Features of enhancing environmentally-oriented green construction at the regional level

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Abstract. The study focused on the challenges of establishing a national market for green housing construction in Russia, particularly highlighting the importance of regional industry level management in its implementation. Using the example of the Penza region, problematic trends in the reproduction of green housing stock through long-term processes of sustainable housing construction are demonstrated. The object of the study is the national housing construction market in the process of its transformation into a green construction market with the priority of environmentally-oriented development and green certification. The purpose of the study is to assess the current state, problems and prospects for the development of green housing construction at the national and regional level based on environmentally-oriented development. The following main scientific results of the study are presented: a review of the modern concept of sustainable development of the construction industry; analysis of the problems of green, energy-efficient construction and eco-development in the Penza region; issues of strategic development of green housing construction; directions for improving the organizational and economic mechanisms of green construction in the context of the priority of environmental development. The study confirms the relevance of the priority transformation of housing markets into green housing construction markets.

1 Introduction

One of the priorities for the development of the construction industry of the Russian Federation is the development of housing strategies to increase industry sustainability and the formation of priority areas for environmentally-oriented development. The concept of sustainability is a modern paradigm of scientific, technical and socio-economic evolution of the world community at the end of the 20th – beginning of the 21st century. It creates socio-economic values based on the actualization of the advantages of environmental orientation in all spheres of human life, taking into account the conservation of natural resources for future generations, while ensuring a high quality of life for the planet's population [1].
Large-scale construction and global urbanization of the territory is one of the main factors of environmental pollution and the cause of climate change. According to recent estimates, the carbon footprint of the construction industry accounts for about 40% of global CO2 emissions, of which 28% comes from the operation of buildings, and 11% from their construction and building materials [2]. Commissioned facilities are very expensive for end consumers: the cost of energy resources is rising, and the population’s demands for comfort, quality and safety are increasing. This issue contributes to the active growth of professional interest in approaches and technologies of sustainability from the standpoint of ensuring housing construction as green construction. In this regard, scientific and practical research with a target orientation towards modeling housing strategies for the implementation of environmentally-oriented development, capable of forming long-term processes of sustainable housing construction according to green standards, is in great demand.

For the implementation of green buildings and sustainable areas in developed countries, green certification systems have been adopted, which are a list of criteria and a set of requirements for environmentally friendly real estate. In turn, these systems stimulate the active development of an innovative market segment in construction – the green housing construction market. At the same time, a system of measures for state support at all stages of the life cycle for the reproduction of these types of green objects for both developers, end users, and other related participants and business partners of the green construction market is mandatory.

The relevance of the research topic is caused by the importance of improving knowledge in the field of transforming the national housing market into green housing construction markets based on the organizational and economic mechanisms of environmentally-oriented development.

The author's research hypothesis is based on a systematic analysis of regional characteristics, trends, and development issues related to environmentally-oriented development. The aim is to provide valuable insights for making informed management decisions in the sustainable development of the construction industry within the region.

The purpose of this research is to study trends in housing construction, taking into account the implementation of environmentally-oriented development and the positions of organizational principles, theoretical approaches and scientific and practical recommendations based on the priority development of the national green construction market.

The most significant contribution to the development of environmental development issues and, in general, the development of the housing market in modern conditions of implementing the concept of sustainability was made by V.I. Telichenko. [3], S.N. Bobylev [4], S.A. Baronin [5,6], A.A. Benuzh [7] and other authors. This study uses the provisions contained in the research works on the topic of the RSF grant No. 22-28-20511.

In 2021, Russia has identified the main areas of sustainable (including green) development, which includes the construction industry, which ensures the achievement of sustainability goals as part of the development of state policy of the Russian Federation. At the federal level, sustainability in construction is determined by the regulatory framework [8,9,10,11], organizational and economic mechanisms [12,13,14], state strategies in the field of ecology and resource conservation [15,16], which are the driving force of a new segment of environmentally-oriented development. The Russian sustainable construction market is actively developing, and building certification systems are currently being created that take into account the domestic characteristics of the industry [17].

The following regional and municipal programs have been adopted in the Penza region in the areas of implementing green and energy-efficient construction: strategy for the development of the construction industry and housing and communal services of the Penza
region for the period until 2030 with a forecast until 2035 (Order of the Government of the Penza Region No. 144-rP dated March 1, 2023); program “Energy saving and increasing energy efficiency of the city of Penza for 2019 - 2026” (Resolution of the Penza City Administration dated September 26, 2019 N 1864); program for the integrated development of public utility infrastructure systems in the city of Penza for 2017 - 2026, in which one of the priority areas is energy saving and increasing the energy efficiency of buildings and structures, as well as increasing greenness, safety and comfort, as the basis of the global concept of sustainability.

An analysis of regional features of the development of environmentally-oriented green construction using the example of the Penza region is being carried out for the first time, which will make it possible to determine general trends and prospects for improving this area, including at the national level.

2 Materials and Methods

The methodological basis of the study includes general scientific principles, as well as methods of research, systematization, and adjustment of new knowledge using rules and principles of reasoning based on empirical data about the object of research. Using logical moderation methods, research was carried out by domestic specialists, and the current state of issues in the field of sustainable development and environmentally-oriented development was analyzed, identifying problematic areas in this field of knowledge.

A statistical quantitative analysis of the dynamics and structure of multi-apartment housing commissioning in the Penza region made it possible to analyze the level of innovative development of the region in the field of green housing construction, as well as the degree of intensity of implementation of environmental housing projects. This analysis made it possible to establish that the increase in the volume of construction of residential apartment buildings according to a number of green transition criteria is accompanied by insufficient penetration of green technologies into domestic construction practice, and also revealed the immaturity of economic and organizational mechanisms for supporting this kind of objects. Materials for the statistical study were obtained from the official electronic resources of DOM.RF and Federal State Statistics Service (Rosstat) of the Russian Federation.

By employing socio-economic forecasting methods and analyzing the regulatory framework along with data on the volume of green construction in the Penza region, a set of recommendations was formulated to guide the future development of the regional green residential real estate market.

3 Results

[Further content related to materials and methods and results would be included here.]

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In Russia, currently, around 98 million square meters of multi-apartment housing are being constructed, of which more than 30% (31.1 million square meters) meet the criteria for being green. The leaders in terms of volumes of green residential construction are Moscow (8.4 million sq. m), Moscow region (4 million sq. m), Sverdlovsk region (1.5 million sq. m), Tyumen region (1.3 million sq. m) and St. Petersburg (1.2 million sq. m). It has been determined that the Penza region, like many regions, is at the initial stages of forming the volume of green construction. At the same time, a significant part of the existing housing stock does not meet the requirements of greenness and energy efficiency, and the most problematic thing is that it does not have the resources to re-equip it. Nevertheless, the pace of green and energy-efficient construction in the Penza region is gaining momentum, and of course, the flagship in terms of the volume of commissioned and planned housing stock is the regional center – 83.5% of the total volume of commissioned housing stock. Among the cities and towns of the Penza region, green and energy-efficient new buildings are being implemented in the city of Kuznetsk, Kamenka and within the boundaries of influence of the Penza agglomeration: Zarechny, village of Zasechnoe, Michurinsky settlement.

Fig. 1. Dynamics of residential real estate commissioning in the period 2019-2022 in the Penza region with a forecast for 2025. [compiled by the authors based on information from Rosstat and DOM.RF]

Quantitative statistical analysis established that among the housing stock commissioned in Penza in the period 2018-2023, the percentage of green funds according to a number of criteria was 38%, and for the period until 2026 (implementation period), this percentage should increase to 76.1% (see Figure 1), among which the planned supply of residential multi-apartment real estate can be categorized as follows: Class A++ accounts for 40.8%, Class A+ for 22%, and Class A for 13.3% (see Figure 2).

Regional developers in the Penza region are developing several eco-areas at once: reducing energy consumption, using environmentally friendly construction technologies in the construction of buildings, creating a special microclimate in residential complexes, increasing safety by providing smart control systems, using ultraviolet systems water purification and other activities.
Fig. 2. Volumes of the housing stock of new buildings (in %) by energy efficiency classes for objects under construction and commissioned in the Penza region and the percentage ratio of the volumes of energy efficient residential construction in the city of Penza and the region. [Compiled by the authors based on data from the DOM.RF resource]

Among the problematic trends, it can be noted that a significant amount of new housing construction is positioned as green, but does not imply comprehensive provision. These housing complexes ‘sit’ on the existing engineering and transport infrastructure and are provided with existing social service facilities for the population. This, in turn, increases the risk of emergency situations, creates an unfavorable human living environment and does not provide a sustainable approach to the development of urban areas as a whole.

At the same time, the mechanism for the integrated development of territories is a fundamental element of the concept of sustainable development, and should function in order to prevent the existing imbalance and create a single integral space for the implementation of effective socio-economic processes.

Fig. 3. Localization of green residential construction projects in the structure of Penza as of June 2023.
Among the objects of integrated green residential construction in the city of Penza, the following projects can be distinguished, which are mainly at the implementation stage: residential complex “Lugometria”, residential complex “Arbekovskaya Zastava”, residential complex “Favorit” and the residential area “Sputnik” in the village of Zasechnoye, Penza region. These complex development objects are located in the peripheral zones of the urban area on outbound urban transport routes (see Figure 3, 4).

Fig. 4. Residential integrated development of territory in the Penza region. (a) residential complex Lugometria; b) residential complex Arbekovskaya Zastava; c) residential area “Sputnik”, the village of Zasechnoye, Penza region; d) residential complex Favorit (Photos taken from open sources on the Internet)

A fundamentally important issue in the sale of green residential real estate remains the question of its affordability for buyers. As a result of a quantitative analysis of the ratio of the average cost of a green square meter of multi-apartment housing and the average per capita income of the population of the Penza region, it was established that the average cost of housing exceeds the income of the population by more than 2 times (see Figure 5).

From Figure 5 it follows that the average per capita income of the population increases every year, while the level of income of citizens in comparison with housing prices remains low. And to stimulate the purchasing power of green real estate, effective economic and organizational mechanisms to support green construction in the Penza region are needed.

Among such mechanisms, the following positions can be distinguished: the formation of a stable green credit and mortgage policy; improving programs for socio-economic support of the population – maternity capital, military certificates with an eye to green real estate, etc. Green real estate developers need mechanisms for implementing public-private partnerships through subsidies, providing tax preferences, introducing green and infrastructure bonds into practice, incentives for the allocation of land plots; stimulation of active green investment, etc.
As a result of research into trends in the development of green construction in the Penza region, it has been established that among the promising directions in the development of housing construction strategies based on the concept of sustainability and environmentally-oriented development, it is possible to identify several guidelines that are realistic in the natural, climatic and socio-economic conditions of the region: the use of renewable energy sources and alternative fuels; use of waste from the wood processing industry in the region; the possibility of developing a regional construction complex based on the creation of industrial clusters of the construction industry in the main areas of use of mineral resources (sand, lime, diatomite, etc.); creation of a complete value chain within the region, creation of new jobs; development of the region’s human resources in the field of sustainable development of the construction industry, etc.

### 4 Discussion

The research carried out made it possible to identify the following set of problematic issues regarding the scientific and practical development of the analyzed subject of research. The analysis revealed trends in the growth of green multi-apartment real estate in the Penza region: over a period of 4 years (2019-2022), the volume of green housing stock increased by 2.5 times, and for the future until 2026, it should increase more than 4.5 times in relation to 2019. This rate of commissioning of green residential real estate at the regional level must be ensured by support mechanisms for both developers and potential consumers of such construction products.

A fundamentally important debatable issue is the danger of crisis collapses in the sale of green residential real estate due to low purchasing power. The solution to this issue should be new fundamental approaches to the implementation of green real estate based on mechanisms for taking into account the minimum total cost of the life cycles of buildings, which will reduce operating costs for end consumers.

As part of the discussion, potential of the topic under study, the following systemic problems have been identified that hinder the development of the regional green residential real estate market, such as: relatively low energy prices do not stimulate development in this sector; lack of a mandatory regulatory framework for green construction activities; insufficiency of economic and organizational green mechanisms for responsible...
5 Conclusion

The completed study confirmed the relevance of the priority transformation of housing markets into green housing construction markets. A significant factor that determined the increase in the pace of housing commissioning according to green criteria in the last five years was the spread of green housing certification mechanisms and the adoption of a new green GOST (Russian National Standard) for multi-apartment residential buildings.

However, the limited adoption of these mechanisms can be attributed to the ongoing development and refinement of economic and organizational incentives required to promote this particular form of construction.

The problems of strategic development of green housing construction are identified, and areas for improving the organizational and economic mechanisms of its implementation are demonstrated in the context of the priority of environmental development.

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References


