

# “ECONOMETRIC ANALYSIS OF THE IMPACT OF ECOLOGICAL INVESTMENTS AND GREEN TECHNOLOGIES ON THE SUSTAINABLE DEVELOPMENT OF UZBEKISTAN”

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**Abstract.** This article analyzes the importance of ecological investments and green technologies in the process of ensuring sustainable development in Uzbekistan using econometric methods. The study examines the relationship between the volume of ecological investments, the share of renewable energy, and the level of implementation of green technologies with sustainable development indicators. Data from the State Committee of the Republic of Uzbekistan on Statistics, the World Bank, and the United Nations were used for the analysis. The results show that ecological investments and green technologies have a positive impact on sustainable development.

**Keywords.** Sustainable development, green economy, ecological investments, green technologies, econometric analysis, renewable energy, CO<sub>2</sub> emissions, energy efficiency, economic growth, regression model.

**Аннотация.** В данной статье с помощью эконометрических методов анализируется значение экологических инвестиций и зелёных технологий в обеспечении устойчивого развития Узбекистана. В исследовании изучается взаимосвязь между объёмом экологических инвестиций, долей возобновляемых источников энергии, уровнем внедрения зелёных технологий и показателями устойчивого развития. Для анализа использованы данные State Committee of the Republic of Uzbekistan on Statistics, World Bank и United Nations. Результаты показывают, что экологические инвестиции и зелёные технологии оказывают положительное влияние на устойчивое развитие.

**Ключевые слова.** Устойчивое развитие, зелёная экономика, экологические инвестиции, зелёные технологии, эконометрический анализ,

возобновляемая энергия, выбросы CO<sub>2</sub>, энергоэффективность, экономический рост, регрессионная модель.

**Introduction.** On a global scale, climate change, the disruption of ecological balance, and resource scarcity are making environmentally sustainable development one of the highest priorities for the global community. Especially for developing countries, the introduction of eco-friendly technologies is becoming a necessary condition not only for ensuring ecological security but also for strengthening economic stability. In the Republic of Uzbekistan, a number of strategic documents have been adopted in this direction, including the “Concept of Transition to a Green Economy,” the “Energy Efficiency Improvement Program,” and the “National Strategy for Adaptation to Climate Change”.

However, in practice, the level of implementation of green technologies and their impact on the real sector have not yet been fully manifested. The role they play in various sectors of Uzbekistan's economy, available resources, financial opportunities, social adaptation, and institutional barriers are covered extensively. Based on the analysis, the issue of "Econometric analysis of the impact of ecological investments and green technologies on the sustainable development of Uzbekistan" is discussed. In the introduction, the urgent problem—how to organize economic growth while reducing ecological footprints (carbon footprint)—is set as the main question, and answers are sought in the subsequent parts of the article. [1]

### **The Essence of the Topic**

- **Sustainable development** – is a process of simultaneously ensuring economic growth, social development, and ecological balance.
- **Green economy** – is implemented by organizing economic activity in an environmentally sustainable manner, through energy efficiency and the rational use of natural resources. [2]

### **Important Aspects for Uzbekistan:**

- The necessity of reducing ecological damage in industry, energy, and agriculture.

- Introduction of green technologies (Renewable energy, energy-efficient equipment).
- Increasing economic and ecological efficiency through ecological investments.

### **Analysis Objects and Indicators Sustainable development indicators (y-dependent)**

- **Sustainable Development Index (SDI)** – calculated based on global or national indicators.
- **CO<sub>2</sub> emissions (tons/half-year or year)** – a measure of ecological pressure.
- **Energy efficiency coefficient (GDP/energy consumption).**
- **Volume of industrial waste.**

### **Independent variables (x-independent)**

1. Volume of ecological investments (billion UZS or million USD).
2. Level of green technology implementation (%).
3. Share of renewable energy (%).
4. Industrial production volume and economic growth (GDP).
5. Indicators related to climate and natural resources. [3]

### **Econometric Model and Methodology**

#### **1. Goal of the Model**

- To determine the relationship between ecological and economic factors affecting sustainable economic growth.
- Through this, to create a scientific basis for the government to make effective policy decisions.

#### **2. Model Structure The proposed classical multi-factor regression model:**

$$\text{GDP} = \beta_0 + \beta_1 \cdot \text{CO}_2 + \beta_2 \cdot \text{QTE} + \beta_3 \cdot \text{INV} + \beta_4 \cdot \text{ISH} + \varepsilon$$

Where:

- **GDP** – real GDP growth rate in year \$t\$.
- **CO<sub>2</sub>** – volume of CO<sub>2</sub> emissions.
- **QTE** – share of renewable energy.
- **INV** – investments in the environment.

- **ISH** – unemployment rate.
- $\epsilon$  – random error. [4]

### **Methods of Econometric Analysis**

- **State Committee of the Republic of Uzbekistan on Statistics** – ecological and economic data.
- **Ministry of Energy of Uzbekistan** – renewable energy data.
- **World Bank and UN** – sustainable development indices and ecological investment statistics.

### **1. Simple Linear Regression**

The simplest model connects the sustainable development index (SDI) with ecological investment:

$$\text{SDI}_t = \beta_0 + \beta_1 \cdot \text{EcoInvest}_t + \epsilon_t$$

- **SDI<sub>t</sub>** – sustainable development index.
- **EcoInvest<sub>t</sub>** – volume of ecological investments.
- $\beta_0, \beta_1$  – parameters.
- $\epsilon_t$  – error.

### **2. Multivariate Regression When sustainable development depends on several factors:**

$$\text{SDI}_t = \beta_0 + \beta_1 \cdot \text{EcoInvest}_t + \beta_2 \cdot \text{GreenTech}_t + \beta_3 \cdot \text{RenewEnergy}_t + \epsilon_t$$

- **GreenTech<sub>t</sub>** – level of green technology implementation.
- **RenewEnergy<sub>t</sub>** – share of renewable energy.
- Using this model, it is possible to determine how much investment and technology affect sustainable development.

### **3. Panel Data Model If you want to analyze by regions (provinces):**

$$\text{SDI}_{i,t} = \alpha + \beta_1 \cdot \text{EcoInvest}_{i,t} + \beta_2 \cdot \text{GreenTech}_{i,t} + u_i + \epsilon_{i,t}$$

- **i** – region.
- **t** – time (year/quarter).
- **u<sub>i</sub>** – regional variability.

This model shows the impact across regions more accurately. [5]

### **Results and Analysis.**

Econometric analysis result:

- $\beta_1 > 0$  rightarrow- ecological investments increase the SDI.
- $\beta_2 > 0$  rightarrow- green technologies have a positive impact on sustainable development.
- Explained variance is evaluated using the model's  $R^2$  coefficient. [6]

### **Conclusion**

From the research, it can be concluded that green technologies are of strategic importance in the environmentally sustainable development of Uzbekistan's economy. These technologies not only ensure ecological security but also increase competitiveness in energy, industry, and agriculture. If current problems—insufficient financing, gaps in legislation, and technological shortages—are resolved, green technologies can become a new driver of Uzbekistan's economy.

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