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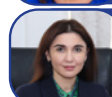
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GREEN FINANCE IN UZBEKISTAN: FROM SOVEREIGN BONDS TO FOREIGN DIRECT INVESTMENT IN RENEWABLE ENERGY (2021–2026)

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Abstract. This article analyzes Uzbekistan's practical mechanisms for financing the transition to a green economy during 2021–2026 - sovereign/corporate green bonds and foreign direct investment (FDI) in renewable energy. The results of a descriptive and statistical analysis based on secondary sources (OECD, UNDP, EBRD, IRENA, official GGGI reports) show that in 2021–2024, the country issued a total of \$1.2 billion in sovereign international bonds, and from the end of 2023 to the end of 2024, the installed solar energy capacity increased almost fivefold. The article presents Uzbekistan's experience as a replicable model for emerging economies.

Keywords: green investments; green bonds; sustainable development; renewable energy; foreign direct investment; Uzbekistan; green economy.

Annotatsiya. Ushbu maqolada 2021–2026-yillarda O'zbekistonning yashil iqtisodiyotga o'tishini moliyalashtirishning amaliy mexanizmlari – suveren va korporativ yashil obligatsiyalar hamda qayta tiklanuvchi energetika sohasiga to'g'ri-dan-to'g'ri xorijiy investitsiyalar (TTXI) tahlil qilinadi. Ikkiyilamchi manbalar (OECD, UNDP, EBRD, IRENA, GGGIning rasmiy hisobotlari) asosida amalga oshirilgan tavsifiy va statistik tahlil natijalari shuni ko'rsatadiki, 2021–2024-yillarda mamlakat jami 1,2 milliard AQSH dollari miqdorida suveren xalqaro obligatsiyalar chiqargan, 2023-yil oxiridan 2024-yil oxirigacha esa o'rnatilgan quyosh energetikasi quvvati qariyb besh baravar oshgan. Maqolada O'zbekiston tajribasi rivojlanayotgan iqtisodiyotlar uchun takror qo'llash mumkin bo'lgan model sifatida taqdim etiladi.

Kalit so'zlar: yashil investitsiyalar; yashil obligatsiyalar; barqaror rivojlanish; qayta tiklanuvchi energetika; to'g'ri-dan-to'g'ri xorijiy investitsiyalar; O'zbekiston; yashil iqtisodiyot.

Аннотация. В данной статье анализируются практические механизмы финансирования перехода Узбекистана к зелёной экономике в 2021–2026 годах - суверенные и корпоративные зелёные облигации, а также прямые иностранные инвестиции (ПИИ) в возобновляемую энергетику. Результаты описательного и статистического анализа, основанного на вторичных источниках (OECD, UNDP, EBRD, IRENA, официальные отчёты GGGI), показывают, что в 2021–2024 годах страна выпустила суверенные международные облигации на общую сумму 1,2 млрд долларов США, а с конца 2023 года до конца 2024 года установленная мощность солнечной энергетики увеличилась почти в пять раз. В статье опыт Узбекистана представлен как модель, которая может быть воспроизведена в странах с развивающейся экономикой.

Ключевые слова: зелёные инвестиции; зелёные облигации; устойчивое развитие; возобновляемая энергетика; прямые иностранные инвестиции; Узбекистан; зелёная экономика.

INTRODUCTION

In the last decade, the concept of “green growth” has moved beyond purely academic and political discussions and has become a set of specific financial instruments used by sovereign and corporate issuers. As noted in the OECD's key study on green investment definitions, there is no single universal definition of what “green” investment means; instead, an open and dynamic governance approach based on transparency and taxonomy standards is emerging as the most viable path [1]. Despite this evolving conceptual framework, the market is expanding rapidly: global sustainable debt issuance and sustainable investment assets continue to grow, while emerging economies continue to require additional financial resources to support their development priorities.

Uzbekistan is a particularly noteworthy case in this regard. Due to the country's high energy intensity, opportunities to improve energy efficiency are associated with potential economic benefits equivalent to

approximately 4.5% of GDP annually; the country has relatively high greenhouse gas emissions per unit of output in the Europe and Central Asia region, with approximately 80% of water resources originating from abroad [2]. These structural characteristics have transformed the green transition from an environmental aspiration into an economic necessity. Since 2017, large-scale reforms aimed at market liberalization, increasing governance transparency, and stimulating foreign investment, including the 2019 Green Economy Transition Strategy and the 2023 Uzbekistan 2030 Strategy, have established an institutional framework for this transition [3].

While there is sufficient coverage of Uzbekistan's green economy policy and its regulatory framework in the available literature, opportunities remain for more systematic statistical analysis of how this policy has translated into concrete financial results – i.e., real bond issuances and investment flows. In order to fill this gap, this article poses the following research question: Through what specific financial mechanisms did Uzbekistan transform its green economy strategy into investment flows during 2021–2026, and what measurable results were achieved during this process? The aim of the study is to conduct a systematic analysis and determine the quantitative dynamics of foreign direct investment in renewable energy through two main channels of attracted green capital in the country: (i) debt market instruments (sovereign and corporate green/SDG bonds) and (ii) systematic analysis of foreign direct investment in renewable energy and determination of its quantitative dynamics.

LITERATURE REVIEW

The literature relevant to this study can be grouped into three strands: (i) research on green bonds as a debt instrument for financing the low-carbon transition; (ii) research on foreign direct investment and the cost of capital in renewable energy; and (iii) regional and country studies on the energy transition in Central Asia and Uzbekistan.

Green Bonds and the Debt Channel of Green Finance. Early analyses treated green bonds as a segment of the conventional bond market distinguished mainly by the use of proceeds. Ehlers and Packer [4] showed that the credibility of the green label depends on external review and certification, and that the pricing difference relative to conventional bonds at issuance was small. Subsequent empirical work has concentrated on the so-called “greenium” – the yield discount on green bonds. Using matched pairs of green and conventional bonds, Zerbib [5] found a small but statistically significant negative premium, which he attributed to investors' pro-environmental preferences. At the corporate level, Tang and Zhang [6] documented positive stock-market reactions to green bond announcements, while Flammer [7] showed that corporate green bond issuance is followed by improvements in environmental performance and by greater ownership on the part of long-term and environmentally oriented investors, interpreting issuance as a credible signal of the issuer's commitment.

Sovereign green bonds have attracted scholarly attention only recently, as issuance has spread from advanced to emerging economies. Panizza et al. [8], using 332 matched pairs of green and conventional bonds issued by sovereigns, sovereign-backed agencies, and multilateral institutions in 2014–2023, estimate an average greenium of about 2 basis points for advanced economies and almost 13 basis points for emerging markets, with larger discounts for lower-rated issuers. At the same time, they find that sovereign green bond documentation generally does not establish legally binding environmental commitments, so that the resulting fiscal savings are relatively modest and the value of the label is largely reputational. Taken together, this strand suggests that for emerging-market sovereigns, the main benefit of green and SDG bonds lies less in cheaper borrowing than in broadening the investor base and building institutional capacity for project selection and reporting – a proposition that the Uzbek case allows to be examined.

Foreign Direct Investment and the Financing of Renewable Energy. A second strand of research examines why private and foreign capital flows into renewable energy in some countries and not in others. Reviewing the empirical evidence from an investor perspective, Polzin et al. [9] conclude that policy stability, remuneration schemes (feed-in tariffs, auctions), and financial risk mitigation instruments are the most consistent drivers of private renewable energy finance. Focusing on developing countries, Keeley and Matsumoto [10] find that foreign investors in wind and solar energy attach greater weight to policy stability and the institutional environment than to resource potential, while Wall et al. [11] show that regulatory and fiscal instruments, including guaranteed power purchase arrangements, are associated with higher renewable energy FDI inflows. At the macro level, Doytch and Narayan [12] provide evidence that FDI can stimulate renewable energy consumption, although the effect differs across sectors and income groups.

The type of financier also matters. Mazzucato and Semieniuk [13] demonstrate that different investor types – public banks, utilities, and institutional investors – finance different technologies and risk profiles, with state investment banks playing a pioneering role in projects with higher risk profiles. For developing economies, the cost of capital is a significant factor: Ameli et al. [14] show that higher financing costs in the Global South create a “climate investment trap”, in which renewable projects face challenges in achieving competitiveness

despite favourable resource endowments. Taghizadeh-Hesary and Yoshino [15] argue that private participation in green investment can be induced through green credit guarantee schemes and by returning to investors part of the tax revenue generated by the spillover effects of green energy projects. These findings explain the central role that multilateral development banks and long-term power purchase agreements play in emerging renewable energy markets.

Green Transition in Central Asia and Uzbekistan. The regional literature on the energy transition in Central Asia is relatively young. In a systematic review of research on energy in the region for 1991–2022, Vakulchuk et al. [16] find that the scholarly focus shifted from fossil fuels to clean energy only around 2019–2020 and that research on renewables is still developing. Laldjebaev et al. [17] document a notable difference between the region's technical potential for solar and wind energy and its actual deployment, and identify interrelated factors affecting development related to the regulatory framework, infrastructure, finance, expertise, and data availability. Assessing the renewable energy FDI ecosystem in Central Asia, the CAREC Institute [18] ranks Uzbekistan second in the region after Kazakhstan, while pointing to opportunities for expanding domestic financing options and further developing the local supply chain. Policy reports by international organizations [20, 21] likewise estimate considerable green investment needs for the country and highlight areas for further development in its investment climate.

Thus, existing studies either analyze green bonds and renewable energy FDI in general cross-country settings or describe Uzbekistan's renewable potential, strategies, and development priorities. Few studies jointly trace how the country's strategic framework has been translated into concrete financial flows through both the debt-market and FDI channels, particularly for the period after 2021, when sovereign green issuance and utility-scale renewable projects accelerated. The present article seeks to fill this gap.

RESEARCH METHODOLOGY

The study utilizes descriptive-statistical and comparative analysis methods based on secondary sources. The analyzed period covers the period from 2021 (the year Uzbekistan's first sovereign SDG bond was issued) to 2026.

Data were collected from several types of sources and triangulated. In particular, official reports from international organizations—the Organization for Economic Cooperation and Development (OECD), the United Nations Development Programme (UNDP), the International Renewable Energy Agency (IRENA), and the Global Green Growth Institute (GGGI)—served as the primary sources. Additionally, project and investment data from financial institutions were utilized, including indicators published by the European Bank for Reconstruction and Development (EBRD) and the Asian Development Bank (ADB). To analyze the state strategic and regulatory framework, relevant decrees of the President of the Republic of Uzbekistan and documents of the Nationally Determined Contribution (NDC) were used. Finally, specialized industry publications and official press releases (Masdar, ACWA Power, Utilities Middle East, The Times of Central Asia) were also involved in the analysis to supplement operational information on major infrastructure projects.

The analysis was conducted in two stages. At the first stage, the country's strategic and regulatory framework (strategies, programs, quantitative targets) was systematized in chronological order. In the second stage, quantitative indicators (bond volumes, coupon rates, project capacities, investment amounts) for two financing channels were summarized in the form of a table, and the dynamics were described by year. To ensure the accuracy of the sources, each quantitative indicator was confirmed by at least one primary or official institutional source; in cases where conflicting data were encountered, information from an official organization (e.g., IRENA or EBRD) was taken as priority. The limitation of the study is that the analysis relies mainly on secondary sources, and primary financial statements (e.g., full prospectuses of issuers) were not included in the analysis.

ANALYSIS AND RESULTS

Institutional and Strategic Framework. The analysis showed that Uzbekistan's policy of transitioning to a green economy is gradually formalized through five key strategic documents (Table 1).

Table 1. Key Strategic Documents of Uzbekistan on the Green Economy¹

Document title	Year	Main content
Green Economy Transition Strategy (2019–2030)	2019	Integration of green growth principles into structural reforms
Development Strategy “New Uzbekistan” (2022–2026)	2022	Common strategic commitment for green growth
Green Economy Transition Program (until 2030)	2022	Decarbonization and resource-saving measures
“Uzbekistan – 2030” Strategy	2023	100 goals; green economy - priority direction
Third Nationally Determined Contribution (NDC 3.0)	2025	Updated climate commitments

The 2023 Uzbekistan 2030 Strategy significantly strengthened national commitments under the Paris Agreement: the updated NDC set a commitment to reduce greenhouse gas emissions per unit of GDP by 35% by 2030 compared to 2010 levels – more than three times the original 10% target [19] (Table 2).

Table 2. Uzbekistan’s Key Green Goals for 2030²

Indicator	Goal
Reduction of greenhouse gas intensity (compared to 2010)	Up to 35%
Renewable energy capacity	25 GW
Share of renewable energy (in generation)	Up to 40-54%
Improving energy efficiency (compared to 2018)	2 times
Expansion of forest areas	6.1 million hectares

At the same time, the analysis identified areas for further development in the investment climate: significant state participation, the capital market’s current stage of development, and opportunities to expand environmental information availability were noted as factors influencing foreign investment inflows [20]. According to OECD estimates, the country requires at least \$6 billion in green investment annually, highlighting the need for additional financing sources to complement domestic government resources [21].

Results of Financing Through the Debt Mechanism. In July 2021, Uzbekistan became one of the first countries in Central Asia to place a sovereign SDG bond on the London Stock Exchange (\$235 million, a national currency tranche, 14% coupon, 3-year term) [22]. In October 2023, the country was the first in the CIS to place sovereign green Eurobonds worth 4.25 trillion soums (16.25% rate, attracting interest from more than 30 international investors) [23]. In October 2024, with the support of GGGI, Agrobank issued its first corporate green Eurobond for \$455 million, with 80% of the funds allocated to climate-smart agriculture [24]. The total result for 2021–2024 is a cumulative sovereign international issuance of \$1.2 billion (Table 3).

Table 3. Uzbekistan Green and SDG Bonds (2021–2024)³

Year	Issuer / type	Volume	Main feature
2021	Sovereign SDG bond	\$235 million (tranche in national currency)	Among the first in the region; 14% coupon; 7 directions
2023	Sovereign green Eurobond	4.25 trillion UZS	First in the CIS; 16.25% rate
2024	“Agrobank” Green Eurobond	equal to ~455 million dollars	Corporate; 80% allocated to climate-smart agriculture
2021–2024	Total (SDG + green)	~1.2 billion US dollars	Cumulative sovereign emission

Results of Foreign Direct Investment. Masdar (UAE) and ACWA Power (Saudi Arabia) were identified as

1 Source: Compiled by the author based on the Green Economy Transition Strategy [3], Uzbekistan’s Third Nationally Determined Contribution (NDC 3.0) [19], and OECD reports [21].

2 Source: Compiled by the author based on Uzbekistan’s Third Nationally Determined Contribution (NDC 3.0) [19], the Green Economy Transition Strategy [3], and OECD reports [21].

3 Source: Compiled by the author based on UNDP reports [22, 23] and the Global Green Growth Institute (GGGI) report [24].

the leading foreign investors in the field of renewable energy. Masdar manages more than 2,000 megawatts of capacity, with investments exceeding \$2 billion since 2019 [25]; the company's first utility-scale solar-and-battery projects in the country mark a further stage in this expansion [26]. ACWA Power's Kungrad project (1.5 gigawatts) and Sazagan project (1 gigawatt of solar + 1,336 MWh of battery storage) are among the largest projects in the region [27] (Table 4).

Table 4. Major Renewable Energy Investment Projects in Uzbekistan⁴

Project	Investor	Power	Status
Navoi (sun)	Masdar (UAE)	100 MW	Active
Zarafshan (wind)	Masdar (UAE)	500 MW	Started in December 2024
Bukhara (solar+battery)	Masdar (UAE)	250 MW	Started in 2025
Guzar (solar+battery)	Masdar (UAE)	300 MW	Construction has begun (2025), and commissioning is scheduled for 2027.
Kungrad 1, 2, 3 (wind)	ACWA Power, Saudi	1500 MW	Construction in progress
Sazagan (solar+battery)	ACWA Power, Saudi	1000 MW	Financed (2025)

The EBRD alone has invested nearly \$6.8 billion in 204 projects (the highest figure in Central Asia) and has funded nearly 7 gigawatts of capacity since 2018 [28]. Summary result: According to IRENA, solar energy capacity increased nearly fivefold—from 475 megawatts at the end of 2023 to 2,275 megawatts by the end of 2024 [29]; in 2025, solar and wind energy accounted for more than 10% of electricity generation (doubling compared to the previous year).

The results obtained reveal a complementary dynamic between the two funding channels. Although financing through the debt market (paragraph 4.2) is more modest in scale compared with FDI flows (paragraph 4.3) (the EBRD's \$6.8 billion portfolio alone against a cumulative \$1.2 billion), it is of particular importance: bonds allow for direct financing of the state budget and social programs (education, healthcare, water management), while FDI is primarily directed toward large-scale energy infrastructure projects.

The second observation is the complexity of financial instruments over time. The transition from a small national currency SDG tranche in 2021 to a fully sovereign Eurobond in 2023 and a corporate issue in 2024 was accompanied by an expansion of the international investor base (more than 30 investors in 2023). This can likely be explained by the country's rising sovereign credit rating and the level of institutional transparency, but a separate econometric analysis is required to confirm this relationship—this falls outside the scope of this article.

Thirdly, the results show a trend toward transitioning to energy storage (battery) technologies (Bukhara, Guzar, and Sazagan projects), which aligns with the global trend noted in OECD and IRENA reports and contributes to improving the balance and integration of renewable energy. At the same time, the results indicate that the investor base remains relatively concentrated: in practice, two companies ("Masdar" and "ACWA Power") and several multilateral banks account for a large portion of the FDI flow, highlighting the importance of investor diversification, which is closely associated with areas for further development in the investment environment (paragraph 4.1).

The results also demonstrate the practical significance of Uzbekistan's experience for other emerging economies: the phased development of the sovereign bond market (starting with a small pilot tranche) and a strategy for simultaneously attracting FDI through multilateral banks can be viewed as a replicable approach for countries seeking to optimize available public resources and possessing the will and ability to implement institutional reforms.

CONCLUSION AND SUGGESTIONS

The study systematically analyzed Uzbekistan's experience with green financing from 2021–2026 through two main channels: debt market instruments and foreign direct investment. The results show that the country has made significant progress both in quantitative terms (\$1.2 billion in bond issuance, a fivefold increase in solar power) and in qualitative terms (transition to energy-saving technologies, expansion of the investor base).

In future studies, it would be advisable to evaluate the extent to which these financing flows are being converted into measurable emissions reductions using econometric methods, as well as to conduct a more in-depth study of the structure and diversification of the investor base and the possibilities for expanding private (non-state) sector participation.

⁴ Source: Compiled by the author based on Masdar [25], Utilities Middle East [26], and The Times of Central Asia [27].

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