

Innovations as a Necessary Factor of Resource Potential of Social and Economic Systems Development

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Abstract. The article reviews an impact of innovation activity of the territories on the basis of the available resource potential by the introduction of resource-saving technologies. A correlation analysis of the relationship between gross domestic product and energy consumption has been carried out. A practice of a some countries on energy intensity reduction has been analyzed. A cluster analysis of the energy sector in a some countries was been completed.

1 Introduction

Modern economic conditions with characteristics of slowing down the rates of economic growth are becoming a real challenge for the Russian economic system. To overcome negative trends it is necessary to intensify the use of own territory resource potential. These processes are connected with several objective factors. Firstly, the consequences of the global financial crisis should be noted, one of the results of which is a slowdown in economic growth, as well as a decrease in the overall efficiency of economic entities. The second factor to be noted is the sanctions impact, characterized by refining resource materials from external sources. Thus, the national system faces not only a quantitative limitation, but also a qualitative one. First of all, it is necessary to slow down the recession and find internal resources to improve the optimality of social and economic processes.

2 Methods

In the course of this study, the methods of analysis, grouping, as well as graphical presentation of data, the method of cluster and regression analysis were used.

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In this case, it is necessary to take into account the global development trends in which, usually, qualitative growth becomes possible in systems based on the use of innovative technologies and management techniques. It should be noted that qualitative growth or economic development is a concept different from the economic growth category and is based precisely on innovation. A classic of economic thought J. Schumpeter, who interpreted economic development as "... the appearance of something new, unknown before," which in its essence is an innovation, while "... economic growth is an increase of production and consumption of the same goods and services over time " came to this conclusion [1].

Thus, despite the fact that a resource-oriented economic system can be effective, economic development will proceed at a faster rate if there is an innovative modernization of existing spheres of economic activity. In this case, the main objectives are the development of new innovative technologies, the transition from non-renewable resource sources to renewable ones, while the Russian economy is growing competitively, rather than striving for quantitative growth of the gross national product by any means [2].

It should be noted that objective conditions for introducing advanced technologies characterized by more optimal parameters in terms of energy efficiency are present in all types of economic activity. One of these areas is construction, the need for qualitative transformation of which is also caused by negative factors that characterize the general state of its material and technical base. We are talking about a high degree of depreciation of fixed assets in Russia, which was at the level of 50% in 2016, in particular. Thus, the processes taking place at world and national levels remain relevant not only for regions and territories but also for certain types of economic activity.

In such conditions, innovations embodied in the newest technologies which are introduced into production, become more significant than the traditional investments in development, such as: capital costs, material values, and so on [3].

It should be noted that the innovative type of development is associated with the functioning of the socio-economic system in an environment of increased risk, which causes the loss of all possible resources [4] and exacerbates existing competition among regions within the country for all sorts of resources [5].

Thus, under the circumstances, introducing innovations is the basis for increasing competitiveness of socio-economic systems at various levels. However, it should also be noted that, despite this fact, one should not forget that this very competitiveness of the territories, as noted above, is based on the available resource potential. In this connection, the resource support of innovation activity acquires a special strategic importance, since on the one hand, it forms not only competitive advantages of the subjects of the federation, but also contributes to the acceleration of economic growth, and on the other hand contributes to a more comprehensive and therefore more optimal spending of the resource potential.

It should be said that creation, development and implementation of resource-saving technologies is the most important manifestation of innovative activity concerning the resource approach, in our point of view.

There is a significant number of approaches to this concept, but the most commonly used is the understanding of it "... careful storage of resources, their preservation, strategically saving them for a possible future, more important use in production, in other promising areas of the economy" [6]. In the context of transition to an innovative type of development, the socio-economic system must be rebuilt, adapted to changing external conditions, including resource constraints, in such a way as to reduce the overall consumption of all types of resources, and to increase the potential for their use by increasing the efficiency of their spending. A well-known fact is the growth of energy consumption in virtually all spheres of the Russian economic system [7], which can partly be explained by the ongoing processes of import substitution and innovative modernization of

enterprises in Russian industry, which entails an increase in demand for all fuel and energy resources [8], although it should be mentioned that practically with any type of socio-economic system there is a high and direct dependence between the level of energy consumption (in all types) and the volume of the final result obtained (effect). At national level, this fact can be proved by calculating the correlation between the consumption of energy and the gross domestic product, the Russian economy in this case is not an exception and completely continues worldwide trends.

Thus, the analysis shows a high level of existing connection (the correlation coefficient equal to 0.84 indicates a direct and rather strong dependence).

Thus, development and implementation of energy-saving technologies is becoming a particularly significant and topical direction of innovative activity at present stage. In the meantime, energy efficiency and energy saving are included in five strategic directions of the priority technological development of the Russian economy [9], and one of the areas ensuring national security is "... raising the level of energy security that includes increasing energy efficiency and energy saving" [10].

This way the Russian Federation demonstrates the following dynamics of the main indicators of the energy sector in the period of 2000-2016 (figure 1): the growth trends of the gross national product and energy production and consumption are similar (the average rate of change for the analysed period was 19.2%, 1.2% and 0.7% respectively).

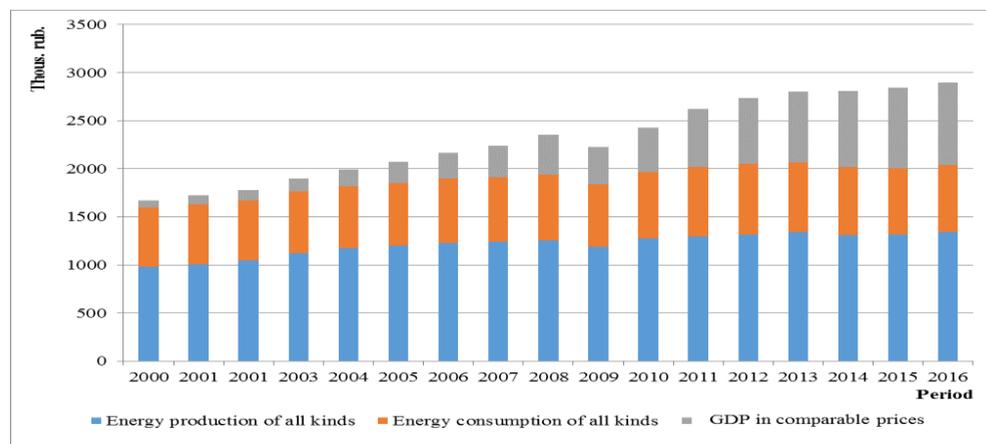


Fig. 1. Dynamics of the main Russian indicators, 2000-2016 [Compiled by the author on the basis of the Statistical Yearbook of the World Energy - <https://yearbook.enerdata.ru>].

A positive aspect is the prevalence of GDP growth rates over the pace of changes in other indicators, as this indicates a decrease in the share of energy in the final product, as well as a slight decrease in the dependence of national economy on energy production.

Note that despite the abundance of interpretations of the concept of energy saving, there is a fairly clear definition of the term in the normative literature: "... energy saving is the implementation of organizational, legal, technical, technological, economic and other measures aimed at reducing the amount of energy resources used while maintaining the relevant useful effect of their use (including the volume of output, work performed, services rendered)" [11].

However, it should be told that, despite the relevance and importance of this concept in the scientific literature, there is no unified concept, most of the interpretations of this definition come from a technical approach to this category.

So Sergeev N. in his monographic study [12], after analyzing the scientific, legislative and methodological literature, revealed signs true "...for the energy saving category:

- reduction of specific final consumption of energy resources;

- effective use of primary (natural) non-renewable energy resources;
- involvement in the economic circulation of renewable energy sources".

It should be noted that this list should be supplemented with several important, in our opinion, characteristics:

- reduction of the environmental load during the use of non-renewable resources;
- reduction in the volume (in the physical sense) of the volume of fuel natural resources used to produce a unit of output (at a national level, the unit of GDP produced).

A similar opinion to our last point was formulated by Danilov O.L. and Kostyuchenko P.A., expressing the idea of "... a decrease in the physical volume of fuel and energy consumed per unit of output" [13]. However, these authors talked about saving energy in general and the enterprise level or micro level, we, however, allocate natural non-renewable resources and the national level. Considering the high cost and low speed of mass introduction of innovations, including in the field of energy saving, this process must be carried out according to the "top-down" scheme, i.e. within the framework of the national policy. At the initial stages it is more rational, in our opinion, to limit the use of natural non-renewable energy sources, which will increase the intensity of alternative renewable sources, and will also contribute to the growth of their share in the overall fuel and energy balance.

A quantitative measure by which it becomes possible to estimate the level of energy use is energy intensity, which at national level is defined as the ratio of the amount of consumed energy of all types to the value of the gross domestic product produced.

In the meantime, the Russian Federation in terms of energy intensity of gross domestic product refers to countries with the highest value of this indicator (Figure 2).

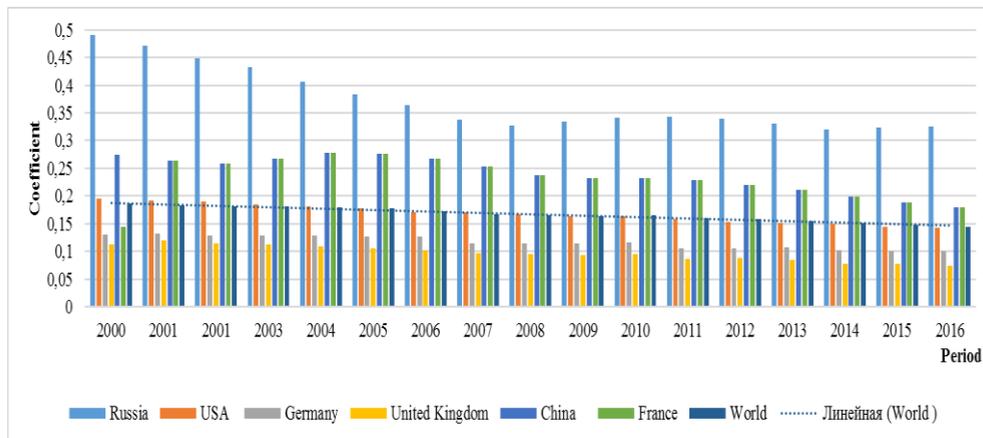


Fig. 2. Indicators of the energy intensity of the world's GNP, $kep / \$2005p$ [According to <https://yearbook.enerdata.ru>].

The indicator of energy intensity is 2 times higher than that of the United States, Germany and the United Kingdom, and this ratio is maintained in comparison with the world average. As a rule, explaining this analysis presented in Figure 2, arguments are given, such as the large territorial extent of the country, climatic features, remoteness from the equator, etc. However, according to the conclusions of some researchers [14] comparing with countries such as Ukraine, Nepal and Iceland, the importance of such arguments is diminishing, and it becomes possible to conclude that in each country the energy intensity indicator is formed under the influence of individual factors determining the features of their development and functioning on this stage of its socio-economic and technological development. Another factor, also partially explaining this ratio, is the obsolescence of Russia's energy and production potential [15], which did not undergo a full modernization

stage in the transition to an innovative type of development. In whole, it can be said that there are quite some unresolved questions about the influence of various factors that have the greatest impact on the energy intensity of national economies in the conditions of crisis development [16].

Analyzing the data presented, it can be concluded that the total energy intensity of Russia's GNP tends to decrease, which is true for the world in whole. Thus, for the period under review, this indicator for Russia decreased by 2 times (by 50.6%), in the UK by 51.3%, the USA by 37.1%, Germany by 28.7%, with a world average decrease by 29,1%. Negative dynamics in analysed countries are observed only in France, where the growth of energy intensity of GDP was almost 20%.

An obvious direction of reducing the overall level of energy intensity is seen in the assimilation of the positive rich empirical experience of world countries [17].

So among the European countries, for example, Germany, which actively uses energy saving technologies and alternative energy sources should be highlighted. About a third of all electricity is received from wind turbines. Private investors have the opportunity to place solar panels on the roofs of public buildings and supply the received energy to the city network.

The Norwegian experience can be described as an energy efficiency process taking into account all aspects of liberalized markets, targeted planning and environmental protection. The main principle in the electric power industry in Norway is that electricity prices must reflect its market value. Norway also pays great attention to the efficiency of energy-intensive industries (aluminum, ferroalloys) and the reduction of electricity consumption for residential heating, and investment support programs for special demonstration and pilot projects are being created. For many years, educational programs have been introduced to improve the skills of implementing programs to improve energy efficiency and technology development in organizations responsible for building management.

Energy saving in Sweden [18]. The Government of Sweden has implemented an effective policy of energy conservation and energy efficiency, which has positive results. And this is reflected in the high level of society's awareness of the benefits of energy-efficient technologies and bioenergy. The first energy saving program was accepted in Sweden in the 1970s, following the oil crisis that hit Western countries. Sweden has a clear system for monitoring the use of energy resources. This can be seen in the mandatory declarations of enterprises on the use of energy resources, energy certificates of buildings, in the labeling of goods and even in the labeling of food products. In addition, economic incentives are actively used to promote the use of alternative and non-traditional energy sources. Exemption for a period of 5 years from the energy tax, state subsidies for the reconstruction of old buildings (replacement of boilers, insulation, etc.), simplified obtaining permits for the construction of wind farms.

The experience of India [19]. To solve the problem of energy saving, the government of India has gone the way of creating special energy efficiency centers with the support of the state organization of the Energy Efficiency Bureau. Such centers are effective enough in the cities of Kolkata, Nagpur and Ahmedabad. The Energy Efficiency Center in Kolkata specializes in reducing electricity consumption at residential premises, where a significant share of electricity is consumed. The Energy Efficiency Bureau launched a program for electrical appliance manufacturers, in the course of this program, electrical appliances, depending on the degree of reduction of electricity consumption during their use, were included in a special rating system and they were labeled to encourage the active acquisition and use of the most energy efficient electrical appliances by the public.

In Nagpur, an Energy Efficiency Center has been established, which specializes in the introduction of energy-efficient production technologies in small and medium-sized enterprises. The goal of this center is not only the introduction of energy-saving

technologies, but also employee training of small and medium-sized enterprises, including management personnel, using these technologies.

The US experience [20]. The functions of the US Energy Ministry in the field of energy efficiency are reduced to the development of initiatives - laws and instructions of the president, as well as financing R & D and promoting the advancement of advanced developments in mass production. Another task to be solved by the Ministry is to increase the energy efficiency of budget facilities. The law introduced significant restrictive measures. For example, from 2014, a ban on the use of incandescent lamps is in order. In 2020 cars must pass at least 35 miles per gallon of fuel. By 2020, biofuel consumption should amount to 36 billion gallons, and it is planned to mainly use biofuel of its own production, for which research is funded on technologies for processing biofuel waste of American pulp and paper mills. The law introduces tax incentives and various grants for gasoline stations selling gasoline with the addition of biofuel.

The federal government allocates significant funds for research into energy efficiency. Financing is carried out for specific projects. Studies are mainly carried out through national laboratories. Some studies are prescribed directly in the federal budget. Part of the funding goes through the National Science Foundation, part - through joint programs of the Ministry of Energy and other federal agencies, for example, on modern materials. Test results and pilot implementations are generally available. Mass introduction of new technologies is stimulated in particular through state guarantees for loans.

The state in recent years has been stimulating mainly alternative fuels, based on the Law on Alternative Motor Fuel. The use of natural gas as a motor fuel has been elevated to the rank of state policy, even President Bill Clinton spent the entire term of his presidency driving a car that operated on natural gas.

However, it is not easy to adopt the positive empirical experience of the countries of the world in the field of energy efficiency and energy saving. In our opinion, this is due to a number of reasons.

First, it is worth noting the peculiarities of the geographical location of Russia, which caused extensive reserves of fuel and energy resources of natural origin. This fact formed the basis for the country's exports and remains the main revenue item of the budget. However, it is the absence of a deficit of energy resources, their relative low cost, which is a deterrent in the process of introducing energy-efficient technologies.

Secondly, it is necessary to note the individual features of socio-economic development, as well as the political situation. It is extremely difficult to adopt the practical experience of the state, which is fundamentally different. In order to identify national economies close to Russia in the general vector of energy development, a cluster analysis was performed (Figure 3).

The analysis is based on a number of parameters through which the state of the energy sector is assessed (total energy production, cumulative energy consumption, trade balance, energy intensity) and the general state of the economy (gross national product, costs for innovative development of the energy complex).

Analyzing the results obtained in Figure 3, it becomes possible to conclude that the Russian economy has an individual development vector that is sharply different not only from the Central European countries (for example, countries such as Norway, Germany, France, Great Britain), Latin American countries (Brazil, Argentina), the countries of the Arabian Peninsula (Iran, Saudi Arabia), but also from the CIS countries - Kazakhstan.

At the same time, it should be noted that the second group of countries with powerful economic systems (the US and China) are also developing using a different model.

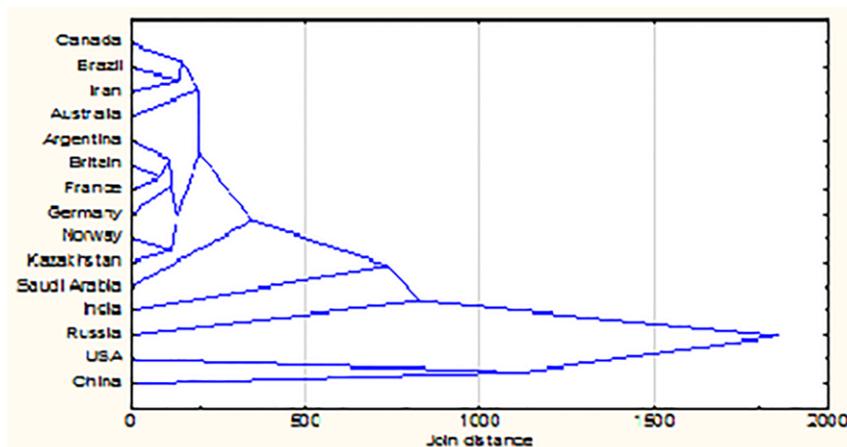


Fig. 3. Cluster analysis of the world in the field of energy. [Built on the materials of <http://www.renac.de/en/home.html>]

The Russian economy is in a position closer to these national economies, which, of course, must be taken into consideration in the formation of mechanisms that increase the overall level of energy conservation and are based on the transfer of empirical experience of other countries.

3 Results

In general, summing up all of the above, it should be noted that in a modern economic system that is adversely affected by sanctions, qualitative growth is possible only if the processes of transition to an innovative type of development are activated.

One of the manifestations of the innovation economy, formalized, as a rule, in intangible assets, is the creation, development and implementation of resource-saving technologies in all spheres.

In the context of transition to an innovative type of development, the socio-economic system must be rebuilt, adapting to changing external conditions, including resource constraints, in such a way as to reduce the total consumption of all types of resources, including energy, and to increase their potential use by increasing the efficiency of their expenditure.

Economic growth has always been accompanied by an adequate increase in energy consumption. Thus, the analysis shows a high level of the existing connection (the correlation coefficient equal to 0.84 indicates a direct and rather strong dependence).

Consequently, development and implementation of energy-saving technologies is becoming a particularly significant and topical direction of innovative activity at the present stage. In the meantime, energy efficiency and energy saving are among the five strategic directions of the priority technological development of the Russian economy.

An analysis of the energy intensity indicator showed that this indicator for the Russian Federation is about 2 times higher than the average for the world and 3 times for some European countries (Great Britain, Germany). However, the world average trend for reducing the overall energy intensity is typical for the Russian economy, since 2000 the value of this characteristic has decreased by 50%. The features of the domestic economy, usually, are explained by the geographical location and obsolescence (both physical and moral) of the energy and production potentials.

One of the directions of solving the current situation is the adaptation of rich empirical experience of the world countries in the field of introducing energy-saving and energy-efficient technologies. It should be noted that in the process of adapting this experience, the domestic socio-economic system may face a number of difficulties and difficulties that do not allow full and effective implementation of similar energy-saving mechanisms.

This is due to some peculiarities of the Russian development model. For example, the wealth of natural non-renewable fuel and energy resources can serve as a deterrent to the introduction of advanced energy-saving technologies and the transition to renewable energy sources. In this regard, it should be noted that the individual characteristics of the Russian economy differ sharply from both the Central European experience and the Asian experience in the field of energy.

These factors should be taken into account when formulating a policy in the field of energy efficiency and development of energy-saving technologies.

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