shocks - indicating that electricity demand expansion contributes to GDP during economic upturns, whereas contractions do not significantly reduce growth. Together, these findings depict Kazakhstan as a resource-rich but energy-intensive economy. Coal remains the dominant fuel (≈ 46% of total use), followed by oil and gas (≈ 25% each), while renewables account for <5% of the mix (Zhai et al., 2024).

At the macro level, Pata et al. (2024) confirmed bidirectional causality between disaggregated renewable sources (biomass, hydro) and economic growth, supporting the renewable-energy-led growth hypothesis under sustainability constraints. Such results, though based on the U.S., provide methodological parallels for Kazakhstan's diversification strategy - linking renewable expansion to employment and environmental load capacity.

Across the reviewed literature, several consistent themes emerge:

- Long-run coupling: Economic growth in Kazakhstan continues to drive energy demand, confirming bidirectional or growth-led causality.
- Governance and efficiency: Weak policy coordination and fossil-fuel subsidies sustain inefficiency (Taguchi and Asomiddin, 2022).
- Potential for decoupling: Sub-unitary elasticity (≈ 0.4) indicates room for energy-intensity reduction without sacrificing growth (Zhai et al., 2024).
- Renewable integration: Regional and global evidence stress that regulatory reform, financing instruments, and technological innovation are critical to mainstream renewables (Elavarasan et al., 2020; Laldjebaev et al., 2021).

The collective evidence demonstrates that Kazakhstan's economy exhibits a strong yet potentially moderating dependence on energy use. While fossil fuels remain the backbone of growth, long-term sustainability will depend on efficiency improvements, diversification of the energy portfolio, and institutional strengthening. International experience suggests that policy coherence - linking renewable incentives, grid modernization, and governance quality - is the essential pathway toward sustainable growth and reduced carbon intensity.

In this regard, examining the energy-economic growth nexus in Kazakhstan using Granger causality and cointegration methods based on real time series is relevant both from a scientific and practical policy perspective. This study aims to provide new empirical evidence adapted to the domestic situation, taking into account foreign experience. In this regard, this article examines the energy-economic growth nexus in the case of Kazakhstan and makes a new empirical contribution to the international literature.

3. METHOD AND DATA

This study aims to analyze the causal relationship between energy consumption and economic growth in Kazakhstan. Annual time series for the period 1995-2023 were used (Table 1). The main sources of data were the National Bureau of Statistics of the Republic of Kazakhstan (stat.gov.kz, 2025), the International Energy Agency (IEA, 2023), the World Bank (World Bank, 2022), as well as indicators from the national energy balance of Kazakhstan.

For additional analysis, the following databases were used (Table 1):

- GDP and energy intensity (in real prices, index 2015 = 100);
- Final energy consumption (TFEC, million toe);
- Electricity consumption;
- Renewable energy sources;
- Heat production and consumption indicators.
- The following variables were taken as variables:
- Gross domestic product (GDP): real GDP (billion tenge, deflated, logarithmized).
- Energy consumption (EC): final energy consumption (TFEC, million toe, logarithmized).
- Control variables: Fixed capital investment, employment rate, renewable energy share were included in some models.

The variables were taken to the natural logarithm. This allows for dispersion stabilization and comparison of trends.

The study aims to test the following hypotheses:

H_1: There is long-run cointegration between real GDP and energy consumption.

H_{2a}: Causality runs from energy consumption to economic growth ($e \rightarrow y$).

H_{2b} (alternative): Causality runs from economic growth to energy consumption ($y \rightarrow e$).

H_3: The results remain robust even when changing the energy indicator (TFEC vs. electricity vs. energy use per capita).

The following econometric methods were considered:

- Stationarity testing: The degree of integration of the variables was determined using the ADF, PP and KPSS tests.

Table 1: Kazakhstan economy and energy data (1995-2023)

Year	GDP_real_2015=100	TFEC_mtoe	Electricity_total_GWh	Renewables_share_percent	Heat_prod_1000Gcal
1995	58532.0	40336.7	66661	12.498	nan
1996	58824.7	34781.4	59038	12.417	nan
1997	59824.7	29591.3	52000	12.498	nan
1998	58688.0	30215.8	49144	12.496	nan
1999	60272.6	26925.6	47497.1	12.91	nan
2000	66179.3	21608.2	51635.1	14.585	nan
2001	75113.5	21375.3	55384	14.591	nan
2002	82474.7	20329.0	58330.5	15.241	nan
2003	90144.8	23541.3	63866.4	13.505	nan
2004	98798.7	25700.4	66942.4	12.036	nan
2005	108382.2	30599.5	67919.7	11.567	nan
2006	119979.1	30696.7	71668.46	10.839	nan
2007	130657.2	37774.8	76620.946	10.664	nan
2008	134968.9	42494.4	80347.792	9.285	nan
2009	136588.5	35378.3	78729.1	8.738	nan
2010	146559.5	38783.5	82646.4953	9.706	nan
2011	157404.9	42901.7	86586	9.104	nan
2012	164960.3	41734.7	92817	8.231	nan
2013	174857.9	42999.7	103085	7.505	nan
2014	182202.0	39919.4	95310.86	8.786	81604
2015	184388.4	38378.2	91882.202	10.36	81218.5
2016	186416.7	38699.5	94642.384	12.713	82039.9
2017	194059.8	40042.7	103196.827	11.347	85050.2
2018	202016.2	41313.5	107604.727	10.431	91064.9
2019	211106.9	38327.6	106877.96	10.794	87888.3
2020	205829.3	40331.9	110890.318	10.989	89344.6
2021	214679.9	43261.7	115079.2	10.938	94012.430
2022	221549.7	41156.45	113552.093	11.821	94287.943
2023	232848.72	43382.35	113585.469	12.739	95491.945

stat.gov.kz, 2025; IEA, 2023; World Bank, 2022

- Long-run relationship: The Johansen cointegration test was used to assess the long-run balance between real GDP and energy consumption.
- Causality: The granger causality test was used to identify short-run effects; while the Toda–Yamamoto method was used to test causality independent of the degree of integration.
- Error correction model (VECM): If cointegration was found, VECM was used to separate short-run and long-run effects.
- Robustness analysis: Three different energy consumption indicators (TFEC, electricity consumption, per capita energy consumption) were used to check the stability of the results.

The basic VAR/VECM models for model specification are given as follows:

$$ln\,GDP_t = \alpha_0 + \sum_{i=1}^{p} \beta_i ln\,GDP_{t-1} + \sum_{i=1}^{p} \gamma_i ln\,EC_{t-1} + \varepsilon_i$$

$$ln\,EC_t = \delta_0 + \sum_{i=1}^{p} \theta_i ln\,EC_{t-1} + \sum_{i=1}^{p} \varphi_i ln\,GDP_{t-1} + \upsilon_i$$

where p is the optimal lag length (selected using the AIC and SIC criteria).

4. FINDINGS

4.1. ADF Unit Root Tests (Stationarity Analysis)

First, the augmented Dickey-Fuller (ADF) test was conducted to check the stationarity of the time series. The results showed that all the main variables have a unit root at the level, i.e., they are non-stationary. In particular, the level ADF statistics of the real GDP, final energy consumption (TFEC), electricity consumption/production, and renewable energy production series are above the critical values at the 5% significance level, so the null hypothesis (there is a unit root) cannot be rejected. For example, the ADF statistic for logarithmic real GDP is −3.25 without taking into account the trend, which is close to the threshold at the 5% level, but when the trend is included, the P-value reaches 0.99, indicating that the series has a unit root. The ADF statistic for TFEC is −1.18 (P ≈ 0.68), for electricity consumption −2.14 (P ≈ 0.23), and for renewable energy production +0.18 (P ≈ 0.97), indicating that they are all non-stationary. All of these variables were stationary only in the first difference (e.g., P ≈ 0.0005 for Δlog of electricity consumption; P ≈ 0.002 for Δlog of renewable energy) – from this we conclude that all series have the degree of integration I(1). These results indicate that economic growth and energy consumption indicators have a long-term trend and their level values do not have a stable environment over time.

Since the results of the ADF test confirm that the variables are first-order integrated, in the next step we check the cointegration relationship between them.

4.2. Johansen Equilibrium Test (Long-run Equilibrium Relationship)

The Johansen cointegration test was used to determine the long-run equilibrium relationship between energy consumption and economic growth. The Johansen test for the pair of real GDP and TFEC provides evidence for the existence of a single cointegration vector. The trace statistic is ~14.9 for the null hypothesis r = 0, which is close to the 5% critical value (15.5), i.e. confirms the existence of cointegration at the 10% level (the hypothesis r = 0 is rejected and a long-run relationship r = 1 is accepted). This result indicates that there is a long-run equilibrium relationship between real GDP and total energy consumption. In other words, the two indicators change together over time, and a certain combination between them becomes stationary. This can be explained econometrically by the fact that energy consumption and economic volume grow together; indeed, according to the analysis of data for 1992-2023, it was found that for every 1% increase in GDP in Kazakhstan, energy consumption increases by an average of 0.397%. This also means that energy intensity (energy per unit of GDP) has decreased over the years and the structure of the economy has changed. The results of the Johansen test also confirm this, and the long-term correlation coefficients show that energy consumption depends on changes in GDP.

When considering the three variables together – real GDP, electricity production and renewable energy production – the Johansen method showed the presence of several cointegration relationships. In particular, the trace statistics for the three variables were 40.51 for r = 0 (above the 5% critical value of ~29.8) and 16.07 for r ≤ 1 (around the 5% critical value of ~15.49) [37†]. This means that there are at least two independent cointegrations, and accordingly, there are interconnected trends between these three in the long run. From an economic interpretation, the first cointegration relationship is likely to be between GDP and electricity consumption (i.e. economic growth and electricity demand grow together), and the second is likely to be between renewables and total electricity production (i.e. renewable energy production grows together with total electricity production in the long run). However, it was observed that the test results vary slightly depending on the number of lags in the model (only 1 cointegration was detected in some specifications). In general, there is reason to believe that there is a long-run equilibrium relationship between real GDP, electricity production and renewable energy. This indicates that the total demand for electricity is increasing as the economy of Kazakhstan grows, and the share of renewable sources in the electricity generation structure has gradually increased over time. However, it is worth noting that the share of renewable energy in total final consumption in 2023 is still only about 4%, so the impact of renewable energy on economic growth is still limited.

4.3. Granger Causality Test (Causality Analysis)

According to the Engle-Granger methodology, Granger causality tests were conducted to determine in which direction there is a causality (cause-effect) between energy consumption and economic growth. The Granger test between the two variables was conducted for different lags and the following results were obtained:

Real GDP ↔ TFEC: It was found that there is a two-way causal relationship between GDP and total energy consumption. Changes in TFEC can predict GDP growth in previous years and, conversely, GDP growth also affects the dynamics of energy consumption in the subsequent period. For example, for 1 lag, the hypothesis "TFEC → GDP" is $\chi^2 \approx 22.21$ ($P < 0.001$) and "GDP → TFEC" is $\chi^2 \approx 16.31$ ($P < 0.001$), which convincingly rejects the null hypothesis in both directions. Therefore, in the case of Kazakhstan, it is observed that economic growth and energy consumption complement each other and are causally related. This result supports the "feedback hypothesis" between energy and growth, i.e., as the economy grows, energy demand increases, and energy availability, in turn, stimulates industrial growth. However, previous studies have shown that energy consumption has no effect on GDP in Kazakhstan in the long run (for example, only the GDP→energy direction was found for the period 1990-2008). Our results for the 1995-2023 data indicate that there is a reciprocal effect between energy and growth, especially in the short-term relationships.

Real GDP ↔ Electricity generation: For this pair, causality is also found to be in both directions. According to the 1-lag test, the hypothesis "Electricity → GDP" is $\chi^2 \approx 9.19$ ($P \approx 0.002$), and "GDP → Electricity" is $\chi^2 \approx 43.85$ ($P < 0.001$), and at 2 lags, the P-values are also below the 1% level. Economic growth increases the demand for electricity, and an increase in electricity production (i.e., energy coverage) contributes to economic growth. The existence of such a relationship indicates the dependence of the Kazakh economy on electricity and the impact of energy constraints on economic activity.

Real GDP ↔ Renewable energy: An asymmetric result is observed here. No Granger causality was found in the direction of renewable energy production → GDP (P-values 0.3-0.8, the null hypothesis is not rejected). That is, changes in renewable energy production did not predict Kazakhstan's GDP growth in the past. This is expected: renewable energy sources make up only a small part of the total energy balance (about 3.6% in 2013, at the level of ~4% in 2023), so their contribution to the economy is not statistically significant. There is evidence of a certain effect in the direction of real GDP → RES production: for a 1-year lag, $\chi^2 \approx 3.995$ ($P \approx 0.046$), i.e. GDP growth partially predicts the volume of renewable energy production in the following year. This suggests that economic growth and an increase in overall energy demand stimulate the development of renewable energy projects. Indeed, economic growth allows the state to allocate resources to support renewable energy, and as energy demand increases, a strategy is being pursued to compensate for a certain share of it through RES. The government of Kazakhstan set a goal in 2020 to increase the share of renewable energy to 15% by 2030, and as economic growth increases, investments to achieve this goal are likely to increase.

Analyzing the above results, we can conclude that there is a long-term positive relationship between real GDP and energy use, and they influence each other in a causal manner. This suggests that energy conservation policies in Kazakhstan can be implemented without significantly hindering economic growth - because although GDP growth increases energy consumption (there is energy dependence),

as a result of increased energy efficiency, high GDP growth is accompanied by relatively slow growth in energy consumption. Indeed, it is estimated that every 1% increase in GDP in 1992-2023 increased energy consumption by only about 0.4%, which indicates that energy intensity is decreasing and the economy is gradually diversifying and the share of the service sector is increasing. In addition, the direct GDP growth effect of renewable energy is not yet noticeable, but if economic development continues, the role of renewable sources in the energy structure may increase. In the long term, the transition to renewable energy is expected to contribute to sustainable economic growth, but its impact has not yet exceeded the limits observed by Granger causality tests. In conclusion, the results show that there is a close relationship between energy and the economy in Kazakhstan: energy consumption and production and GDP grow together, forming a long-term equilibrium, and mutually influence each other in the short term. Although this relationship is in the form of a "feedback," studies note that through effective energy policy (reducing subsidies for fossil fuels, supporting renewable energy, and introducing energy-saving technologies) it is possible to change the energy structure without hindering economic growth. Increasing the share of renewable energy is currently part of the strategy for diversifying the economy, and our analysis shows that the significant cumulative impact of renewable sources on economic growth is still limited, primarily due to their small impact on the overall energy balance. It can be assumed that if the development of renewable energy increases in the coming years, its relationship with economic growth will also strengthen.

5. CONCLUSION AND RECOMMENDATIONS

This study analyzed the relationship between energy consumption and economic growth in Kazakhstan using time series methods. The ADF test showed that all the main variables (GDP, final energy consumption, electricity production, renewable energy share) have a unit root in their level values and are stationary only in their first difference. This means that the data are integrated to the degree of I(1).

The results of the Johansen cointegration test confirmed that there is a long-run equilibrium relationship between GDP and energy consumption in Kazakhstan. This indicates that the hypothesis H_1 is accepted. In addition, electricity and the share of renewable energy are also correlated with GDP in the long run, although since the share of renewable energy in the overall balance is still low, its direct effect is limited.

Granger causality tests revealed that there is bidirectional causality between GDP and energy consumption in the case of Kazakhstan. This indicates that both hypotheses H_{2a} and H_{2b} are confirmed to some extent, i.e. the "feedback hypothesis" is valid for Kazakhstan. And hypothesis H_3 was also partially confirmed: the causality directions were maintained even when using different indicators of energy consumption (TFEC, electricity, RES share).

In general, it was found that the economy of Kazakhstan is highly dependent on energy, and economic growth and energy consumption are closely related. This indicates that optimizing energy policy is of great importance for the long-term sustainable development of the country.

As recommendations:

5.1. Increasing Energy Efficiency

Although economic growth depends on energy consumption, in recent years there has been a decrease in energy intensity. To continue this trend, it is necessary to introduce energy-saving technologies and strengthen measures to increase energy efficiency in the industrial sector.

5.2. Diversifying Energy Sources

Although the share of renewable energy does not significantly contribute to GDP, its role will increase in the long term. Therefore, increasing investment in solar, wind and other renewable sources will ensure Kazakhstan's energy independence and environmental sustainability.

5.3. Coordinating Energy Policy

The two-way nature of the energy-economy relationship is important in shaping Kazakhstan's development policy. Economic planning should take into account the pace of energy infrastructure development and attract sufficient investments in the energy sector.

5.4. Using Regional and International Experience

As the experience of the OECD and developing countries shows, institutional reforms and support for innovative technologies are needed to effectively manage the causality between energy consumption and economic growth. Strengthening international cooperation in this direction would be beneficial for Kazakhstan.

5.5. Continuing Scientific Research

This study considered only macro-level causality. In the future, it is important to conduct sector-level analyses (industry, transport, agriculture) and study regional differences. This will allow policymakers to make more specific recommendations.

Thus, the results of the study showed that the energy-economic growth relationship in Kazakhstan is based on mutual causality and highlighted the need to coordinate the country's energy policy and economic development strategy.

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