

# Tools to Improve the Energy Efficiency of the Russian Regions in a Nonstationary Economic Regime

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**Abstract**— Reducing energy intensity, increasing energy efficiency are key areas for achieving sustainable growth of the country's economy in conditions of non-stationarity.

Reforms related to tariff regulation, the development of subsidies and the abandonment of cross-subsidization, the delineation of social and energy policies and the introduction of stringent requirements for the quality of services, the increasing access to financing, and fiscal stimulation of the energy complex are moving slowly and inefficiently. In addition, the aging infrastructure of the energy complex requires large investment. In the conditions of the non-stationary economic regime, the optimal choice of financial, economic, institutional, administrative and regulatory instruments plays a special role in implementing measures aimed at increasing energy efficiency and developing energy saving. The nature of the use of tools to improve the energy efficiency of the regional economy depends primarily on the level of socio-economic development of the territory that has been achieved. The current market mechanisms do not give the desired effect under non-stationary conditions. In such conditions, the basis for improving the energy efficiency of the region will be the instruments of state support. For the most effective use of instruments of state support in the region, the authors singled out:

- Key elements that determine success in achieving the goal;
- Power characteristics of the impact on the target;
- The conditions for the most effective impact of instruments

are not the resulting indicators: the way, direction and nature of the impact, the ability to adapt instruments to changing conditions. Any tool used to achieve the goals in the field of energy conservation and energy efficiency has certain characteristics. The set of characteristics of any instrument is standard, but in different types of regions it will appear in different ways. As a result, several tools with different characteristics and a combination of these characteristics in the group will give a synergistic effect that will increase the effectiveness of achieving the goals set with the least cost. The right combination of tools will achieve the maximum possible efficiency by reducing and strengthening the impact vector.

**Keywords**— energy efficiency, tools for energy efficiency improvements, energy intensity of GRP

## I. INTRODUCTION

Improving energy efficiency is one of the key factors in the transition of energy-intensive economies to sustainable development, because it allows to limit energy consumption

by reducing dependence on the use of environmentally unsafe energy sources, increasing productivity, reducing environmental pollution, and creating new markets for environmental products and services, workers places.

Russia is one of the most energy-intensive countries in the world and has a huge potential to reduce inefficient energy consumption. The energy intensity of Russia's GDP is 2.3 times higher than the world average, and 3.5 times higher than in the European Community. For the period from 1990 to 2016 there was a significant excess of the energy intensity of Russia's GDP in comparison with the world indices. There has been no significant reduction in energy intensity in the country for many years. However, during the period from the end of the 1990s to the year 2008 there was a tendency to reduce the energy intensity of the country's GDP, but today the dynamics have changed in the direction of growth.

The dynamics of GRP energy intensity indicators in Russia reflects the low efficiency of applying tools of improving the energy efficiency of the country's economy, the lack of unified approaches and approaches to selecting tools with the maximum multiplier effect. At present, in contrast to the trend of reducing energy intensity both in the world average and for individual integration associations, in Russia there is a slight but steady growth. This happens despite the beginning of active implementation and use of energy saving instruments and instruments of improving the energy efficiency of the Russian economy.

Reduction of energy intensity is the most important direction of the social and economic development of the Russian Federation in the conditions of the current non-stationary economic regime. In recent years, new instruments for energy saving and improving the energy efficiency of the economy have been actively introduced, but it should be noted that the application of such instruments is ambiguous. So, within the framework of the state program "Energy Efficiency and Energy Development" adopted by Decision No. 321 of the RF Government of April 15, 2014, less than 1% of the budget is allocated to the implementation of activities under the subprogram "Energy Saving and Energy Efficiency" every year, with a planned value of the entire implementation period is about 14%.

And in 2017, such funding was generally not provided. To implement the activities of the subprogram "Development and use of renewable energy sources" it was initially planned to spend less than 0.2% of the total funding of the program. The values of target indicators for the implementation of mechanisms and support instruments are changing. So, the Decree of the President of Russia No. 889 envisaged reducing the energy intensity of GDP by 40% in 2020 compared to 2007, and already in the text of the State Program: it is planned to reduce the energy intensity of Russia's GDP by 13.5% by the year 2007.

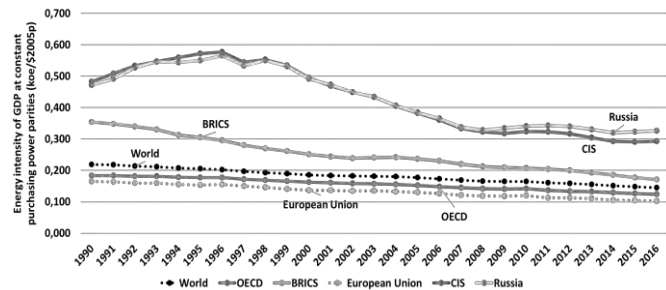


Fig. 1. Comparison of the dynamics of energy intensity in Russia and some integration associations.

In the current situation, the choice of the most optimal mechanisms and instruments for increasing energy efficiency begins to take on special importance. The complexity of this choice is related to the need to consider the variability of the instrument factors in the current conditions of the Russian economy. The basis for the effective use of government support tools is, first of all, the allocation of their key elements that determine the success in achieving the stated goal and conditions for the most effective impact of this set of tools and their power characteristics on the achievement of results: the way, direction and nature of the impact, to changing conditions.

Any tool that we use to achieve our energy saving and energy efficiency goals has certain characteristics. The set of characteristics of any instrument is standard, but in regions of different types it will appear in different ways. Several tools with different characteristics and a combination of these characteristics in the group will give a synergistic effect that will accelerate or increase the effectiveness of achieving the goals set at the lowest cost. The right combination will achieve the maximum possible efficiency by reducing and strengthening the impact vector.

**II. METHODOLOGY**

The analysis of foreign experience in the application of support activities, including the toolkit, allowed us to identify several of the most common approaches in their classification. Thus, in the UN report, the actions of the authorities are divided into political measures and price (quotas and tariffs) [6]. In the scientific literature of the countries of the European Union, one can find a division into financial, institutional tools, tools aimed at establishing production volumes using renewable energy technologies, and software tools.[4] Another approach to classification is related to the influence of instruments on the demand and

supply of market incentives (the possibility of using market mechanisms to increase energy efficiency).[1] In our opinion, in the context of the need to organize stabilizing mechanisms for increasing energy efficiency, a special role is played by government mechanisms for supporting activities aimed at energy saving and improving the energy efficiency of the subjects of the Russian Federation.

A set of support tools for fuel and energy complex used in the domestic economic system, the authors propose to classify according to the organizational and economic characteristics, dividing them into general and specific ones (Table 1). Such an approach to classification makes it possible to emphasize the most significant mechanisms and forms of organizing support for the development of enterprises of the fuel and energy complex while increasing energy efficiency in a non-stationary economy.

TABLE I. SYSTEMATIZATION OF THE INSTRUMENTS USED TO SUPPORT MEASURES FOR IMPROVING THE ENERGY EFFICIENCY OF THE ECONOMY IN TERMS OF ORGANIZATIONAL AND ECONOMIC CHARACTERISTICS

No	Factors of grouping	General Tools	Specific tools
1	Financial and economic support tools	Investment tax credit	Leasing of energy equipment
		Accelerated depreciation	Quota of harmful emissions
		Special tax benefits	Tariff differentiation in power engineering
		Subsidizing the interest rate on loans	Granting subsidies from budgets for energy saving and energy efficiency measures
		Grant of guarantees	Tariff differentiation (social benefits) in the field of energy consumption
		Granting of subsidies from budgets	
		Tariff incentives	
2	Institutional Support Tools	Special investment contracts	Energy service contracts
		Concession	Energy audit
			Norms of generation and consumption of energy from renewable sources
3	Administrative and regulatory tools	Expanding the use of incentive-type contracts	Stimulating end-users for energy saving
		Patent and legal regulation of innovation activities in the framework of state contracts	Implementation of renewable energy technologies
		Improvement of the tariff indicator of quality management of energy efficiency of the region's economy) regulation	Energy audit

Compiled by the authors on the basis of the study of domestic and foreign regulatory and legal framework for the regulation of the fuel and energy sector.

### III. RESULTS OF THE STUDY

The author's approach to the systematization of support measures on the basis of organizational and economic features is also conditioned by the characteristic stage of the development of the regional economy in the context of energy efficiency and energy independence as an initial one. At the same time, as the analysis showed, not all tools are used in regional support programs, and the use of applied tools has extremely different degrees of effectiveness. Therefore, in our opinion, it is necessary to study the developing interrelations between increasing the energy efficiency of the economy, the specifics of the support tool and the nature of the emerging interrelations between the instruments used and the dynamics of energy efficiency indicators in a non-stationary economy.

In this regard, at the first stage of the study, an author's methodology for assessing the energy efficiency of the regional economy was developed. In the world practice there were several methodological approaches to its evaluation. Thus, the experts of the International Energy Agency consider diagnostics from the perspective of the index approach based on general decomposition methods or factor analysis of indicators (International Energy Agency, 2014), which are disaggregated or divided by the factors of the change in energy consumption in the end-use sectors (residential sector, service sector, industrial production and transport), as well as in the economy in general and in individual territories. The use of a multidimensional approach within the framework of energy efficiency diagnostics (Burnashev K., 2015) is based on an analysis of the nature of energy conservation and energy efficiency in terms of the innovativeness of the modern economic process. One of the most common approaches is the so-called indicative approach. But its application raises a number of questions in the objectivity of the results obtained. For example, in the framework of the index approach, a number of experts (Gayfullina M.M., Khaliullina D.R., Khafizova L.K., 2017) calculate the level of energy efficiency through energy security and energy efficiency indicators and compare them with threshold values. At the same time, the main problem of using this method is the selection of those indicators whose comparison with the threshold values will allow a comprehensive assessment of the state of energy security and energy efficiency of individual enterprises, companies and territories, and to identify objective dangerous trends and threats.

In the world practice, a significant part of the research is based on the analysis of the energy intensity of GDP (GRP) or on the environmental indicators that characterize the operation of enterprises in the fuel and energy sector (the volume of emissions from the fuel and energy complex). In our opinion, this approach is rather one-sided, since it does not allow to analyze the situation in the field of energy saving and energy efficiency in a comprehensive manner. In this connection, the authors proposed the choice of tools for increasing energy efficiency in their interrelation with indicators reflecting the basic factors of socio-economic and energy stability of the regional economy, analyzed in the context of 7 basic blocks:

- 1) Indicators of economic stability (energy security), representing the nature of the fuel and energy balance of the region's economy, the reliability of the energy infrastructure, the financial and economic returns of economic entities in the region's fuel and energy complex;
- 2) Indicators of social stability (energy equality), characterizing the availability and accessibility of energy for the population;
- 3) Indicators of environmental sustainability, considering the role of energy in the environmental pollution of the region, as well as the energy production from renewable sources;
- 4) Indicators of socio-economic sustainability, considering generally the increase in energy efficiency in terms of the qualifications of the labor force employed in the fuel and energy sector and the labor market situation in the industry;
- 5) Indicators, environmental and economic sustainability, based on estimates of the dynamics of the energy intensity index of the gross regional product;
- 6) Indicators of socio-environmental sustainability, estimated on the basis of per capita indicators of environmental pollution;
- 7) Indicators of quality of the energy efficiency management of the regional economy, based on a comparison of the methodology of the energy efficiency rating of the subjects of the Russian Federation (the Ministry of Energy of the Russian Federation), assessing the implementation of key policies in the field of energy conservation and energy efficiency by the subjects of the Russian Federation, programs in the field of energy conservation and energy efficiency.

During the study, the authors selected several indicators in each of the blocks, reflecting the nature of each of the main and intermediate directions of sustainable development (Table 2.)

Each of the analyzed specific tools has its own key element that determines success in achieving the goal, power characteristics of the impact on the target object, as well as the way, direction and nature of the impact and the ability to adapt to changing conditions.

Thus, the application of the mechanism of energy service contracts based on the principle of payment for energy-saving measures implemented by specialized energy service companies through funds saved from energy savings allows the consumer to obtain significant advantages. Energy service contracts help overcome financial constraints on investment and pay off initial costs through energy conservation savings caused by reduced energy consumption, provide an opportunity to curb energy consumption and manage CO<sub>2</sub> emissions while providing market benefits to the customer by reducing energy costs and concomitant profit-making.

**TABLE II. INTERDEPENDENCE BETWEEN THE INDICATORS OF ENERGY EFFICIENCY OF THE REGIONAL ECONOMY AND SPECIFIC TOOLS OF STATE SUPPORT FOR IMPROVING THE ENERGY EFFICIENCY OF THE REGIONS**

№	Specific tools	Indicator
1	Leasing of energy equipment	Depreciation of fixed assets of energy-intensive industries in the region
	Quota of harmful emissions	The volume of emissions from enterprises of the fuel and energy complex per capita
	Tariff differentiation (social benefits)	Coefficient of energy accessibility to the population
2	Granting of subsidies from budgets	Effectiveness of the implementation of measures of state programs on energy saving and energy efficiency improvement (based on existing methods) The share of extrabudgetary funds in the total amount of financing activities in the field of energy conservation and energy efficiency
	Energy service contracts	The nature of the market (scale and institutional features) of energy service contracts (an indicator of the quality of managing the energy efficiency of the regional economy)
	Energy audit	The introduction of energy declarations (an indicator of the quality of managing the energy efficiency of the region's economy)
3	Norms of generation and consumption of energy from renewable sources	The share of renewable energy sources in the total volume of final energy consumption
	Stimulating end-users for energy saving	Specific consumption of fuel and energy resources / per capita
	Implementation of renewable energy technologies	Share of renewable energy in the total production volume of the region's fuel and energy sector
	Energy audit	The introduction of energy declarations (an indicator of the quality of managing the energy efficiency of the region's economy)

There are several approaches to the selection of indicators for assessing the efficiency of the market for energy service contracts. Most often, when assessing the ESCO market, indicators characterizing the scale of the energy service market are used: the volume of production and the number of contracts concluded. But, in our opinion, the most complete state of the market for energy services reflects an approach that uses a balanced system of indicators, reflecting both the scale of the market itself and its institutional characteristics. This approach allows you to take into account the largest number of aspects of market development and its effectiveness. The need to use two types of indicators characterizing the market of energy services is due to the fact that players in this market are not only energy service companies, but also energy auditing companies, banks, suppliers of equipment and energy efficiency solutions, development institutions from state and private companies that carry out consulting services, training and promotion of energy services.

The analysis of the specifics of the activity of key players on the Russian energy service market and the indicators characterizing the efficiency of its development made it possible to determine the insignificant level of its development and identify several groups of factors hindering the active

development of the market: the extremely low information awareness of the potential client, the lack of normative and methodological documents regulating this area, gives rise to the lack of a mechanism to identify and prove savings in cash after the implementation of projects. It seriously hinders the development of the market of energy services and a limited understanding of energy efficiency and the principles of the operation of energy service contracts by financial institutions. In addition, the current legislative and regulatory framework, most often not compatible with investments in energy efficiency. There is no motivation for the implementation of energy-efficient technologies and for potential customers due to the fact that energy costs are only a small part of the total costs.

Solving these problems will not only lead to the development of the energy service market itself, but also significantly improve the importance of its energy efficiency indicators for all 7 blocks of the region's sustainable social, economic and energy development.

**Conclusions.** The analysis of the existing approaches in the world and domestic practice, both methodologies for assessing the level of energy efficiency and methods of selecting tools to support energy efficiency measures, helped to develop an authorial mechanism for the relationship between instruments and indicators of the energy efficiency of the regional economy. This approach, on the one hand, considers the complexity of the assessment of activities and the nature of the impact of energy efficiency on the socio-economic development of the territory. On the other hand, it allows to monitor the effectiveness of the support instruments on the nature of the processes for improving the energy efficiency of the regional economies.

The proposed approach makes it possible to assess the role of various factors, including the nature of the impact of the instruments of state support for the implementation of activities in energy conservation and improving the energy efficiency of individual territories

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