Identification of development drivers of using "green" technologies in investment and construction projects of the Russian Federation

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Abstract. A high level of energy consumption per GDP unit is typical for the territories of the Russian Federation. Technical wear and tear and obsolescence of technological and energetic equipment, high energy losses in buildings and structures are the main reasons that caused a high level of energy intensity of GDP. Rapid population growth and competition for limited resources have further increased the need to design and construct buildings using sustainable construction technologies. These buildings must be able to maintain quality of life and ultimately ensure long-term human survival. The construction industry plays an important role in preserving the environment through the rational use of resources and assets that require the immediate massive implementation of the principles and methods of sustainable construction. One of the components of the principles of sustainable construction is the use of "green" technologies in construction projects, reconstruction, and overhaul of structures. The Russian Federation has a huge potential in reducing the negative impact of the construction industry on the environment and the social sphere. That is why it is very important to develop methodological foundations which are conducive to the successful development of the so-called "green" construction market in all regions of the country. Therefore, it is necessary to identify the main constraints to the development of "green" technologies. This article is intended to identify obstacles to the implementation of the "green" construction from the general contractors’ point of view. The article identifies points of growth based on the identified problem areas. Growth points are needed to form further positive dynamics of construction volumes using "green" technologies. The identified development drivers will contribute to the expansion of demand and provide a multiplicative stimulating effect on related sectors of the investment and construction complex.

The annual increase in energy consumption leads to natural resource reduction, degrading the quality of the environment. This problem creates a need to apply the resource-saving policy. It is going to stimulate various sectors of the economy to switch to a reasonable saving of resources and building production activities. That policy takes into account the principles of efficient natural resources consumption.

The construction industry plays the leading role in the implementation of resource-saving policy because materials and structures generate over 40% of global greenhouse gas emissions and 15% of global carbon dioxide emissions [1]. Therefore, increasing resource conservation in the construction industry contributes to the formation of a sustainable environment and improves the quality of citizens’ life. The necessity of energy-efficient and environmentally friendly construction is written in a number
of the most important strategic documents. This is specified in the Strategy for the development of the building materials industry for the period until 2020 and further prospects until 2030, the National Project "Housing and Urban Environment", the draft Strategy for the innovative development of the construction industry. An immanent condition for achieving strategic goals is the development and implementation of management decisions aimed at introducing innovative technologies for environmental protection, ensuring the ecological well-being of settlements and resource efficiency, creating a healthy comfortable living environment. All these tasks can only be implemented by revitalizing the development of "green" construction [2].

The principles of sustainable construction are based on the reduction of energy consumption of buildings in terms of used materials and waste production. Sustainable construction is aimed at ensuring harmony between the natural and built environment. The goal of sustainable construction is to minimize the impact of environmental, social, and economic problems on the quality of life of the population. Successful implementation of the principles requires effective action and commitment from all parties involved in construction projects, including government, service providers, and consumers.

An analysis of the experience in implementing sustainable construction projects, mainly in European countries, shows that the current areas of greening real estate objects are environmental certifications according to various standards. Environmental certification is based on "green" technologies which can serve as a good basis for the development of a resource-saving mechanism.

"Green" technologies maximize resource conservation, save energy and water and reduce pollution throughout the entire life cycle. Thereby, they are strategically important solutions for reducing the negative impact of the industry on the environmental and social sphere. The statistics show that "green" buildings can potentially help reduce greenhouse gas emissions by 35%, waste emissions by 70%, and save more than 65% of your water use costs [3].

"Green" technologies are environmentally oriented and based on different standards. These standards include energy conservation and environmental management at all stages of a building's life cycle. These requirements comprise energy conservation and environmental management at all stages of a building's life cycle.

There are three "green" certification schemes on the Russian market today - BREEAM, LEED, and DGNB. More than 70% of "green" buildings are BREEAM certified. This is primarily because the BREEAM standard was the first to appear in Russia and has a fairly extensive network of independent auditors offering certification services throughout the country [4].

According to Knight Frank, only 177 buildings are certified by "green" standards in 2020 in Russia. The higher number of constructions are assessed according to the BREEAM scheme (Fig. 1) [5].

![Figure 1. Structure of the number of "green" buildings by real estate segment.](image-url)
Offices are usually built according to "green" standards (46%) on the Russian market. Retail properties account for 24% and warehouse properties - for 15%. These indicators are low in comparison with foreign countries. The insufficient energy efficiency of the Russian economy and the construction industry is a significant obstacle to economic growth.

The high energy intensity of the housing stock in Russian cities depends on the following factors:
- long duration of the heating period;
- a high proportion of dilapidated, emergency buildings, the heat consumption for heating which significantly exceeds the current standards [5];
- significant energy losses during its transportation due to the deterioration of engineering networks and equipment;
- a disdainful attitude towards saving resources on the part of consumers - Russian citizens;
- low professional training in energy conservation and efficient use of energy resources.

According to the International Energy Agency, the energy intensity of the housing stock in Russia is 11 times higher than in Germany, 6 times higher than in Canada, and 4 times higher than in Poland. Reducing this gap means not only direct savings for individual enterprises but also an increase in the competitiveness of Russian manufacturers [6]. Therefore, the issues of energy saving in housing construction are of great interest to Russian and foreign scientists. Continuous development of resource-saving technologies, improvement of building materials, building structures, taking into account the requirements of energy conservation, ensure constant expansion, clarification of the scientific tasks range faced by the construction industry. And everything mentioned above also ensures the relevance and significance of research and development carried out in this direction.

Providing the successful development of the "green" building market is important given the enormous potential of the Russian Federation in reducing or eliminating the negative impact of the construction industry on the environment. Therefore, it is advisable to identify the key factors constraining the development of "green" technologies in the construction sphere.

The construction industry is characterized by the participation of a large number of relevant stakeholders such as the client, developer, general contractors, subcontractors, consultants, designers, end-users, suppliers, property managers, government, realtors, etc. Each of these actors performs its functions throughout the life cycle of construction projects. Projects using green technologies are more complex from a technical and managerial point of view. Also, those projects require the use of innovative product [7,8]. This fact contributes to the emergence of typical problems for all subjects of investment and construction projects. As a result of the analysis of projects implemented on the territory of the Russian Federation, it was determined that general contractors face problems in three functions of their activities: organization and planning of activities; management and control during project implementation; provision of materials and resource. Let's take a closer look at the problems above.

Table 1. List of problems hindering the introduction of "green" technologies in Russia.

| Function                           | Factors causing the problem                                                                 | Solution to the problem                                                                 |
|------------------------------------|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Organization and planning of activities | Green technologies require high initial financial investments;                              | Development of building codes and standards in the field of "green" construction;       |
|                                    | Lack of instructions for the use of "green" technologies in special climatic zones;         | Encouraging developers with incentives to increase the attractiveness of "green"       |
|                                    | Restricted access or complete absence of appropriate tools and equipment for construction   | construction;                                                                          |
|                                    | works that meet the requirements of "green" technologies;                                    | Dissemination of information about the actual benefits and payback of the project.     |
|                                    | Lack of construction laboratories for testing and certification of construction products in |                                                                                       |
|                                    | terms of environmental friendliness;                                                       |                                                                                       |
Difficulty in forming a competent team due to the lack of qualified personnel - managers, engineers, designers; The quality management system is not adapted for the implementation of "green" technologies; Specifications that contain information about "green" technologies are difficult for performers to understand; The contractor does not have the resources to support technological changes [9].

Management and control

Lack of legal regulations; Lack of data on the cost of implementation of one or another technology of "green" building; Conflict of interests of the project participants caused by the lack of open data and knowledge in the field of "green" technologies; Difficulty in preparing project documentation for a project using "green" technologies.

Creation of a national standard; Elaboration and improvement of legislative norms by analogy with the leading countries of the world [10].

Securing of materials and resources (Supply chain)

Lack of a well-developed state policy to stimulate the development of "green" technologies [11]; Lack of reliable suppliers of materials and structures that meet the requirements of energy efficiency and environmental friendliness; Low awareness of suppliers and consumers about "green" technologies; Lack of effective financing schemes for suppliers of materials and structures that meet the requirements of energy efficiency and environmental friendliness; Lack of legal framework in the field of insurance of structures made with the use of "green" technologies.

Use of environmental labels; Increasing the level of requirements for building materials; Updating methods, norms, and rules in regulation the quality and environmental friendliness of building materials; Environmental education and the formation of environmental awareness and responsibility.

The table shows that most of the limitations in the implementation of "green" technologies are associated with an increase in project development costs and a lack of resources that can support technological change. The table shows that most of the limitations in the implementation of "green" technologies are associated with an increase in project development costs and a lack of resources that can support technological changes.

Businesses need a clear understanding of the cost-effectiveness of investing in green building technologies and materials. There is no massive use of "green" technologies in construction today. Therefore, the economic efficiency of green technologies can be assessed only after the completion of the project [12]. Consequently, there is no relevant information, and the flow of investments in green construction is decreasing. But it is already becoming obvious that the strategy of the decrease in the total value of the property should prevail over the strategy of reducing only costs at the construction stage, taking into account the cost of exploitation during whole the life span.

It is necessary to develop and implement programs to create environmentally friendly demand and increase the environmental awareness of consumers, including undertaking activities, shown on the diagram (Fig. 2) to minimize the listed problems and to increase the demand for green buildings in the medium term.
Taking into account the general construction features, objectives of each phase of the construction life cycle, and their contribution to the overall sustainability and resource efficiency of the building, the main tasks in the area of sustainable resource-saving for each stage of the life cycle were determined [14].

Basing on the implementation of the above-proposed tasks, it is possible to reach for the transition of Russian development to a brand new level. The investing attractiveness of the domestic property market can also rise after the implementation of proposed tasks.

Eco-certification, hi-tech in the area of environmental protection and energy-saving are not new for Russia, but the development of the ecological aspect of the building and the exploitation is quite weak now and requires some additional actions. At the same time, the efficiency of the implementation of proposed actions depends on every interesting subject of investment and construction project implementation. Initially, it is the Government of the Russian Federation that should play a key role in accelerating the process of the integral development of legal regulations, technical codes, and standards, where the target of green construction is explained systematically. Moreover, in parallel, the work for the efficient promotion for R&D in the area of green technologies should be provided.

The certification according to green building standards is a process of greening both the construction industry and the process of exploiting the objects. As the result, the best technologies and practices are being introduced to ensure the maximum possible reduction of the negative impact on the environment and the economy of limited natural resources. Moreover, the social effect is manifested in the form of ensuring healthier and more comfortable living conditions, work, and leisure of people, increasing their labor productivity and life expectancy. The company, the owner of the project, in addition to the "green" image, receives economic efficiency in the form of large income from the sale and lease of real estate, reducing the cost of its operation by saving resources and introducing advanced management technologies. The dynamic nature is the most important feature of the certification process provides for the constant updating of compliance indicators based on the latest scientific and technological advances. It toughens environmental requirements and provides a more favorable environment for humans, on the one hand, and sets the modernization vector of direction, which is so necessary for our country. Domestic standards most applicable to Russia are unpopular. The greatest demand is for international standards that are not adapted to Russian specifics. This is reflected in the rating system of certification of "green" buildings, which does not allow at the moment to take into account the level of energy intensity of buildings when establishing the level of resource consumption; differentiation of

Figure 2. The main tasks in the field of application of "green" technologies at all stages of the life cycle of a construction site [13].
environmental problems. Thereby the formation of the Russian mechanism of resource-saving, which takes into account the peculiarities of the Russian construction industry and ensures the ecological efficiency of buildings, seems to be an effective direction of transformations. As an evolutionary direction for the further development of housing, it is advisable to make a transition from a narrow consideration of energy efficiency issues concerning a building only to facilities with an ultra-low level of consumption of energy, water, and other resources and a minimal negative impact on the environment throughout their entire life cycle, the orientation of housing construction towards "Green" standards, taking into account the principles of active and eco-houses.

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