



## **Regional Programs on Energy Saving and Energy Efficiency: The National Construction Sector**

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### **ABSTRACT**

The research is aimed at identifying patterns of implementation of regional programs for energy saving and increasing energy efficiency in the context of innovative development of the construction industry. Authors held a critical analysis of the existing regional programs in the field of energy saving, the development of proposals for improvement of existing and development of new energy efficiency programs for the building complex, including low-rise housing construction. The study applies economic and statistical methods as to establish quantitative relationships and evaluation of existing programs for the development of new instruments of territorial-sectoral development. The conclusions are made on the overall inefficiency of the implementation of existing regional programs on energy saving and energy efficiency, as well as the need to change them in terms of the introduction of industrial components. Implementation of the results can lead to performance improvement of both the regional energy efficiency programs, and the development of the construction industry.

**Keywords:** Construction Industry, Regional Development, Energy Conservation, Energy Efficiency

**JEL Classifications:** R63, R11, Q48

### **1. INTRODUCTION**

Increasing energy efficiency and energy saving development is a contemporary priority of national economic development. The Russian government has set a goal to reduce energy consumption by 40% by 2020, in turn, the main consumer of all produced energy is the construction industry, which accounts for 40-45% of the energy consumption.

In order to improve activities in the field of energy saving and energy efficiency, certain regional programs to promote this

process are developed, but it became obvious that most of them are either ineffective or not implemented in most cases. This requires an analysis of the existing programs in this area, identifying the causes of their inefficiency in particularly sensitive sectors, like construction, as it is the construction industry that provides the input homes with a certain class of energy efficiency.

These issues are relevant for low-rise residential buildings (LRB), which is not paid due attention in existing regional programs of energy conservation and energy efficiency, although the industry is the most mobile and the modernization of production and fixed

assets there is of no special difficulties. Unfortunately, the use of energy-saving technologies in the construction of low-rise housing is merely a formality. An increase in energy-efficiency of LRB is possible via single updates in the structure of fixed assets and the development of model projects. These requirements are indicated by the share of LRB in the total volume of construction in Russia. All the above-numbered points to the need of analysis of regional programs and the development of proposals for development/revision of the regional programs on energy efficiency and energy efficiency in line with the development of low-rise building construction.

## 2. LITERATURE REVIEW ON ENERGY SAVING TECHNOLOGIES IN CONSTRUCTION INDUSTRY

Currently, energy conservation and energy efficiency is a topic of a significant amount of national and international research.

Beregovoy (2005) has given much attention to energy efficiency studies in the construction sector. He considered the possibility of using local building materials in the development of architectural solutions to reduce heat losses and create favorable conditions in the room, through the rational use of energy. Beregovoy (2005) held research on assessing heat loss of walling, the use of geothermal energy by the underground space, as well as the development of architectural and construction part of the project and energy efficiency measures, taking into account the climatic conditions of the territory in question.

Sheina and Minenko (2013) have focused on the issues of energy supply in the low-rise building. They have developed an optimization model for the choice of energy-efficient solutions in the low-rise building, which in turn is an important moment in the construction industry in general and the low-rise buildings in particular.

Lugin and Zigmantovich (2005) proposed various ways to reduce the energy intensity of the object through the use of appropriate technical solutions. The use of energy efficient technologies leads to an increase in construction costs, but today the main criterion for the construction of low-rise housing is the availability of housing for the population, which in turn leads to the development of methods of the organization of investment and construction activities in low-rise housing construction, which reduces the cost of construction while increasing quality of the constructed housing and reduce construction time.

Egorov et al. (2011) suggested innovative ways of development of low-rise housing construction. According to the authors, all innovation activities in low-rise buildings should be primarily focused on reducing costs, improving quality and reducing construction time.

On the basis of the analyzed Russian (Gasho et al., 2010; Bashmakov, 2013) and foreign (Luong, 2015; Aste et al., 2014; Alberini and Bigano, 2015; Lu et al., 2015; Siddiqui and Christensen, 2016)

publications on the given topic, we can conclude that the issue of energy saving and energy efficiency in low-rise construction, today, is quite topical, and there are a number of problems that require detailed study not only at the stage of development of the regional programs, but in addressing the issues of optimization of technological solutions in the low-rise building (Sheina et al., 2012; Kazeikin et al., 2011; Baronin and Groboviy, 2011; Asaul et al., 2005), the use of energy-saving equipment, development of new energy-saving technologies as well as risk assessment in low-rise building (Minaev et al., 2014), etc., Thus, the present study focuses on the development of theoretical concepts on energy-saving measures and techniques to improve energy efficiency in investment and construction projects of Russian low-rise construction sector.

## 3. METHODOLOGY

Analysis of the approved regional programs of development of the construction sector and the programs on energy saving and energy efficiency should start with the development of the analysis algorithm (Figure 1). Consistently conducted analysis stages will enable to conclude on the effectiveness of implementation of these programs.

When analyzing regional programs, the following patterns were revealed, firstly, in definition of objectives of these programs (Figure 2).

Most of the regions (24) reflect the aim of the energy-saving and energy efficiency development programs as being cost-oriented; 19 regions have the target of social orientation; another 17 regions carry out a mixed character targets, and in 15 regions, it is not possible to determine the orientation of the target. Of the 87 subjects of the Russian Federation in the 12 regions, there are no energy-saving and energy efficiency development programs, and 53 regions have no development programs on the construction industry, while the analyzed programs have no objective aimed at the development of the LRB.

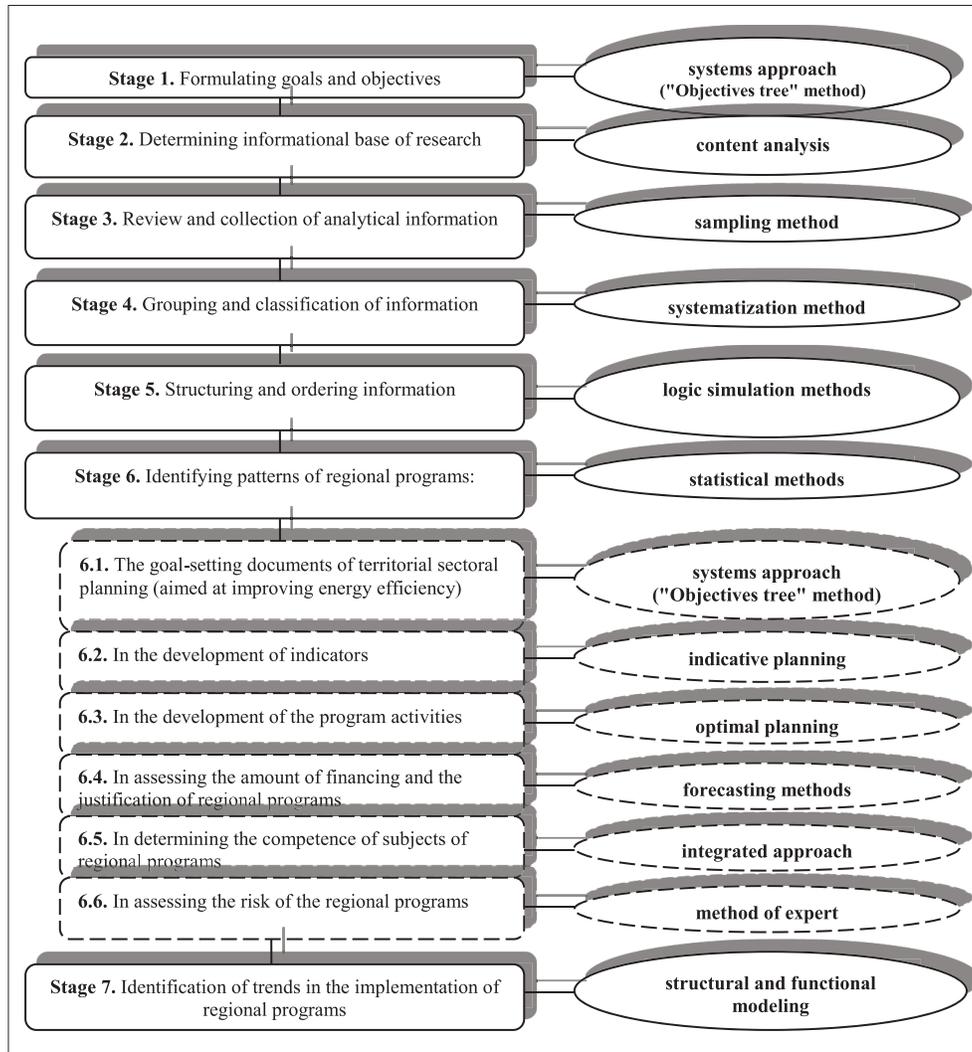
These targeted orientations enable to allocate a focus of regional programs, on the adequacy of wasted resources, as well as the volume of funding. The second pattern can be observed in the course of analysis of indicators of regional sectoral programs (Figure 3).

Example of typical indicators of regional sectoral programs:

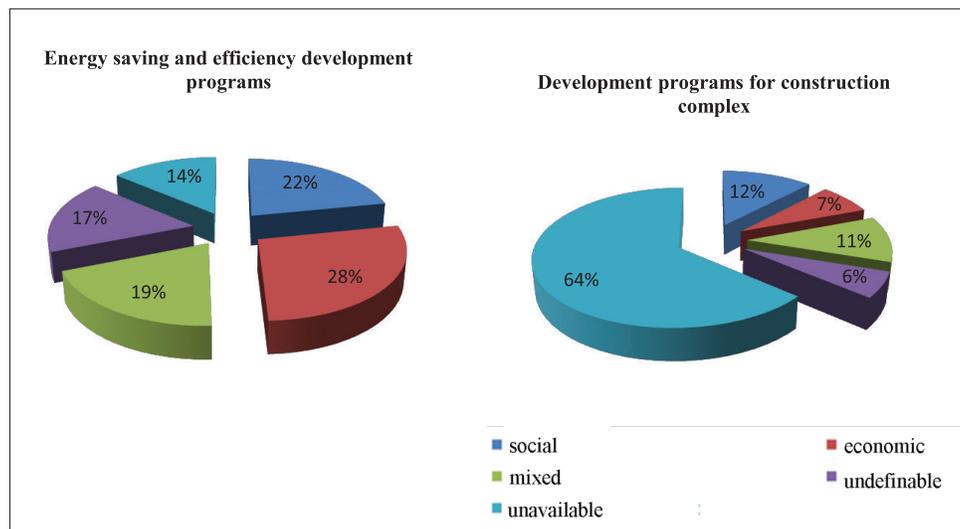
- Social - Housing supply;
- Economic - The dynamics of energy intensity of gross regional product;
- Technical and technological - Annual volume of housing construction.

Analysis of the data presented on the typical indicators suggests that the goal setting and indicators as the reflection of the issues, are not obvious. There are no indicators aimed at monitoring the development of LRB. The construction sector developing programs should be dominated with social indicators, namely the provision of affordable housing for different categories of citizens. While the development of energy saving and efficiency should

**Figure 1:** Stages of analysis of regional programs for the development of the construction sector and the programs on energy efficiency and saving



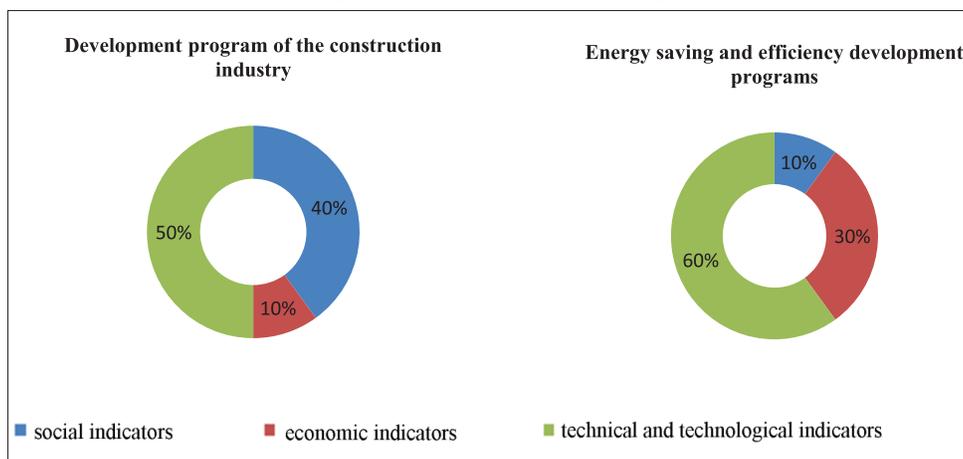
**Figure 2:** Target orientation of regional programs



prevail with economic indicators, as these programs are designed primarily for companies dealing with construction and energy supply. As we can observe, in the programs of development of the

building complex, are dominated by technical and technological indicators (50%), which in fact should be social-oriented. Therefore, further elaboration is required for social indicators,

**Figure 3:** The most commonly used indicators in the implementation of regional sectoral programs (average within the same regional program)



namely, the development of such indicators, as e.g., the volume of construction per capita, housing provision per certain number of families, the volume of construction of low-rise housing for the population, etc.

The economic effects should be the end result of the energy-saving and energy efficiency programs, but we are seeing the reverse situation. Namely, technical and technological indicators dominate these programs by 60%, which are only the means of achieving economic effects.

The third pattern observed in the analysis of program activities, developed in the sectoral regional programs presented in Table 1 and Figure 4.

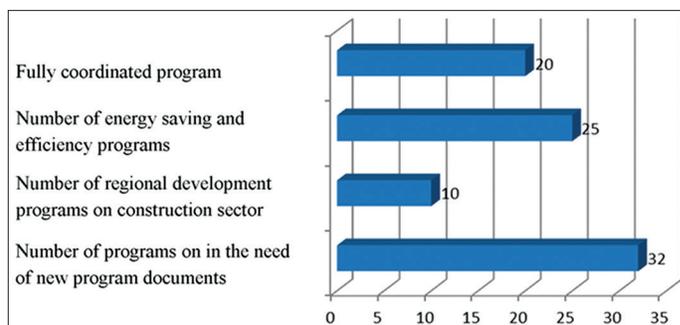
Based on the data presented, we can conclude that only in 20 regions approved fully agreed programs, i.e., there are development programs of both the construction industry and the development of energy-saving technologies, while 32 regions of Russia require the development/revision of regional sectoral programs. Therefore, we can conclude that more than 75% of the RF subjects undertake ineffective regional policy in the field of energy saving in construction, namely the development of energy-saving in the construction sector are present only in 10 regions, while measures to develop LRB are limited and are also not present in all regional programs.

An example of the most common events for the construction sector:

- Encourage the development of low-rise building;
- The introduction of energy-efficient and resource-saving technologies and construction materials in residential construction.

The fourth pattern is the fact that over the past few years there has been widespread under-funding of regional programs, which is caused by both subjective and objective circumstances. As the objective is economic difficulties faced by the Russian Federation in recent years due to the deterioration of the overall political situation. The subjective factors include the poor quality of program planning, i.e., the main problem is inconsistency in funding of regional programs, as there is

**Figure 4:** Number of regions implementing coordinated programs on energy efficiency and development of the building complex



no mutual coordination between sectoral departments for the implementation of programs and the department of finance on the cost of carrying out energy-saving measures. The level of funding does not correlate with the proposed regional sectoral indicators of the programs. Namely, 92% of the regions of Russia have a common underfunding of regional sectoral programs, including about 40% of the regions are underfunded by more than 50%, which entails the following options for the development of regional programs:

- The program is fully funded, but the proposed indicators are not met. This problem affects those entities, which are competent for the execution of the program activities;
- The program is partially funded, but the proposed indicators are fulfilled. This reflects efficiency of the performance of the subjects of the regional program; the difference between the underfunding and the full implementation of the indicators speaks to their effectiveness;
- The program is underfunded and indicators are not fulfilled. This problem indicates unbalance of the interactions between actors implementing a regional program.

These options make it possible to judge the effectiveness of the entities in the implementation of regional programs.

The fifth pattern is in violation of the competency approach. The functions of the subjects in the implementation of the program often overlap, intersect. For example, this trend is observed in all (100%) of the studied regional sectoral programs, which entails a

violation of the rhythm of implementation of new energy-efficient and resource-saving technologies, building materials, development of new technological processes in the construction, the introduction of new technology, namely decreases the effectiveness of implementation of the proposed measures in the regional programs.

The sixth pattern says about the lack of developed activities of regional programs for assessment and analysis of potential risks (Table 2).

Typical risks considered in the regional sectoral programs are: Legal risks, financial risks, technical risks, administrative risks, technological and environmental risks, social risks, financial and economic risks, operational risks, legal and regulatory risks, low motivation risks, macroeconomic risks, organizational risks of force majeure, the institutional and legal risks, endogenous risks, exogenous risks, industry risks, systemic risks, market risks, political risks.

Of all programs of development of a building complex the risk analysis is conducted in eight programs only and two programs involved risks assessment. Number of regional programs for the development of energy saving and energy efficiency in which a risk analysis is carried out much more - 20 programs, but the risk assessment is done only in two. Only in the five regions of the Russian Federation a risk assessment in both regional programs are carried out, but for LCB the analysis and risk assessment is generally not specifically designed.

#### 4. RESEARCH RESULTS

Identified patterns of development of regional programs in the field of energy saving and efficiency as well as the development of the construction sector enabled to identify the following trends in the development of these programs:

The objectives laid down in the development of the programs are not achievable. There is no direct relationship between all components of the program, namely the objectives should be the outcome of the goal, of which, in turn, formed the indicators. Thanks to these indicators, one can identify potential risks associated with the implementation of regional sectoral programs. However, this type of trends are not in the programs we reviewed.

Indicators should strictly comply with the proposed measures in the programs, which is not observed in the programs under study, as each event entails its performance indicator by which to determine the effectiveness of the proposed program activities.

Each action proposed in the regional sectoral programs must be tied to certain risks arising from the realization of certain events. Making it possible to assess the potential damage caused by the occurrence of a risk and to predict the possible options for interaction with the occurrence of a risk event in advance, as well as to develop measures to prevent, eliminate or minimize potential risks. However, this is not the case in the regional programs under study.

In regional sectoral programs under consideration the process of financial planning and forecasting of needs are not qualitatively performed, which indicates a lack of adequate methods and techniques in the development of strategic financial planning and forecasting of regional programs.

#### 5. CONCLUSIONS

Most of the programs reviewed do not meet the requirements set for the development of programs, as the construction sector is energy-intensive industry and the lack of energy-saving components in the programs of development of the construction complex indicates misunderstanding of the essence of the organization of the developers of the construction process. According to the Federal Law "On energy saving" and starting from 2016 the energy efficiency class for newly and renovated buildings must not be less than B+, designing buildings with energy efficiency Class C, D and E is not allowed. Supervision over the implementation of this requirement is the responsibility of the state examination of construction documents. It indicates the insolvency of the transition process, as the construction companies had not implemented the modernization of its production, which in turn indicates the absence events on modernization and innovative development of the construction companies in the regional programs for energy efficiency.

After reviewing the overall construction sector and trying to determine is the role of low-rise housing construction, we can conclude that LRB is currently underestimated, no target settings

**Table 1: The grouping of regional programs by activities in the field of construction and energy-saving**

Regional development programs	Number of programs with energy saving measures in the construction	The amount of funding, billion ruble	The amount of funding per capita, thousand ruble
Construction industry	30	1047.54	95.66
Energy-saving and energy efficiency	45	1872.46	216.33

**Table 2: Analysis and assessment of risks in regional programs**

Regional development programs	Number of programs that includes		Subjects of Russia in which the risk assessment is carried out both in the two programs
	Risk analysis	Risk assessment	
Construction industry	8	2	Republic of Adygea, Republic of Kalmykia, Republic of North Ossetia, Republic of Mordovia, Nizhny Novgorod region
Energy-saving and energy efficiency	20	2	

are developed, the normative regulation of LRB is not harmonized. There is no gradation of regulatory documents for various classifications of low-rise buildings (individual, multi-blocked). It is obvious that the LRB is a reserve for the development of rural areas, small towns or suburban areas of major cities (Zharova et al., 2015; Dobrynina et al., 2015). At the same time, a key requirement to the objects of LRB should be energy efficiency, so it is important to have a complete coordination between the regional programs on development of building complex and the programs on energy saving and efficiency.

The research results showed that the ongoing regional and sectoral programs violated the fundamental principles in their design, which entails serious risks in obtaining the expected results.

## 6. ACKNOWLEDGMENT

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