International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2026, 16(1), 218-224.

Renewable Energy Consumption, Tourism and Climate Change Relationship in Developed Countries

Aizhan Omarova[1], Bibigul Saubetova[1]*, Aktolkin Abubakirova[2], Gaukhar Saimagambetova[3], Nurgul Pernebekkyzy[1]

[1]Yessenov University, Aktau, Kazakhstan, [2]International University of Tourism and Hospitality, Turkestan, Kazakhstan, [3]Caspian University of Technology and Engineering, Aktau, Kazakhstan. *Email: bibigul.saubetova@yu.edu.kz

Received: 27 May 2025 **Accepted:** 27 September 2025 **DOI:** https://doi.org/10.32479/ijeep.20360

ABSTRACT

This study aims to examine the long-term effects of tourism revenues and renewable energy consumption on carbon emissions in developed countries. In this context, the analysis was conducted using annual panel data covering the period from 2000 to 2023. To test the long-term relationship among the variables, the Pedroni and Kao cointegration tests were employed, and evidence of cointegration was found among the variables. For the estimation of long-run coefficients, the fully modified ordinary least squares (FMOLS) and dynamic ordinary least squares (DOLS) methods were applied. The FMOLS results indicate that both renewable energy consumption and tourism revenues have statistically significant negative effects on carbon emissions. Accordingly, an increase in renewable energy consumption leads to a reduction in carbon emissions, and similarly, an increase in tourism revenues contributes to environmental improvement. However, according to the DOLS estimates, the effects of both variables on carbon emissions were found to be statistically insignificant. The divergence in the results of the FMOLS and DOLS methods may be attributed to the structure of the panel data set and the sensitivity of the estimation techniques. The findings suggest that sustainable energy and tourism policies in developed countries can serve as important tools in the fight against climate change. The study offers policy recommendations, emphasizing the need to promote renewable energy use and environmentally friendly tourism activities.

Keywords: Carbon Emission, Renewable Energy Consumption, Tourism Sector, Developed Countries, Panel Cointegration Analysis
JEL Classifications: E44, F40, K32, C23

1. INTRODUCTION

Global warming and climate change have emerged as critical environmental challenges that lie at the heart of international policy agendas and academic research in recent years. In particular, the rise in greenhouse gas emissions has led to increasing global temperatures and the disruption of environmental equilibrium. Developed countries, due to their high levels of industrialization, energy consumption, and outward-oriented economic structures, account for a substantial share of global carbon emissions (Syzdykova et al., 2021). In this context, carbon emissions (CO_2 emissions) have gained significance as a key indicator in terms of both the sustainability of economic growth and the formulation of environmental policies. Developed countries, due to their high levels of industrialization, energy consumption, and outward-oriented economic structures, account for a substantial share of global carbon emissions. However, these countries are also at the forefront in implementing environmental sustainability policies.

In recent years, the tourism sector has become a dynamic contributor to economic growth in developed economies. Nevertheless, increasing tourism activities also drive up energy demand and exert environmental pressure through transportation, accommodation, and other tourism-related services. Assessing the environmental impacts of tourism, particularly its effect on carbon emissions, is crucial for the development of sustainable development strategies. On the other hand, the increased use of renewable energy sources stands out as a fundamental strategy to reduce carbon emissions. The growing use of environmentally friendly energy sources—such as solar, wind, hydroelectric, and biomass—contributes to environmental sustainability by reducing reliance on fossil fuels.

This study aims to empirically investigate the effects of tourism and renewable energy consumption on carbon emissions in developed countries using a panel data set covering the period from 2000 to 2023. While numerous studies have examined the impact of each variable on carbon emissions separately, there remains a limited body of literature that evaluates the joint effect of tourism and renewable energy consumption. Furthermore, this study employs the Pedroni (1999, 2004) panel cointegration tests to reveal the long-term nature of the relationship and uses the fully modified ordinary least squares (FMOLS) and dynamic ordinary least squares (DOLS) methods to estimate the long-run coefficients. These methods are preferred as they provide unbiased and consistent long-run estimates in the presence of cointegration relationships.

The findings of this study are expected to guide policymakers and decision-makers in shaping environmental policies in developed countries and in harmonizing sustainable tourism with clean energy strategies. Moreover, the results contribute to filling gaps in the existing literature and offer new perspectives for a more comprehensive understanding of the tourism-energy-environment nexus.

2. LITERATURE REVIEW

The relationship between renewable energy consumption, tourism, and climate change in developed countries is complex and multifaceted. While renewable energy consumption is generally regarded as a positive force in mitigating climate change, tourism can exert both beneficial and adverse effects on carbon emissions. Developed countries—particularly those within the OECD—exhibit varying impacts of tourism on CO_2 emissions; while some countries have experienced reductions, others have seen increases. This variation underscores the need for tailored strategies to balance tourism growth with environmental sustainability. Renewable energy consumption is associated with reduced CO_2 emissions, as it replaces more polluting energy sources (Syzdykova et al., 2021; Syzdykova et al., 2020).

Renewable energy consumption is associated with reduced CO_2 emissions, as it replaces more polluting energy sources. This effect is particularly evident in developed countries where infrastructure supports such transitions (Ghosh et al., 2024; Spetan et al., 2024). In high-income countries, renewable energy consumption is sometimes linked with climate change indicators, suggesting complex interactions that warrant further investigation (Spetan et al., 2024). The impact of tourism on CO_2 emissions varies by country; in some OECD nations, tourism development has led to emission reductions, while in others, it has contributed to increases (Dogru et al., 2020). Promoting sustainable tourism practices—such as environmentally friendly investments and technology transfer—is essential in mitigating the negative environmental effects of tourism (Ghosh et al., 2024; Dogru et al., 2020).

There is a strong long-term causal relationship between renewable energy consumption and tourism, suggesting that both sectors, when effectively managed, can contribute to emissions reduction (Ben Jebli et al., 2019). Policies that encourage the use of renewable energy and the development of green tourism are beneficial in combating climate change (Thi et al., 2023). Although renewable energy and sustainable tourism practices are crucial in addressing climate change, the relationship between them is not straightforward. Policies that encourage the use of renewable energy and the development of green tourism are beneficial in combating climate change. In some developed countries, tourism still contributes to rising emissions, highlighting the need for comprehensive policies that integrate renewable energy use with tourism development. This complexity emphasizes the importance of region-specific strategies and international cooperation in effectively addressing climate change challenges.

Ghosh et al. (2024) emphasize the potential of renewable energy consumption to reduce CO_2 emissions, particularly in developing countries, while implicitly suggesting that developed countries should adopt environmentally friendly investments and technology transfer. The interaction between tourism and climate change in developed countries necessitates specific environmental policies to address the unique challenges they face. The study underlines the importance of region-specific strategies to promote sustainable tourism practices and mitigate the adverse effects of climate change in these economies.

Ben Jebli (2019) focuses on the relationship between renewable energy consumption, tourism, and climate change across 22 Central and South American countries. The study finds a strong long-term causal relationship between renewable energy and tourism in contributing to the reduction of CO_2 emissions. However, it does not provide insights or data regarding developed countries, making it less suitable for addressing the relationship in that context.

Dogru et al. (2020) examine the relationship between renewable energy consumption, tourism development, and CO_2 emissions in OECD countries. They find that tourism development negatively affects CO_2 emissions in Canada, the Czech Republic, and Turkey, while having a positive effect in Italy, Luxembourg, and the Slovak Republic. Additionally, countries such as Belgium, France, New Zealand, and the Slovak Republic are progressing towards sustainable tourism practices, highlighting the complex interaction among tourism, renewable energy, and climate change in developed nations.

Spetan et al. (2024) suggest that renewable energy consumption in high-income countries exhibits positive correlations with climate change indicators, proposing that although renewable energy is essential, its relationship with climate change remains complex.

Thi et al. (2023) demonstrate that renewable energy consumption and innovation contribute to reducing carbon emissions in developed countries, whereas international tourism tends to exacerbate environmental degradation. The analysis of 53 countries from 1990 to 2019 also shows that trade openness plays a role in enhancing environmental quality. Thus, while renewable energy and technological advancements are crucial for sustainable development, the adverse impact of global tourism on climate change persists, underscoring the need for balanced policy approaches.

Khan et al. (2022) show that in high-income countries, renewable energy consumption, tourism development, and financial development significantly influence economic growth and carbon emissions. While tourism and financial development enhance economic growth and reduce emissions, renewable energy consumption tends to lower both economic growth and emissions. The study supports the Environmental Kuznets Curve hypothesis only in high-income countries, suggesting that the effects of these variables on economic growth and emissions vary across income groups, especially in developed economies.

Kuldasheva et al. (2023) focus on tourism-dependent countries and find that a 1% increase in renewable energy consumption leads to a 1% reduction in CO_2 emissions, highlighting the potential of renewable energy to mitigate the impacts of climate change in tourism-oriented nations. Moreover, by confirming the Environmental Kuznets Curve phenomenon, they emphasize the need for renewable energy strategies in the tourism sector, suggesting that environmental impacts may initially worsen before improving as countries develop economically.

Mehmood and Kaewsaeng-on (2025) primarily focus on the interaction between renewable energy, tourism, and carbon footprints in the top 10 tourism destinations. They find that renewable energy and financial development significantly reduce carbon footprints, whereas tourism development increases them with varying magnitudes. The study emphasizes the need for sustainable practices in tourism and energy consumption to mitigate the effects of climate change, offering insights applicable to both developed and developing contexts.

Avcı et al. (2024) investigate the relationship between tourism, green technological innovation, and CO_2 emissions in the top 15 most-visited countries. They highlight that renewable energy consumption contributes to environmental quality by reducing CO_2 emissions alongside tourism. However, the study does not specifically address the dynamics within developed countries. Findings indicate that while tourism and renewable energy consumption can mitigate the effects of climate change, financial development and economic growth may exacerbate CO_2 emissions, suggesting a complex interaction in environmental outcomes.

Acaroğlu et al. (2023) find that renewable energy consumption (REC) positively influences climate change by reducing temperature and precipitation levels, whereas tourism negatively affects the climate through increased energy demand. A decline in tourist arrivals and an increase in REC could mitigate the effects of climate change in Turkey.

Leitão and Balsalobre-Lorente (2021) confirm a negative relationship between renewable energy consumption and carbon dioxide emissions, while demonstrating that increased tourism is associated with higher emissions. Their findings suggest that tourism may exacerbate climate change, despite the mitigating benefits of renewable energy.

Yaseen et al. (2024) report that renewable energy consumption and tourism contribute to the reduction of CO_2 emissions in Indonesia. A 1% increase in renewable energy leads to a long-term 0.287% decrease in emissions, indicating a positive influence on climate change.

Raihan (2024) finds a negative link between renewable energy consumption and carbon emissions, showing that increased use of renewable energy could reduce the carbon impact of tourism in Malaysia. Otherwise, tourism would make a positive long-term contribution to carbon emissions and climate change.

According to the findings of Tanrisever et al. (2024), tourism may intensify climate change through increased energy use, long-haul flights, and unsustainable consumption. Conversely, adopting renewable energy, enhancing efficiency, and promoting sustainable practices can reduce these impacts, facilitating the transition to a low-carbon, climate-resilient sector.

Bantoudi and Pentaftiki (2022) argue that tourism contributes to climate change by increasing greenhouse gas emissions through travel and energy consumption. However, these effects can be mitigated through sustainable practices, promotion of eco-friendly tourism, and supportive policies aimed at reducing energy use and enhancing climate resilience.

Singh et al. (2022) suggest that tourism can both mitigate and intensify climate change. It reduces impacts by promoting environmental protection and conservation, but contributes to them through greenhouse gas emissions from travel and infrastructure. Adaptation measures such as destination diversification and investment in sustainable practices are essential for balancing these effects.

Samanta (2021) finds that tourism may intensify climate change due to increased pollution and resource consumption by stakeholders. However, it can also mitigate these effects by promoting responsible behavior, raising awareness, and encouraging sustainable practices among tourists and businesses, with government regulations playing a critical role.

Omar et al. (2024) suggest that tourism can reduce the impacts of climate change through eco-tourism initiatives that promote sustainability and conservation. Conversely, it can exacerbate climate change by increasing carbon emissions and resource depletion, especially in scenarios of overtourism that stress local environments and communities.

Grimm et al. (2018) state that tourism contributes to climate change mitigation by promoting sustainable practices and reducing greenhouse gas emissions. However, it also intensifies climate change through increased travel-related emissions and resource consumption, emphasizing the need for sustainable tourism development to balance these effects.

Wiratama et al. (2024) note that tourism can mitigate climate change impacts through energy efficiency, sustainable resource management, and waste reduction initiatives. On the other hand, it exacerbates climate change through greenhouse gas emissions related to transportation, energy consumption, and waste production from tourism activities.

3. DATA AND METHOD

In this study, the impact of tourism and renewable energy consumption on carbon emissions is tested using annual data from developed countries (Spain, France, Italy, Germany, Austria, Switzerland, Portugal, Greece, Sweden, and Norway) for the period 2000-2023. To examine the relationship in question, the following baseline panel data model is constructed based on the studies by Khan et al. (2017; 2019):

$$lnco2_{it} = \alpha + \beta_1 \, lntourism_{it} + \beta_2 \, lnrec_{it} + \mu_{it}$$

All variables were included in the model logarithmically, and the definitions and data sources of the relevant variables are given in Table 1.

Under this section, the test procedures for the panel unit root test, panel cointegration tests, and long-run coefficient estimation methods employed in the study are presented in sequence. First, the stationarity of the series is tested using the Levin-Lin-Chu (LLC) panel unit root test proposed by Levin et al. (2002). The basic equation of the test is as follows:

$$\Delta\gamma_{it} = \beta_i + \delta\gamma_{it-1} + \sum_{k=1}^{Z} \rho_K \Delta\gamma_{it-k} + \theta_{it} + \vartheta_t + \mu_{it}$$

Here, Δ denotes the first-difference operator, Z represents the lag length, β indicates unit-specific fixed effects, and ϑ denotes unit-specific time effects. In the LLC unit root test, the coefficient δ is assumed to be homogeneous across all cross-sectional units.

Table 1: Definition of variables

Variables	Definition	Source
lnrec	Renewable energy consumption	World Bank
lntourism	Number of international tourists	Development
lnco2	Carbon dioxide emissions	Indicators

Following the stationarity analysis, the Pedroni and Kao panel cointegration tests are employed to determine the existence of long-run dynamic relationships among the variables. The basic equation of the Pedroni panel cointegration test, proposed by Pedroni (1999, 2004), is as follows:

$$Y_{it} = \propto_i + \varnothing_i t + \sum_{n=1}^{N} \beta_{ni,} X_{nit} + \varepsilon_{it}$$

Here, $\propto_\iota$, $\varnothing_\iota$, and n represent the unit-specific constant, deterministic trend component, and the number of predictors, respectively. This test includes four within-group statistics and three between-group statistics. Following the Pedroni cointegration analysis, the cointegration analysis proposed by Kao (1999) is applied to strengthen the reliability of the results.

After detecting the long-run cointegration relationship among the variables, the study proceeds to the long-run coefficient estimation stage. For this purpose, the fully modified ordinary least squares (FMOLS) method proposed by Pedroni (2000) and the dynamic ordinary least squares (DOLS) method proposed by Mark and Sul (2003) are adopted. These estimators follow an I(1) process to analyze the relationship between cointegrated variables. The following equation is considered for the FMOLS and DOLS estimators in the analysis:

$$Y_{it} = \partial_i + \delta_i t + \sum_{p}^{P_i} \beta_{ip,} \Delta X_{it-p} + \sigma_{it}$$

In general, although it is accepted that the DOLS estimation results are more reliable than the FMOLS results, the lack of consensus on this matter provides the rationale for including the results of both estimators in the study and making a comparison between them.

4. RESULTS

In this section, firstly, the stationarity tests of the variables used in the analysis are given in Table 2. When the findings are examined, it is understood that all series are stationary in the first difference in the model without constant and trend.

The results of the Pedroni and Kao panel cointegration tests, applied to detect the long-term cointegration relationship after the unit root test, are presented in Table 3. Upon examining the results, it can be stated that both tests indicate a strong long-term cointegration relationship. In this case, the next step is to proceed

Table 2: Levin-lin-chu panel unit root test results

Variable	Intercept		Intercept and trend		None	
	Statistics	Probability	Statistics	Probability	Statistics	Probability
lnco2	6.712	1.000	7.704	1.000	2.365	0.989
lnrec	9.277	1.000	16.832	1.000	3.964	0.876
lntourism	9.715	1.000	16.645	1.000	1.201	0.905
dlnco2	−3.014	0.001	−0.916	0.480	−2.959	0.001*
dlnrec	−3.589	0.013	−4.203	0.000*	−4.589	0.000*
dlntourism	−5.086	0.000*	−6.178	0.000*	−6.959	0.000*

* indicates 1% statistical significance level

Table 3: Cointegration test results

Pedroni cointegration test results				
Tests	**Statistics**	**Probability**	**Statistics**	**Probability**
Panel v-statistic	−5.071236	0.9645	−5.123464	0.6374
Panel rho-statistic	−0.297134	0.4579	0.1012387	0.6098
Panel PP-statistic	−7.315067	0.0000*	−6.798023	0.0000*
Panel ADF-statistic	−7.036456	0.0000*	−7.045630	0.0000*
Group rho-statistic	1.7034623	0.8023		
Group PP-statistic	−7.178239	0.0000*		
Group ADF-statistic	−7.079843	0.0000*		
Kao cointegration test results				
ADF	6.703654	0.0000*		

*indicates 1% statistical significance level

Table 4: Long-term coefficient estimation results (dependent variable lnco2)

Variables	FMOLS		DOLS	
	Coefficient	t-statistic (probability)	Coefficient	t-statistic (probability)
lnrec	−0.137426	−4.504697 (0.000)*	−0.153169	−1.113641 (0.251)
lntourism	−0.370894	−3.347896 (0.000)*	−0.076238	−0.414697 (0.690)

*indicates 1% statistical significance level

with the coefficient estimation phase to determine the degree and direction of the impact between the cointegrated variables.

The long-run coefficient estimation results obtained from the FMOLS and DOLS estimators are presented in Table 4 below. Upon examining Table 4, the DOLS test results indicate that an increase in renewable energy consumption does not have a significant effect on pollution in the long run. The effect of increased renewable energy consumption and tourism revenues in reducing carbon emissions is revealed through the FMOLS test results. The FMOLS results are statistically significant, indicating that there are strong, long-term relationships between the variables. The FMOLS method corrects for autocorrelation and simultaneity biases while calculating the cointegrated relationships between the series, providing more precise and econometrically robust results. Based on the study findings:

- An increase in renewable energy consumption reduces carbon emissions in the long run. A 1% increase in renewable energy consumption leads to a reduction of approximately 0.14% in carbon emissions on average.
- An increase in tourism revenues also has a negative (reducing) impact on carbon emissions. A 1% increase in tourism revenues reduces carbon emissions by 0.37%.

The insignificant results from the DOLS estimation may suggest that the temporal structure or structural breaks might not have been adequately captured in the modeling. The FMOLS results provide strong evidence that renewable energy consumption and sustainable tourism policies in developed countries could have long-term positive effects on carbon emissions. However, the DOLS results not finding these effects significant may imply that the policy effectiveness could vary from country to country or that the impact of these variables might be delayed or indirect over time.

These results demonstrate that the shift towards renewable energy and sustainable tourism activities support environmental sustainability in developed countries. The increase in tourism revenues, when supported by environmental policies (such as eco-tourism or carbon footprint-reducing practices), plays a role in reducing carbon emissions. Likewise, the use of renewable resources reduces fossil fuel consumption, thereby decreasing emissions.

5. CONCLUSION

This study aims to examine the long-term effects of tourism revenues and renewable energy consumption on carbon emissions in developed countries using annual panel data from the period 2000-2023. Firstly, a long-term cointegrated relationship between the variables was identified using the Pedroni and Kao panel cointegration tests. Following this finding, long-term coefficient estimations were carried out using the FMOLS (fully modified ordinary least squares) and DOLS (dynamic ordinary least squares) methods. The results obtained vary depending on the estimation method used.

The FMOLS estimation results reveal that both renewable energy consumption and tourism revenues have negative and statistically significant effects on carbon emissions. Accordingly, a 1% increase in renewable energy consumption reduces carbon emissions by approximately 0.14%; similarly, a 1% increase in tourism revenues reduces carbon emissions by approximately 0.37%. These results indicate that renewable energy investments and sustainable tourism policies play a role in enhancing environmental quality in developed countries. The widespread use of renewable energy reduces dependence on fossil fuels and has a significantly reducing effect on carbon emissions. On the other hand, the impact of tourism revenues in reducing carbon emissions may reflect eco-tourism policies developed in accordance with the principle of environmental sustainability in these countries.

However, the DOLS estimation results show that neither renewable energy consumption nor tourism revenues have a statistically significant impact on carbon emissions. Although the coefficients of both variables are negative, the obtained t-statistics are low and well above the 5% significance level. This suggests that the impact of renewable energy and tourism on reducing carbon emissions may not be strong enough in the short run or within the framework of current time-series dynamics. In this context, the findings obtained from the DOLS method suggest that the relationships between environmental indicators and economic activities may be more complex, and cross-country heterogeneities may play a role.

The differences in the results of FMOLS and DOLS estimations may depend on the structural assumptions of the econometric methods used and the sensitivity of the estimates. While the FMOLS method addresses potential issues such as simultaneity and autocorrelation, providing more reliable coefficient estimates, the DOLS method models the relationships between variables with a different approach by adding dynamic differences. In this context, the FMOLS findings appear to be more stable and meaningful.

Based on the findings of this study, the following policy recommendations can be made:

- Increase renewable energy investments: Even in developed countries, the share of renewable sources in total energy supply can remain limited. Increasing incentives for renewable energy technologies and gradually removing fossil fuel subsidies will significantly contribute to reducing carbon emissions.
- Promote sustainable tourism policies: The FMOLS results suggest that tourism revenues do not harm the environment; on the contrary, they can reduce carbon emissions. To ensure the sustainability of this effect, it is crucial to support environmentally friendly transportation infrastructure, energy-efficient accommodation facilities, and nature-sensitive tourism activities.
- Environmental policies should be differentiated by country: The insignificance of the DOLS estimates suggests that policy impacts may vary from country to country. Therefore, when formulating energy and tourism policies, it is essential to consider each country's energy infrastructure, economic structure, and environmental priorities; customized strategies should be developed.
- Improve data quality and modeling techniques; conduct alternative analyses: Particularly, models should be re-examined by considering the effects of structural breaks, institutional reforms, and external shocks such as pandemics. Future studies should incorporate panel causality tests (e.g., Hatemi-J, Dumitrescu-Hurlin) or panel structural break models.

In conclusion, this study highlights the potential of renewable energy consumption and tourism revenues in reducing carbon emissions in developed countries, while also emphasizing that different findings sensitive to methodology need careful evaluation. In line with sustainable development goals, integrating environmentally compatible energy and tourism policies plays a key role in combating climate change.

REFERENCES

Acaroğlu, H., Güllü, M., Seçilmiş, C. (2023), Climate change, the by-product of tourism and energy consumption through a sustainable economic growth: A non-linear ARDL analysis for Turkey. Environmental Science and Pollution Research, 30(34), 81585-81599.

Avcı, P., Sarıgül, S.S., Karataşer, B., Çetin, M., Aslan, A. (2024), Analysis of the relationship between tourism, green technological innovation and environmental quality in the top 15 most visited countries: Evidence from method of moments quantile regression. Clean Technologies and Environmental Policy, 26(7), 2337-2355.

Bantoudi, F., Pentaftiki, M. (2022), Climate change and tourism: Challenges and prospects. In: The Academic Language of Climate Change: An Introduction for Students and Non-native Speakers. England: Emerald Publishing Limited, p13-19.

Ben Jebli, M., Ben Youssef, S., Apergis, N. (2019), The dynamic linkage between renewable energy, tourism, CO_2 emissions, economic growth, foreign direct investment, and trade. Latin American Economic Review, 28(1), 2.

Dogru, T., Bulut, U., Kocak, E., Isik, C., Suess, C., Sirakaya-Turk, E. (2020), The nexus between tourism, economic growth, renewable energy consumption, and carbon dioxide emissions: Contemporary evidence from OECD countries. Environmental Science and Pollution Research, 27, 40930-40948.

Ghosh, A., Kayal, P., Bagchi, P. (2024), Climate change and tourism: Assessing the nexus and climate-related disasters in diverse economies. Journal of Cleaner Production, 443, 141097.

Grimm, I.J., Alcântara, L.C., Sampaio, C.A.C. (2018), Tourism under climate change scenarios: Impacts, possibilities, and challenges. Revista Brasileira de Pesquisa em Turismo, 12(3), 1-22.

Kao, C. (1999), Supirious regression and residual-based tests for cointegration in panel data. Journal of Econometrics, 90, 1-44.

Khan, I., Han, L., Khan, H. (2022), Renewable energy consumption and local environmental effects for economic growth and carbon emission: evidence from global income countries. Environmental Science and Pollution Research, 29, 1-18.

Khan, M.T.I., Yaseen, M.R., Ali, Q. (2017), "Dynamic relationship between financial development, energy consumption, trade and greenhouse gas: Comparison of upper middle income countries from Asia, Europe, Africa, and America". Journal of Cleaner Production, 161, 567-580.

Khan, M.T.I., Yaseen, M.R., Ali, Q. (2019), "Nexus between financial development, tourism, renewable energy, and greenhouse gas emission in high-income countries: A continent-wise analysis". Energy Economics, 83, 293-310.

Kuldasheva, Z., Ahmad, M., Salahodjaev, R., Fahlevi, M. (2023), Do tourism and renewable energy influence CO_2 emissions in tourism-dependent countries?. International Journal of Energy Economics and Policy, 13(6), 146-152.

Leitão, N.C., Balsalobre-Lorente, D. (2021), The effects of tourism, economic growth and renewable energy on carbon dioxide emissions. In: Strategies in Sustainable Tourism, Economic Growth and Clean Energy. Switzerland, AG: Springer Nature, 67-87.

Levin, A., Lin, C.F., Chu, C.S.J. (2002), Unit root tests in panel data: Asymptotic and finite-sample properties. Journal of Econometrics, 108(1), 1-24.

Mehmood, S., Kaewsaeng-on, R. (2025), Greening wallets or worsening landscapes: Exploring carbon footprints of renewable energy, tourism, and financial development indices. Natural Resources Forum, 49(1), 407-424.

Omar, N., Safeei, R., Jali, F.A., Mohammed, S. (2024), Tourism under pressure: Analyzing the impacts of climate change and over-tourism on destinations. International Journal of Research and Innovation in Social Science, 8(9), 1688-1697.

Pedroni, P. (1999), Critical values for cointegration tests in heterogeneous panels with multiple regressors. Oxford Bulletin of Economics and

Statistics, 61, 653-670.

Pedroni, P. (2000), "Fully-modified OLS for Heterogeneous Cointegrated Panels". Department of Economics Working Papers 2000-03, Department of Economics, Williams College.

Raihan, A. (2024), The influence of tourism on the road to achieving carbon neutrality and environmental sustainability in Malaysia: The role of renewable energy. Sustainability Analytics and Modeling, 4, 100028.

Samanta, P. (2021), Sustainable Tourism-A Comprehensive Measure for Counteracting Climate Change [SSRN Working Paper].

Singh, A., Bhatt, P., Modi, N.R. (2022), Bilateral relationship between tourism and climate change: Impacts, vulnerability and solutions. International Association of Biologicals and Computational Digest, 1(2), 182-187.

Spetan, K.A.A., AL-Rawabdeh, M.M., Al-Assaf, G.I., Al-Tal, R.M. (2024), Renewable energy consumption, climate change, and economic growth: A case of selected countries. Journal of Ecohumanism, 3(6), 1645-1665.

Syzdykova, A., Abubakirova, A., Erdal, F.B., Saparova, A., Zhetibayev, Z. (2021), Analysis of the relationship between renewable energy and economic growth in selected developing countries. International Journal of Energy Economics and Policy, 11(1), 110-116.

Syzdykova, A., Azretbergenova, G.Ž., Massadikov, K., Kalymbetova, A., Sultanov, D. (2020), Analysis of the relationship between energy consumption and economic growth in the commonwealth of independent states. International Journal of Energy Economics and Policy, 10(4), 318-324.

Tanrisever, C., Pamukçu, H., Baydeniz, E. (2024), Climate change in tourism: Understanding the impacts and opportunities for sustainability. In: Future tourism Trends Volume 1: Tourism in the Changing World. England: Emerald Publishing Limited, p33-45.

Thi, D., Tran, V.Q., Nguyen, D.T. (2023), The relationship between renewable energy consumption, international tourism, trade openness, innovation and carbon dioxide emissions: International evidence. International Journal of Sustainable Energy, 42(1), 397-416.

Wiratama, I., Wijaya, I., Kenedy, F.V. (2024), Climate mitigation and waste management in the tourism industry for a sustainable ecosystem. International Journal of Applied Science and Sustainable Development (IJASSD), 6(1), 12-22.

Yaseen, A., Suseno, P., Shah, S.G.H. (2024), Tourism, information communication and technology, renewable energy consumption, economic growth and CO_2 emissions in Indonesia. EkBis: Jurnal Ekonomi dan Bisnis, 8(1), 29-41.