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## Article

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## Provided in Cooperation with:

International Journal of Energy Economics and Policy (IJEPP)

**Reference:** Soltangazinov, Aibek/Smagulova, Zubirash et. al. (2020). Energy efficiency as a factor of sustainable development in Kazakhstan. In: International Journal of Energy Economics and Policy 10 (1), S. 325 - 330.

<https://www.econjournals.com/index.php/ijeep/article/download/8618/4788>.

doi:10.32479/ijeep.8618.

This Version is available at:

<http://hdl.handle.net/11159/8240>

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## Energy Efficiency as a Factor of Sustainable Development in Kazakhstan

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**Received:** 23 August 2019

**Accepted:** 11 November 2019

**DOI:** <https://doi.org/10.32479/ijeeep.8618>

### ABSTRACT

The principles of sustainable development and the green economy are aimed at improving energy efficiency. Kazakhstan's joining the international environmental movement testifies to the country's desire to reduce the energy intensity of the economy and to carry out practical actions aimed at sustainable development. This is confirmed by target indicators in the field of energy efficiency, which are reflected in the documents of the State Planning System of the Republic of Kazakhstan and are aimed at increasing energy security, labor productivity, the rational use of budget funds, as well as improving the health and welfare of citizens. The current energy balance of Kazakhstan is dominated by coal, used primarily by thermal power plants to generate electricity. Therefore, GDP's high energy intensity is indicative of irrational energy consumption, which is accompanied by an increase in environmental pollution. This paper gives a review of some aspects of the energy saving sphere and the international energy saving experience, as well as analyzes the current situation with regard to the implementation of energy efficiency policies in Kazakhstan. The study shows that the domestic economy has a significant energy saving potential in key sectors of the economy, identifies energy efficiency problems, and proposes solutions to them.

**Keywords:** Energy Efficiency, Decarbonization, Energy Intensity, Energy-saving Technologies, Green Economy, Sustainable Development

**JEL Classification:** Q4

### 1. INTRODUCTION

Climate changes associated with anthropogenic impacts characterize the problem of high-carbon development in the global context, which is the result of human activities. The sustainable development of the energy system requires an efficient and cost-effective tool aimed at increasing energy efficiency and competitiveness, reducing the energy sector's need for financial resources during the post-investment period and preserving nature by reducing local environmental pollution.

A key provision of the concepts of sustainable development and the green economy is to ensure environmentally friendly economic growth. At the same time, the high energy efficiency of production activities and the reduction of the impact on the environment are considered an indicator of the balanced development of society.

The high level of the energy intensity of the economy negatively affects the environmental situation due to the irrational use of fuel and energy resources and the safety of national energy consumption. In this regard, one of the priority areas of economic development is to increase energy efficiency by reducing energy consumption through the widespread use of energy-saving technologies. This stems, first of all, from the importance and necessity to reduce environmental pollution, because in the process of the reckless use of energy resources by consumers, the anthropogenic load on the environment increases.

An analysis of the current situation of energy consumption in Kazakhstan shows that there are a number of problems associated with the high level of energy costs of industrial enterprises and the high energy intensity of products.

The purpose of the study is to develop methodological recommendations for improving the formation mechanism of the green economy in the context of ensuring the sustainable development of the Republic of Kazakhstan.

To achieve this goal, the following tasks are set:

- To analyze the energy market of Kazakhstan, and to identify the problems of the high energy intensity of the domestic economy;
- To study the main factors contributing to a successful transition to the green economy;
- To investigate the regulatory legal framework of Kazakhstan in the field of energy saving and energy efficiency; to identify weaknesses and develop measures to improve them;
- To develop measures aimed at decarbonization and stimulation of system energy-saving measures.

The relevance of the research consists in the need to develop scientifically grounded recommendations on improving the mechanism of implementing the transition of the Republic of Kazakhstan to the green economy and ensuring sustainable development, based on a thorough analysis of the institutional aspects of the formation of the green economy.

The comparison of energy efficiency indicators of the domestic economy and those of developed countries shows that the specific energy intensity of Kazakhstan's GDP is several times higher than in developed countries.

The national economy, characterized by high energy intensity and the low efficiency level of the domestic consumption of energy resources, indicates:

- Low energy efficiency, which reduces the competitiveness of products in the domestic and world markets;
- Available significant energy reserves due to the use of modern resource-saving technologies that provide low-carbon emissions.

The general structure of energy resources aimed at generating electricity in Kazakhstan is dominated by non-renewable natural energy resources, of which coal accounts for 72%, natural gas – 10.2%, and oil – 4.9%. At the same time, 12.2% of electricity is generated by using the energy of the water flow. In the country's fuel and energy balance, the share of carriers for traditional energy is 99.8%, and for alternative (renewable energy sources) – about 0.3% (Saylaubekov and Baytanayeva, 2015).

The intensity of energy consumption stems from the current problem of the inefficient use of fuel and energy resources, which is explained, first of all, by the use of obsolete and physically worn out energy-intensive technologies in the production process.

To ensure decarbonization and solve the problem of the high energy intensity of the country's economy, the Strategy "Kazakhstan-2050" establishes clear guidelines for building a stable and efficient economy model and developing alternative energy production. By 2050, alternative and renewable energy

sources are expected to account for not less than half of total energy consumption (The Strategy "Kazakhstan-2050").

Kazakhstan, being a party to the UN Framework Convention on Climate Change, has undertaken obligations to reduce environmental pollution. The main provisions of the Concept on the Transition of the Republic of Kazakhstan to the Green Economy laid the principles aimed at implementing systemic transformations for the transition of the national economy to a new level of development while minimizing the anthropogenic load on the environment.

One of the target indicators of the green economy is the reduction of GDP's energy intensity by 25% by 2020, 30% – by 2030, and 50% – by 2050. At the same time, the following main energy-consuming sectors are the main levers for improving energy efficiency:

1. Housing and communal services (buildings): Installation of communal meters and thermostats, warming of buildings.
2. Industry: Targeted programs aimed at teaching and implementing energy-efficient production technologies.
3. Transport: Increasing the efficiency of fuel use (renewal of cars, gas fuel, development of transport infrastructure).
4. Power supply: Repair and renewal of networks for energy and heat transmission, modernization of CHP plants and boiler houses; decrease in the need for generation through lower final consumption and own levers for increasing energy efficiency.

The implementation of the Concept on the Transition of the Republic of Kazakhstan to the Green Economy is envisaged in three stages:

1. 2013-2020 – The main priority is to optimize the use of resources and increase the effectiveness of environmental protection activities, create a "green" infrastructure;
2. 2020-2030 – Transformation of the economy on the basis of the careful use of water resources, introduction of renewable energy technologies and construction of facilities based on high energy efficiency standards;
3. 2030-2050 – Transition to the principles of the "third industrial revolution," requiring the use of natural resources, provided they are renewable and stable (The Concept on the Transition of the Republic of Kazakhstan to the Green Economy, 2013).

The key national indicators of the Strategic Development Plan of the Republic of Kazakhstan until 2025 reflect the target results to be achieved by 2021, 2025 and 2050:

- Reduction of GDP's energy intensity from the level of 2008 by 20%, 25% and 50% respectively;
- The share of alternative (solar and wind) sources in electricity generation will be 3%, 6% and 50%, respectively ("On Approval of the Strategic Development Plan of the Republic of Kazakhstan Until 2025," 2018).

The systemic measures of Kazakhstan's transition to energy saving and energy efficiency improvement are the formation of a regulatory legal framework and the improvement of mechanisms for the implementation of legal acts in this area. In this regard,

the relevant Law of the Republic of Kazakhstan “On Energy Saving and Energy Efficiency Improvement” was adopted, which defines legal, economic and organizational measures to reduce GDP’s energy intensity and improve energy efficiency. Technical standards were also developed and approved, and regional energy efficiency plans for 2016-2020 were implemented.

The main directions of state regulation in the field of energy saving and energy efficiency are as follows:

1. Implementation of technical regulation in the field of energy saving and energy efficiency;
2. Implementation of a balanced tariff policy and pricing in the production and consumption of energy resources;
3. Stimulation of energy saving and energy efficiency, including the use of energy-saving equipment and materials;
4. Implementation of state control over the effective use of energy resources;
5. Popularization of economic, environmental and social advantages of the effective use of energy resources, increase of public educational level in this field;
6. Enforcement of the legislation of the Republic of Kazakhstan on energy saving and energy efficiency (“On Energy Saving and Energy Efficiency Improvement,” 2012).

Energy saving issues have been addressed in almost all the main documents of the country. In accordance with the Law of the Republic of Kazakhstan “On Energy Saving and Energy Efficiency Improvement,” amendments and additions were made to the Budget Code, the codes of the Republic of Kazakhstan “On Administrative Offenses,” “On Taxes and Other Mandatory Payments to the Budget” (the Tax Code), as well as to the laws “On Transport,” “On Natural Monopolies and Regulated Markets,” “On Local Government and Self-Government in the Republic of Kazakhstan,” “On Architectural, Town-Planning and Construction Activities in the Republic of Kazakhstan,” “On Electric Power,” “On State Control and Supervision,” “On Housing Relations,” “On Subsoil and Subsoil Use.”

Within the framework of the Plan of Action for the Development of Alternative and Renewable Energy in Kazakhstan for 2013-2020, it is planned to put into operation about 106 renewable energy sources with a total installed capacity of 3,054.55 MW by 2020, including:

1. 34 wind power plants - 1787 MW
2. 41 hydroelectric power plants - 539 MW

3. 28 solar power plants - 713.5 MW
4. 3 bio-electric stations - 15.05 MW (“On Approval of the Plan of Action for the Development of Alternative and Renewable Energy in Kazakhstan for 2013-2020,” 2013).

Public policy plays a key role in promoting renewable energy sources, which must take into account guaranteed price schemes and investment incentives (Drivers of Renewable Energy Innovation in the EU, 2017).

One of the mechanisms for reducing the consumption of fuel and energy resources is the formation and maintenance of the State Energy Register (SER), which is being implemented in Kazakhstan on the basis of a model that has proven itself and is used in South Korea and Japan. This tool allows reducing energy consumption, since SER entities, including large industrial enterprises, have information on the possibility and directions of saving energy resources on the basis of energy audit.

The total number of SER entities as of January 01, 2018 was 6066 (Ministry of National Economy of the Republic of Kazakhstan Committee on Statistics, 2019). This amount does not cover all subjects of energy consumption. The number of SER entities is expected to increase annually and reach about 20,000 entities (Samruk Energy Company, 2019).

In order to develop the institutional structure that facilitates the transition of the national economy to energy saving and energy efficiency, a national institute for energy saving and energy efficiency improvement has been created as a subordinate organization of the Ministry of Investment and Development of the Republic of Kazakhstan. It is regarded as a competence center for conducting system studies, as well as reviewing and adapting the best foreign experience. The main areas of its activity are shown in Table 1.

Recently, the National Institute has been transformed into the Competence Center for Energy Saving and Energy Efficiency. One of the functions of this Center is the formation and maintenance of an energy efficiency map that represents a single republican list of energy saving and energy efficiency projects, indicating sources of financing, schedules and plans for implementing them.

**Table 1: Tasks and functions of the national institute in the field of energy saving and energy efficiency**

Tasks and functions	Completion
Maintenance of the state energy register (SER)	As of January 01, 2018, there are 6066 SER entities; information has been maintained since 2012
Analysis of energy audit findings; assessment and analysis of activities of SER entities	More than 100 conclusions on energy audit findings have been prepared. Based on energy audit findings, 299 action plans have been developed
Expert evaluation	Expert evaluation of projects for the implementation of energy service contract mechanisms. Expert reports on tenders and regulatory framework
Formation and maintenance of energy efficiency maps	113 applications for inclusion have been received, 23 projects are being developed. It is planned to include 15 projects. Competence in the field of PPP
Development of international cooperation	Over 40 memorandums and contracts have been concluded. 500 thousand US dollars have been raised under the AP3F program
Implementation of the project “Improving energy efficiency in Kazakhstan”	Modernization of 100 social facilities until 2020

Compiled by the authors based on data from (Samruk Energy Company, 2019)



## 2. RESULTS

The International Energy Agency (IEA) is an autonomous institution established in 1974 to promote energy security for its 29 member countries and other states. The IEA report “On the Energy Efficiency Market 2016” notes that global investment in energy efficiency was 221 billion US dollars in 2015, an increase of 6% from 2014 (International Energy Agency, 2019).

The energy-intensive structure of the domestic economy with low labor productivity and added value is a factor of significant consumption rates of all types of energy carriers per unit of output. At the same time, the analysis of dynamics of the energy intensity of the country’s GDP for 2012–2015 shows a positive trend in increasing energy efficiency (Figure 1).

The reduction in the energy intensity of Kazakhstan’s GDP by 29% in 2015 compared to the level of 2012 is due to structural changes in the national economy, the tendency to reduce the number of energy-intensive and low-profitable industries, and the implementation of organizational and technical measures aimed at thermomodernization and the introduction of energy-saving technologies. This indicates the beginning of the effective use of fuel and energy resources, which in turn contributes to energy savings, lower costs for utilities and, on the whole, has a positive effect on improving the state of the environment.

However, despite these positive changes, the domestic economy requires further modernization and transformation, as currently energy efficiency in Kazakhstan does not exceed 30%.

The main factors of the low level of efficiency in the use of fuel and energy resources are as follows:

- High energy intensity of the economy;
- Significant specific consumption of energy resources for electricity generation due to high wear and obsolescence of production infrastructure equipment;
- High share of non-production heat and electricity losses associated with their transportation in heat and power supply systems;
- Deterioration of housing stock and inadequate level of thermal insulation.

The evaluation of energy audit activities indicates that the most common activities recommended by energy auditing organizations are:

- Modernization of lighting systems with a transition to LED lighting;
- Installation of heat-reflecting screens behind radiators;
- Replacement of window blocks with energy-efficient double-glazed windows;
- Automation of lighting in common areas;
- Insulation or reconstruction of structural elements of buildings (roof, walls, doorways);
- Installation of automatic heat points;
- Implementation and maintenance of the energy management system (Donskikh, 2015; Belyy and Tleubayev, 2015).

The study of the problem of sustainable development in Kazakhstan shows that the country has determined its strategic guidelines for the formation of a systemic state policy in the field of environmental protection, the reduction of GDP’s energy intensity and the development of the green economy, outlined in the documents of the state planning system.

## 3. DISCUSSION

Within the framework of the energy efficiency map, the National Center searches for energy saving and energy efficiency projects to be financed under the energy service contract (ESC). The 59<sup>th</sup> step of the National Plan “100 Concrete Steps to Implement the Five Institutional Reforms” suggests involving strategic investors to the energy saving industry through the internationally recognized ESC mechanism.

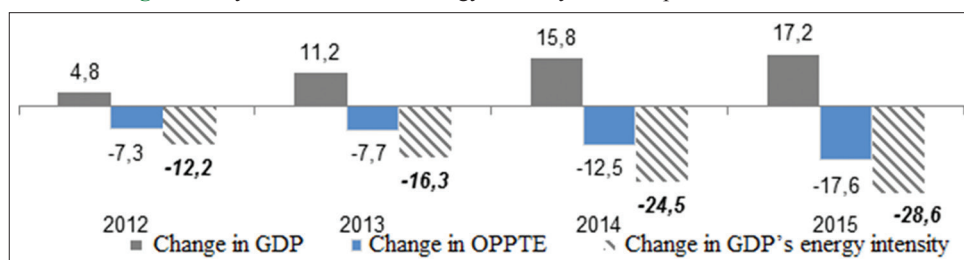
The economic ideology of the ESC is that this contract, being one of the effective organizational tools aimed at the implementation of energy saving measures, provides an opportunity to compensate for the investments made and to receive financial profit by means of money received from the real energy saving achieved as a result of project implementation.

For an energy service company, from the point of view of developing the energy service business, this energy service activity, being an internationally accepted method of improving energy efficiency, is viewed as an opportunity to participate in the business of this direction.

For consumers, the business model for the implementation of energy saving measures provides:

- An advantageous principle of budgeting, which does not provide for an increase in the current level of operating costs;

**Figure 1:** Dynamics of GDP’s energy intensity in the Republic of Kazakhstan



Source: Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan (Ministry of National Economy of the Republic of Kazakhstan Committee on Statistics, 2019)

- Real savings of the budget of individuals and legal entities by reducing the consumption of energy resources and, accordingly, reducing operating costs;
- Using the ESC mechanism, consumers pay for financial resources and energy-saving technologies that not only increase the commercial attractiveness of the facility, but also bring it to a higher technological level. This payment is made at the expense of funds, which constitute the economic effect of the project implementation.

The ESC tool should be used as one of the priority areas. At the same time, with regard to the budgetary sphere, the implementation of ESC projects does not have a load on the budget, since the maintenance costs in the budget remain the same after the project implementation. Covering the investment costs as noted above is realized by saving on the energy consumption costs.

Despite the obvious advantages of ESCs, there are a number of problems that hinder their active use.

For example, in order to increase the use of this mechanism in the budgetary sector, in our opinion, local executive bodies should create a pool of energy-intensive public utilities, conducting their certification and defining the potential for energy saving through energy auditing. This in turn will allow the national operator in the field of energy saving to involve energy service companies in the implementation of energy modernization projects for budget social facilities (schools, kindergartens, hospitals, street lighting and others), as the scale and scope of work proportionally affects the level of attractiveness of the ESC, increases the interest of investors in the project, and contributes to the return on the initial investment (Martynova and Tsymbal, 2014).

In order to activate the processes of introducing energy-saving technologies that promote and ensure the reduction of carbon emissions in the Kazakhstani market, it is necessary to strengthen methodological approaches to the wide use of ESCs, including through economic incentive measures.

According to the specific law on energy saving, SER entities, with the exception of state institutions, are obliged to obtain an evaluation report on the energy audit findings within 4 years from the date of enactment of the current law.

The state assets, fixed on the balance (operational management) of various state institutions, contain energy-intensive movable and immovable property (street lighting networks, social and engineering infrastructure facilities, transport, etc.). Based on this, we believe that in this case, state institutions that have energy-intensive assets on their balance sheet should not be excluded from the list of SER entities that are subject to the energy audit, since they have a significant energy saving potential.

Currently, in Kazakhstan, a system of differentiated tariffs has been introduced in accordance with which the standardized volume of consumption for heat and electric energy is established, based on its normalization for consumers, which is calibrated in volume

per one person living in an apartment or apartment building, and per 1 square meter of the heated area, respectively. This measure certainly contributes to energy saving, however, in order to intensify actions aimed at reducing the energy intensity of the economy, it is necessary to take systemic measures. In our opinion, this requires state support aimed at broad economic incentives for activities requiring that business entities and, in general, the population replace energy-intensive technological and household equipment with innovative one. This, in turn, will serve as an incentive for attracting investment in energy saving and improving the energy efficiency of the national economy.

## 4. CONCLUSION

Based on the findings of the study, the following conclusions can be drawn.

1. The indicators of the consumption of energy of all types in the national economy of Kazakhstan demonstrate a key correlation between energy production, its consumption in the process of economic activity and the level of tariffs and prices for energy.
2. The intensification of measures to switch to energy-saving technologies will reduce greenhouse gas emissions into the environment. This, in turn, will provide not only socio-economic and local benefits, but also the possibility of attracting environmental (green) investments into the country's economy through the reserve of units of the assigned amount (an accounting unit equivalent to one ton of carbon dioxide, or a carbon unit).
3. The SER does not cover all the entities that consume energy resources, which does not allow to reveal a holistic picture in terms of energy consumption volumes and energy consumption problems. The lack of complete data prevents the development of appropriate economic indicators and the elaboration of effective actions aimed at important changes in the context of energy efficiency.
4. The ESC is an effective financial and incentive mechanism in the field of energy efficiency, the important advantage of which is that ESCs are budget-neutral, thanks to which the introduction of energy-saving technologies can be accelerated.
5. Reducing the inefficient use of fuel and energy resources requires additional measures that will be aimed at accelerating the introduction of energy-saving technologies and the international standard of energy management, as well as improving energy efficiency in various segments of the national economy.
6. Taking into account that about 70% of the energy produced is consumed by the industry of Kazakhstan, the SER obliges its entities to reduce the consumption of energy resources per unit of output, which in general allows planning measures to reduce GDP's energy intensity. The public sector and businesses, proceeding from the principle of economy, will consistently switch to energy saving. At the same time, in our opinion, one should pay attention to the reduction of energy consumption and the provision of an energy efficient budget sector, characterized on the one hand by the lack of economic motivation in this direction, and on the other hand, by significant opportunities for energy saving.

7. Achieving sustainable and environmentally friendly development, ensuring a reduction in the energy intensity of the economy and increasing energy efficiency is possible with a reasonable and responsible consumption of energy resources, with regard to the economic, legal and organizational aspects of the careful and economical consumption of energy resources.

Thus, in order to ensure the country's competitiveness, energy and environmental security, as well as to improve the quality of life, it is important to take measures to solve systemic energy saving problems within the parameters set by technological progress and world energy efficiency standards.

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