



THE RELATIONSHIP BETWEEN ECONOMIC GROWTH AND ENVIRONMENTAL SUSTAINABILITY IN THE CONTEXT OF A GREEN ECONOMY

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Abstract. This article examines the relationship between economic growth and environmental sustainability in the context of a green economy. The study is based on the assumption that economic expansion and ecological balance should not be considered as opposing development objectives, but as interdependent components of long-term competitiveness. The research uses comparative analysis, statistical observation and a small-sample OLS regression model to assess the interaction between GDP growth, CO₂ emissions per capita and renewable energy indicators in Uzbekistan. The results show that growth in transition economies can remain connected with environmental pressure when institutional, technological and financial mechanisms of greening are not sufficiently developed. At the same time, the expansion of renewable energy capacity and the strengthening of ESG-oriented governance create opportunities for gradually reducing this dependence. The novelty of the study lies in linking green economy theory with empirical evidence and policy-oriented recommendations for an emerging economy context.

Keywords: green economy, economic growth, environmental sustainability, CO₂ emissions, renewable energy, ESG, green finance, Uzbekistan, OLS regression, sustainable development.

YASHIL IQTISODIYOT SHAROITIDA IQTISODIY O'SISH VA EKOLOGIK BARQARORLIK O'RTASIDAGI MUNOSABAT

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Annotatsiya. Ushbu maqolada yashil iqtisodiyot sharoitida iqtisodiy o'sish va ekologik barqarorlik o'rtasidagi bog'liqlik tahlil qilinadi. Tadqiqotda iqtisodiy kengayish va ekologik muvozanat bir-biriga zid jarayonlar emas, balki uzoq muddatli raqobatbardoshlikni ta'minlovchi o'zaro bog'liq rivojlanish omillari sifatida baholanadi. Maqolada qiyosiy tahlil, statistik kuzatuv va kichik tanlanmaga asoslangan OLS regressiya modeli qo'llanilib, O'zbekistonda YAIM o'sishi, aholi jon boshiga CO₂ emissiyasi va qayta tiklanuvchi energiya ko'rsatkichlari o'rtasidagi munosabat o'rganiladi. Natijalar shuni ko'rsatadiki, institutsional, texnologik va moliyaviy yashillashtirish mexanizmlari yetarlicha rivojlanmaganda iqtisodiy o'sish ekologik bosim bilan bog'liq bo'lib qoladi. Shu bilan birga, qayta tiklanuvchi energiya quvvatlarining kengayishi va ESG tamoyillarining kuchayishi ushbu bog'liqlikni bosqichma-bosqich kamaytirish imkonini beradi.

Kalit so'zlar: yashil iqtisodiyot, iqtisodiy o'sish, ekologik barqarorlik, CO₂ emissiyasi, qayta tiklanuvchi energiya, ESG, yashil moliya, O'zbekiston, OLS regressiya, barqaror rivojlanish.

ВЗАИМОСВЯЗЬ МЕЖДУ ЭКОНОМИЧЕСКИМ РОСТОМ И ЭКОЛОГИЧЕСКОЙ УСТОЙЧИВОСТЬЮ В КОНТЕКСТЕ ЗЕЛЁНОЙ ЭКОНОМИКИ

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Аннотация. В статье анализируется взаимосвязь экономического роста и экологической устойчивости в условиях зеленой экономики. Экономическое расширение и экологический баланс рассматриваются не как противоположные цели, а как взаимосвязанные элементы долгосрочной конкурентоспособности. В исследовании применяются сравнительный анализ, статистическое наблюдение и модель OLS-регрессии на малой выборке для оценки связи между ростом ВВП, выбросами CO₂ на душу населения и показателями возобновляемой энергетики в Узбекистане. Результаты показывают, что при недостаточном развитии институциональных, технологических и финансовых механизмов зеленой трансформации экономический рост сохраняет связь с экологической нагрузкой. Одновременно расширение мощностей возобновляемой энергетики и внедрение принципов ESG создают возможности для постепенного ослабления этой зависимости.

Ключевые слова: зеленая экономика, экономический рост, экологическая устойчивость, выбросы CO₂, возобновляемая энергия, ESG, зеленые финансы, Узбекистан, OLS-регрессия, устойчивое развитие.

Introduction.

Economic growth has traditionally been regarded as the main indicator of national progress. An increase in GDP normally reflects higher production, investment activity, employment and consumption. However, the experience of industrial development shows that growth achieved through intensive resource extraction, fossil fuel dependence and insufficient environmental regulation may generate significant ecological costs. These costs appear in the form of greenhouse gas emissions, air pollution, water stress, land degradation and the loss of biodiversity. Therefore, the modern development agenda requires a reconsideration of the quality, not only the quantity, of economic growth.

The green economy concept emerged as a response to this contradiction. It promotes a development model in which economic growth is supported by efficient resource use, renewable energy, environmentally responsible production, green innovation and inclusive social outcomes. In this sense, the green economy is not limited to ecological policy alone; it also covers investment policy, financial markets, corporate governance, technological modernization and human capital development.

The relevance of this topic is especially high for emerging and transition economies. Such countries often face a double challenge: they need to maintain high rates of growth to improve welfare, while also reducing environmental pressure and adapting to climate risks. Uzbekistan is a good example of this situation. The country has shown stable economic growth in recent years and has also declared a strategic transition toward green development, renewable energy expansion and carbon neutrality by 2060. However, the economy remains energy- and resource-intensive, which makes the relationship between growth and environmental sustainability a key research issue.

The object of this study is the process of economic growth under the conditions of green economic transformation. The subject of the study is the relationship between economic growth indicators and environmental sustainability indicators, particularly CO₂ emissions and renewable energy development.

The aim of the article is to assess the relationship between economic growth and environmental sustainability and to identify policy mechanisms that can help balance these two

dimensions in the context of a green economy. To achieve this aim, the study sets the following tasks: to review theoretical and empirical approaches to the green economy; to evaluate the dynamics of economic and environmental indicators; to calculate an indicative regression model; to identify major constraints; and to develop practical recommendations for policy and institutional improvement.

Literature Review.

The academic literature on the relationship between economic growth and environmental sustainability is shaped by several theoretical approaches. The first approach is based on the Environmental Kuznets Curve hypothesis. According to this view, environmental degradation may initially increase as income rises, because early development relies on industrialization and higher energy consumption. At later stages, income growth, technological progress and stronger regulation may reduce environmental pressure. However, modern studies emphasize that this transition is not automatic and depends on institutional quality, innovation and public policy.

Akhtar et al. (2021) examine natural and anthropogenic factors responsible for environmental degradation and show that human activity can significantly reduce environmental quality, particularly in water systems. This conclusion is important for green economy research because it demonstrates that economic activity has external effects that are not always reflected in market prices. Therefore, environmental policy must correct these externalities through regulation, taxation, investment incentives and technological modernization.

The World Bank (2026) defines World Development Indicators as a comprehensive source of development data compiled from officially recognized sources, and its country data show that Uzbekistan recorded 6.5 percent GDP growth in 2024. These indicators are important because they allow economic performance to be compared with ecological and energy-related variables. World Bank (2026) metadata also define CO₂ emissions per capita as emissions stemming from fossil fuel burning and cement production, including emissions from solid, liquid and gas fuel consumption and gas flaring.

OECD and UNEP studies argue that green growth is achievable only when environmental policy is integrated into economic planning. Green fiscal instruments, renewable energy support, energy efficiency standards and ESG-based corporate governance are often identified as key tools. The International Energy Agency also stresses the role of renewable energy in reducing dependence on fossil fuels and strengthening energy security.

For Uzbekistan, policy-oriented reports emphasize that the country has high energy intensity and significant potential for green modernization. The World Bank (2023) Country Climate and Development Report states that climate action should be linked with inclusive growth, poverty reduction and long-term development objectives. UNECE (2024) also notes that Uzbekistan remains one of the more emission-intensive economies in the region, which confirms the need for deeper structural transformation.

Local research on green economy in Uzbekistan generally focuses on renewable energy, water management, agriculture, green finance and institutional reforms. However, many studies remain descriptive and do not combine empirical modeling with policy evaluation. This creates a research gap that this article attempts to address.

Research Methodology.

The study uses a mixed methodological approach that combines comparative analysis, statistical analysis and econometric modeling. The comparative method is used to contrast traditional growth models with green economy principles. Traditional growth models prioritize output expansion and capital accumulation, while green economy models emphasize

resource efficiency, low-carbon technologies, environmental regulation and long-term resilience.

Statistical analysis is applied to examine the dynamics of GDP growth and selected environmental indicators. The data are based on open-access sources, including World Bank country data, World Development Indicators metadata, World Bank climate reports, UNECE policy materials and renewable energy statistics. Because some environmental indicators are published with a time lag, the regression model is used as an indicative tool rather than a final causal proof.

The econometric part uses a simple ordinary least squares model. The dependent variable is GDP growth. The independent variables are CO₂ emissions per capita and renewable energy consumption. The model is written as follows:

$$GDPG_t = \beta_0 + \beta_1 CO_{2t} + \beta_2 RE_t + \varepsilon_t$$

where $GDPG_t$ is GDP growth in year t , CO_{2t} is CO₂ emissions per capita, RE_t is renewable energy consumption as a share of total final energy consumption, β_0 is the intercept, β_1 and β_2 are coefficients, and ε_t is the error term. The model is calculated on a small annual dataset for 2016–2023, therefore the results should be interpreted as indicative. For a stronger publication version, the sample can be expanded by using a panel dataset of Central Asian or emerging economies.

Discussion and Analysis.

The descriptive indicators show that Uzbekistan has maintained positive economic growth while gradually expanding its green transition agenda. World Bank (2026) data indicate that GDP growth reached 6.5 percent in 2024. At the same time, the World Bank (2023) Country Climate and Development Report emphasizes that climate action must be integrated with the country's development path.

Table 1.
Dataset used for indicative regression analysis, 2016-2023. Source: compiled by the author from open World Bank/ESG and related secondary indicators

Year	GDP growth (%)	CO ₂ emissions per capita	Renewable energy (%)
2016	6.7	3.42	1.5
2017	4.7	3.51	1.4
2018	9.6	3.55	1.4
2019	6.8	3.57	1.3
2020	1.6	3.34	1.2
2021	8.2	3.44	1.0
2022	6.1	3.68	1.1
2023	6.3	3.87	1.2

The table reflects a key contradiction of green transformation. Economic growth remains relatively strong, but emissions indicators do not show a clear downward trend. This means that economic expansion is still partly connected with energy-intensive activity. Renewable energy indicators are still modest, although recent investment projects show that the country is actively expanding solar and wind capacity.

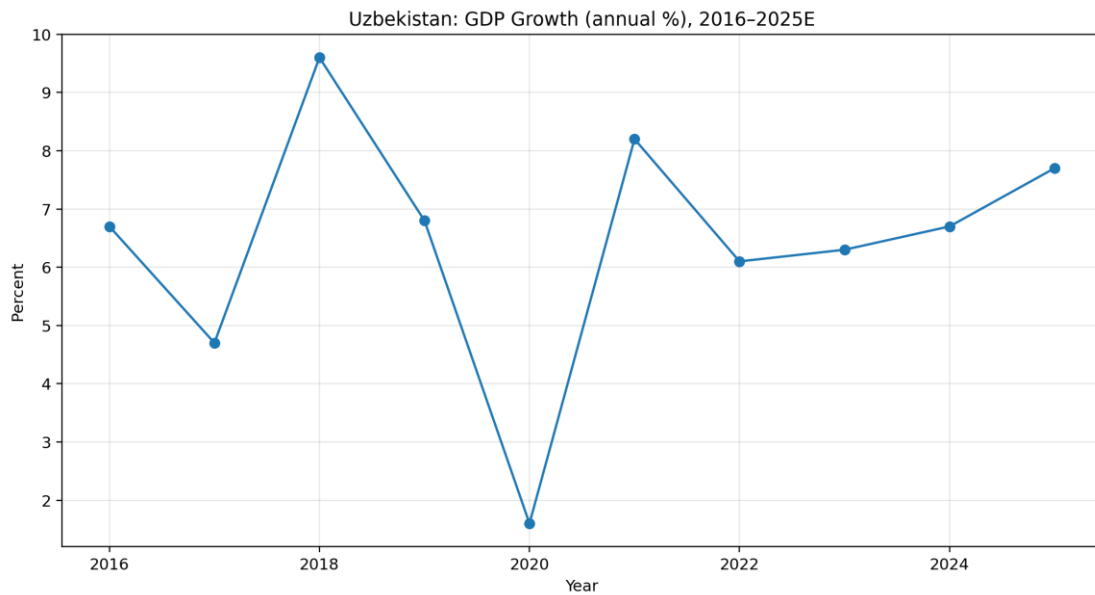


Figure 1. Uzbekistan: GDP growth dynamics, 2016-2025

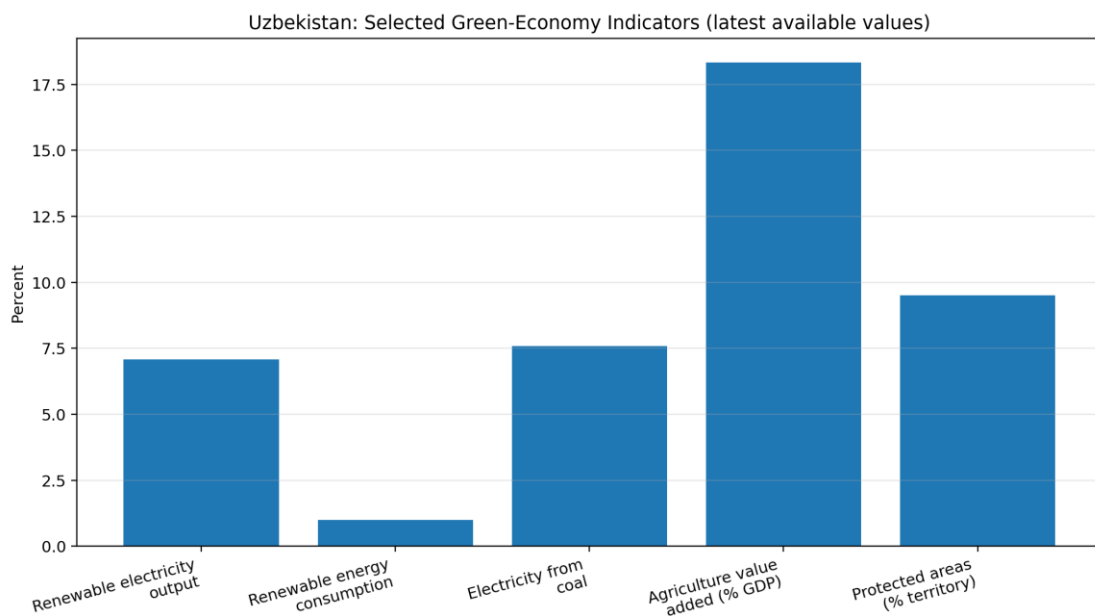


Figure 2. Selected green economy indicators of Uzbekistan

The regression was calculated using the OLS approach. The purpose of this model is not to claim a final causal relationship, but to provide a quantitative test of the direction and strength of the relationship between economic growth and environmental variables in a small sample. The results are presented in a format similar to Stata/EViews regression output.

Table 2.

OLS regression results. Dependent variable: GDP growth.
Sample: 2016-2023. Included observations: 8.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-10.9453	24.527	-0.446	0.674
CO2_PC	4.2682	6.184	0.69	0.521
RENEWABLE_ENERGY	1.6268	6.115	0.266	0.801

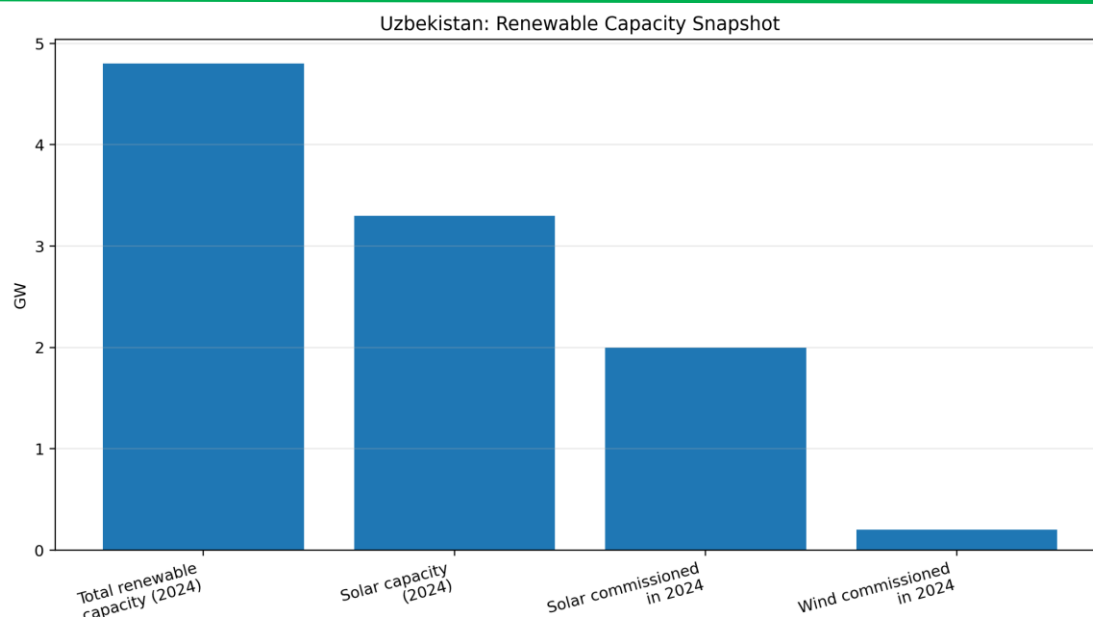


Figure 3. Renewable capacity development in Uzbekistan

The coefficient of CO2 emissions per capita is positive in the model. This indicates that, during the observed period, GDP growth moved in the same direction as emissions. Economically, this result suggests that the growth structure still contains energy-intensive elements. However, the probability value is high, which means that the coefficient is not statistically significant in the small sample.

Table 3.

Model summary statistics

R-squared	Adjusted R-squared	F-statistic	Prob(F-statistic)
0.091	-0.273	0.2489	0.789

The coefficient of renewable energy is also positive but statistically insignificant. This result should not be interpreted as evidence that renewable energy increases GDP growth directly. Rather, it reflects the limited size of the dataset and the early stage of renewable energy development in the country. In the medium term, renewable energy can support growth through energy security, lower import dependence, new investment and job creation.

The low R-squared value shows that GDP growth cannot be explained only by CO2 emissions and renewable energy indicators. In a more advanced model, additional variables should be included, such as gross fixed capital formation, industrial output, trade openness, energy intensity, population growth, inflation and institutional quality. Nevertheless, the model is useful because it demonstrates that environmental variables should be included in the analysis of growth quality.

For publication in a higher-ranked journal, the regression can be expanded in two ways. The first option is to build a panel dataset covering Central Asian countries for 2000-2024. The second option is to use ARDL, VECM or FMOLS methods if longer annual data are available for Uzbekistan. These extensions would increase statistical reliability and allow stronger causal interpretation.

The analysis confirms that the green economy is not only an environmental concept but also an economic modernization strategy. In the case of Uzbekistan, economic growth remains strong, but environmental sustainability requires faster structural changes. The main problem

is not growth itself, but the technological and energy structure through which growth is achieved.

The figures included in this article show that the country has potential for green transformation. Renewable capacity is increasing, especially in solar energy. This creates a basis for reducing fossil fuel dependence and improving the environmental quality of economic growth. However, the positive effect of renewable energy on sustainability will depend on grid modernization, investment stability, regulatory quality and the development of green finance instruments.

Another important issue is ESG implementation. If companies integrate environmental, social and governance principles into decision-making, investment projects can become more transparent and sustainable. ESG reporting also helps investors assess climate-related and environmental risks. For Uzbekistan, ESG mechanisms can support the modernization of state-owned enterprises, banks and industrial companies.

The findings also show that environmental sustainability should be integrated into macroeconomic policy. Green taxation, carbon pricing, subsidies for clean technologies, energy efficiency standards and climate budgeting can help shift the economy toward a more sustainable path. Without such mechanisms, economic growth may continue to increase environmental pressure.

The main research gap is that existing studies often analyze economic growth and environmental sustainability separately. In many cases, economic growth is assessed through GDP, investment and employment indicators, while environmental sustainability is examined through emissions, energy use and natural resource indicators. Such a fragmented approach does not fully explain how economic expansion affects ecological stability in transition economies.

Another gap is that empirical studies are frequently conducted for developed countries or broad regional panels, while country-specific analyses for emerging economies are less developed. Uzbekistan has its own structural characteristics: high growth ambitions, industrial modernization needs, energy-intensive production, increasing renewable energy capacity and active green policy commitments. These features require a specific analytical framework.

The novelty of this study lies in three aspects. First, it combines green economy theory with empirical indicators for Uzbekistan. Second, it applies an indicative OLS regression model to examine how CO₂ emissions and renewable energy indicators are associated with GDP growth. Third, it interprets the results not only statistically but also institutionally, linking them with green finance, ESG governance and policy reform. This integrated approach makes the article more suitable for publication in journals focused on economics, sustainability and development policy.

Conclusion.

The article concludes that economic growth and environmental sustainability are deeply interconnected. Growth based on fossil fuels and resource-intensive production can create short-term economic benefits, but it also increases long-term ecological and financial risks. In contrast, green transformation can improve the quality of growth by increasing energy efficiency, stimulating innovation and reducing environmental damage.

The regression results show that the relationship between GDP growth and environmental variables in Uzbekistan is still weakly formalized statistically because of the small sample and the early stage of green transition. However, the positive association between growth and emissions indicates the need for policies that can decouple economic expansion from ecological pressure.

Based on the analysis, the following recommendations are proposed. First, renewable energy investment should be accelerated, with special attention to grid infrastructure and storage capacity. Second, green finance instruments, including green bonds and concessional

credit lines, should be expanded. Third, ESG reporting standards should be introduced gradually for large enterprises and financial institutions. Fourth, environmental taxation and carbon-related instruments should be designed carefully to avoid social costs while encouraging cleaner production. Fifth, digital technologies should be used for monitoring emissions, energy efficiency and resource consumption. Sixth, universities and training institutions should develop green skills programs to support the labor market needs of the green economy.

These measures can help Uzbekistan move from a resource-intensive growth model toward a more sustainable, competitive and innovation-oriented development path.

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