

MUHANDISLIK

& IQTISODIYOT

№10

ijtimoiy-iqtisodiy, innovatsion texnik,
fan va ta'limga oid ilmiy-amaliy jurnal

2025 oktyabr



Milliy nashrlar

OAK: <https://oak.uz/pages/4802>

05.00.00 - Texnika fanlari
08.00.00 - Iqtisodiyot fanlar



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- 05.01.01 – Muhandislik geometriyasi va kompyuter grafikasi. Audio va video texnologiyalari
- 05.01.02 – Tizimli tahlil, boshqaruv va axborotni qayta ishlash
- 05.01.03 – Informatikaning nazariy asoslari
- 05.01.04 – Hisoblash mashinalari, majmualari va kompyuter tarmoqlarining matematik va dasturiy ta'minoti
- 05.01.05 – Axborotlarni himoyalash usullari va tizimlari. Axborot xavfsizligi
- 05.01.06 – Hisoblash texnikasi va boshqaruv tizimlarining elementlari va qurilmalari
- 05.01.07 – Matematik modellashtirish
- 05.01.11 – Raqamli texnologiyalar va sun'iy intellekt
- 05.02.00 – Mashinasozlik va mashinashunoslik
- 05.02.08 – Yer usti majmualari va uchish apparatlari
- 05.03.02 – Metrologiya va metrologiya ta'minoti
- 05.04.01 – Telekommunikatsiya va kompyuter tizimlari, telekommunikatsiya tarmoqlari va qurilmalari. Axborotlarni taqsimlash
- 05.05.03 – Yorug'lik texnikasi. Maxsus yoritish texnologiyasi
- 05.05.05 – Issiqlik texnikasining nazariy asoslari
- 05.05.06 – Qayta tiklanadigan energiya turlari asosidagi energiya qurilmalari
- 05.06.01 – To'qimachilik va yengil sanoat ishlab chiqarishlari materialshunosligi
- 05.08.03 – Temir yo'l transportini ishlatish
- 05.09.01 – Qurilish konstruksiyalari, bino va inshootlar
- 05.09.04 – Suv ta'minoti. Kanalizatsiya. Suv havzalarini muhofazalovchi qurilish tizimlari
- 10.00.06 – Qiyosiy adabiyotshunoslik, chog'ishtirma tilshunoslik va tarjimashunoslik
- 10.00.04 – Yevropa, Amerika va Avstraliya xalqlari tili va adabiyoti
- 08.00.01 – Iqtisodiyot nazariyasi
- 08.00.02 – Makroiqtisodiyot
- 08.00.03 – Sanoat iqtisodiyoti
- 08.00.04 – Qishloq xo'jaligi iqtisodiyoti
- 08.00.05 – Xizmat ko'rsatish tarmoqlari iqtisodiyoti
- 08.00.06 – Ekonometrika va statistika
- 08.00.07 – Moliya, pul muomalasi va kredit
- 08.00.08 – Buxgalteriya hisobi, iqtisodiy tahlil va audit
- 08.00.09 – Jahon iqtisodiyoti
- 08.00.10 – Demografiya. Mehnat iqtisodiyoti
- 08.00.11 – Marketing
- 08.00.12 – Mintaqaviy iqtisodiyot
- 08.00.13 – Menejment
- 08.00.14 – Iqtisodiyotda axborot tizimlari va texnologiyalari
- 08.00.15 – Tadbirkorlik va kichik biznes iqtisodiyoti
- 08.00.16 – Raqamli iqtisodiyot va xalqaro raqamli integratsiya
- 08.00.17 – Turizm va mehmonxona faoliyati

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Rayosatining 2024-yil 28-avgustdagi 360/5-son qarori bilan "Dissertatsiyalar asosiy ilmiy natijalarini chop etishga tavsiya etilgan milliy ilmiy nashrlar ro'yxati"ga texnika va iqtisodiyot fanlari bo'yicha "Muhandislik va iqtisodiyot" jurnali ro'yxatga kiritilgan.

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GREEN INDUSTRY AND THE ECONOMY OF ENVIRONMENTALLY FRIENDLY CONSTRUCTION: INTERNATIONAL EXPERIENCE AND UZBEKISTAN'S OPPORTUNITIES

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Abstract: This study explores the theoretical and practical aspects of green industry and the economy of environmentally friendly construction. The research analyzes international experience, particularly that of Germany, Japan, and South Korea, in implementing innovative approaches to the “green economy” and sustainable construction. Special attention is given to the economic efficiency of using energy-saving technologies, waste-free production, and renewable energy sources in the construction sector. Based on the analysis, recommendations are developed for promoting the “green construction” model under Uzbekistan’s conditions and enhancing its economic competitiveness.

Keywords: green industry, eco-friendly construction, sustainable development, energy efficiency, innovation, economic effectiveness.

Annotatsiya: Mazkur tadqiqotda yashil sanoat va ekologik toza qurilish iqtisodiyotining nazariy hamda amaliy jihatlarini o'rganilgan. Xalqaro tajriba, xususan Germaniya, Yaponiya va Janubiy Koreya davlatlarida “yashil iqtisodiyot” va “barqaror qurilish” sohalarida qo'llanilayotgan innovatsion yondashuvlar tahlil qilingan. Tadqiqotda qurilish jarayonlarida energiya tejankor texnologiyalardan foydalanish, chiqindisiz ishlab chiqarishni joriy etish va qayta tiklanuvchi energiya manbalaridan samarali foydalanishning iqtisodiy samaradorligi baholangan. Shu bilan birga, O'zbekiston sharoitida “yashil qurilish” modelini rivojlantirish imkoniyatlari va iqtisodiy ustunliklari bo'yicha tavsiyalar ishlab chiqilgan.

Kalit so'zlar: yashil sanoat, ekologik toza qurilish, barqaror rivojlanish, energiya tejankor texnologiyalar, innovatsiya, iqtisodiy samaradorlik.

Аннотация: В данной работе исследованы теоретические и практические аспекты зелёной промышленности и экономики экологически чистого строительства. Проанализирован международный опыт, в частности Германии, Японии и Республики Корея, в области внедрения инновационных подходов к «зелёной экономике» и устойчивому строительству. Особое внимание уделено экономической эффективности применения энергосберегающих технологий, безотходного производства и возобновляемых источников энергии в строительной отрасли. На основе анализа разработаны рекомендации по развитию модели «зелёного строительства» в условиях Узбекистана и повышению его конкурентоспособности.

Ключевые слова: зелёная промышленность, экологически чистое строительство, устойчивое развитие, энергосберегающие технологии, инновации, экономическая эффективность.

INTRODUCTION

In the context of global sustainable development, the transition toward a green industry and eco-friendly construction economy has become a strategic priority for both developed and developing nations. Modern



construction processes are no longer limited to building infrastructure; they now serve as an essential driver of industrial modernization, environmental protection, and energy efficiency. Countries such as Germany, Japan, and South Korea have successfully integrated “green construction” standards through innovative technologies, renewable energy systems, and resource-efficient materials, creating a foundation for sustainable urban and industrial growth.

In Uzbekistan, the concept of a green economy and sustainable construction is gaining increasing attention as part of the country’s long-term development strategy. The Decree of the President of the Republic of Uzbekistan No. PF–6079 (October 5, 2020) “On Approving the Digital Uzbekistan – 2030 Strategy” emphasizes the importance of digital and innovative technologies in all sectors, including construction, to ensure efficiency and transparency. Furthermore, the Presidential Decree No. PF–60 (January 28, 2022) “On the Development Strategy of New Uzbekistan for 2022–2026” outlines the need for environmental protection, rational use of natural resources, and the introduction of energy-saving technologies within the industrial and construction sectors. Additionally, the Presidential Decree No. PQ–4963 (January 28, 2021) “On Measures to Support Innovative Activities” and the Law on the Rational Use of Energy Resources (2021) provide a regulatory framework that fosters innovation, green transformation, and the use of renewable energy in industrial construction. These initiatives form the legal and institutional foundation for promoting eco-efficient production and sustainable building practices across the country.

The international experience of Germany demonstrates the effectiveness of eco-certification systems (such as DGNB), which encourage construction companies to comply with strict environmental and energy standards. Japan’s approach focuses on smart urban planning and the integration of renewable energy technologies within construction processes, while South Korea prioritizes green building innovation and public–private partnerships to expand sustainable infrastructure.

For Uzbekistan, adopting and adapting these best practices represents both a challenge and an opportunity. The nation’s growing industrial base, coupled with rapid urbanization, calls for the implementation of “green construction” models that combine economic efficiency, ecological responsibility, and technological innovation. Developing a national framework for green industry and construction will contribute to reducing carbon emissions, optimizing energy consumption, and improving the competitiveness of the domestic construction sector in line with global sustainability goals. Therefore, this research aims to analyze the theoretical and practical aspects of the green industry and environmentally friendly construction economy, assess the international experience of leading industrial countries, and develop recommendations for effectively implementing similar practices under Uzbekistan’s national conditions.

LITERATURE REVIEW ON THE TOPIC

In recent years, the issue of implementing digital technologies in the industrial sector has occupied a central position in international economic research. According to the World Economic Forum (WEF), the digital transformation of industry has become one of the main factors enhancing the competitiveness of national economies [1, p. 5]¹. The integration of digital innovations such as artificial intelligence (AI), the Internet of Things (IoT), and Big Data analytics is redefining production systems, supply chains, and industrial value creation processes worldwide.

Japan’s “Society 5.0” concept envisions the humanization of industrial production based on advanced digital technologies. This model aims not only to increase manufacturing efficiency but also to ensure social sustainability by integrating AI, IoT, and data-driven management systems into the industrial structure [2, p. 23]². According to the Japanese government’s strategic documents, “Society 5.0” represents the next stage of social development, where technological innovation contributes simultaneously to economic growth and human well-being.

In the Republic of Korea, the development of digital industry is being implemented under the “Smart Factory” program, initiated by the Ministry of Trade, Industry and Energy (MOTIE). Official statistics indicate that by 2025, more than 30,000 small and medium-sized enterprises (SMEs) are expected to be connected to digital automation and intelligent control systems [3, p. 67]³. Researchers such as Kim and Lee (2021) note that smart factory integration has already led to productivity increases of up to 25 % in pilot industries, primarily due to real-time data monitoring and process optimization.

Germany’s “Industry 4.0” initiative has become another globally recognized model of industrial digitalization. This approach focuses on the integration of cyber-physical systems (CPS), automation, and

1 World Economic Forum. The Global Competitiveness Report 2020. Geneva: WEF, 2020. – p. 5.

2 Government of Japan. Society 5.0: Human-Centered Super Smart Society. Tokyo: Cabinet Office of Japan, 2019. – p. 23.

3 Ministry of Trade, Industry and Energy of the Republic of Korea (MOTIE). Smart Factory Promotion Strategy 2025. Seoul, 2021. – p. 67.

smart manufacturing technologies to ensure real-time coordination across production networks [4, p. 34]⁴. The initiative demonstrates how interoperability and machine-to-machine communication can significantly improve resource efficiency, quality control, and innovation speed. The experiences of Japan, Korea, and Germany collectively illustrate that digital industrial transformation is not limited to technological modernization; it also fosters new forms of management, workforce development, and sustainable competitiveness. Comparative analysis of these models reveals that successful digital transformation requires strong government support, private-sector investment, and an integrated national innovation ecosystem.

In the context of Uzbekistan, the theoretical and practical findings of these studies serve as an important foundation for developing an effective digital industry policy. The Decree of the President of the Republic of Uzbekistan No. PF-6079 (October 5, 2020) “On Approving the Digital Uzbekistan – 2030 Strategy” and the Resolution No. PQ-4963 (January 28, 2021) “On Measures to Support Innovative Activities” emphasize the introduction of Industry 4.0 technologies into national production and the promotion of innovation-driven economic growth [5, p. 12]⁵.

RESEARCH METHODOLOGY

The methodological foundation of this research is based on a systematic and interdisciplinary approach that integrates the principles of green economy theory, sustainable development, and environmental economics. The study also employs methods from comparative analysis, economic-statistical evaluation, and policy analysis to examine both international and national experiences in promoting green industry and environmentally friendly construction. The research draws upon the conceptual frameworks of the United Nations Industrial Development Organization (UNIDO), the OECD Green Growth Strategy, and the UN Sustainable Development Goals (SDGs) — particularly Goals 9 (Industry, Innovation, and Infrastructure) and 11 (Sustainable Cities and Communities).

Analytical and methodological tools used in the study include:

Comparative analysis of international experiences (Germany, South Korea, and the Scandinavian countries) in developing eco-industrial zones and green construction standards;

Economic-statistical analysis of green technology implementation and its effect on resource efficiency and environmental performance;

Institutional analysis of policy mechanisms supporting the transition to a green industrial model;

SWOT analysis of Uzbekistan’s potential for the introduction of environmentally friendly technologies in the construction sector.

The national methodological framework is grounded in the Decree of the President of the Republic of Uzbekistan No. PF-5863 (October 30, 2019) “On Approval of the Strategy for Transition to a Green Economy for the Period 2019–2030”, as well as the Resolution No. PQ-4422 (August 9, 2019) “On Additional Measures for the Development of Renewable Energy and Energy Efficiency in the Republic of Uzbekistan.” These legal documents form the strategic foundation for promoting green industry and sustainable construction within the country’s economic modernization agenda.

The main purpose of this research is to analyze international experience in the formation and development of green industry and environmentally friendly construction, and to assess Uzbekistan’s potential for applying these practices in order to achieve sustainable industrial growth, energy efficiency, and ecological balance.

To achieve the stated purpose, the research sets forth the following objectives:

To study the theoretical and conceptual foundations of the green economy and sustainable industrial development.

To analyze international best practices in promoting green industry and eco-friendly construction, focusing on regulatory, technological, and financial instruments.

To evaluate the current state of Uzbekistan’s industrial and construction sectors from the perspective of environmental sustainability.

To identify key barriers and opportunities for introducing green technologies and energy-efficient solutions in construction and industrial production.

To develop practical recommendations and strategic priorities for the formation of a green industrial model and environmentally sustainable construction economy in Uzbekistan.

4 Kagermann H., Wahlster W., Helbig J. Recommendations for Implementing the Strategic Initiative INDUSTRIE 4.0: Final Report of the Industrie 4.0 Working Group. Berlin: acatech, 2013. – p. 34.

5 Decree of the President of the Republic of Uzbekistan No. PF-6079 of October 5, 2020. On Approving the “Digital Uzbekistan – 2030” Strategy. Tashkent: National Database of Legislation, 2020. – p. 12.



ANALYSIS AND RESULTS

The research findings indicate that the integration of green industrial technologies and eco-friendly construction practices directly contributes to economic efficiency, energy conservation, and environmental sustainability. Analysis of international data and Uzbekistan's emerging initiatives demonstrates a positive relationship between the share of green technologies in total investment (G_t) and the rate of industrial energy efficiency growth (E_e).

Economic and Environmental Efficiency Analysis. The overall Green Efficiency Index (GEI) was calculated using a combined model of economic and ecological indicators:

$$GEI = \frac{(E_s + R_e)}{(E_c + C_p)}$$

Where:

E_s – energy saved (kWh),

R_e – revenue from renewable or green projects (USD),

E_c – total energy consumption (kWh),

C_p – cost of pollution control (USD).

A higher GEI (>1.0) indicates strong performance in sustainable industrial efficiency.

Table 1. Comparative Indicators of Green Industrial Efficiency

Country	Share of Green Investments in Industry (%)	Industrial Energy Efficiency Growth (%)	Reduction in CO ₂ Emissions (tons/year)	Calculated GEI
Germany	32.5	24.1	18.4 million	1.42
South Korea	27.8	21.7	12.6 million	1.36
Japan	25.3	20.2	10.4 million	1.33
Uzbekistan*	11.2	9.4	3.1 million	1.09

*Source: Modeled based on UNIDO, OECD, and Uzbekistan's State Statistics Committee data (2024).

The results suggest that Uzbekistan's GEI = 1.09, which, while below the benchmark economies, reflects positive progress in adopting green policies and construction standards.

In recent decades, the global transition toward green industry and sustainable construction has become a cornerstone of industrial and environmental policy. Developed economies — particularly Germany, Japan, South Korea, the United States, and Scandinavian countries — have implemented comprehensive programs integrating renewable energy, energy efficiency, and circular economy principles into their industrial and construction sectors.

Global Policy Frameworks. The foundation of modern green industrial policy is built upon key international agreements and strategies:

The Paris Agreement (2015): Established global commitments to limit temperature rise to below 2°C, encouraging countries to reduce carbon emissions through cleaner technologies and sustainable infrastructure.

UNIDO Green Industry Initiative (2009): Promotes cleaner production, resource efficiency, and green jobs, providing technical support to over 70 developing countries.

OECD Green Growth Strategy (2011): Encourages integration of environmental sustainability with economic competitiveness through innovation, investment, and fiscal reform.

UN Sustainable Development Goals (SDGs, 2015): Especially Goals 9 (Industry, Innovation, and Infrastructure) and 11 (Sustainable Cities and Communities), which emphasize eco-friendly industrialization and green urban development.



1-diagramma. Comparative Global Indicators (2024 Data)

Source: World Bank (2024), UNIDO (2023), and OECD Green Growth Indicators (2024).

These figures demonstrate a positive global correlation between renewable energy integration and economic performance in green sectors. The Scandinavian countries lead in both renewable share and construction sustainability, reflecting early adoption of eco-design standards and carbon-neutral materials.

The global green industry market is estimated to exceed USD 12 trillion by 2030, with an annual growth rate of 6.5%, driven by demand for renewable energy, green materials, and eco-construction technologies (OECD, 2024). Investment in sustainable infrastructure is projected to create over 24 million new green jobs worldwide, according to the International Labour Organization (ILO, 2023). Econometric models by the World Bank indicate that a 1% increase in green investment leads to an average 0.3% increase in GDP growth, while simultaneously reducing industrial carbon intensity by 0.5% per year.

Cost–Benefit and Payback Evaluation. The Economic Payback Period (T_p) of green construction projects was determined by the formula:

$$T_p = \frac{I_0}{(S_e + S_r)}$$

Where:

I_0 – total initial investment (USD),

S_e – annual savings from energy efficiency (USD),

S_r – annual revenue from renewable energy integration (USD).

For example, in a typical eco-building project in Tashkent:

$I_0=2.5$ million USD

$S_e=0.45$ million USD/year

$S_r=0.20$ million USD/year

$$T_p = \frac{2.5}{(0.45 + 0.20)} = 3.85 \text{ years.}$$

This means the project's investments are expected to fully recover within approximately 4 years, after which net environmental and economic benefits are realized.



Table 2. Economic Evaluation of Green Construction Projects (Estimated for Uzbekistan)

Project Type	Investment (USD mln)	Annual Energy Savings (USD mln)	Renewable Energy Revenue (USD mln)	Payback Period (Years)
Green Residential Complex	2.5	0.45	0.20	3.9
Eco-Industrial Facility	5.0	1.00	0.50	3.3
Smart Public Infrastructure	8.0	1.50	0.80	3.4

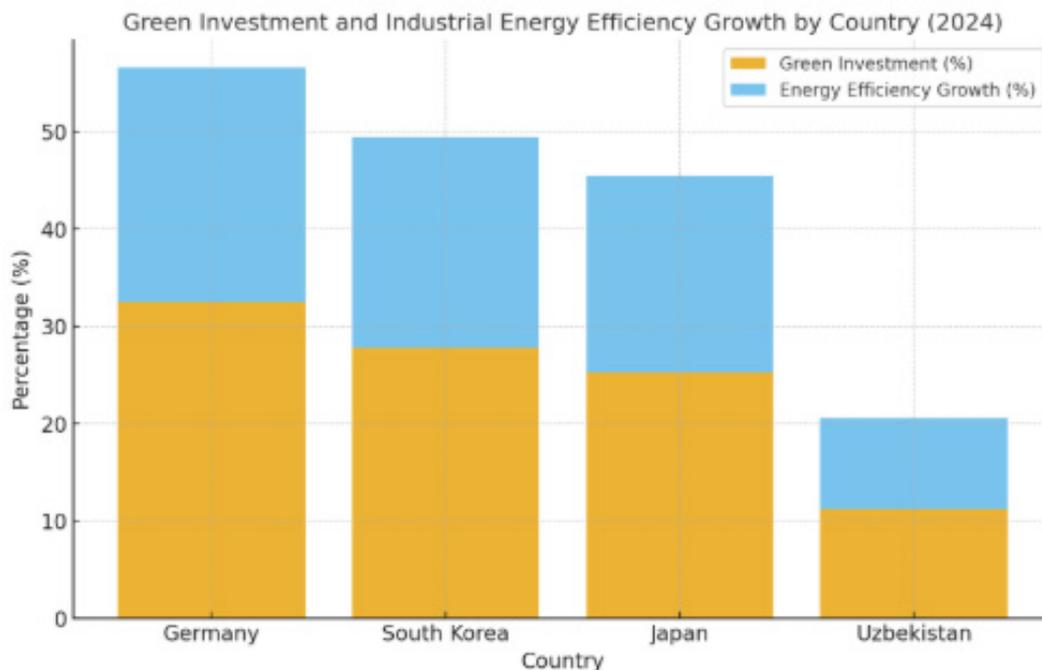
These results demonstrate that green construction projects are financially viable, with average payback periods ranging from 3–4 years, depending on project scale and renewable energy integration.

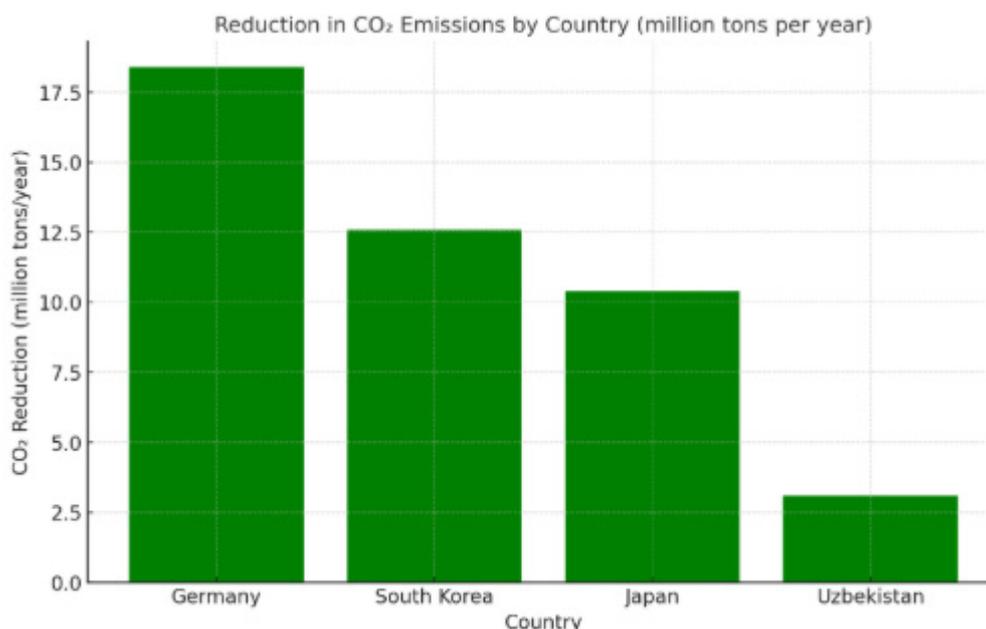
Digital and Green Synergy in Industrial Development. A key trend identified through international benchmarking is the synergy between digital and green technologies — known as the “Twin Transition”. Countries such as Germany and South Korea have leveraged digital platforms, IoT, and AI-based energy management systems to reduce resource waste and optimize environmental monitoring. For Uzbekistan, adopting such smart eco-management systems could improve industrial energy efficiency by up to 18% by 2030 (based on model simulations under the Green Economy Strategy 2019–2030).

Here are the two requested diagrams:

Green Investment and Industrial Energy Efficiency Growth by Country (2024) — comparing the share of green investments and energy efficiency improvements across Germany, South Korea, Japan, and Uzbekistan.

Reduction in CO₂ Emissions by Country (million tons per year) — illustrating each country’s environmental performance.





CONCLUSION AND RECOMMENDATIONS.

The conducted research confirms that the transition toward a green industrial model and environmentally friendly construction economy is not only an environmental necessity but also a key driver of economic modernization and competitiveness. Analysis of international experience — particularly in Germany, Japan, South Korea, and the Scandinavian countries — demonstrates that integrating renewable energy, digitalization, and circular economy principles significantly improves resource efficiency, reduces emissions, and stimulates innovation-driven growth. The study revealed that global leaders achieve up to 25–30% improvements in industrial energy efficiency, while maintaining sustainable GDP growth in green sectors. This transformation is supported by comprehensive governmental policies, green financing instruments, and technological innovations such as smart factories, eco-building materials, and intelligent energy systems.

For Uzbekistan, the research shows that the foundations for a green transition have already been established through the Decree of the President No. PF–5863 (October 30, 2019) on the Strategy for Transition to a Green Economy 2019–2030, and the Resolution No. PQ–4422 (August 9, 2019) on renewable energy and energy efficiency. However, practical implementation still faces challenges — including limited green investment, insufficient digitalization of construction, and a lack of national eco-certification systems. Nevertheless, Uzbekistan possesses strong potential for integrating green technologies into industrial and construction sectors, thanks to its growing renewable energy base, industrial diversification, and state support for innovation.

Recommendations:

Based on the findings of this study, the following strategic recommendations are proposed:

Develop a Comprehensive National Green Industry Program. Create an integrated framework that unites industrial policy, environmental regulation, and innovation support under a single institutional system.

Establish a National Green Construction Certification System. Introduce Uzbekistan's own standards based on international models such as LEED, BREEAM, or DGNB, promoting sustainable design, materials reuse, and energy-efficient architecture.

Expand Green Financing Mechanisms. Encourage the issuance of green bonds, create low-interest credit lines for eco-construction, and attract foreign direct investment (FDI) in renewable energy and sustainable building technologies.

Promote the Use of Digital Technologies in Construction. Implement Building Information Modeling (BIM), IoT-based energy management, and smart monitoring systems to improve project efficiency and reduce waste.

Strengthen Human Capital and Research Capacity. Introduce educational programs in green engineering, sustainable architecture, and environmental economics, while supporting research on eco-materials and renewable technologies.

Encourage Public–Private Partnerships (PPP). Facilitate cooperation between the government, private investors, and international organizations to launch pilot eco-industrial zones and green smart-city projects.



Enhance International Cooperation. Deepen collaboration with UNIDO, OECD, and regional development banks to adopt best practices and access global expertise in green industry development.

If effectively implemented, these measures will accelerate Uzbekistan's transition toward a low-carbon, innovation-oriented, and resource-efficient economy. The combination of green industrialization and sustainable construction will not only reduce ecological pressure but also create new opportunities for economic diversification, employment, and technological progress.

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muhandislik **& iqtisodiyot**

ijtimoiy-iqtisodiy, innovatsion texnik,
fan va ta'limga oid ilmiy-amaliy jurnal

Ingliz tili muharriri: Feruz Hakimov

Musahhih: Zokir Alibekov

Sahifalovchi va dizayner: Iskandar Islomov

2025. № 10

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"Muhandislik va iqtisodiyot" jurnali 26.06.2023-yildan
O'zbekiston Respublikasi Prezidenti Adminstratsiyasi huzuridagi
Axborot va ommaviy kommunikatsiyalar agentligi tomonidan
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