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## FROM CLASSROOMS TO DESTINATIONS: RETHINKING ENERGY USE IN TOURISM THROUGH EDUCATION

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### Abstract

*This study investigates the education–tourism–energy nexus in a European context over the period 2016–2024, aiming to assess how tourism dynamics, human capital, and energy efficiency interact within a sustainability framework. Using harmonized Eurostat data, the analysis adopts a comparative and descriptive approach to identify temporal trends. The results reveal that tourism is a cyclically sensitive sector, characterized by pre-pandemic stability, a sharp contraction during 2020–2021, and an asymmetric post-pandemic recovery. International tourism demand exhibits high elasticity and non-linear rebound effects, reflecting strong responsiveness to external shocks. In contrast, energy efficiency shows lower volatility, with temporary deterioration during the pandemic followed by gradual improvement, although convergence across countries remains incomplete.*

Key Words: education, energy, tourism, development, paradigm

JEL classification: L83; I25; O44

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## Introduction

Tourism represents a critical sector in this regard, given its dual role as a driver of economic growth and a significant contributor to energy consumption and environmental degradation. Simultaneously, education systems are widely acknowledged as fundamental instruments for fostering sustainability through knowledge diffusion, behavioral change, and the development of skills aligned with green transitions.

The concept of educational tourism has undergone significant transformation in recent years. McGladdery and Lubbe (2017) reconceptualize educational tourism as a multidimensional phenomenon that extends beyond traditional study travel, incorporating experiential learning, cultural immersion, and skills development. This perspective aligns with the teaching–research nexus emphasized by Edelheim (2017), who argues that tourism education has a determinant role in bridging theoretical knowledge and industry practice. More recent contributions further expand this framework by integrating technological innovation.

Parallel to these developments, a substantial body of empirical research has examined the tourism–energy–environment nexus. Early theoretical contributions, such as those by Holden (2009), emphasize the ethical and institutional dimensions that shape the environmental impacts of tourism. Subsequent empirical studies consistently identify tourism as a significant driver of energy consumption and environmental degradation. Bano et al. (2021) find that tourism expansion is closely associated with increased energy use and declining environmental quality, although the adoption of renewable energy can mitigate these effects. Similarly, Raihan et al. (2022) and Raihan and Tuspekova (2022) demonstrate that tourism-led economic growth often intensifies carbon emissions unless accompanied by structural changes in energy systems. The complexity of these relationships is further highlighted by Bi and Zeng (2019), who reveal nonlinear and spatial dynamics in the impact of tourism on carbon emissions, indicating that effects vary across regions and levels of development.

More recent studies adopt a broader and more integrative perspective. Gao et al. (2024) emphasize the role of globalization and renewable energy in shaping sustainable tourism futures, while Alcalá-Ordóñez et al. (2024) provide empirical evidence from European countries, confirming the interdependence between tourism development, economic growth, and

environmental quality. Additional context-specific analyses, such as Nawaz et al. (2023) and Qadri (2026), further illustrate that tourism–energy interactions are embedded within complex socio-economic and geopolitical contexts.

Within this framework, an emerging strand of research highlights the role of education as a moderating and transformative factor in the energy–environment relationship. Katircioglu et al. (2020) provide empirical evidence that higher education systems can attenuate the relationship between energy consumption and climate change, suggesting that increased levels of education contribute to more efficient energy use and improved environmental outcomes. This finding is supported by Osuntuyi and Lean (2023), who demonstrates that education significantly moderates the energy–growth–environment nexus by reducing environmental degradation. Chahal et al. (2025) show that education fosters sustainable entrepreneurial behavior, which in turn promotes innovation and environmentally responsible practices.

The integration of education into tourism-energy analyses remains limited, existing studies tend to prioritize economic and structural variables, often treating education as a secondary or control factor. Systematic reviews, such as Eluwole et al. (2022), highlight this imbalance and call for a more comprehensive inclusion of knowledge-based drivers in tourism research. Although recent contributions incorporate broader sustainability dimensions-including natural resources and renewable energy (Gao et al., 2024; Zheng et al., 2023) education is rarely positioned as a central explanatory variable.

The study bridges the gap between micro-level processes and macro-level outcomes by linking educational systems with observable patterns of energy use in tourism destinations. The study adopts an integrative perspective that connects educational systems (“classrooms”) with tourism practices (“destinations”), thereby linking knowledge formation processes with real-world sustainability outcomes. The research emphasizes the behavioral and institutional mechanisms through which education affects energy consumption, including changes in tourist behavior, improvements in workforce competencies, and the adoption of energy-efficient technologies.

### Data and methodology

This study employs a comparative framework to analyze the education–tourism–energy nexus across some of European and Western Balkan countries over the period 2015–2024, using harmonized data from Eurostat (2026), presented in Table 1. The study integrates key dimensions of the education–tourism–energy nexus, combining tourism activity, economic performance, and energy efficiency. The dataset includes three core variables: (i) nights spent by educational attainment level of tourists, capturing tourism demand across all ISCED 2011 levels; (ii) gross value added by main industries reflecting the contribution of tourism and services to GDP; and (iii) energy efficiency index, measuring the ratio between economic output and energy use. All variables are expressed in relative or indexed terms to ensure cross-country comparability.

Methodologically, the study follows a descriptive and comparative analytical approach, structured in three sub-periods: pre-pandemic (2016–2019), pandemic shock (2020–2021) and post-pandemic recovery (2022–2024). The analysis focuses on identifying temporal trends, structural breaks, and cross-country heterogeneity, with particular emphasis on volatility and recovery dynamics.

Table 1: *Summary of the indicators analyzed, 2015-2024*

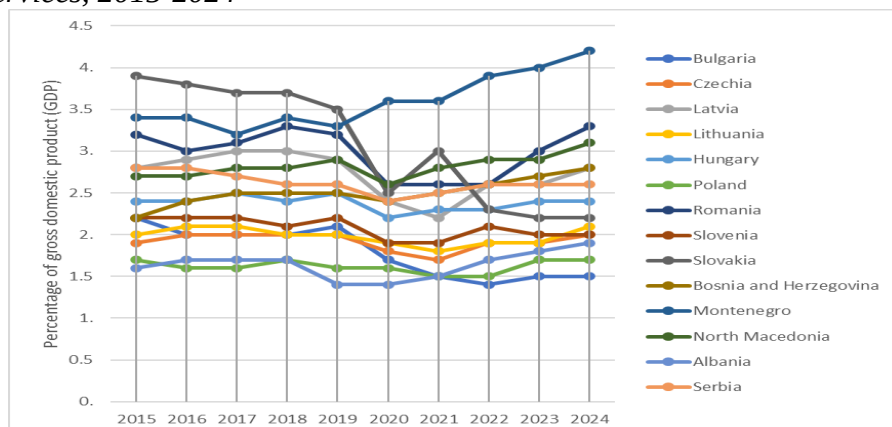
| Indicator                                                   | Eurostat code | DOI                                                                                           |
|-------------------------------------------------------------|---------------|-----------------------------------------------------------------------------------------------|
| Nights spent by educational attainment level of the tourist | tour_dem_tned | <a href="https://doi.org/10.2908/TOUR_DEM_TNED11">https://doi.org/10.2908/TOUR_DEM_TNED11</a> |
| Gross value added and income by main industry (NACE Rev.2)  | nama_10_a10   | <a href="https://doi.org/10.2908/NAM_A_10_A10">https://doi.org/10.2908/NAM_A_10_A10</a>       |
| Energy efficiency                                           | nrg_ind_eff   | <a href="https://doi.org/10.2908/NRG_IND_EFF">https://doi.org/10.2908/NRG_IND_EFF</a>         |

Source: *Aauthors selection from Eurostat database*

### Results and Discussions

The empirical analysis focuses on the European Union, leveraging harmonized datasets to provide a comparative and policy-relevant assessment across countries. This regional focus addresses a significant gap in the literature and aligns with ongoing efforts to achieve climate neutrality and sustainable tourism development within the EU.

Figure 1: *Gross value added and income by main industry, tourism and services, 2015-2024*



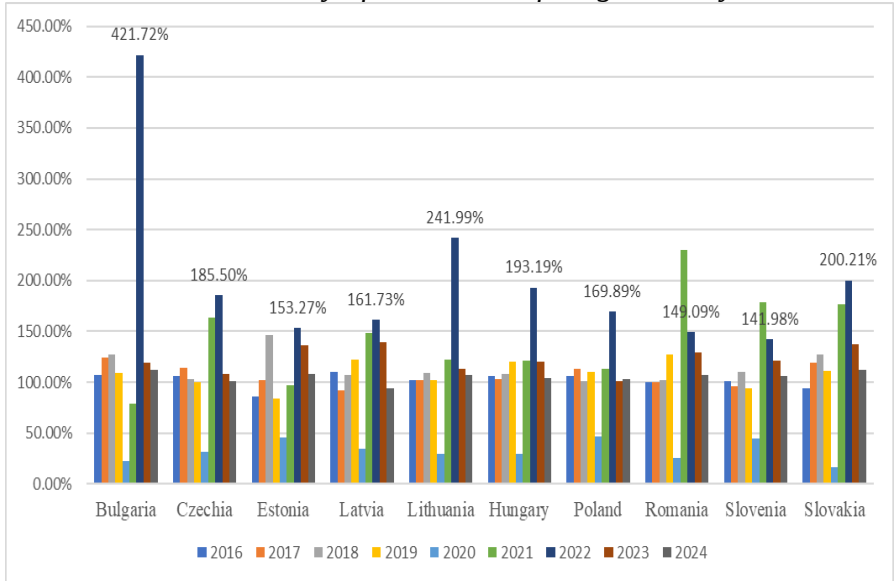
Source: *Authors computations based on Table 1*

The evolution of tourism and related services value added as a share of GDP over 2015–2024 reveals a clear cyclical pattern, characterized by pre-pandemic stability, a sharp pandemic-induced contraction, and an uneven recovery. During 2015–2019, tourism value added remains relatively stable, generally within the range of 2% to 3.5% of GDP, with only modest upward trends. Countries such as Hungary, Poland, and Montenegro exhibit gradual increases, indicating steady sectoral expansion, while Romania, Bulgaria, and Albania maintain lower and stable levels, reflecting limited tourism dependence. In contrast, Latvia and Montenegro display higher shares, pointing to stronger structural reliance on tourism activities.

The recovery phase (2022–2024) is asymmetric, Montenegro shows a strong rebound, exceeding pre-pandemic levels (above 4% of GDP), while Poland, Czechia, and Romania exhibit moderate recovery toward previous levels. Latvia and Slovakia demonstrate slower adjustment, remaining below pre-2020 values.

The results indicate that tourism is a moderately significant but volatile contributor to GDP, with higher specialization associated with greater vulnerability. From a nexus perspective, the rebound in tourism value added likely implies increased energy demand, reinforcing the need for education-driven improvements in efficiency and sustainable practices.

Figure 2: *Nights spent by educational attainment level of the tourist All ISCED 2011 levels, Country of destination, foreign country, 2015-2024*



Source: *Authors computations based on Table 1*

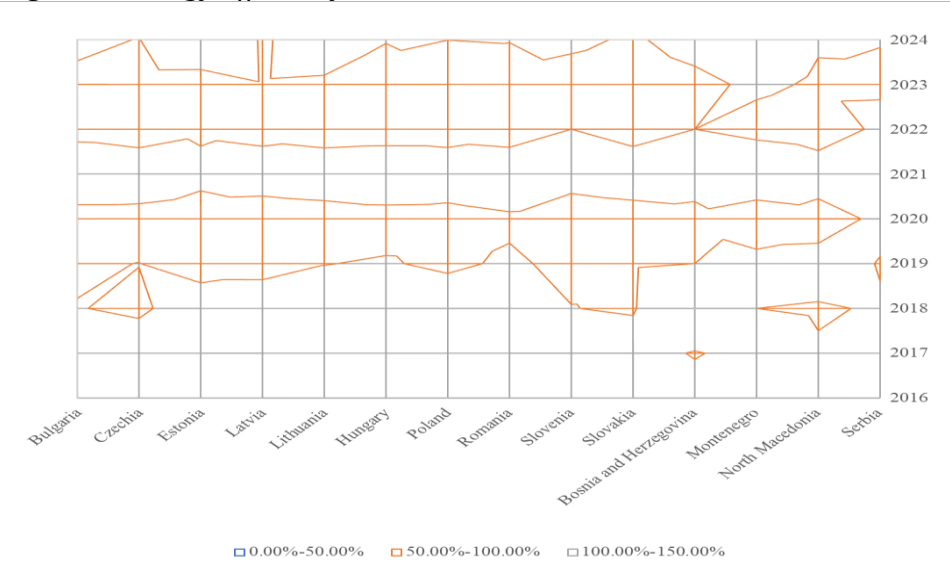
The evolution of nights spent abroad (all ISCED 2011 educational levels) over 2016–2024 evidences volatility, a pandemic-induced contraction, and a rebound effect, with substantial cross-country heterogeneity. In the pre-pandemic period (2016–2019), values remain relatively stable, generally fluctuating within a range of ~90% to 130%, indicating consistent outbound tourism demand across countries.

A sharp contraction occurs in 2020–2021, where most countries experience substantial declines, in several cases falling below 50% of baseline levels. This reduction is particularly evident in Romania, Slovakia, and the Baltic states, reflecting the high elasticity of international tourism to mobility restrictions. The magnitude and uniformity of this decline confirm the sector’s systemic vulnerability to external shocks.

The recovery phase (2022–2024) is characterized by strong rebound effects and asymmetry. Exceptional growth rates are observed in 2022, notably in Bulgaria (~421.7%), Lithuania (~242.0%), Czechia (~185.5%) and Hungary (~193.2%), largely driven by base effects and pent-up demand following the pandemic. However, this recovery is not uniform. While some countries stabilize near pre-pandemic levels (e.g., Czechia,

Estonia, Slovenia), others exhibit overshooting followed by correction, indicating transitional adjustment dynamics. From a nexus perspective, the rebound implies a rapid increase in tourism-related energy demand, particularly in transport and accommodation sectors. The use of aggregated ISCED levels indicates that the recovery is broad-based across educational groups, suggesting that higher educational attainment alone does not automatically translate into more energy-efficient tourism behavior.

Figure 3: *Energy efficiency in EU, 2015-2024*



Source: *Authors computations based on Table 1*

The evolution of energy efficiency over 2016–2024 indicates moderate levels, temporal instability, and partial post-pandemic improvement across countries. In the pre-pandemic period (2016–2019), most observations cluster within the 50–100% interval, reflecting relatively homogeneous and stable efficiency conditions with limited cross-country dispersion. A structural disturbance is observed in 2020, characterized by increased variability and slight efficiency deterioration, consistent with pandemic-induced distortions in the relationship between energy consumption and economic output. From 2021 onward, a gradual upward shift is evident, with several countries intermittently reaching the 100–150% range, indicating improvements in energy efficiency. However, this recovery is heterogeneous and non-linear, with persistent cross-country

differences and occasional volatility, pointing to uneven structural adjustments.

### **Conclusions**

The results indicate that tourism constitutes a cyclically sensitive component of economic activity, exhibiting a pattern of relative stability during the pre-pandemic period, followed by a sharp contraction in 2020–2021, and subsequently an asymmetric and non-linear recovery. The behavior of international tourism demand, proxied by nights spent abroad, reveals high elasticity and pronounced rebound effects, driven by base effects and pent-up demand. In contrast, energy efficiency displays comparatively lower volatility, reflecting its more structural nature. The gradual improvement observed after 2021 suggests adaptive adjustments in energy use, potentially supported by technological adoption, policy interventions, and shifts in economic structure. The persistence of cross-country disparities indicates incomplete convergence, pointing to uneven progress in efficiency gains and underlying structural differences among economies. Within the nexus framework, the findings suggest that the recovery of tourism activity is inherently associated with increased energy demand, particularly in energy-intensive sectors such as transport and accommodation. At the same time, variations in recovery trajectories and efficiency outcomes appear to be influenced by differences in human capital, institutional quality, and innovation capacity. In this context, education emerges as a latent but critical structural determinant, shaping both demand-side behavior (e.g., consumption patterns and environmental awareness) and supply-side practices (e.g., adoption of energy-efficient technologies and managerial efficiency), although the impact is largely indirect and mediated, depending on the extent to which knowledge and skills are effectively translated into operational and behavioural changes.

### **References**

1. Alcalá-Ordóñez, A., Brida, J. G., Cárdenas-García, P. J., & Segarra, V. (2024). The Nexus Between Tourism, Economic Growth and Environment: Empirical Evidence from European Countries. In *International Conference on Geographic Perspectives on Climate Change Mitigation in Urban and Rural Environments* (pp. 31–41). Springer Nature Switzerland. [https://doi.org/10.1007/978-3-031-92115-5\\_3](https://doi.org/10.1007/978-3-031-92115-5_3)

2. Bano, S., Alam, M., Khan, A., & Liu, L. (2021). The nexus of tourism, renewable energy, income, and environmental quality: an empirical analysis of Pakistan. *Environment, Development and Sustainability*, 23(10), 14854–14877. <https://doi.org/10.1007/s10668-021-01275-6>
  
3. Bi, C., & Zeng, J. (2019). Nonlinear and spatial effects of tourism on carbon emissions in China: a spatial econometric approach. *International Journal of Environmental Research and Public Health*, 16(18), 3353. <https://doi.org/10.3390/ijerph16183353>
  
4. Chahal, J., Dagar, V., & Shoukat, M. H. (2025). Sustainable entrepreneurship: examining stimulus-organism-response to the nexus of environment, education and motivation. *Management Decision*, 63(5), 1391–1416. <https://doi.org/10.1108/MD-04-2024-0845>
  
5. Edelheim, J. R. (2017). Teaching–research nexus in tourism, hospitality and event studies. In *Handbook of teaching and learning in tourism* (pp. 467–483). Edward Elgar Publishing. <https://doi.org/10.4337/9781784714802.00044>
  
6. Eluwole, K. K., Bekun, F. V., & Lasisi, T. T. (2022). Fresh insights into tourism-led economic growth nexus: a systematic literature network analysis approach. *Asia Pacific Journal of Tourism Research*, 27(4), 374–410. <https://doi.org/10.1080/10941665.2022.2075775>
  
7. Gao, L., Ali, Q., Yaseen, M. R., Makhdum, M. S. A., Sarkodie, S. A., Nisa, M., & Khan, M. T. I. (2024). Global nexus between tourism and sustainable futures: the role of economic growth, globalization and renewables. *Environment, Development and Sustainability*, 1–36. <https://doi.org/10.1007/s10668-024-05124-0>
  
8. Holden, A. (2009). The environment-tourism nexus: Influence of market ethics. *Annals of Tourism Research*, 36(3), 373–389. <https://doi.org/10.1016/j.annals.2008.10.009>
  
9. Katircioglu, S., Katircioğlu, S., & Saqib, N. (2020). Does higher education system moderate energy consumption and climate change nexus? Evidence from a small island. *Air Quality, Atmosphere & Health*, 13(2), 153–160. <https://doi.org/10.1007/s11869-019-00778-6>

10. McGladdery, C. A., & Lubbe, B. A. (2017). Rethinking educational tourism: proposing a new model and future directions. *Tourism Review*, 72(3), 319–329. <https://doi.org/10.1108/TR-03-2017-0055>
11. Nawaz, M. Z., Guo, J., Nawaz, S., & Hussain, S. (2023). Sustainable development goals perspective: nexus between Christians' religious tourism, geopolitical risk, and CO2 pollution in Italy. *Environmental Science and Pollution Research*, 30(22), 62341–62354. <https://doi.org/10.1007/s11356-023-26463-x>
12. Osuntuyi, B. V., & Lean, H. H. (2023). Moderating impacts of education levels in the energy–growth–environment nexus. *Sustainability*, 15(3), 2659. <https://doi.org/10.3390/su15032659>
13. Qadri, F. S. (2026). Nexus between tourism, renewable energy, and unemployment in South Africa. Insight from KRLS analysis. *Economic Change and Restructuring*, 59(1), 15. <https://doi.org/10.1007/s10644-025-09958-0>
14. Raihan, A., & Tuspekova, A. (2022). Dynamic impacts of economic growth, energy use, urbanization, tourism, agricultural value-added, and forested area on carbon dioxide emissions in Brazil. *Journal of Environmental Studies and Sciences*, 12(4), 794–814. <https://doi.org/10.1007/s13412-022-00782-w>
15. Raihan, A., Muhtasim, D. A., Farhana, S., Hasan, M. A. U., Paul, A., & Faruk, O. (2022). Toward environmental sustainability: Nexus between tourism, economic growth, energy use and carbon emissions in Singapore. *Global Sustainability Research*, 1(2), 53–65. <https://doi.org/10.56556/gssr.v1i2.408>
16. Zheng, C., Wu, S., Teng, Y. P., Wu, S., & Wang, Z. (2023). Natural resources, tourism resources and economic growth: A new direction to natural resources perspective and investment. *Resources Policy*, 86, 104134. <https://doi.org/10.1016/j.resourpol.2023.104134>