THE IMPACT OF RENEWABLE ENERGY DEVELOPMENT ON ECONOMIC GROWTH IN UZBEKISTAN: A STATISTICAL ANALYSIS FOR 2021–2025

Tukumbetov Shavkat
Tashkent State University of Economics
Tukumbetov Ogabek
Tashkent State University of Economics
https://doi.org/10.5281/zenodo.21946654

Abstract

This article assesses the contribution of renewable energy development to economic growth in Uzbekistan using updated statistics for 2021–2025. The analysis relies on existing data from the International Renewable Energy Agency, the National Statistics Committee of the Republic of Uzbekistan, the Ministry of Energy, the Presidential Press Service, the World Bank, and the European Bank for Reconstruction and Development. Index analysis, structural decomposition, annual growth rates, compound annual growth rates, and comparative dynamic analysis are applied. The results show that renewable power capacity increased from 2,056 MW in 2021 to 10,027 MW in 2025, or 4.88 times, while its share in total electricity capacity rose from 12.5 percent to 36.1 percent. During the same period, average annual real GDP growth was 7.0 percent, and electricity generation recorded a compound annual growth rate of 4.4 percent. More than 95 percent of new capacity came from solar and wind energy. The article develops proposals for strengthening the growth effects of renewable energy through the development of grid infrastructure, energy storage systems, market reforms, and open statistical data.

Keywords: renewable energy, economic growth, solar power, wind power, electricity, green investment, energy security, Uzbekistan.

Abstract

This article assesses the contribution of renewable energy development to economic growth in Uzbekistan using updated statistics for 2021–2025. The analysis relies on existing data from IRENA, the National Statistics Committee of Uzbekistan, the Ministry of Energy, the Presidential Press Service, the World Bank and the EBRD. Index analysis, structural decomposition, annual growth rates, compound annual growth rates and comparative dynamics are applied. Renewable power capacity increased from 2,056 MW in 2021 to 10,027 MW in 2025, while its share in total electricity capacity rose from 12.5% to 36.1%. Average real GDP growth was 7.0%, and total electricity generation grew at a compound annual rate of 4.4%. More than 95% of net renewable capacity additions came from solar and wind. The paper proposes measures related to grid expansion, storage, market reform and statistical transparency.

Keywords: renewable energy, economic growth, solar power, wind power, electricity, green investment, energy security, Uzbekistan.

1. Introduction

Energy infrastructure is one of the fundamental factors determining production capacity, capital efficiency, and labour productivity in economic growth. Interruptions in electricity supply reduce firms' production time, increase the costs of backup generators and fuel, and heighten the risks associated with new investment. Conversely, an adequate and stable electricity supply supports the expansion of industry, services, the digital economy, and

transport infrastructure. This issue is particularly relevant in Uzbekistan because population growth, urbanisation, and expanding industrial production are rapidly increasing demand for electricity.

In recent years, the priority of the country's energy policy has been to reduce its high dependence on natural gas and make extensive use of solar and wind resources. According to IRENA's updated 2026 statistical database, renewable electricity capacity in Uzbekistan increased from 2,056 MW in 2021 to 10,027 MW in 2025, while the share of renewable sources in total electricity capacity rose from 12.5 percent to 36.1 percent. This change indicates that a system that had previously relied almost entirely on hydropower is being diversified through solar and wind capacity.[1]

According to national statistics, real GDP growth in 2021–2025 amounted to 8.2, 6.1, 6.3, 6.7, and 7.7 percent, respectively. GDP at current prices increased from UZS 861.2 trillion to UZS 1,849.7 trillion. At the same time, electricity generation rose from 71.4 billion kWh to approximately 84.8 billion kWh. These parallel trends warrant an examination of the relationship between renewable energy and economic growth; however, the simultaneous increase in both indicators does not in itself prove a causal effect.[2]

The main study period was defined as 2021–2025. This choice is explained by the fact that it fully covers the most recent five-year period requested by the user and corresponds to the stage during which large solar and wind power plants were actively commissioned in Uzbekistan. Statistical data were obtained from the following sources: IRENA Renewable Capacity Statistics 2026; the SIAT database of the National Statistics Committee of the Republic of Uzbekistan and its press releases on the results of 2025; materials of the Ministry of Energy and the Presidential Press Service; and project and analytical documents of the World Bank and the EBRD.

Five main indicators were used in the analysis: (1) installed renewable electricity capacity, MW; (2) hydropower, solar, and wind capacity by technology, MW; (3) the share of renewable sources in total electricity capacity, percent; (4) electricity generation, billion kWh; and (5) the real GDP growth rate and GDP at current prices.

The annual growth rate was calculated using the formula $g_t = (X_t / X_{t-1} - 1) \times 100$, while the compound annual growth rate was calculated using CAGR = $(X_n / X_0)^{(1/k)} - 1$. The structural analysis determined the share of solar and wind capacity in total renewable capacity, as well as the contribution of each technology to net capacity additions in 2021–2025. The cumulative real GDP index was constructed by successively multiplying the annual real growth rates.

An important methodological limitation is that five annual observations are insufficient for the reliable application of regression, ARDL, VAR, or Granger causality tests. In addition, renewable capacity, GDP, and electricity generation share a common time trend. Therefore, even a high simple correlation may be spurious. This article does not estimate a causal econometric coefficient; the results are interpreted on the basis of descriptive statistical evidence and transmission mechanisms confirmed in the contemporary academic literature.

[1] International Renewable Energy Agency (IRENA). Renewable Capacity Statistics 2026. Abu Dhabi: IRENA, 2026. Installed renewable capacity in Uzbekistan in 2021–2025 and its share in total capacity.
[2] International Renewable Energy Agency (IRENA). Renewable Capacity Statistics 2026. Abu Dhabi: IRENA, 2026. Installed renewable capacity in Uzbekistan in 2021–2025 and its share in total capacity.

4. Results

Key Macroeconomic and Energy Indicators

Table 1. Key Economic and Energy Indicators of Uzbekistan, 2021–2025

Year	Real GDP growth, %	GDP, UZS trillion	Electricity generation, billion kWh	Renewable energy capacity, MW	Renewable energy share, %	Solar, MW	Wind, MW
2021	8.2	861.2	71.4	2,056	12.5	4	0
2022	6.1	1,041.9	74.3	2,429	13.8	204	0
2023	6.3	1,261.8	77.7	3,250	17.2	867	1
2024	6.7	1,535.4	81.6	6,079	27.5	3,188	500
2025	7.7	1,849.7	84.8	10,027	36.1	5,934	1,652

Note: Electricity generation figures for 2021–2022 were taken from the SIAT annual series, while the values for 2023–2025 were obtained from a subsequently revised press release of the National Statistics Committee. GDP and some energy indicators for 2025 are preliminary. Source: Author's calculations based on data from IRENA and the National Statistics Committee of the Republic of Uzbekistan.

As Table 1 shows, renewable energy capacity grew much faster than the economy and total electricity generation. Between 2021 and 2025, renewable energy capacity increased by 7,971 MW, rising 4.88 times. The CAGR for this period was 48.6 percent. Total electricity generation increased by 18.8 percent, with a CAGR of 4.4 percent. Compared with the 2021 level, real GDP in 2025 was approximately 29.6 percent higher; using 2020 as the initial base, cumulative real growth over 2021–2025 amounted to 40.2 percent.

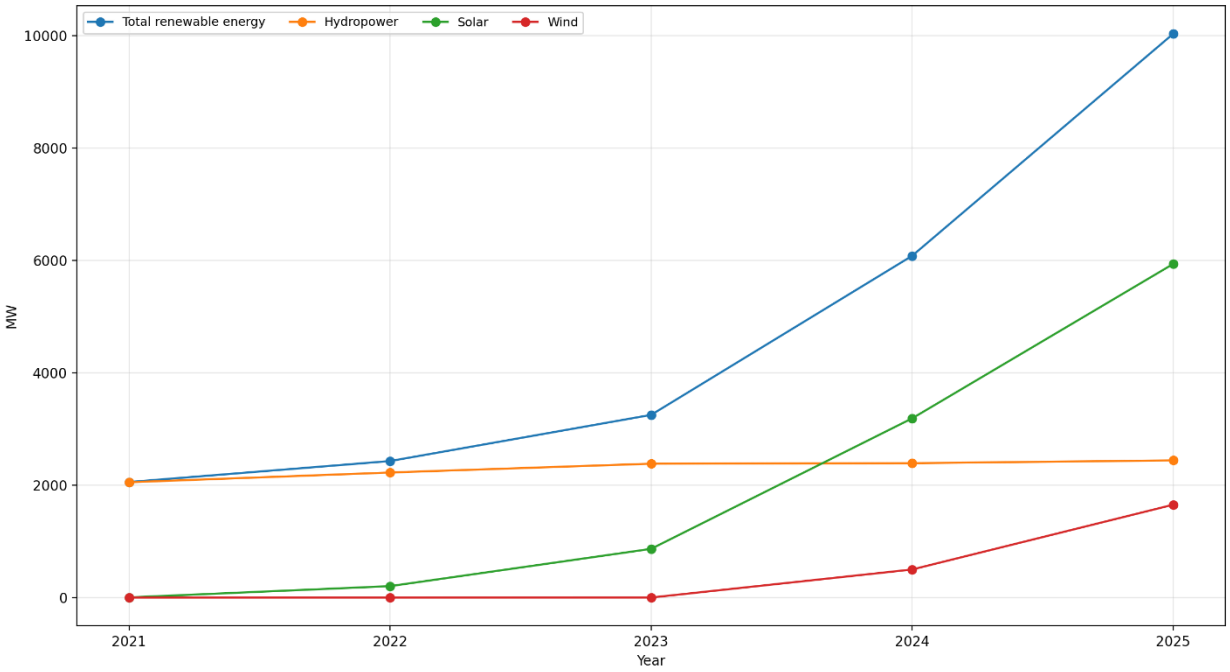

Figure 1. Dynamics of Renewable Energy Capacity by Technology, MW

Figure 1 clearly illustrates the structural nature of the energy transition. Whereas hydropower accounted for 99.8 percent of renewable capacity in 2021, its share had fallen to 24.3 percent by 2025. This does not mean that hydropower capacity declined; rather, solar and wind capacity expanded more rapidly. Of the 7,971 MW in net additions during 2021–2025,

solar accounted for 5,930 MW, or 74.4 percent; wind for 1,652 MW, or 20.7 percent; and hydropower for 389 MW, or 4.9 percent. Thus, 95.1 percent of new capacity growth was associated with solar and wind technologies.

Growth Rates and Structural Shifts

Table 2. Dynamic and Structural Calculations

Year	Annual growth of renewable energy capacity, %	Annual growth of electricity generation, %	Real GDP growth, %	Share of solar and wind in renewable energy capacity, %
2021	—	—	8.2	0.2
2022	18.1	4.1	6.1	8.4
2023	33.8	4.6	6.3	26.7
2024	87.0	5.0	6.7	60.7
2025	64.9	4.0	7.7	75.7

Source: Author's calculations based on the data in Table 1.

The years 2024 and 2025 represented a turning point in the energy transition. Renewable energy capacity grew by 87.0 percent in 2024 and by 64.9 percent in 2025. It is natural that the effect of new capacity on electricity generation is not immediately reflected in full: the month in which a plant is commissioned, grid connection, technical testing, the seasonality of solar and wind resources, and storage capacity all determine actual generation. Consequently, there is a time lag between capacity growth and generation growth.

In the national statistical series, annual electricity generation growth ranged from 4.0 to 5.0 percent in 2022–2025. This was lower than real GDP growth of 6.1–7.7 percent. The difference may be explained by improvements in energy efficiency, the share of services in the economic structure, distribution losses, import-export flows, and latent demand. At the same time, a steady increase in the volume of electricity supply is a necessary infrastructural condition for a rapidly growing economy.

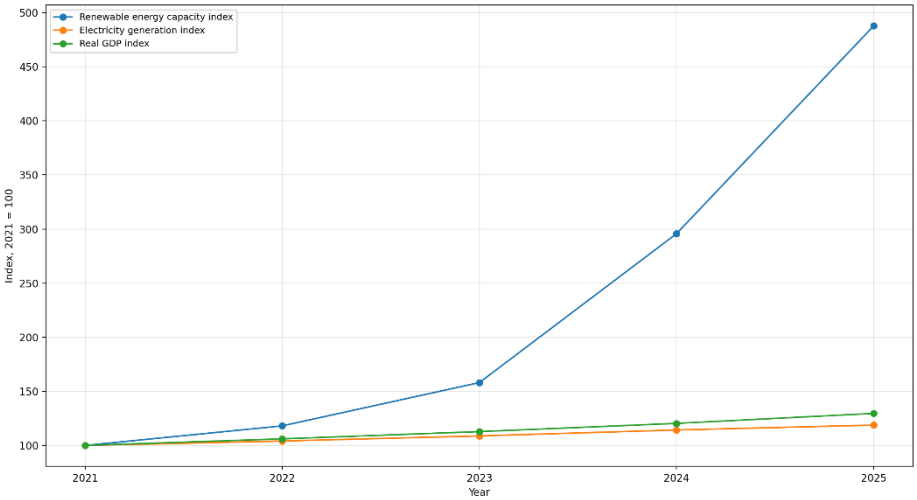

Figure 2. Indices of Renewable Energy Capacity, Electricity Generation, and Real GDP (2021=100)

According to Figure 2, in 2025 the renewable energy capacity index reached 487.7, the electricity generation index 118.8, and the real GDP index 129.6. The very rapid growth of

renewable capacity suggests that its impact on the economy may become even more pronounced in the coming years. However, this outlook depends directly on grid integration, storage, demand management, market tariffs, and technical losses.

Channels of Impact on Economic Growth

The first channel is capital investment and foreign direct investment. According to official information from December 2024, nearly USD 20 billion in foreign direct investment was attracted to Uzbekistan's energy sector over five years, and 24 independent power producers began operating. This amount covers the entire energy sector rather than renewable energy alone and therefore cannot be interpreted entirely as an effect of renewable energy. Nevertheless, the implementation of major solar and wind projects through public-private partnerships, which reduce the direct capital burden on the state budget, demonstrates the effect of mobilising private capital.3

The second channel is the reliability of electricity supply and continuity of production. The World Bank's iCRAFT document on Uzbekistan states that total electricity grid losses in 2021 were approximately equal to 20 percent of net generation, while natural gas accounted for up to 83 percent of primary energy consumption and more than 80 percent of the electricity mix. Under these conditions, diversification of energy sources reduces seasonal pressure on the gas supply. However, to increase the economic benefits of renewable capacity, the grid, transformers, high-voltage lines, and dispatch systems must be modernised in parallel.4

The third channel is natural gas savings and lower opportunity costs. According to official data as of 29 October 2025, 12 solar and 5 wind power plants had generated 9.1 billion kWh of electricity since the beginning of the year, saving 2.7 billion cubic metres of natural gas and preventing 4 million tonnes of harmful emissions; green electricity generation of 11.5 billion kWh was forecast for the full year. The gas saved creates a resource for producing higher-value-added products in domestic industry, meeting winter demand, or increasing export opportunities. To assess this benefit accurately, the alternative value of the saved gas, transport costs, and export contracts should be calculated separately.5

The fourth channel is domestic industrial cooperation. Official information from December 2025 stated that local enterprises supplied USD 700 million worth of construction materials, metal structures, cables, electrical equipment, design, and engineering services for new power plants and grids. This result indicates that renewable energy investment can create demand for domestic metallurgy, electrical engineering, construction, and professional services rather than being spent solely on imported equipment. The economic benefits of localisation must be balanced with the principles of quality and competition; excessive protectionism may raise project costs.6

Uzbekistan's experience in 2021–2025 confirms several regularities identified in the contemporary literature. First, renewable energy need not be a compulsory cost that constrains

[3] Press Service of the President of the Republic of Uzbekistan. New Capacities and Projects in the Energy Sector. 13 December 2024. The official information concerns nearly USD 20 billion attracted to the energy sector over five years and 24 independent producers.

[4] World Bank. Innovative Climate and Carbon Finance for Energy Reform (iCRAFT): Project Appraisal Document. Washington, DC, 2023. Assessments of Uzbekistan's energy balance, dependence on gas, and grid losses.

[5] National Committee of the Republic of Uzbekistan on Ecology and Climate Change. Uzbekistan Takes Decisive Steps Toward Green Energy. 29 October 2025.

[6] Press Service of the President of the Republic of Uzbekistan. Major Capacities Commissioned and a Range of New Energy Projects Launched. 5 December 2025. Official information on the value of domestic supplies and services in 2025.

economic growth; it can be a sector that supports growth through investment, technology, and infrastructure. Second, the economic result arises not from installed capacity alone but from its effective integration into the grid, actual generation, and connection to production chains. Third, the institutional environment, tariffs, and financial stability are as important as technological potential.

The World Bank's 2023 Country Climate and Development Report estimated that, without adequate action against climate change, Uzbekistan's economy could be 10 percent smaller in 2050 than under a scenario without climate-related damage. From this perspective, renewable energy is not only a means of meeting current electricity demand but also part of a strategy to reduce long-term growth losses. However, renewable energy is not free from climate risks: hydrological variability affects hydropower generation, high temperatures reduce photovoltaic panel efficiency, and dust and water scarcity increase maintenance costs.7

In 2024, the EBRD arranged up to USD 229.4 million to finance a 200 MW solar power plant and a 500 MWh energy storage system in the Tashkent Region. This project demonstrates the economic importance of storage for aligning variable solar generation with peak demand. By 2025, the EBRD reported that it had financed more than 3 GW of renewable generation capacity in Uzbekistan and that the new Law on Electric Power adopted in 2024 had strengthened the sector's regulatory environment.8

Three cautions should be observed when interpreting the study results. First, the more than twofold increase in nominal GDP also reflects inflation and price changes; therefore, real growth rates were used as the main measure of economic dynamics. Second, commissioned capacity and the electricity generated over a year are not the same concept. Third, while energy investment affects economic growth, rapid economic growth itself also increases electricity demand and energy investment. Thus, two-way causality may be present.

6. Conclusion and Practical Recommendations

The analysis shows that renewable energy development in Uzbekistan entered a new stage in 2021–2025. Over five years, renewable electricity capacity increased from 2,056 MW to 10,027 MW, rising 4.88 times. The share of renewable energy in total electricity capacity increased from 12.5 percent to 36.1 percent. Solar accounted for 74.4 percent of net capacity additions, wind for 20.7 percent, and hydropower for 4.9 percent. During the same period, electricity generation increased by 18.8 percent, while real GDP was approximately 29.6 percent higher than in 2021.

The results indicate that renewable energy supports economic growth through investment, reliable electricity supply, gas savings, domestic cooperation, and the carbon competitiveness of exports. However, a five-year annual series is insufficient for an econometric estimate of the magnitude of the causal effect. Therefore, the term "impact" in this article refers not merely to parallel statistical growth but to evidence-based economic transmission channels.

[7] World Bank. Uzbekistan Country Climate and Development Report. Washington, DC: World Bank, 2023.

[8] European Bank for Reconstruction and Development (EBRD). Transforming Economic Governance in Uzbekistan's Energy Sector. 2025.

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