



## IQTISODIYOT & TARAQQIYOT

*Ijtimoiy, iqtisodiy, texnologik, ilmiy, ommabop jurnal*

**No6**  
MAXSUS SON



## BAKALAVR TALABALARINIG MAQOLALARI TO'PLAMI



ISSN: 2992-8982

<https://yashil-iqtisodiyot-taraqqiyot.uz/>

**2025**



## IQTISODIYOT&TARAQQIYOT

*Ijtimoiy, iqtisodiy, texnologik, ilmiy, ommabop jurnal*

### Bosh muharrir:

**Sharipov Kongiratbay Avezimbetovich**

### Bosh muharrir o'rinbosari:

**Karimov Norboy G'aniyevich**

### Muharrir:

**Qurbonov Sherzod Ismatillayevich**

*Elektron nashr. 107 sahifa.*

*E'lon qilishga 2025-yil mayda ruxsat etildi.*

### Tahrir hay'ati:

**Salimov Oqil Umrzoqovich**, O'zbekiston Fanlar akademiyasi akademigi  
**Abduraxmanov Kalandar Xodjayevich**, O'zbekiston Fanlar akademiyasi akademigi  
**Sharipov Kongiratbay Avezimbetovich**, texnika fanlari doktori (DSc), professor  
**Rae Kvon Chung**, Janubiy Koreya, TDIU faxriy professori, "Nobel" mukofoti laureati  
**Osman Mesten**, Turkiya parlamenti a'zosi, Turkiya – O'zbekiston do'stlik jamiyati rahbari  
**Axmedov Durbek Kudratillayevich**, iqtisodiyot fanlari doktori (DSc), professor  
**Axmedov Sayfullo Normatovich**, iqtisodiyot fanlari doktori (DSc), professor  
**Abduraxmanova Gulnora Kalandarovna**, iqtisodiyot fanlari doktori (DSc), professor  
**Kalonov Muxiddin Baxritdinovich**, iqtisodiyot fanlari doktori (DSc), professor  
**Siddiqova Sadoqat G'afforovna**, pedagogika fanlari bo'yicha falsafa doktori (PhD)  
**Xudoyqulov Sadirdin Karimovich**, iqtisodiyot fanlari doktori (DSc), professor  
**Maxmudov Nosir**, iqtisodiyot fanlari doktori (DSc), professor  
**Yuldashev Mutallib Ibragimovich**, iqtisodiyot fanlari doktori (DSc), professor  
**Samadov Asqarjon Nishonovich**, iqtisodiyot fanlari nomzodi, professor  
**Slizovskiy Dimitriy Yegorovich**, texnika fanlari doktori (DSc), professor  
**Mustafakulov Sherzod Igamberdiyevich**, iqtisodiyot fanlari doktori (DSc), professor  
**Axmedov Ikrom Akramovich**, iqtisodiyot fanlari doktori (DSc), professor  
**Eshtayev Alisher Abdug'aniyevich**, iqtisodiyot fanlari doktori (DSc), professor  
**Xajiyev Baxtiyor Dushaboyevich**, iqtisodiyot fanlari doktori (DSc), professor  
**Hakimov Nazar Hakimovich**, falsafa fanlari doktori (DSc), professor  
**Musayeva Shoiraz Azimovna**, iqtisodiyot fanlari bo'yicha falsafa doktori (PhD), professor  
**Ali Konak (Ali Ko'nak)**, iqtisodiyot fanlari doktori (DSc), professor (Turkiya)  
**Cham Tat Huei**, falsafa fanlari doktori (PhD), professor (Malayziya)  
**Foziljonov Ibrohimjon Sotvoldix'o'ja o'g'li**, iqtisodiyot fanlari bo'yicha falsafa doktori (PhD), dots.  
**Utayev Uktam Choriyevich**, O'z.Respub. Bosh prokuraturasi boshqarma boshlig'i o'rinbosari  
**Ochilov Farkhod**, O'zbekiston Respublikasi Bosh prokuraturasi IJQKD boshlig'i  
**Buzrukxonov Sarvarxon Munavvarxonovich**, iqtisodiyot fanlari nomzodi, dotsent  
**Axmedov Javohir Jamolovich**, iqtisodiyot fanlari bo'yicha falsafa doktori (PhD)  
**Toxirov Jaloliddin Ochil o'g'li**, texnika fanlari bo'yicha falsafa doktori (PhD), katta o'qituvchi  
**Bobobekov Ergash Abdumalikovich**, iqtisodiyot fanlari bo'yicha falsafa doktori (PhD), v.b. dots.  
**Djudi Smetana**, pedagogika fanlari nomzodi, dotsent (AQSH)  
**Krissi Lyuis**, pedagogika fanlari nomzodi, dotsent (AQSH)  
**Glazova Marina Viktorovna**, iqtisodiyot fanlari nomzodi (Moskva)  
**Nosirova Nargiza Jamoliddin qizi**, iqtisodiyot fanlari bo'yicha falsafa doktori (PhD), dotsent  
**Sevil Piriyeva Karaman**, falsafa fanlari doktori (PhD) (Turkiya)  
**Mirzaliyev Sanjar Makhamatjon o'g'li**, TDIU ITI departamenti rahbari  
**Ochilov Bobur Baxtiyor o'g'li**, TDIU katta o'qituvchisi





## IQTISODIYOT & TARAQQIYOT

*Ijtimoiy, iqtisodiy, texnologik, ilmiy, ommabop jurnal*

### Editorial board:

**Salimov Okil Umrzokovich**, Academician of the Academy of Sciences of Uzbekistan  
**Abdurakhmanov Kalandar Khodjayevich**, Academician of the Academy of Sciences of Uzbekistan  
**Sharipov Kongirاتبay Avezimbetovich**, Doctor of Technical Sciences (DSc), Professor  
**Rae Kwon Chung**, South Korea, Honorary Professor at TSUE, Nobel Prize Laureate  
**Osman Mesten**, Member of the Turkish Parliament, Head of the Turkey–Uzbekistan Friendship Society  
**Akhmedov Durbek Kudratillayevich**, Doctor of Economic Sciences (DSc), Professor  
**Akhmedov Sayfullo Normatovich**, Doctor of Economic Sciences (DSc), Professor  
**Abdurakhmanova Gulnora Kalandarovna**, Doctor of Economic Sciences (DSc), Professor  
**Kalonov Mukhiddin Bakhridinovich**, Doctor of Economic Sciences (DSc), Professor  
**Siddikova Sadokat Gafforovna**, Doctor of Philosophy (PhD) in Pedagogical Sciences  
**Khudoykulov Sadirdin Karimovich**, Doctor of Economic Sciences (DSc), Professor  
**Makhmudov Nosir**, Doctor of Economic Sciences (DSc), Professor  
**Yuldashev Mutallib Ibragimovich**, Doctor of Economic Sciences (DSc), Professor  
**Samadov Askarjon Nishonovich**, Candidate of Economic Sciences, Professor  
**Slizovskiy Dmitriy Yegorovich**, Doctor of Technical Sciences (DSc), Professor  
**Mustafakulov Sherzod Igamberdiyevich**, Doctor of Economic Sciences (DSc), Professor  
**Akhmedov Ikrom Akramovich**, Doctor of Economic Sciences (DSc), Professor  
**Eshtayev Alisher Abduganiyevich**, Doctor of Economic Sciences (DSc), Professor  
**Khajiyev Bakhtiyor Dushaboyevich**, Doctor of Economic Sciences (DSc), Professor  
**Khakimov Nazar Khakimovich**, Doctor of Philosophy (DSc), Professor  
**Musayeva Shoira Azimovna**, Doctor of Philosophy (PhD) in Economic Sciences, Professor  
**Ali Konak**, Doctor of Economic Sciences (DSc), Professor (Turkey)  
**Cham Tat Huei**, Doctor of Philosophy (PhD), Professor (Malaysia)  
**Foziljonov Ibrokhimjon Sotvoldikhoja ugli**, Doctor of Philosophy (PhD) in Economic Sciences, Associate Professor  
**Utayev Uktam Choriyevich**, Deputy Head of Department, Prosecutor General's Office of Uzbekistan  
**Ochilov Farkhod**, Head of DCEC, Prosecutor General's Office of Uzbekistan  
**Buzrukkhonov Sarvarkhon Munavvarkhonovich**, Candidate of Economic Sciences, Associate Professor  
**Akhmedov Javokhir Jamolovich**, Doctor of Philosophy (PhD) in Economic Sciences  
**Tokhirov Jaloliddin Ochil ugli**, Doctor of Philosophy (PhD) in Technical Sciences, Senior Lecturer  
**Bobobekov Ergash Abdumalikovich**, Doctor of Philosophy (PhD) in Economic Sciences, Acting Associate Professor  
**Judi Smetana**, Candidate of Pedagogical Sciences, Associate Professor (USA)  
**Chrissy Lewis**, Candidate of Pedagogical Sciences, Associate Professor (USA)  
**Glazova Marina Viktorovna**, Candidate of Economic Sciences (Moscow)  
**Nosirova Nargiza Jamoliddin kizi**, Doctor of Philosophy (PhD) in Economic Sciences, Associate Professor  
**Sevil Piriyeva Karaman**, Doctor of Philosophy (PhD) (Turkey)  
**Mirzaliyev Sanjar Makhamatjon ugli**, Head of the Department of Scientific Research and Innovations, TSUE  
**Ochilov Bobur Bakhtiyor ugli**, Senior lecturer at TSUI

#### Ekspertlar kengashi:

**Berkinov Bazarbay**, iqtisodiyot fanlari doktori (DSc), professor  
**Po'latov Baxtiyor Alimovich**, texnika fanlari doktori (DSc), professor  
**Aliyev Bekdavlal Aliyevich**, falsafa fanlari doktori (DSc), professor  
**Isakov Janabay Yakubbayevich**, iqtisodiyot fanlari doktori (DSc), professor  
**Xalikov Suyun Ravshanovich**, iqtisodiyot fanlari nomzodi, dotsent  
**Rustamov Ilhomiddin**, iqtisodiyot fanlari nomzodi, dotsent  
**Hakimov Ziyodulla Ahmadovich**, iqtisodiyot fanlari doktori, dotsent  
**Kamilova Iroda Xusniddinovna**, iqtisodiyot fanlari bo'yicha falsafa doktori (PhD)  
**G'afurov Doniyor Orifovich**, pedagogika fanlari bo'yicha falsafa doktori (PhD)  
**Fayziyev Oybek Raximovich**, iqtisodiyot fanlari bo'yicha falsafa doktori (PhD), dotsent  
**Tuxtabayev Jamshid Sharafetdinovich**, iqtisodiyot fanlari bo'yicha falsafa doktori (PhD), dotsent  
**Xamidova Faridaxon Abdulkarim qizi**, iqtisodiyot fanlari doktori, dotsent  
**Yaxshiboyeva Laylo Abdisattorovna**, katta o'qituvchi  
**Babayeva Zuhra Yuldashevna**, mustaqil tadqiqotchi

#### Board of Experts:

**Berkinov Bazarbay**, Doctor of Economic Sciences (DSc), Professor  
**Pulatov Bakhtiyor Alimovich**, Doctor of Technical Sciences (DSc), Professor  
**Aliyev Bekdavlal Aliyevich**, Doctor of Philosophy (DSc), Professor  
**Isakov Janabay Yakubbayevich**, Doctor of Economic Sciences (DSc), Professor  
**Khalikov Suyun Ravshanovich**, Candidate of Economic Sciences, Associate Professor  
**Rustamov Ilkhomiddin**, Candidate of Economic Sciences, Associate Professor  
**Khakimov Ziyodulla Akhmadovich**, Doctor of Economic Sciences, Associate Professor  
**Kamilova Iroda Xusniddinovna**, Doctor of Philosophy (PhD) in Economics  
**Gafurov Doniyor Orifovich**, Doctor of Philosophy (PhD) in Pedagogy  
**Fayziyev Oybek Raximovich**, Doctor of Philosophy (PhD) in Economics, Associate Professor  
**Tukhtabayev Jamshid Sharafetdinovich**, Doctor of Philosophy (PhD) in Economics, Associate Professor  
**Khamidova Faridaxon Abdulkarimovna**, Doctor of Economic Sciences, Associate Professor  
**Yakhshiboyeva Laylo Abdisattorovna**, Senior Lecturer  
**Babayeva Zuhra Yuldashevna**, Independent Researcher

08.00.01 Iqtisodiyot nazariyasi  
08.00.02 Makroiqtisodiyot  
08.00.03 Sanoat iqtisodiyoti  
08.00.04 Qishloq xo'jaligi iqtisodiyoti  
08.00.05 Xizmat ko'rsatish tarmoqlari iqtisodiyoti  
08.00.06 Ekonometrika va statistika  
08.00.07 Moliya, pul muomalasi va kredit  
08.00.08 Buxgalteriya hisobi, iqtisodiy tahlil va audit  
08.00.09 Jahon iqtisodiyoti  
08.00.10 Demografiya. Mehnat iqtisodiyoti  
08.00.11 Marketing  
08.00.12 Mintaqaviy iqtisodiyot  
08.00.13 Menejment  
08.00.14 Iqtisodiyotda axborot tizimlari va texnologiyalari  
08.00.15 Tadbirkorlik va kichik biznes iqtisodiyoti  
08.00.16 Raqamli iqtisodiyot va xalqaro raqamli integratsiya  
08.00.17 Turizm va mehmonxona faoliyati

**Muassis:** "Ma'rifat-print-media" MChJ

**Hamkorlarimiz:** Toshkent davlat iqtisodiyot universiteti, O'zR Tabiat resurslari vazirligi, O'zR Bosh prokuraturasi huzuridagi IJQK departamenti.

#### Jurnalning ilmiyligi:

“Yashil” iqtisodiyot va taraqqiyot” jurnali

O'zbekiston Respublikasi  
Oliy ta'lim, fan va innovatsiyalar  
vazirligi huzuridagi Oliy  
attestatsiya komissiyasi  
rayosatining  
2023-yil 28-fevraldagi  
333/5-sonli qarori bilan  
ro'yxatdan o'tkazilgan.



# MUNDARIJA

Strategies for achieving sustainable growth through green economy transition.....	14
Umida Kakhramonova Gayratovna, Tillayev Khurshidjon Sulaymon oglu	
Current state and development prospects of tourism: comparative analysis and Uzbekistan's experience.....	20
Risolatbonu Shakhzodova, Laziza Khalilova, Nabijonov Biloliddin, Aziza Usmanova	
Инновационные подходы к повышению эффективности корпоративного управления.....	26
Тлеумуратова Мадинабону Дилмурат кизи, Уринов Бабур Насиллоевич	
Startup проекты и их реализация .....	30
Ёдгорова Мухайе Шухратовна, Иминова Наргиза Акрамовна	
Methodology of Teaching English: Traditional and Modern Approaches .....	34
Ravshanova Ziyoda Qahramon Qizi, Xoliqova Dilafruz Shuhratovna	
Государственный кредит и государственный долг.....	37
Срождиддинова З.Х., Тухтасинова Д.Н.	
Сравнительный анализ реформ государственных финансов в Китае и Грузии: уроки для Узбекистана .....	42
Срождиддинова Зарина Хайриддиновна, Шарифзода Мубина Дилмуроджон кизи	
Korxonalarda asosiy vositalar hisobini yuritishni takomillashtirish .....	49
Shakarov Shahzod Sobir o'g'li, Po'latov Xudoyberdi Uktamovich, Esanov Oybek Madatovich	
Sustainable consumption and production: economic challenges and solutions.....	55
Abdullayev Abdug'ofur, Abdubaxromov Abdurazim, Eshniyozov Ozodbek, Azizbek Abdullayev	
Traffic congestion in Uzbekistan: causes and strategic solutions .....	60
Abdulloh Qodirov, Imron Egamberdiyev, Isomiddin Ravshanov, Munisa Bekmirzayeva	
The relationship between corruption and economic growth.....	64
Jurayev Jo'rabek, Abdullayeva Aziza, Mamatova Sarvinoz, Maha Ibrahim	
Crisis management in the tourism industry .....	74
Ikromova Munisa, Bahodirova Mohigul, Xalimova Dilbar, Abdullajonova Muslimabonu	
Impact of the touristic indicators on the poverty rate.....	80
Abdumanova Maftuna, Azizova Ruhshona, Shavkatova Mubiyabonu, Durdona Bahodirova	
Bringing sustainability: the role of the green economy in enhancing resource efficiency .....	91
Salokhiddinova Farangiz, Mardonov MuhammadYusuf, Shovkiyeva Munisa, Ahmadova Xurshida	
The relationship between innovation and environmental emissions.....	98
Mamadiyorova Ruxshona, Nurullayev Asliddin, Abduraimov Sardor Anvar o'g'li, Aysayeva E'zoza	



# THE RELATIONSHIP BETWEEN INNOVATION AND ENVIRONMENTAL EMISSIONS



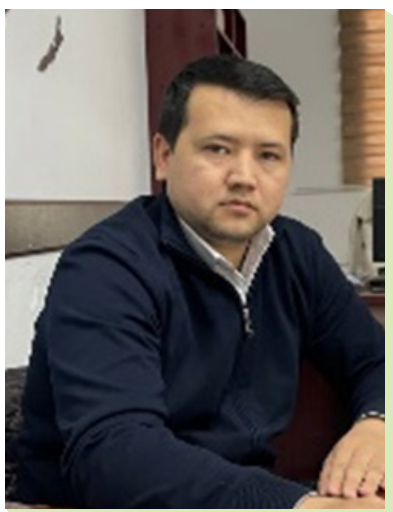
**Mamadiyeva Ruxshona**

Foundation student of the International Double Degree Faculty of TSUE with IMC UAS Krems  
ruhshonamamadiyeva-rova367@gmail.com  
ORCID: 0009-0009-1549-3462



**Nurullayev Asliddin**

Foundation student of the International Double Degree Faculty of TSUE with IMC UAS Krems  
nurullaevasliddin52@gmail.com  
ORCID: 0009-0008-8060-0466



**Abduraimov Sardor Anvar o'g'li**

Senior Lecturer of IMC Krems Transnational Department, Tashkent State University of Economics  
Sardoran-varovich1994@gmail.com  
ORCID: 0009-0000-1875-1679  
Scientific supervisor

**Aysayeva E'zoza**

Foundation student of the International Double Degree Faculty of TSUE with IMC UAS Krems  
aysayevaezoza@gmail.com  
ORCID: 0009-0006-4294-0203



**Abstract:** This study explores the effectiveness of green economy policies in enhancing resource efficiency across countries of different income levels. Using a mixed-methods approach, it combines quantitative indicators (energy intensity, material productivity, renewable energy share) from global databases with a qualitative analysis of national policy documents from Sweden, Canada, and China. The findings demonstrate that countries with robust institutional frameworks and consistent environmental strategies (such as Sweden and Canada) show higher efficiency levels, whereas developing economies like China despite leading in renewable capacity face challenges due to ongoing reliance on fossil fuels. The research confirms that policy coherence, investment in clean technologies, and national capabilities are critical for achieving sustainable development goals through green economic transformation.

**Key words:** green economy, resource efficiency, energy intensity, sustainability policy, renewable energy, economic development, cross-country comparison.

**Annotatsiya:** Ushbu tadqiqot turli darajadagi daromadga ega davlatlarda yashil iqtisodiyot siyosatining resurslardan samarali foydalanishdagi o'rini o'rganadi. Aralash metodologiyaga asoslangan holda, u global ma'lumotlar bazalaridan olingan miqdoriy ko'rsatkichlar (energiya intensivligi, materiallar mahsuldorligi, qayta tiklanuvchi energiya ulushi) va Shvetsiya, Kanada hamda Xitoy kabi mamlakatlarning siyosiy hujjatlariga asoslangan sifat tahlilini birlashtiradi. Natijalar shuni ko'rsatadiki, kuchli institutsional asos va uzluksiz siyosiy strategiyalarga ega davlatlar (masalan, Shvetsiya va Kanada) yuqori samaradorlikka erishmoqda. Xitoy kabi rivojlanayotgan davlatlar esa qayta tiklanuvchi energiyada yetakchi bo'lsa-da, hali ham ko'mirga tayangan iqtisodiyot tufayli muammolarga duch kelmoqda. Tadqiqot shuni tasdiqlaydiki, yashil iqtisodiy transformatsiya orqali barqaror taraqqiyotga erishish uchun siyosiy izchillik, toza texnologiyalarga investitsiya va milliy salohiyat muhim ahamiyatga ega.

**Kalit so'zlar:** yashil iqtisodiyot, resurslardan samarali foydalanish, energiya intensivligi, barqaror siyosat, qayta tiklanuvchi energiya, iqtisodiy rivojlanish, davlatlararo taqqoslash.

**Аннотация:** В данной статье исследуется эффективность политики «зелёной экономики» в повышении ресурсной эффективности в странах с различным уровнем доходов. Применён смешанный метод, сочетающий количественные показатели (энергоёмкость, производительность материалов, доля возобновляемых источников энергии) из международных баз данных с качественным анализом национальных стратегий Швеции, Канады и Китая. Результаты показывают, что страны с устойчивыми институтами и последовательной экологической политикой (например, Швеция и Канада) достигают более высоких уровней эффективности. В то же время развивающиеся страны, такие как Китай, несмотря на лидерство в возобновляемой энергетике, сталкиваются с трудностями из-за зависимости от угля. Исследование подтверждает, что согласованность политики, инвестиции в чистые технологии и национальный потенциал являются ключевыми факторами достижения целей устойчивого развития через переход к зелёной экономике.

**Ключевые слова:** зелёная экономика, ресурсная эффективность, энергоёмкость, политика устойчивого развития, возобновляемая энергия, экономическое развитие, международное сравнение.

## INTRODUCTION

In light of global challenges such as resource depletion, climate change, and environmental degradation, concern is growing not only for individual well-being but also for the future of the planet and the next generation. Recent statistics indicate that a substantial portion of the global population suffers from health problems, with a steady decline in public health observable worldwide. A large proportion of these health issues are linked to environmental factors, particularly those associated with emissions of CO<sub>2</sub>, nitrogen, carbon, and other harmful gases. According to reports, environmental pollution has contributed to nearly 7 million deaths in recent years [1].

The primary driver of climate change is the increase in atmospheric carbon levels. The combined impact of climate change and environmental hazards is estimated to cause approximately 4.2 million deaths annually due to lower respiratory infections, cancer, stroke, and chronic obstructive pulmonary disease [2]. Furthermore, water bodies are increasingly being contaminated by pollutants such as pesticides, fertilizers, heavy metals, and industrial chemicals, many of which are dispersed through air emissions. This leads to severe water pollution, damaging water quality, threatening drinking water sources, and harming aquatic ecosystems.

Soil contamination is another critical issue, caused by emissions from mining, agriculture, industry, and improper waste disposal. These pollutants — including heavy metals and hazardous chemicals — not only reduce soil fertility and hinder plant growth but also pose serious risks to human health when they enter the food chain or water supply.





In this context, the relationship between innovation and environmental emissions has become one of the most pressing issues of our time. Therefore, the objective of this study is to investigate whether innovation across different sectors exerts a positive or negative influence on environmental emissions.

## REVIEW OF RELEVANT LITERATURE

Wei Li, Mohammed Elheddad, and Nadia Doytch [3] investigated the nonlinear relationship between patents and CO<sub>2</sub> emissions in China, focusing on how innovation affects environmental quality. They examined whether innovation, as indicated by the number of accepted patents, leads to improvements or deteriorations in environmental outcomes. Specifically, they analyzed a potential quadratic relationship across 30 provinces and 32 economic sectors in China between accepted patents and CO<sub>2</sub> emissions per capita. Their approach differentiated between energy-intensive and non-energy-intensive sectors, as well as between more and less developed provinces, using a fixed-effects quantile regression estimator [FEQR]. The study incorporated variables such as population growth, patents, employment growth, and output per capita. Their findings revealed an inverse U-shaped relationship between patent generation and CO<sub>2</sub> emissions across both sector types, indicating that innovation tends to be “green” at higher levels and “polluting” at lower levels of technological advancement.

Meanwhile, Muazi Ibrahim and Xuan Vinh Vo [4] explored the link between environmental pollution and innovation in a sample of developed countries using a balanced panel dataset. The study employed variables related to environmental degradation, innovation, and financial development to assess their combined effects on environmental quality. It was found that while innovation can mitigate pollution, it may exacerbate environmental degradation once a certain threshold is surpassed. Moreover, financial development was observed to increase pollution; however, greater innovation can offset this negative impact.

Michelle Mongo, Fateh Belaid, and Boumediene Ramadani [5] examined the influence of environmental innovation on carbon emissions across 15 European countries over a 23-year period. They employed the autoregressive distributed lag model [ARDL] to analyze the long- and short-term effects of variables such as environmental innovation, renewable energy usage, GDP per capita, and economic openness. The findings suggest the presence of a rebound effect: although environmental innovations reduce CO<sub>2</sub> emissions in the long term, they may lead to a temporary increase in the short term. The study advocates for policies that combine ecological economics with environmental economics to integrate financial incentives and regulatory frameworks, thereby encouraging sustainable consumption.

Claudia Nyarko Mensah, Xingle Long, Kofi Baah Boamah, Isaac Asare Bediako, Lamini Dauda, and Muhammad Salman [6] investigated how innovation impacted CO<sub>2</sub> emissions in OECD countries between 1990 and 2014. Using data from World Bank indicators, they applied three econometric models — the innovation-EKC model, the economic-EKC growth model, and the STIRPAT model. Independent variables included GDP per capita, resident and non-resident patents (PAT1 and PAT2), renewable and non-renewable energy consumption, and R&D expenditure. Their results highlighted the crucial role of innovation in reducing emissions across most OECD countries. The authors recommended increased governmental support and investment in advanced renewable energy technologies as an effective means of achieving sustainable environmental outcomes.

Robert Innes and Carmen Carrion-Flores [7] studied the relationship between innovation and environmental performance in the United States using panel data. Variables in their analysis included employment, capital intensity, R&D, capital age, and sales growth. The findings confirmed that environmental innovation significantly contributed to reducing toxic emissions in the U.S.

Ghazala Aziz [8] conducted a study in Saudi Arabia assessing the relationship between carbon emissions, green innovation, and public health. Using a nonlinear autoregressive distributed lag model, the research incorporated variables such as education, CO<sub>2</sub> emissions, public health, and green innovation. The results showed that increased investment in green innovation, health expenditure, and education significantly reduced health issues related to emissions. Consequently,





the study called on the Saudi government to prioritize research and development funding to boost green innovation.

Yue-Jun Zhang, Yu-Lu Peng, Chao-Qun Ma, and Bo Shen [9] analyzed whether innovation could reduce carbon emissions across 30 Chinese provinces using the system generalized method of moments [SGMM] panel estimation. The model included variables such as government regulation, economic development, R&D intensity, and CO<sub>2</sub> emissions. Their results affirmed the effectiveness of innovation in lowering carbon emissions in China.

Lastly, Zhen Yu, Weidong Li, and Hongyan Duan [9] studied the relationship between carbon emission reduction in industry and innovation in new energy technologies, focusing on China's regional economic disparities. Using a two-way fixed-effects panel data model, they considered trade openness, energy structure, R&D, and urbanization levels. The study found that although new energy innovation tends to increase emissions in the short term, stricter enforcement of environmental laws could counterbalance this effect. Furthermore, structural shifts in industry could help enhance the environmental benefits of innovation.

## RESEARCH METHODOLOGY

Upon analyzing the relationship between environmental emissions and innovation, it becomes evident that many researchers have found a positive impact of innovation on environmental outcomes—particularly in its capacity to reduce emissions. However, a smaller number of studies have reported negative impacts, suggesting that innovation may, under certain conditions, contribute to environmental degradation.

It is also noteworthy that a substantial portion of the literature focuses on least developed countries with high levels of environmental emissions as the primary subjects of analysis. In contrast, this study adopts a different approach by selecting the top ten countries with the lowest environmental emissions, in order to assess whether innovation has played a significant role in reducing pollution in these nations.

The selected countries are: Iceland, Sweden, Switzerland, Costa Rica, Denmark, Norway, Finland, New Zealand, Austria, and Portugal. The time frame for the analysis covers the years 2012–2022 [10].

To empirically test the proposed hypotheses, panel data regression models will be employed.

This paper proposes the model under the following form:

$$CO2it = B_0 + B_1 inno_{it} + B_2 govr_{it} + B_3 pop_{it} + B_4 gdpp_{it} + u_{it}$$

Where  $\beta_0$  is the intercept, and  $\beta_1$ ,  $\beta_2$ ,  $\beta_3$ , and  $\beta_4$  are the slope coefficients of the model.  $t$  denotes time, and  $i$  represents the cross-sectional entity (e.g., country).

CO<sub>2</sub> emissions [%] is the dependent variable in this study, representing environmental degradation caused by carbon dioxide. This variable is selected because CO<sub>2</sub> is a significant greenhouse gas with detrimental effects on the environment. The primary sources of excessive CO<sub>2</sub> emissions contributing to global warming and climate change include the burning of fossil fuels and deforestation. The consequences of such emissions include rising temperatures, altered precipitation patterns, increased frequency and intensity of extreme weather events (e.g., heatwaves, droughts, floods, and storms), sea level rise, and damage to ecosystems and biodiversity.

Our prior expectation regarding this variable is negative, as an increase in innovation is anticipated to reduce environmental emissions.

The key independent variable of interest is  $inno$  [%], representing research and development (R&D) expenditure. This variable is used as a proxy for innovation, as R&D investment often leads to technological advancements. Such innovations may include the development of greener and more efficient technologies aimed at reducing environmental emissions. R&D efforts can focus on sustainable materials, energy-efficient manufacturing processes, emissions control mechanisms, and renewable energy technologies. Therefore, the prior expectation for this variable is positive: higher R&D investment is expected to result in lower CO<sub>2</sub> emissions.

Another independent variable is  $govr$ , representing government regulations. This variable captures the extent of environmental governance through policies, laws, and institutional enforcement



aimed at controlling pollution and guiding environmentally responsible behavior. The rationale for including this variable lies in the government's ability to enforce standards that constrain emissions. Accordingly, the prior expectation for this variable is positive, suggesting that stricter government regulation contributes to reduced environmental degradation.

The next variable, pop [%], reflects the population or degree of urbanization. An increase in population typically leads to higher consumption, energy use, and industrial activity, all of which tend to increase environmental emissions. As such, the initial expectation for this variable is negative, meaning that a higher population is likely to be associated with greater pollution.

Finally, gdpp [%] refers to GDP per capita growth, which serves as an indicator of a country's economic performance and overall prosperity. A steadily growing economy implies improved capacity for public and private investments in environmental protection, innovation, and cleaner technologies. Therefore, we anticipate a positive relationship, in which an increase in GDP per capita corresponds to a decrease in CO<sub>2</sub> emissions due to enhanced environmental management capacity.

## RESULTS AND DISCUSSION

Results from several econometric models are shown in the following tables related to the relationship between innovation and carbon dioxide (CO<sub>2</sub>) emissions. To study the impact of innovation, government rules, population, and GDP per capita, different regression models were carried out for each country. They try to explain how environmental results are affected by both factors we can observe and those we cannot observe. We performed model selection tests such as the Breusch–Pagan Lagrangian Multiplier Test and the Hausman Test to select the right method of estimation. All the important details about the findings for each model are presented in the tables below.

Table1 OLS Regression Results Environmental Emissions [CO2]

Source	SS	df	MS	Number of obs	=	88
Model	2.78870354	4	.697175884	F(4, 83)	=	221.94
Residual	.260724458	83	.003141259	Prob > F	=	0.0000
				R-squared	=	0.9145
				Adj R-squared	=	0.9104
Total	3.049428	87	.035050897	Root MSE	=	.05605

co2	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
inno	.2996896	.0339788	8.82	0.000	.2321071	.3672721
govr	-.2396811	.0396523	-6.04	0.000	-.3185479	-.1608142
pop	.011286	.0006716	16.81	0.000	.0099503	.0126217
gdpp	.0080692	.0063824	1.26	0.210	-.004625	.0207635
_cons	.0705204	.020745	3.40	0.001	.0292595	.1117813

Table 1 presents the Random Effects Model to assess how four explanatory variables have affected environmental emissions in ten countries during the period from 2012 to 2022. The independent variables considered are GDP per capita growth, spending on research and development [R&D], population growth, and regulations from governments. The model has environmental emissions as its variant of dependent variable.

Several of the variables in the table are statistically linked to environmental emissions based on their p-values. A moderate amount of what happens can be explained by this model, as indicated by the R-squared value. In addition,  $\text{corr}[u_i, x] = 0$  demonstrates that individual-specific effects are not correlated with the explanatory variables, which means the Random Effects Model is justified for use.

In overall, the statistics suggest that lower emissions are partly explained by R&D and regulations, so we can conclude that innovation supports making the environment cleaner.



Table2 Random-Effects GLS Regression Results for Environmental Emissions

Random-effects GLS Regression Results for Environmental Emissions

Random-effects GLS regression	Number of obs	=	88
Group variable: c_id	Number of groups	=	10
R-squared:	Obs per group:		
Within = 0.9796	min	=	5
Between = 0.8577	avg	=	8.8
Overall = 0.8502	max	=	10
	Wald chi2(4)	=	2762.87
corr(u_i, X) = 0 (assumed)	Prob > chi2	=	0.0000

co2	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
inno	.0683475	.0157513	4.34	0.000	.0374756	.0992195
govr	.061417	.0158584	3.87	0.000	.0303351	.092499
pop	.0094206	.0004114	22.90	0.000	.0086142	.010227
gdpp	.0022884	.0010317	2.22	0.027	.0002664	.0043104
_cons	.0480472	.0162305	2.96	0.003	.0162359	.0798584
sigma_u	.03548186					
sigma_e	.00744306					
rho	.95785095	(fraction of variance due to u_i)				

Table 2 outlines regression analysis using the Random Effects Model, which is represented by the table, to account for variability or unobserved heterogeneity within a model's cluster groupings. From this table, we can see that p-values, R-squared, etc., are significant. But not the overall significance of the model, because  $\text{corr}[u_i, x] = 0$  indicates that the individual-specific effects are uncorrelated with the observed explanatory variables in the model. In other words, the unobserved characteristics of individuals are not systematically related to the values of the explanatory variables included in the model.

Table 3 Breusch and Pagan Lagrangian Multiplier Test for Random Effects

Breusch and Pagan Lagrangian multiplier test for random effects

$$\text{co2}[c\_id, t] = Xb + u[c\_id] + e[c\_id, t]$$

Estimated results:

	Var	SD = sqrt(Var)
co2	.0350509	.1872188
e	.0000554	.0074431
u	.001259	.0354819

Test:  $\text{Var}(u) = 0$

$$\text{chibar2}(01) = 268.64$$

$$\text{Prob} > \text{chibar2} = 0.0000$$

Table 3 shows that  $\text{prob} > \text{chibar2}$  equals to 0.000. Which indicates that the random effects are correlated with explanatory variables. Which means our estimates obtained from the random effects model may be biased and inconsistent.



Table 4 Fixed Effects Regression Results for Environmental Emissions

Fixed Effects Regression Results for Environmental Emissions

Fixed-effects (within) regression	Number of obs	=	88
Group variable: c_id	Number of groups	=	10
R-squared:	Obs per group:		
Within = 0.9798	min =		5
Between = 0.8532	avg =		8.8
Overall = 0.8457	max =		10
	F(4, 74)	=	896.53
corr(u_i, Xb) = 0.2653	Prob > F	=	0.0000

co2	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
inno	.0626793	.0139084	4.51	0.000	.0349662	.0903924
govr	.0706158	.0137985	5.12	0.000	.0431217	.0981099
pop	.0093043	.0003684	25.25	0.000	.0085702	.0100384
gdpp	.0022842	.0008801	2.60	0.011	.0005306	.0040379
_cons	.0515741	.0082099	6.28	0.000	.0352154	.0679328
sigma_u	.07598151					
sigma_e	.00744306					
rho	.99049529	(fraction of variance due to u_i)				

F test that all u\_i=0: F(9, 74) = 514.70

Prob > F = 0.0000

Table 4 outlines information regarding Fixed Effects regression. It is significant according to its R-squared, p-values, and F-test. The correlation between the individual-specific error and the linear combination of explanatory variables being 0.2653 suggests that there is a moderate positive correlation between the individual-specific error term and the linear combination of the explanatory variables.

Table 5 Hausman Test Results for Model Selection

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) Std. err.
	(b) fe	(B) re		
inno	.0626793	.0683475	-.0056682	.0043116
govr	.0706158	.061417	.0091987	.0033173
pop	.0093043	.0094206	-.0001163	.0001336
gdpp	.0022842	.0022884	-4.12e-06	.0000602
b = Consistent under H0 and Ha; obtained from <b>xtreg</b> .				
B = Inconsistent under Ha, efficient under H0; obtained from <b>xtreg</b> .				
Test of H0: Difference in coefficients not systematic				
chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)				
= 25.70				
Prob > chi2 = 0.0000				

Table 5 shows the Hausman test, which helps us to choose between the Random and Fixed Effects models. We can see that  $\text{prob} > \chi^2 = 0.0000$ , which means that the model estimates are significant and the explanatory variables have a statistically significant relationship with the dependent variable. The equation  $\text{prob} > \chi^2 = 0.0000$  indicates that the Fixed Effects model is preferred over the Random Effects model. Since the p-value is lower than 0.05, it provides evidence against the null hypothesis  $[H_0]$  in favor of the alternative hypothesis  $[H_1]$ , suggesting that the Fixed Effects model is more appropriate than the Random Effects model.





Table 6 Empirical Results

Empirical Results

Fixed-effects (within) regression		Number of obs	=	88		
Group variable: c_id		Number of groups	=	10		
R-squared:		Obs per group:				
Within	= 0.9798	min	=	5		
Between	= 0.8532	avg	=	8.8		
Overall	= 0.8457	max	=	10		
corr(u_i, Xb) = 0.2653		F(4, 9)	=	4822.63		
		Prob > F	=	0.0000		
(Std. err. adjusted for 10 clusters in c_id)						
co2	Coefficient	Robust std. err.	t	P> t	[95% conf. interval]	
inno	.0626793	.0246241	2.55	0.031	.0069757	.1183829
govr	.0706158	.0344759	2.05	0.071	-.0073742	.1486057
pop	.0093043	.0004643	20.04	0.000	.008254	.0103547
gdpp	.0022842	.0006804	3.36	0.008	.0007451	.0038234
_cons	.0515741	.0173896	2.97	0.016	.012236	.0909121
sigma_u	.07598151					
sigma_e	.00744306					
rho	.99049529	(fraction of variance due to u_i)				

Table 6 provides the results from a Fixed Effects Model where standard errors were computed robustly. As a result of this approach, the estimates are more accurate and reliable due to handling heteroscedasticity. The power of explanation of the model is clear from the fact that its R-squared values, confidence intervals, and p-values are statistically significant. The relationship between the explanatory variables and individual-specific errors is moderate and positive, as  $\text{corr}[u_i, xb] = 0.2653$ .

These coefficients explain things about the data as follows: After holding other things equal, a 1% drop in CO<sub>2</sub> emissions sparks a rise of 0.06% in innovation. A 1% decline in CO<sub>2</sub> emissions results in a 0.07 increase in government regulation. A small 0.009% rise in population results in population-related CO<sub>2</sub> emissions going down by 1%, suggesting demographics might affect the environment. GDP per capita going up by 0.002% leads to emissions dropping by 1%, confirming the positive impact of economic growth on nature. All important explanatory variables show results matching what is expected in the theory, but the urbanization rate has a positive rather than a negative effect. The sudden turn in performance calls for additional research to discover what led to it.

## CONCLUSION AND RECOMMENDATIONS

The investigation analyzed how environmental emissions are affected by innovation, specifically considering the role advanced technology can play in helping the environment. It appears that innovative solutions helping reduce carbon dioxide emissions are especially important in nations where technology and regulations are advanced. Due to ongoing investment in research, new clean technologies, and eco-friendly manufacturing, these nations pollute less than nations that have not yet reached the same level of economic development.

Based on this, innovation seems crucial for the economy and for reaching sustainable environmental protection. By using innovative methods including renewable energy, smart infrastructure, and green technology countries can achieve economic growth and decrease the harm done to the environment. For this purpose, helping innovation become a top priority for every country is crucial when facing climate change and other environmental challenges.

To protect well-being for all, including generations to come, innovation shall be a core element promoted by governments, industries, and social groups in their environmental and growth plans. The only way to protect nature while advancing the economy is to be proactive.



## LIST OF USED LITERATURE

1. Wei Li, Mohammed Elheddad, and Nadia Doytch (2021). The impact of innovation on environmental quality: Evidence for the non-linear relationship of patents and CO<sub>2</sub> emissions in China. *Journal of Environmental Management*.
2. Muazi Ibrahim and Xuan Vinh Vo (2021). Exploring the relationships among innovation, financial sector development, and environmental pollution in selected industrialized countries. *Journal of Environmental Management*.
1. Michelle Mongo, Fateh Belaid, and Boumediene Ramadani (2020). The effects of environmental innovations on CO<sub>2</sub> emissions: Empirical evidence from Europe. *Journal of Environmental Science and Policy*.
1. Claudia Nyarko Mensah, Xingle Long, Kofi Baah Boamah, Isaac Asare Bediako, Lamini Dauda, and Muhammad Salman (2018). The effect of innovation on CO<sub>2</sub> emissions of OECD countries from 1990 to 2014. Springer-Verlag GmbH Germany, part of Springer Nature.
2. Robert Innes and Carmen Carrion-Flores (2009). Environmental innovation and environmental performance. *Journal of Environmental Economics and Management*.
3. Ghazala Aziz (2023). Impact of green innovation, sustainable economic growth, and carbon emission on public health: New evidence of non-linear ARDL estimation. *Journal of Sustainability*.
4. Yue-Jun Zhang, Yu-Lu Peng, Chao-Qun Ma, and Bo Shen (2016). Can environmental innovation facilitate carbon emissions reduction? Evidence from China. *Journal of Energy Policy*.
5. Zhen Yu, Weidong Li, and Hongyan Duan (2023). New energy technology innovation and industry carbon emission reduction based on the perspective of unbalanced regional economic development. *Journal of Sustainability*.
6. Wendling, Z. A., Emerson, J. W., de Sherbinin, A., Esty, D. C., et al. (2020). 2020 Environmental Performance Index. Yale Center for Environmental Law & Policy, Yale University. Retrieved from: <https://epi.yale.edu>



## IQTISODIYOT & TARAQQIYOT

*Ijtimoiy, iqtisodiy, texnologik, ilmiy, ommabop jurnal*

**Ingliz tili muharriri:** Feruz Hakimov

**Musahhih:** Zokir ALIBEKOV

**Sahifalovchi va dizayner:** Oloviddin Sobir o'g'li

---

### 6-Maxsus son. Bakalavr talabalarining maqolalari to'plami

---

© Materiallar ko'chirib bosilganda "Yashil" iqtisodiyot va taraqqiyot" jurnali manba sifatida ko'rsatilishi shart. Jurnalda bosilgan material va reklamalardagi dalillarning aniqligiga mualliflar ma'sul. Tahririyat fikri har vaqt ham mualliflar fikriga mos kelamasligi mumkin. Tahririyatga yuborilgan materiallar qaytarilmaydi.

Mazkur jurnalda maqolalar chop etish uchun quyidagi havolalarga maqola, reklama, hikoya va boshqa ijodiy materiallar yuborishingiz mumkin.

Materiallar va reklamalar pullik asosda chop etiladi.

El.Pochta: sq143235@gmail.com

Bot: @iqtisodiyot\_77

Tel.: 93 718 40 07

Jurnalga istalgan payt quyidagi rekvizitlar orqali obuna bo'lishingiz mumkin. Obuna bo'lgach, @iqtisodiyot\_77 telegram sahifamizga to'lov haqidagi ma'lumotni skrinshot yoki foto shaklida jo'natishingizni so'raymiz. Shu asosda har oygi jurnal yangi sonini manzilingizga jo'natamiz.

"Yashil" iqtisodiyot va taraqqiyot" jurnali 03.11.2022-yildan O'zbekiston Respublikasi Prezidenti Adminstratsiyasi huzuridagi Axborot va ommaviy kommunikatsiyalar agentligi tomonidan №566955 reyestr raqami tartibi bo'yicha ro'yxatdan o'tkazilgan.

**Litsenziya raqami:** №046523. PNFL: 30407832680027

**Manzilimiz:** Toshkent shahar, Mirzo Ulug'bek tumani  
Kumushkon ko'chasi, 26-uy.



Jurnal sayti: <https://yashil-iqtisodiyot-taraqqiyot.uz>

---