FOREIGN EXPERIENCE OF "GREEN" CONSTRUCTION IN THE RESIDENTIAL SECTOR AND PROSPECTS FOR ITS APPLICATION IN UZBEKISTAN

Dilfuza Bobomuratovna Tozhiyeva
Independent Researcher at Tashkent State University of Economics

Abstract. This article examines modern approaches to assessing the economic efficiency of "green" construction in the context of the global transition to sustainable development. Particular attention is paid to the analysis of international experience in both developed and developing countries, where the environmental transformation of the construction industry is considered a key area of investment and urban development policy. The necessity of considering not only traditional financial indicators but also environmental parameters is substantiated, including carbon footprint reduction, energy and water efficiency, and the operational performance of buildings. The key tools for evaluating the effectiveness of environmental standards and their role in increasing the investment attractiveness of construction projects are identified. The study concludes that adapting international practices to the conditions of Uzbekistan is advisable, taking into account the national characteristics of housing sector development.

Keywords: green technologies, environmental standards, energy and water efficiency, economic evaluation methods, urbanization, construction market transformation.

INTRODUCTION

In the context of the global transition to sustainable development, the analysis of international experience in assessing the economic efficiency of "green" construction, as well as the potential for adapting these approaches to the conditions of Uzbekistan, is gaining increasing scientific and practical significance. For countries with a well-developed construction industry, environmental transformation has evolved from being solely an ecological consideration into a strategic direction of investment and urban development policy.

At the international level, a stable practice has emerged of applying economic evaluation methods that take into account not only traditional profitability indicators but also key environmental parameters, such as carbon footprint reduction, energy and water efficiency, operating costs, and building durability. This has led to the development of analytical tools that enable the assessment of not only financial attractiveness but also the broader impact of implementing environmental standards in the housing sector.

Particular interest lies in the experience of countries such as the United States, Germany, France, the United Kingdom, and Japan, where national certification systems and methodologies for calculating environmental benefits have been developed and effectively integrated into public policy and construction regulations. At the same time, the experience of developing countries is also significant, as "green" construction is increasingly viewed as an effective tool for sustainable urban development, especially in the context of high population density and rapid urbanization.

LITERATURE REVIEW

Foreign researchers note that in developed countries "green" construction has reached a significant scale, and the number of certified buildings continues to grow. According to rankings published by the *Radi Doma Pro* platform, some of the most innovative and environmentally friendly structures include the Empire State Building in New York, The Crystal complex in London, the Sino-Italian Ecological Building in China, the congress center in Dezhou, and the Gardens by the Bay complex in Singapore. These facilities are characterized by the integrated use of renewable energy sources, intelligent microclimate management systems, solar panels, and water-saving technologies [3].

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For example, the Empire State Building, after modernization, received a LEED Platinum certificate, which enabled a substantial reduction in air conditioning costs. The Crystal is equipped with a system that accumulates heat in summer and releases it in winter, while the congress center in Dezhou operates entirely on solar energy. Gardens by the Bay combines elements of an eco-park with advanced engineering systems: vertical gardens collect rainwater, purify air, and generate electricity [3]. These examples demonstrate that the global community not only strives for high energy efficiency but also implements the concept of "green" construction as an essential component of sustainable development.

Studies also show that in South Korea the concept of a "green" building encompasses the entire life cycle of a facility-from design and construction to operation and demolition-with an emphasis on minimizing environmental impact at each stage. This reflects a comprehensive approach aimed at integrating sustainability principles into all phases of the real estate life cycle [4].

In the United Kingdom, a well-defined concept of "green" construction has been formed, emphasizing energy efficiency, the reduction of greenhouse gas emissions, the use of renewable energy sources, and the improvement of indoor environmental quality. Particular attention is also given to water resource management and the creation of a comfortable and environmentally safe living environment.

Other countries have developed national certification systems adapted to their specific climatic, economic, and legal conditions. Thus, standards such as DGNB in Germany, GRIHA in India, Estidama in Abu Dhabi, Green Mark in Singapore, and GBI in Malaysia reflect regional priorities in sustainable construction. These systems serve as instruments for implementing environmental strategies and enable governments to shape national policies in the field of "green" construction in line with local characteristics and needs [4].

Against the backdrop of international practices of tax incentives for environmentally responsible behavior in industry and the innovation sector, the relevance of applying similar mechanisms in residential construction is increasingly evident. The experience of France, Sweden, the Netherlands, and several other countries with well-developed environmental taxation systems demonstrates the effectiveness of financial incentives as a tool for sustainable development. In these countries, environmental benefits not only help reduce the fiscal burden on businesses but also act as an important factor in enhancing the investment attractiveness of sustainable projects.

RESEARCH METHODOLOGY

The study employs a combination of general scientific and special research methods, including retrospective analysis, logical generalization, comparative analysis, and graphical representation. The application of these methods enables a comprehensive examination of the economic efficiency of "green" construction and the identification of key trends in its development.

The information base of the research consists of analytical materials and scientific publications from domestic and foreign research institutions, as well as data and reports from international organizations. This ensures the reliability and validity of the findings and supports a well-grounded analysis of international practices.

ANALYSIS AND RESULTS

An example of the adaptation of environmental approaches in the housing sector is Indonesia-a country with one of the largest populations in the world and a growing demand for energy-efficient and environmentally sustainable infrastructure.

Indonesia, as one of the most densely populated countries, faces increasing demand for housing and infrastructure, which intensifies the need to develop sustainable architectural solutions. Given the significant environmental impact of construction activities, the country is implementing sustainable development concepts through the "smart city" initiative, within which the city of Makassar has been selected as a pilot site for testing environmentally oriented approaches. This

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section examines Makassar's experience in implementing green construction practices, including existing challenges and promising directions for the development of this segment [3].

A significant role in promoting environmental standards is played by the Green Building Council Indonesia (GBCI), which in Makassar is implementing a comprehensive strategy covering the transformation of the construction market, educational initiatives, certification of facilities, and coordination with key stakeholders. The country has developed a national assessment system, GREENSHIP, which includes key categories of sustainable construction adapted to local conditions. Despite these efforts, the level of implementation of "green" standards in the city remains limited. This is due both to the limited access of specialists to relevant professional education and to the relatively high initial costs associated with implementing such projects.Although reduced operating costs make them more beneficial in the medium term, the lack of sufficient informational support and the need for further improvement of the regulatory framework slow down the widespread adoption of green practices. Considering these factors, researchers note that further development of green construction in Indonesia is possible with enhanced government support, the expansion of educational platforms, and increased public awareness of the long-term benefits of sustainable architectural solutions [3].

The example of Indonesia clearly demonstrates that the successful implementation of "green" construction requires consideration not only of technical solutions but also of social, institutional, and cultural contexts. In this regard, national environmental certification systems emerging in countries with an active environmental agenda should be adapted to local realities-from climate and resource conditions to legal frameworks and the level of environmental awareness among the population. International "green" standards such as BREEAM or LEED can serve as benchmarks; however, without considering national specifics, they perform primarily a methodological rather than a fully practical function.

Within the global environmental movement, a significant role is played by the World Green Building Council, which coordinates the activities of national organizations in this field. These councils typically operate as non-profit structures, bringing together experts such as architects, engineers, investors, and representatives of the construction sector. Their mission is to promote the principles of voluntary environmental certification, develop standards adapted to local conditions, and raise awareness among professionals and the public regarding sustainable construction practices [4]. Such institutional models can serve as an important reference point for Uzbekistan, where the development of a national system of "green" standards requires a strong scientific foundation, international experience, and alignment with national sustainable development priorities.

Global experience shows that a number of countries have achieved significant progress in implementing certified eco-projects, indicating a high level of institutional and investment maturity in this field. The most notable results are observed in countries where comprehensive environmental standards systems are in place and where effective mechanisms of public and private support are functioning. A summary of leading countries in terms of registered and certified sustainable construction projects is presented below (Table 1).

Table 1

Top 10 Leading Countries by Number of Registered and Certified Construction Projects, 2025 [5]

№	Country	Number of Projects (units)	Area (million sq. m)
1.	United States	44 270	595,8
2.	Canada	4 212	62,3
3.	China	1 156	66,5

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4.	United Arab Emirates	808	46,1
5.	Brazil	638	18,1
6.	India	405	6,9
7.	Mexico	322	7,9
8.	Germany	299	6,1
9.	Turkey	194	8,9
10.	South Korea	188	15,0

Analysis of Table 1 shows that the United States remains a global leader in the field of "green" construction, where a large-scale and institutionalized system of environmentally sustainable building has been developed, with the LEED certification system widely applied. A notable example is the renovation of the Empire State Building, which resulted in a significant reduction in energy consumption.

In Canada, environmentally certified office and residential complexes have become widespread. For instance, the Manitoba Hydro Place building in Winnipeg was designed with consideration of extreme climatic conditions and a strong focus on energy efficiency. In China, the Sino-Italian Ecological and Energy Efficient Building project demonstrates the effective integration of architectural traditions with modern eco-technologies. In the UAE, the concept of sustainable cities is actively evolving, with projects such as The Edge skyscraper in Dubai serving as symbols of innovation and compliance with international environmental standards [5].

These examples confirm that the high indicators presented in the table are supported by well-defined strategies, substantial investments, and large-scale projects implemented in leading countries.

Despite the impressive achievements of leading countries, it is equally important to analyze the experience of states that are geographically and socio-economically closer to Uzbekistan. Of particular interest are the countries of Central Asia, where issues of eco-construction are gradually acquiring strategic importance in response to growing sustainable development challenges.

Under conditions of increasing environmental pressure and relatively high energy intensity in Kazakhstan, the development and implementation of national "green" construction standards are becoming priority directions. The gradual introduction of such standards requires not only technical and regulatory preparation but also the formation of a stable institutional framework [6].

Table 2 presents a phased implementation strategy, starting with the establishment of a green building council and culminating in the implementation of pilot projects. Each stage is aimed at forming a systematic and consistent approach to the greening of the construction sector, adapted to national conditions.

Table 2

Key Stages of Implementing "Green" Building Standards in Kazakhstan [6]

Stage	Key Activities
Step 1: Establishment of the Kazakhstan Green Building Council	Formation of an initiative group
Step 2: Raising awareness and improving financial attractiveness	Conducting specialized events
Step 3: Development of a National Standard	Creation of specialized media outlets
Step 4: Implementation and execution of pilot projects	Adaptation of international standards

As foreign authors note, "in the context of intensifying environmental challenges, the principles of the 'green economy' are becoming increasingly relevant, especially for countries with

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vulnerable ecosystems such as the Kyrgyz Republic. Environmental pressures affecting air quality, water resources, and soil, resulting from traditional economic activity, highlight the importance of introducing new models of economic development based on the sustainable use of natural resources and environmental responsibility. The application of 'green economy' mechanisms makes it possible to reduce technogenic pressure on the environment through the expansion of renewable energy sources, improved energy efficiency of buildings and transport infrastructure, as well as the rationalization of production and consumption processes" [7].

One of the key directions for the environmental transformation of Kyrgyzstan's economy is the development of renewable energy, particularly solar and wind energy. The country's geographical and climatic conditions create favorable prerequisites for forming a sustainable "clean" energy system. At the same time, the realization of this potential is associated with several institutional and technological challenges, including the high cost of modernizing the energy sector, the need for qualified specialists, and the ongoing development of the regulatory framework.

In Turkmenistan, environmentally oriented architectural solutions actively support the principles of sustainable development. One of the key directions is the advancement of "green" construction through the introduction of energy-efficient technologies, the use of renewable energy sources, and environmentally safe building materials. At the state level, sustainable construction standards have been adopted, aimed at minimizing environmental impact. These standards emphasize the use of local and recycled materials, which contributes to reducing carbon footprints by lowering transport costs and energy consumption during production. Buildings are also designed with efficient water use in mind, including water-saving technologies and resource reuse systems.

"Environmentally oriented architecture in Turkmenistan contributes not only to reducing greenhouse gas emissions but also to improving indoor microclimates. The use of non-toxic materials and modern ventilation systems helps ensure a safer and more comfortable living environment. This approach reflects the country's intention to develop a sustainable and environmentally balanced urban infrastructure that supports long-term public well-being and the preservation of natural resources" [8].

According to researchers from neighboring countries, "Tajikistan has significant potential for transitioning to a 'green economy' model. Institutional prerequisites include the state's commitment to reforms aimed at improving economic governance and creating conditions for active civil society participation in environmentally oriented initiatives. In the context of a 'green economy,' environmental protection is increasingly integrated into production and consumption processes, becoming an essential component of sustainable development" [9].

The key natural resources of Tajikistan create real opportunities for the environmental transformation of its economy. The country possesses the largest freshwater reserves in Central Asia, significant hydropower potential, and diverse land resources, including underutilized agricultural areas. These advantages are complemented by favorable climatic and geographical conditions for the development of eco-tourism and recreational infrastructure, as well as the presence of strategically important mineral resources. Together, these factors form a solid foundation for a comprehensive transition toward a sustainable and resource-efficient model of economic growth.

CONCLUSION AND RECOMMENDATIONS

In our view, a particularly promising direction in the context of the sustainable transformation of the construction sector is the institutionalization of a phased system for the ecological and economic assessment of buildings. Such a system would make it possible to consider not only energy efficiency but also resource conservation, emission levels, and the use of "green" materials and technologies. The introduction of reduced property tax coefficients linked to the rating assessment of buildings could serve as an effective financial incentive for developers. In turn, this would facilitate

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the broader implementation of green building standards and the expansion of the energy-efficient housing segment within the national economy.

Thus, the analysis of international experience demonstrates that the successful development of "green" construction across different countries is driven by a systemic approach that includes government support, the development of national standards, and the active participation of the professional community. Countries such as the United States, Canada, Germany, China, and the UAE have achieved significant results through the implementation of certification systems (LEED, BREEAM, DGNB, etc.), which promote environmentally responsible design and building operation.

Particular importance is attached to the transfer and adaptation of innovative technologies aimed at improving energy efficiency, reducing carbon footprints, and ensuring the rational use of resources, which collectively contribute to the formation of a sustainable urban environment. International practices confirm that with consistent institutional support and well-designed economic incentives, sustainability principles can be effectively integrated into the construction sector.

These findings provide a solid foundation for adapting and developing similar approaches in Central Asian countries, including Uzbekistan, taking into account national priorities and development conditions.

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