ENHANCING ENERGY EFFICIENCY IN THE CONTEXT OF INNOVATIVE MODERNIZATION OF THE AZERBAIJANI ECONOMY

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Abstract

This article examines the development of a mechanism to stimulate energy conservation and enhance energy efficiency as a key direction of the innovative modernization of the national economy during its transition to a new technological paradigm. The study explores the strategic prospects for the development of the Azerbaijani economy, substantiates the role of energy conservation and energy efficiency within the system of priorities for its innovative modernization, and evaluates the extent to which the energy factor influences overall economic performance.

The paper presents forecasting models and simulates the dynamics of the economy's energy intensity under alternative scenarios of changes in the external political and economic environment. It further identifies the mechanisms of interaction between innovation-driven development processes and energy conservation and efficiency improvements across different levels of economic governance. Particular attention is devoted to the conceptual and methodological foundations for designing a mechanism to promote energy conservation and improve energy efficiency at multiple levels of governance, positioning it as a central component of the innovative modernization of the Azerbaijani economy in the context of its transition to a new technological paradigm.

Keywords: national economy, energy efficiency, innovative development, modernization, model

I. Introduction

The issue of transitioning the national economy to an innovation-driven development path has received sustained attention at all levels of governance for many years. As a result of the measures undertaken, the country has established the foundations of a legislative and regulatory framework governing various aspects of innovation management and the protection of intellectual property rights. Significant efforts have been directed toward supporting state corporations and creating specialized development institutions, particularly research and innovation funds endowed with substantial financial resources for subsequent investment in promising innovation projects. The practice of developing sectoral innovation development programs has also become widespread.

However, a number of unresolved systemic problems in this domain continue to constrain Azerbaijan's transition to a trajectory of sustainable innovation-driven growth. In the context of the emerging new technological paradigm in the global economy, these constraints may further weaken the country's competitive position. The current situation necessitates a substantial intensification of efforts aimed at advancing the national economy along an innovation-based development path. One of the critical challenges in this regard is improving energy efficiency.

This challenge is largely обусловлено тем, что уровень потребления энергетических ресурсов на единицу валового внутреннего продукта в Азербайджане, по различным оценкам, по-прежнему в three to five times higher than in developed economies. Moreover, in recent years this gap has not narrowed; on the contrary, it shows a tendency to widen. Accordingly, the present study is focused on addressing both theoretical and applied issues related to enhancing energy efficiency at various levels of economic governance as a key direction of the innovative modernization of the Azerbaijani economy in the context of its transition to a new technological paradigm.

International ranking assessments serve as clear indicators of the success and shortcomings in organizing and supporting innovation activities across national economies. For instance, the Global Innovation Index (GII), published since 2024 through the joint efforts of Cornell University, INSEAD Business School, and the World Intellectual Property Organization, ranks 128 national economies according to their level of innovation development, thereby enabling the identification and dissemination of best global practices in fostering innovation processes.

As evidenced by the data presented in Figure 1, Azerbaijan's position in this ranking demonstrates a positive trend, reflected in its advancement from 98th place in 2012 to 77th place in 2024.

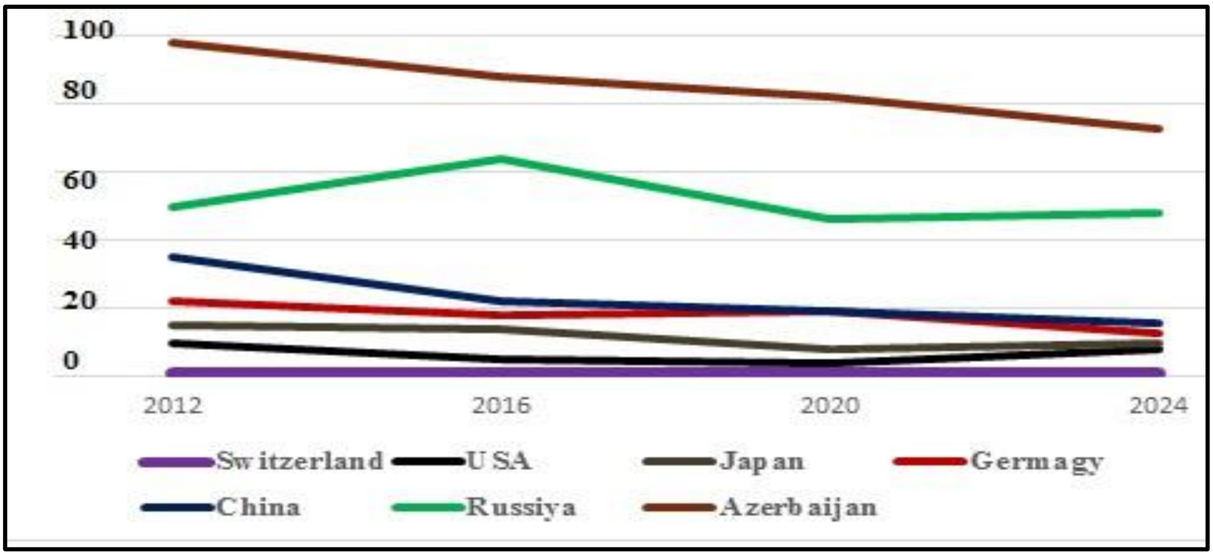

Figure 1. Comparison of countries' positions in the Global Innovation Index

However, a closer examination of the Global Innovation Index (GII) reveals that its values have remained largely unchanged over at least the past eight years. When comparing Azerbaijan's progress within the GII with the dynamics of a number of other countries, forecasts regarding its potential entry into the Top 25 of the ranking—even in the long term, not to mention more ambitious targets— appear rather uncertain.

Similarly to the GII and the Human Capital Index, the Global Competitiveness Index (GCI) has also remained broadly stable. Improvements in Azerbaijan's ranking positions in certain years are explained not so much by an enhancement in the quality of the business environment, but rather by a relative deterioration in other countries, which consequently lost their positions in the ranking.

The situation reflected in international rankings can largely be explained by the fact that, for a

long period, the country has attempted to address its innovation development challenges by following a so-called catch-up development model. This approach has been based on supporting technological areas that had already been disseminated globally and had formed corresponding international markets [1–4].

While this model may produce certain positive outcomes in the medium term, it is unlikely to significantly alter the long-term dynamics of innovation processes, as it effectively confines technological development to areas that are already at either the maturity or decline stage of their product life cycle.

The inefficiency of the chosen innovation development model has been further exacerbated by the traditionally weak demand for innovative developments in the domestic Russian market. On the one hand, this was due to the long-standing availability of budget revenues derived from the export of raw materials, primarily oil and gas. On the other hand, it reflected the highly cautious attitude of most domestic enterprises towards innovative projects even with a moderate level of risk, which, under relatively low competitive pressure in many domestic goods and services markets, were often perceived as a threat to established business practices. As a result, the limited number of initiatives undertaken by producers was mainly focused on the acquisition of ready-made foreign technologies and equipment, which can only conditionally be classified as innovative.

In this context, the structure of investment in innovation activity has predictably been shaped in such a way that the most important source of funding for research activities—forming the core of the innovation process—has been, and continues to be, the state budget.

Accordingly, the relatively low share of research and development expenditures in GDP is not surprising. According to this indicator, Azerbaijan ranked only 84th globally in 2024, with a value of 1.13%.

II. The impact of energy conservation and energy efficiency improvement processes on the innovative development of national economies.

Energy conservation and energy efficiency improvement have, in recent years, become one of the most important strategic directions in the economic development of many countries. In the context of global economic integration, this direction has gained particular significance, as it enhances the competitiveness of national economies.

A key indicator used to assess the effectiveness of state policy in the field of energy conservation and energy efficiency is the dynamics of energy intensity of gross domestic product (GDP). It should be noted that changes in GDP energy intensity are influenced not only by energy policy measures, but also by a range of other factors, including structural shifts in the economy, energy price dynamics, and technological aspects of energy production, transmission, distribution, and consumption. In economically developed countries, the economic structure is characterized by a large service sector; therefore, ceteris paribus, their GDP energy intensity is significantly lower than in economies dominated by heavy industry.

Based on the analysis of data on the energy intensity of national economies in developed countries, a clearly observable trend has been identified: a decline in gross inland energy consumption relative to GDP.

According to Eurostat, the Organisation for Economic Co-operation and Development (OECD), and the European Environment Agency, energy intensity decreased in all G20 countries over the period 2010–2024, with the exception of Mexico, where it remained stable. Over the period 2015– 2025, significant energy efficiency measures were implemented in Indonesia, India, the United States, and Japan. As a result, energy intensity in these countries decreased by almost 20%. At the same time, Japan, Türkiye, and European Union (EU) countries demonstrate the lowest levels of energy intensity [5–9].

In our view, the reduction in energy intensity across G20 economies, along with decreases in indicators such as per capita gross inland energy consumption by fuel type and final energy consumption, is primarily the result of effective energy conservation and energy efficiency policies implemented by these countries. In contrast, Azerbaijan, despite the measures adopted, has maintained its position as one of the most energy-intensive economies among major global states.

One of the main drivers of declining energy intensity in developed economies is the widespread application of advanced technologies and modern equipment. In turn, this has been facilitated by the inclusion of energy conservation and energy efficiency as strategic priorities within national science and technology development policies.

According to OECD data, average government expenditure on R&D in the energy sector among member countries accounts for approximately 4.5% of total public R&D spending, while environmental R&D accounts for nearly 1.7%. Countries that have achieved the most significant reductions in energy intensity have simultaneously made substantial investments in energy-related R&D. At first glance, the Republic of Korea appears to be an exception in this group. It invests more than USD 2 billion annually in energy R&D (or 8.8% of total R&D expenditure). However, its energy intensity decreased by only 5% over the period 2010–2024. In this context, it should be taken into account that South Korea has experienced relatively high economic growth rates (average annual real GDP growth of 4% in 2000–2024), a high share of energy-intensive industries in its economy, and a near-complete dependence on imported energy resources.

It should also be noted that the relative level of budget expenditures in Azerbaijan in the considered area is significantly lower than in most of the countries under review. An even higher level of R&D expenditure in the energy sector is observed in Japan. In relative terms, its expenditure amounts to 12.1%, while in absolute terms it reaches USD 4,800 million.

All of the above may serve as evidence supporting the conclusions of domestic researchers that the decline in the energy intensity of Azerbaijan's economy over the considered period was not the result of efforts aimed at the innovative modernization of energy-intensive industries, but rather due to other factors, including structural shifts in the economy. Although innovation-driven modernization of infrastructure was implemented, it remained local in nature and was concentrated in a limited number of high-tech industrial clusters.

At the same time, an increase in the innovation potential of G20 countries has been observed in recent years. As shown by data from the INSEAD Business School, Cornell University, and the World Intellectual Property Organization (WIPO), the Global Innovation Index, calculated on the basis of 79 indicators, has declined over the past four years for Japan, the United States, China, and several other G20 countries. This decline reflects a relative improvement in their positions within the overall sample of 128 countries. Thus, under conditions of intensifying global competition among leading world economies, the role of innovation continues to grow steadily, increasingly determining national competitiveness and, ultimately, the position and role of countries in the global economic system.

In light of the above, it can be concluded that the priority and scale of public financing of innovation activities in the field of energy conservation and energy efficiency are largely determined by the degree of national governments' interest in addressing related challenges aimed, ultimately, at strengthening the energy security of their economies. This is reflected in the fact that countries pursuing active state policies in energy conservation and efficiency use public R&D funding as one of the main sources for developing innovative technologies and equipment aimed at improving energy efficiency across various sectors and activities.

Thus, these countries have identified the enhancement of national energy security as a key priority of innovation-driven development, which serves as an integrating objective at the state level. This priority provides a strong impetus for the innovative modernization of national economies and contributes to maintaining their competitiveness in the context of the emerging new technological paradigm. Therefore, international experience in implementing state policies in energy conservation and energy efficiency within the framework of innovative development should be given close attention at different levels of economic governance in Russia.

An analysis of macroeconomic indicators of developed countries shows that the most active state policies in the field of energy conservation and energy efficiency management are implemented in countries characterized, first, by a positive trend of declining energy intensity independent of structural economic changes; second, by a high level of public financial support for R&D projects in the energy and environmental sectors; and third, by a high level of energy dependence and recent measures aimed at its reduction [39]. According to the study, the United States, EU countries, Japan, and China most closely meet these criteria. The extensive experience accumulated by these countries in public administration in the field of energy conservation and the application of efficient energyuse technologies is embedded in their established regulatory and legal frameworks and is reflected in legislation, national targeted programs for energy saving, systems of standardization and certification, and related instruments [10–13].

Among the identified characteristic features of energy conservation and energy efficiency management practices across different countries, the following can be highlighted:

First, a clearly defined hierarchy of strategic and tactical managerial interventions in the field of energy conservation and energy efficiency can be observed. This hierarchy may be considered in terms of the scale and scope of transformations, the methods and nature of interventions, sectoral specificity, and time horizons of implementation. In particular, a consistent tightening of regulatory measures is evident, ranging from informational and educational initiatives to the introduction of mandatory and voluntary technical standards; from the free dissemination of information on energysaving behavior among all economic agents as general guidelines, to the adoption of binding action plans and the development of comprehensive monitoring mechanisms ensuring their implementation.

Second, there are clearly identifiable common ideological principles and structural features underlying the formation of regulatory frameworks in different countries. These relate to the structure of national legislation, procedures for its implementation, the degree of regulatory strictness, the balance between state regulation and market mechanisms, and the extent of alignment between national energy efficiency legislation and international commitments.

This is reflected in the fact that in the countries under review, a regular strategic review of national development priorities is conducted, during which the interconnections between energy conservation and energy efficiency systems and broader state strategic priorities are updated or reconfigured. This, in turn, enables the synchronization of goals and objectives across different policy domains, increases implementation efficiency through coordination, and generates additional effects through policy integration.

For example, EU legislation establishes a flexible balance between state regulation and market mechanisms, allowing member states to account for their legal and socio-economic specificities while simultaneously fulfilling their obligations. This is achieved through mechanisms for harmonizing national legislation and EU regulatory acts in the field of energy conservation and energy efficiency.

Third, there are clearly defined common features of public policy implemented by virtually all developed countries actively engaged in energy conservation and efficiency improvement, aimed at stimulating innovation processes associated with the application of new technologies and scientific breakthroughs in the energy sector.

For instance, in the United States and EU countries, the voluntary product labeling program “Energy Star” has been implemented. It is periodically revised in such a way that, upon adoption of a new standard, only about one quarter of the currently produced equipment complies with it. As a result, manufacturers seeking to remain part of the program are compelled to continuously improve their products, investing significant resources in research and development and intensifying their innovation activities.

Among the most important energy efficiency measures introduced in the United States in recent years are the following: the “Superior Energy Performance” certification program, which provides industrial enterprises with technological roadmaps for continuous improvement of energy efficiency while maintaining competitiveness; energy efficiency standards for the residential and utilities sector; fuel economy standards for motor vehicles; rebates for consumers purchasing energy-efficient appliances; grants to states and local authorities to support energy efficiency and conservation projects in public buildings; targeted investments in energy-saving and public transport development projects; improvement of energy efficiency in information and communication technologies; expansion of tax incentives for homeowners and businesses undertaking energy-efficient retrofits at their own expense; promotion of electricity generation based on renewable energy sources; and a range of other measures.

In the EU, measures have been adopted to stimulate technological modernization and expand demand in innovative product markets. The most important include minimum energy efficiency standards for products; CO_2 emission standards for cars and vans; regulatory measures for EU structural and investment funds; the Electricity Internal Market Directive, including provisions for smart meter deployment; and the EU Emissions Trading System.

To stimulate research and development in energy conservation and energy efficiency, the Strategic Energy Technology Plan was revised in 2013, and an energy efficiency component was introduced into the “Horizon 2020” programme, which represented the largest EU framework programme for research and innovation during the period 2014–2020. Its total budget exceeded EUR 80 billion, of which approximately 7.5% was allocated to energy-efficient technologies in construction and industry, as well as supporting technologies, including information, telecommunications, and related fields. In addition, funding procedures were simplified, thereby granting researchers greater flexibility in implementing their ideas and developing genuinely innovative technological solutions.

In several European countries (including the United Kingdom and Italy) as well as in the United States, steps have also been taken in recent years to gradually reduce the dominant position of large electricity companies in the market. To this end, new electricity generation companies employing innovative energy technologies are being progressively integrated into the energy market.

In Japan, one of the key instruments of state policy in the field of energy efficiency is a system supporting business enterprises in the implementation of innovative energy-saving technologies, as well as preferential lending for energy-saving measures provided by the Japan Development Bank

[14–16].

Legally established criteria define the requirements for companies obliged to use energy rationally in production processes, alongside guidelines for the preparation of long-term plans across various industrial sectors with regard to electricity supply, gas supply, heat supply, and industrial waste management. The tax system is continuously evolving, introducing new mechanisms to encourage investment in the restructuring of energy supply systems, and a dedicated support framework has been established for enterprises implementing innovative energy-saving technologies. In addition, measures for technological development in this area have been defined, including research into fundamental technologies for rational energy use and the development of methods for their practical application.

In Asian industrialized countries (China, the Republic of Korea, Singapore, Hong Kong, and Taiwan), the legislative restriction of the use of certain obsolete technologies is widely practiced. For example, China has implemented a program for the closure of small-scale plants and outdated production capacities ("CSPOC"). At the same time, bans on obsolete technologies are generally accompanied by measures stimulating the dissemination of new technologies, including support for enterprises engaged in the production of new goods, the transfer and localization of innovative technologies from foreign companies, as well as budget subsidies for consumers of such products.

Thus, the analysis of leading global practices in public administration demonstrates that state policy in the field of energy conservation and energy efficiency is integrated into a country's system of strategic priorities and generates demand within the national economy for the development of advanced, including innovative, technologies and equipment. Moreover, energy conservation and energy efficiency, as a key direction of priority technological development, create an additional vector for the implementation of scientific, technical, and experimental design projects aimed at improving machinery, equipment, and technologies.

The findings obtained are supported by empirical studies conducted in developed countries. These studies substantiate the role of state support for innovation activity in the energy sector as a means of improving the energy efficiency of the economy and suggest that public policy should ensure regulated yet sufficiently flexible conditions for stimulating innovation in the energy domain. In this context, particular emphasis is placed on the synchronization of innovation and energy policies. The necessary conditions and potential effects of such synchronization at both national and supranational levels have been examined using the example of cooperation between the European Union and the United States in transforming their energy systems through technological innovation, as well as through an assessment of the impact of electricity market reforms in the United Kingdom on the innovative development of the power sector, where liberalization of the electricity market was accompanied by a decline in innovation performance until specific state support measures were introduced.

However, such studies have been conducted to a very limited extent for developing countries. Moreover, it has been found that the results of research obtained for developed economies cannot be directly generalized to developing countries.

Thus, international experience demonstrates that addressing energy conservation and energy efficiency challenges through their close integration with innovation activities yields significantly higher results compared to their independent implementation. Consequently, the interrelationship between energy efficiency policy and innovation-driven development is becoming increasingly strong, creating broad opportunities for technological modernization of industrial production and its orientation toward advanced energy-saving technologies. In other words, countries pursuing active policies in energy conservation and energy efficiency increasingly regard the stimulation of innovation processes related to new technologies and scientific discoveries in the energy sector as one of the key priorities.

The results obtained and the conclusions drawn may serve as a basis for the development of domestic practices in managing energy conservation and energy efficiency, which is particularly relevant in the context of innovative modernization of the national economy during its transition to a new technological paradigm of development [17–19].

III. Formation of a mechanism for activating energy conservation and improving the energy efficiency of the economy.

In recent years, increasing attention has been paid at various levels of governance to improving the energy efficiency of the Azerbaijani economy. At present, the energy intensity of Azerbaijan's gross domestic product is almost four times higher than the global average and nearly seven times higher than that of leading European countries. Therefore, it is not surprising that one of the state development programs of Azerbaijan is fully devoted to various aspects of improving energy efficiency and developing the energy sector.

The results of the conducted analysis indicate that institutional conditions necessary for stimulating energy conservation and energy efficiency improvements are being developed at sectoral levels of economic governance. However, despite the measures undertaken, various aspects of activating energy conservation and energy efficiency processes have not been reflected in innovation development programs. This situation is further exacerbated by the low level of synchronization between policies in the field of energy conservation and energy efficiency and those in the field of innovation development. In practice, these represent two relatively isolated areas of activity, within which independent strategic documents are formulated, target indicators are defined, planning and implementation procedures are regulated, monitoring systems are established, and distinct organizational, informational, legal, and financial-economic support mechanisms are developed.

Therefore, without integrating the energy conservation and energy efficiency management mechanism into the innovation development system of the national economy, issues of energy saving and energy efficiency will not be regarded as a key priority of innovative modernization of the Azerbaijani economy.

To address this situation, the following conceptual model is proposed, which outlines the logical sequence of actions for forming a mechanism to activate energy conservation and improve energy efficiency as a key direction of innovation-driven economic development.

At the first stage, activities are focused on identifying factors that may influence the activation of energy conservation and energy efficiency processes in the Azerbaijani economy in the context of its innovation development. The diversity of these factors is grouped into three categories: political, economic, and organizational-communication factors.

At the second stage, an economic assessment of the potential consequences of the influence of different factors on the activation of energy conservation and energy efficiency processes is conducted. This is necessary because the magnitude of influence of each group of factors may vary significantly. The obtained results can be used to forecast the possible impact of these processes on the outcomes of innovation-driven economic modernization.

The entire set of tasks within this stage involves modeling the influence of various activation factors on the results of innovation modernization and includes both direct and inverse forecasting problems.

Direct problems are associated with assessing changes in key economic indicators at different levels of governance as a result of the activation of energy conservation and energy efficiency processes. By modeling the dynamics of various factors, their impact on the outcomes of innovation modernization of the Azerbaijani economy can be studied in order to introduce necessary adjustments into management processes.

The second group consists of inverse problems. These are aimed at determining threshold values of the influence of identified activation factors under which target economic indicators at different levels of governance can still be achieved. Therefore, solving inverse problems is of particular importance from the perspective of active management of innovation modernization processes in the Azerbaijani economy under current development conditions.

At the third stage of the proposed model, conceptual design of possible directions for activating energy conservation and energy efficiency processes is carried out.

At the fourth stage, organizational aspects of implementing the developed activation mechanism are considered, including, first and foremost, an assessment of the readiness of managers at different levels of economic governance to address activation problems of varying complexity and scale.

At the fifth stage of the conceptual model, a comprehensive assessment is conducted of the intellectual, material, financial, organizational, administrative, and other resources required to launch the proposed activation mechanism.

The methodological framework underlying the proposed approach is based on viewing the energy sector as a complex system that, from the perspective of national economic interests, can be analyzed from two standpoints. On the one hand, it represents an independent production and technical system; on the other hand, it constitutes a key subsystem of the national economy. As a production and technical system, the energy sector is a basic industry of the Azerbaijani economy, ensuring all spheres of socio-economic activity with energy products generated through a complex set of processes involving the production, conversion, transmission, distribution, and utilization of energy resources.

Considering the domestic energy sector from this perspective, it can be stated that the goals and objectives of its functioning have not undergone significant changes compared to earlier stages of development. As before, the primary priority remains the provision of all categories of consumers with various types of energy resources required for their activities. Therefore, from the standpoint of strategic management of energy conservation programs, the most relevant approach is normative (target-oriented) forecasting. Under this approach, specific energy-saving parameters required to achieve the desired outcomes in this field are clearly defined. The target indicator in this context is the energy intensity of the national economy [20–21].

However, even under this approach, the key issue accompanying the formation of an energy conservation strategy is transformed, first, into the justification of target indicators for different levels of governance, and second, into their transmission and implementation at each managerial level.

The first problem arises already at the stage of coordinating sectoral-level interests. From a mathematical perspective, this task is distributive in nature. Its solution consists of determining numerical values of energy conservation and energy efficiency indicators to be assigned to individual regions. Once such a solution is obtained, the issue of harmonizing regional energy-saving targets can be considered resolved.

Another important aspect should also be emphasized. The degree of influence of energy costs on gross regional product varies significantly across regions due to the factors mentioned above. Therefore, the development of strategic and program documents requires addressing two major issues.

First, it is necessary to analyze the impact of various factors on key macroeconomic indicators of regional development, including gross regional product (both in total and per capita terms), labor productivity, and related indicators. Based on such an analysis, a selective approach can be applied to setting specific energy-saving and energy efficiency targets for different regions, as well as to assessing possibilities for financial support of regional initiatives in this area.

Second, it is necessary to identify the impact of various factors on the magnitude of energy expenditures and determine the degree of their influence. For example, research results may show that the dominant influence is exerted by industrial production costs or by the level of investment in innovative technologies, etc. Based on this, regions would be able to independently determine priority areas for addressing energy efficiency challenges, with corresponding financial allocations.

The next problem in developing energy conservation and energy efficiency programs arises from the fact that a region, as an administrative-territorial unit, does not itself produce or consume resources. Production, economic, social, cultural, and other activities are carried out by enterprises, organizations, and institutions located within its territory. These entities are also the direct consumers of various types of resources, including energy.

This leads to a second coordination problem, which arises between, on the one hand, the regional level that must ensure the implementation of previously established and agreed federal indicators, and, on the other hand, individual enterprises, organizations, and institutions operating within its territory.

Thus, the task of allocating targets for achieving energy conservation and energy efficiency indicators is further extended and transferred to the next level of governance—namely, between the regional authorities and the individual economic entities operating within the region.

As a solution to this problem, the numerical values of energy conservation and energy efficiency indicators to be assigned to individual regional entities now serve as the key output parameters. Failure to ensure coordination of interests between different levels of governance, as well as the absence of a scientifically grounded justification for the feasibility of achieving the set targets, may result in the developed strategies, programs, forecasts, and other policy documents becoming purely declarative in nature, often acquiring a political rather than practical character, as was previously the case, for example, with the anticipated but unrealized doubling of national gross domestic product. In such cases, highly optimistic target benchmarks, indicators, and performance metrics may be established for the economy as a whole or its individual sectors; however, despite their apparent significance and formal robustness, they are unlikely to be achieved in practice.

Another possible approach to addressing this issue is to allocate targets not among individual enterprises, organizations, and institutions, but rather among specific projects in the field of energy conservation and energy efficiency improvement. In this case, regional authorities select on a competitive basis those projects that ensure the best performance indicators in the field of energy efficiency. Funding from the regional budget is then allocated to the selected projects. The implementation of these projects is expected to deliver the required outcomes in energy conservation.

Of particular importance in the proposed methodological framework are the organizational and economic aspects of designing and implementing the activation mechanism for energy conservation and energy efficiency, integrated into the innovation development system of the national economy. Their relevance stems from the fact that neglecting organizational issues may become a critical barrier to achieving the overall objectives of the mechanism. Among these, two aspects are of primary importance: first, the harmonization of legislation in the fields of energy conservation, energy efficiency, and innovation development; and second, the provision of adequate information support for the integration of these processes.

The harmonization of legislation in these areas may serve as one of the key factors stimulating the processes of creation, implementation, and commercialization of energy-efficient innovations.

Conclusion

At all levels of governance, the transition of the national economy to an innovation-driven development path places particular emphasis on the selection of such development priorities that can provide a strong impetus for innovative modernization and enhance competitiveness under the emerging new global technological paradigm. One of these priorities is the improvement of energy efficiency in the Azerbaijani economy. The present study is focused on addressing the challenges associated with the implementation of this priority, which is considered a system-forming factor in the context of innovation-driven economic development. The main results obtained are as follows:

1. An assessment of the strategic development prospects of the economy under the transition to a new technological paradigm based on innovation-driven modernization was carried out. The specific features of the existing system of innovation activity organization were identified. It was established that the measures implemented by the state authorities have enabled the economy to follow a relatively balanced and well-structured trajectory of innovation development policy.
2. The causes and cyclical nature of intensified efforts to address energy conservation and energy efficiency challenges at different stages of economic development were identified. It was demonstrated that the existing model of energy efficiency management is not fully adequate to current economic conditions, thereby necessitating its further improvement and adaptation.
3. A model describing the dependence of GDP energy intensity on changes in key indicators was proposed, including the share of the service sector in the economy and the share of natural resource revenues in GDP. Simulation modeling of energy intensity dynamics under different scenarios of external political and economic conditions was conducted.
4. It was noted that a priority direction for improving energy efficiency in the national economy is the enhancement of innovation activity among domestic producers, implying an increase in innovation financing at different levels of governance. Minimum threshold values for the growth of domestic expenditures on research and development required to maintain GDP energy intensity at the 2035 level were substantiated.
5. A significant and statistically meaningful correlation between innovation activity indicators and energy efficiency indicators was confirmed, and the strength of this relationship was determined. It was substantiated that the coordination of innovation development processes and energy efficiency within a unified management framework can be considered a key direction for improving enterprise-level energy efficiency under conditions of innovation-driven economic development.
6. It was established that addressing energy conservation and energy efficiency challenges in different countries through their close integration with innovation activity yields higher results compared to their independent implementation. It was shown that the interconnection between state policies in the fields of energy efficiency and innovation development is becoming increasingly strong at different levels of national economic governance.
7. The proposed approach to the development and implementation of energy conservation and energy efficiency programs under conditions of innovation-driven development will enhance and expand the potential of energy-saving processes through their alignment with innovation processes at various levels of economic governance. It will also contribute to the development of globally competitive products and

technologies, while significantly supporting the resolution of technological lag and accelerating national economic growth.

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