Journal of Economics, Finance and Management Studies

ISSN (print): 2644-0490, ISSN (online): 2644-0504

Volume 08 Issue 11 November 2025

Article DOI: 10.47191/jefms/v8-i11-14, Impact Factor: 8.317

Page No: 7266-7272

Ways to Develop Investment and Innovation Processes in Uzbekistan's Industry Under the Conditions of a Green Economy

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ABSTRACT: This article examines effective ways to develop investment and innovation processes in Uzbekistan's industrial sector within the framework of a green economy which crucial for new way of development in Uzbekistan situation. The study emphasizes the growing importance of integrating environmental sustainability into several points and mechanisms of industrial policy, highlighting economical importance how green investment and technological innovation contribute to long-term economic growth and ecological balance in Uzbekistan part of developments strategies which is under development nowadays. Using analytical and comparative methods, the paper reviews national strategies such as the "Uzbekistan-2030 Strategy" and the "Green Economy Transition Strategy 2019-2030", along with international experiences promoted by the World Bank, UNDP, and OECD have been used.

The findings reveal that Uzbekistan's industrial development increasingly depends on attracting green financing from several foreign institutions, introducing energy-efficient technologies which is part of development new economical and environmental structures, and supporting digital transformation tools such as smart energy systems and eco-innovation clusters are under development. The article provides policy recommendations for improving institutional mechanisms which key part, investment incentives, and public-private partnerships aimed at achieving sustainable industrial competitiveness. The results of the study contribute to expanding the theoretical and practical foundations of green industrial policy and can serve as a guideline for policymakers, researchers, and investors interested in sustainable economic transformation in Uzbekistan because it not only for development of economics but also protecting environment.

KEYWORDS: Green economy, Uzbekistan green development, investment of green technologies, innovation mechanisms, sustainable industry, renewable energy, circular economy.

INTRODUCTION

The study shows that ways to develop investment and innovation processes in Uzbekistan's industry under the conditions of a green economy is highly significant because it addresses one of the most urgent challenges of modern economic development which is main part in today world which is shows the need to ensure industrial growth while preserving environmental sustainability because it effects to whole world simultaneously. In the context of Uzbekistan's ongoing reforms and the implementation of the "Uzbekistan-2030 Strategy", the transition to a green economy is recognized as a strategic priority aimed at improving resource efficiency, energy security, and social welfare which makes improvements not only in to part of economics but also for the world. In this article we analyze industrial sector, as a key driver of economic progress, requires new approaches to investment and innovation that align with ecological principles and international sustainability standards which opens new concept for applying in Uzbekistan context.

This research is important because it explores practical ways to attract green financing, promote eco-innovation, and apply advanced digital technologies such as energy-efficient production systems and smart management tools which make senses to improve Uzbekistan economically. The article's findings help identify mechanisms that can strengthen the competitiveness of national industries in part of international trade , create favorable conditions for public-private partnerships, and increase the attractiveness as progress of Uzbekistan for both domestic and foreign investors which is key for improving both economics and ecology.

Moreover, by linking theoretical frameworks with practical policy recommendations, the study contributes to improving the effectiveness of government strategies in the part of industrial modernization, innovation management, and environmental

protection because we need to improve it more deeply for next generation. From a scientific perspective we can create the work enriches the national academic base on sustainable industrial development and offers a methodological foundation in sphere for evaluating the efficiency of green investments and innovations which makes more senses in prospects of sciences. Overall, the importance of this article lies in its contribution to building a resilient, innovative, and environmentally responsible industrial economy which makes realistic concept that supports the long-term sustainable development goals of Uzbekistan for long term development.

LITERATURE REVIEW

The green economy frames growth that improves human well-being while reducing environmental risk in terms and approach articulated by UNEP's flagship report towards a green economy and used widely in policy design which can be implemented in to Uzbekistan also. This literature positions greening as compatible with competitiveness when investment and innovation are aligned with environmental goals [1]. In this point we will think that improvements toward to ways to develop investment and innovation processes in Uzbekistan's industry under the conditions of a green economy need to be redesigned because the way of development changes according time and prospective which the. Theoretical work links innovation, regulation, and productivity are demonstrated Porter and van der Linde argue that well-designed environmental policies can stimulate innovation that offsets compliance costs which in the Porter Hypothesis shows that providing a mechanism through which environmental stringency can enhance firm and sector competitiveness also intended to explain [2].

Subsequent eco-innovation research broadens innovation beyond technology to organizational and institutional change that reduces environmental impacts which clarifying channels by which firms and industries transition toward sustainability [3]. Additionally, we support both ideas but enhancing more periodical changes and analyzing more data shows several partly new points.

When we are analyzing in the macro level, international institutions emphasize green investment as a driver of diversification, jobs, and resource efficiency but it changes because it is correlated not only with ecological but also power of economical imitation which is working in Uzbekistan. OECD's green-growth indicators framework is used to monitor progress and guide policy mixes that couple productivity with environmental outcomes which demonstrates the big data to search. Complementary evidence from IRENA shows the cost and capacity dynamics that make renewables an increasingly competitive backbone for industrial decarbonization, strengthening the case for scaling clean energy as an input to industry which show new way to analyze this point in Uzbekistan level more deeper [4].

For Uzbekistan, the policy architecture for green industrial transformation is anchored in two core act is the Presidential decree number. dp-158 which have been signed in September of 19 in 2023 this called approving the Uzbekistan-2030 Strategy, which elevates energy efficiency, clean energy, and sustainable industry as national priorities and second is the Resolution of the President № PP-4477 which have been signed 2019 an called adopting the Strategy for the Transition to a Green Economy for 2019-2030. These acts establish mandates and instruments for efficiency targets, renewable expansion, and enabling measures to the guide investment and innovation decisions in the industrial sector for Uzbekistan development [6,7].

Recent country diagnostics reinforce this direction n to deep research. The world bank's country economic memorandum analyzes Uzbekistan's reform trajectory and highlights opportunities to unlock productivity and private investment areas which closely linked to green upgrading and digitalization of industry because improvement in to green economics needed as main part of development of new renewable resources.

UNDP's analytical work on the digital economy complements this by documenting how digital infrastructure and capabilities like data, platforms, smart systems can accelerate resource efficiency and eco-innovation across firms and adapt them to new changes not only market segments but also for whole systematical changes and increase productivity [9]. Together, these sources suggest that Uzbekistan's most effective pathway for combining green finance, technology adoption, and digital transformation to raise industrial competitiveness while meeting sustainability goals which can be crucial in the future and new world which has been increasingly develop nowadays [8].

Synthesis shows that the cross-national literature and Uzbekistan's legal framework converge on three levers for green industrial development. The first is policy coherence that ties environmental objectives to investment and innovation incentives needs improvements; Secondly is scaling renewable and efficiency technologies as cost-competitive industrial inputs because it will decrease cost of production; The third and final portion is digitalization and applying technologies like ERP, AI, smart energy management to monitor, optimize, and verify performance which will be best part as more improvements. These levers define the empirical and policy context for identifying practical ways to develop investment and innovation in Uzbekistan's industry under

green-economy conditions which definitely makes more changes in industrial which basically correlates in GPD and ecological part of Uzbekistan.

RESEARCH METHODOLOGY

In this study we have been applied a combined qualitative and quantitative approach to examine ways of developing investment and innovation processes in Uzbekistan's industry under green economy conditions which is base of this article. The main data sources include official legal acts as well as analytical reports in the Uzbekistan with world the best institutions reports.

The research uses comparative, statistical, and systemic analysis methods together with expert evaluation. Key indicators such as green investment share, energy efficiency, and innovation performance were analyzed. We have been created the several new points and way to develop Uzbekistan based on these analyses, the study identifies the role of green financing, digital technologies energy systems, and public-private partnerships in enhancing industrial competitiveness and supporting sustainable economic growth in Uzbekistan level and also contributing new part of analyzes in the scientific point.

ANALYSIS AND DISCUSSION

The analysis of industrial and renewable energy data for Uzbekistan from 2010 to 2024 reveals a strong upward trend in industrial production, accompanied by a more gradual increase in renewable energy output which contributes to development of economics. Industrial production volume grew almost eighteenfold during this period which is big point, reflecting significant modernization and investment in industrial capacity increase. However, the slower growth in renewable energy generation indicates that green transition processes are still developing and require further technological and financial support in this part.

These contrasting trends highlight the need for balanced policies that promote both industrial expansion and sustainability in terms of development of Uzbekistan. In this context, attracting green investments, fostering innovation in clean technologies, and expanding public-private partnerships become key directions for ensuring long-term improvements, eco-efficient industrial growth in the base context of Uzbekistan.

Table 1 Industrial production volume and total renewable energy volumes in Uzbekistan[1]

Year	Industrial production volume	Total renewable energy
2010	38119	29528,4
2011	47587,1	28899,2
2012	57552,5	31128,9
2013	70634,8	29647,6
2014	84011,6	33808,1
2015	97598,2	34368,6
2016	111869,4	31921,9
2017	148816	30766,3
2018	235340,7	30936,5
2019	322535,8	33873,2
2020	368740,2	30328,03
2021	456056,1	28927,3
2022	553265	28773,5
2023	658991,7	28850,4
2024	880198,5	29629

[1] National statistics committee of the republic of Uzbekistan https://stat.uz

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The data shows a steady and significant growth in Uzbekistan's industrial production over the period of 2010-2024 years. Industrial output increased from 38,119 units in 2010 to 680,198.5 units in 2024, reflecting a nearly 18-fold expansion which is absolutely big. This upward trend demonstrates the rapid industrialization and modernization of the national economy in terms of economical changes. In contrast, total renewable energy production also shows a gradual rise from 29,528.4 units in 2010 to 29,629 units in 2024 year but it is with slower growth dynamics compared to industrial output in this point. This indicates that, while the industrial sector has expanded substantially, the share of renewable energy within total energy production remains relatively modest in this period. The divergence between the two trends suggests that industrial growth has outpaced green energy development, underscoring the need for greater investment in renewable energy technologies and innovation in using and developing energy efficiency.

Strengthening green financing mechanisms, introducing modern energy-saving technologies, and fostering eco-innovation clusters are essential for ensuring sustainable industrial competitiveness in Uzbekistan's industrial changes in transition to a green economy.

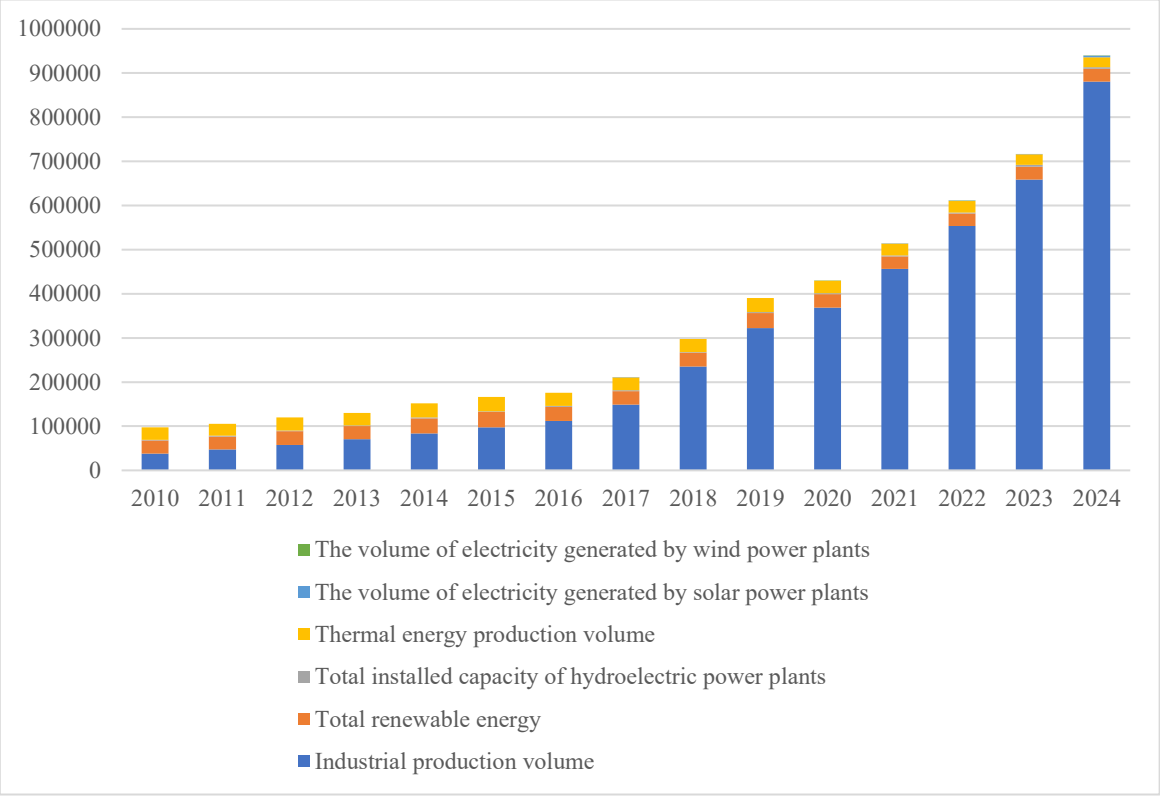

Figure 1. The trend of electricity and industry production, 2010-2024 for Uzbekistan[2]

The figure shows the trend of electricity generation and industrial production in Uzbekistan from 2010 to 2024. During this period, industrial production volume increased sharply-from about 38,000 units in 2010 to over 880,000 in 2024, reflecting rapid industrial growth and modernization. Thermal energy production grew steadily, remaining the dominant energy source throughout the period. Hydroelectric capacity also increased gradually, showing moderate expansion of traditional renewable sources. From 2016 onward, solar and later wind energy began to appear and expand rapidly, especially after 2020, when solar power generation exceeded 3,900 units and wind reached 7.2 units by 2024.

This dynamic indicates that while Uzbekistan's industrial output has expanded significantly, the energy mix is diversifying. Renewable energy, although still a small share, is growing fast, supported by the "Green Economy Transition Strategy (2019-2030)" and investments in solar and wind infrastructure. In summary: industrial growth and renewable energy development in Uzbekistan show a positive correlation, marking the start of a sustainable transition from fossil-based production toward cleaner, innovation-driven energy.

[2] National statistics committee of the republic of Uzbekistan https://stat.uz

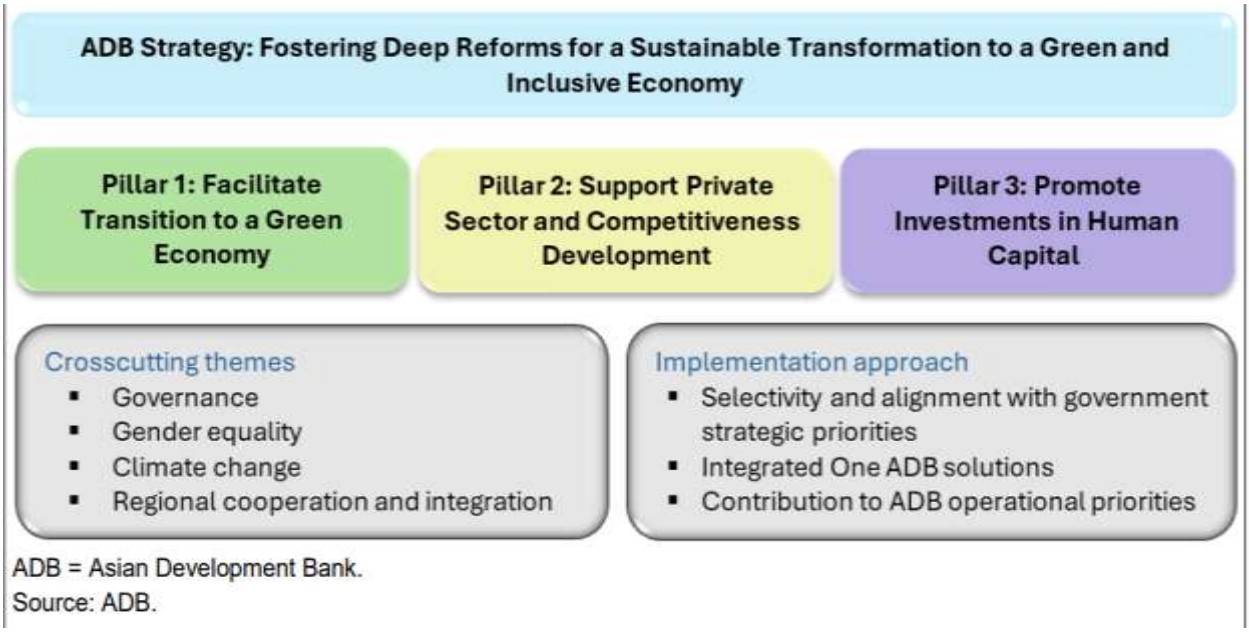

Figure 2. ADB Country Partnership Strategy, 2024-2028 for Uzbekistan[3]

The ADB Country Partnership Strategy (2024-2028) for Uzbekistan focuses on building a green, inclusive, and competitive economy through three key pillars first pillar is green transition supports renewable energy, energy efficiency, and climate-resilient infrastructure to accelerate Uzbekistan's shift toward a green economy which basically demonstrate to change prospective. The second pillar is that private sector development used to strengthens business competitiveness, innovation, and access to finance, promoting private-sector-led industrial growth which helps to improve overall situation in Uzbekistan. The third one is a human capital which connect invests in education, healthcare, and skills training to increase productivity and social inclusion which help to increase innovation itself.

Crosscutting themes include good governance, gender equality, climate change, and regional integration is significant point. Implementation emphasizes partnership with the government, policy alignment, and integrated ADB support which better coordination. In brief, the strategy guides Uzbekistan's transformation toward sustainable industrialization, green energy development, and human-centered growth, consistent with the Uzbekistan-2030 Strategy and global SDGs which make sense to take this strategy more deeper and analyze it better. In conclusion we ca enhance that it will be better to make this research more deeper with several points because it is not deeply learning analyze the situation.

Table 2 Industrial production volume and total renewable energy volumes in Uzbekistan[4]

Year	GDP current USD billion	GD growth percent	Export growth percent	Import growth percent	Fiscal deficit percent GDP	External debt percent GDP	CO2 emissions Mt	Renewable share percent	Population million
2019	60,3	5,6	28	16,1	-3,8	26,2	108,9	4	33
2020	62	1,9	8,6	1	-4,4	36,5	120,6	3,2	36
2021	69,6	7,4	9	20,3	-6	31,6	122	3,6	37
2022	81,1	5,7	15,3	23,6	-4	32,4	131	3,8	38
2023	90,9	6	17,8	21,8	-5,5	34,3	134,2	4,2	39

Between 2019 and 2023, Uzbekistan's GDP rose from USD 60.3 billion to 90.9 billion, reflecting strong industrial and investment-driven growth. However, GDP growth fluctuated - peaking at 7.4 % in 2021 after the COVID-19 slowdown in 2020 (1.9 %), and stabilizing near 6 % in 2023. Export and import growth increased steadily, indicating expanding trade and industrial capacity.

[3] Government of Uzbekistan. 2022. Presidential Decree No. 436 "On Measures to Improve the Efficiency of Reforms aimed to the Transition of the Republic of Uzbekistan to a Green Economy by 2030".
[4] Government of Uzbekistan. 2022. Presidential Decree No. 436 "On Measures to Improve the Efficiency of Reforms aimed to the Transition of the Republic of Uzbekistan to a Green Economy by 2030".

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Population grew from 33 million to 39 million, creating a larger labor force and energy demand. Uzbekistan's economy shows robust industrial growth with rising energy consumption in this point. The small but growing renewable energy share indicates a gradual transition toward cleaner energy, though further investment and policy support are needed to balance economic expansion with environmental sustainability.

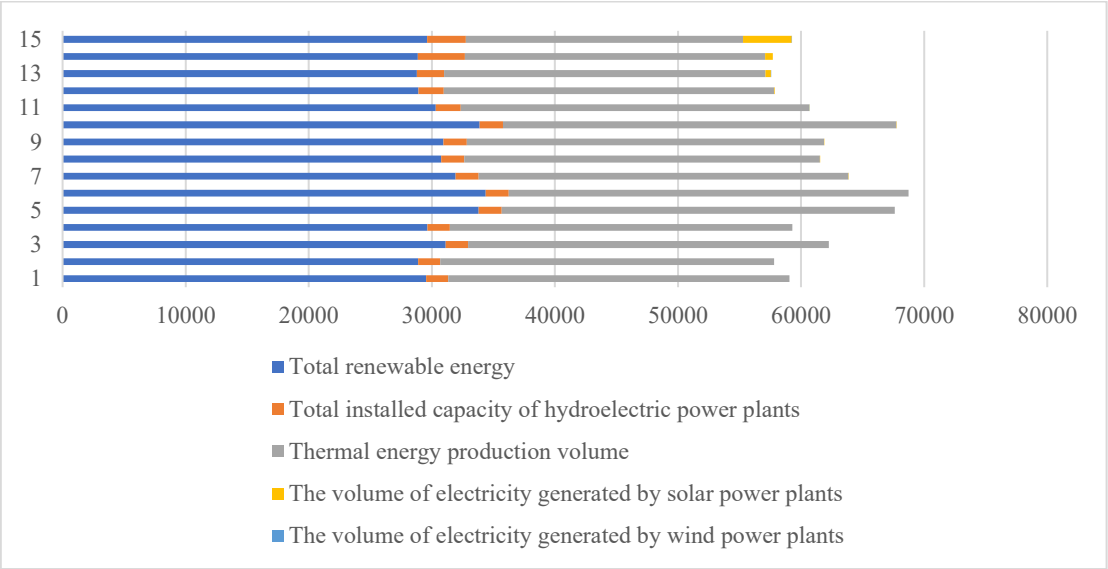

Figure 3. Renewable energy volume and dynamics for Uzbekistan[5]

The figure illustrates Uzbekistan's renewable energy dynamics from 2010 to 2024 years. During this period, thermal energy production remained dominant, averaging around 28,000-32,000 units, while hydroelectric capacity increased moderately from about 1,800 to 3,800 units. Starting in 2016, solar power generation began to grow rapidly-from 0 to about 3,965 units by 2024 and wind energy, first appearing in 2021, reached 7.2 units by 2024. Total renewable energy rose from around 29,500 units in 2010 to 34,300 units in 2024, reflecting gradual but steady growth. These trends show that Uzbekistan's energy sector is transitioning from traditional sources to a more diversified and sustainable system. While thermal energy still leads, the sharp increase in solar and wind production demonstrates the effectiveness of the Green Economy Transition Strategy (2019-2030) and rising investment in renewable infrastructure.

CONCLUSION AND RECOMMENDATIONS

The analysis of Uzbekistan's industrial and energy data from 2010-2024 demonstrates a clear dual trend: rapid industrial growth alongside a slow but steady rise in renewable energy production. Industrial output expanded from 38.1 thousand units in 2010 to 880.2 thousand units in 2024, reflecting nearly an 18-fold increase, while renewable energy production grew modestly from 29.5 thousand units to 29.6 thousand units during the same period. This imbalance highlights that while industrial modernization is progressing strongly, the green transition remains gradual and requires stronger policy and financial support.At the macroeconomic level, Uzbekistan's GDP increased from USD 60.3 billion in 2019 to 90.9 billion in 2023, with average annual growth of around 6%, supported by expanding exports, industrial capacity, and digital infrastructure. However, CO_2 emissions also rose from 108.9 Mt to 134.2 Mt, confirming that industrial progress still depends heavily on carbon-intensive energy. The renewable energy share (3-4%) remains below potential, signaling the urgent need to accelerate investment in clean technologies. Important recommendations

-First is expanding green financing instruments Develop a national "Green Investment Fund" to co-finance renewable and energy-efficient industrial projects, using concessional loans and green bonds to attract private investors.

-Second is strengthen innovation ecosystems establish eco-innovation clusters that unite industry, universities, and research institutions for developing clean production technologies, digital energy management, and smart industrial systems.

-Third point is Promote Renewable Energy Integration.

Increase the share of solar and wind energy in the industrial energy mix to at least 10% by 2030, in line with the green economy transition strategy (2019-2030).

[5] [5] National statistics committee of the republic of Uzbekistan https://stat.uz/en

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This also shows importance of whole research and demonstrates more developing and recommendation will improve the system itself in green economics improvements.

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