



It organizes May 23, 2025 from the New Economy cycle  
XIII Traditional Scientific Conference on the subject:

*"The Innovative Economy in Times of Global Challenges:  
New Approaches to Growth and a Sustainable Future"*

# HOW CAN INNOVATION ECOSYSTEMS ACCELERATE DECARBONIZATION AND GREEN GROWTH?

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# Motivation for the research



Green growth and decarbonization are strategic imperatives aiming for a high-income economy. To achieve long-term goals, it is necessary to establish a stimulating innovation ecosystem, supported by a developed infrastructure, which can accelerate decarbonization and green growth.

We investigate how far the Western Balkan countries are along the road to decarbonization, and what remains to be done in the innovation ecosystem in the strategic framework and policy recommendations.

The research question: Whether Western Balkan countries that have more developed innovation ecosystem measured by the AI Preparedness Index (API) published by International Monetary Fund, achieve greater Green Growth and lower Global Greenhouse Gas (GHG) total emissions and GHG per GDP emissions.

The results obtained from the comparative analysis could be the basis for creating strategic priorities and convergence policies in selected countries in the coming period.

# Agenda



Introduction



Environmental quality in developing countries and the need to introduce green innovations, decarbonization and green growth, as well as the influence of digital innovation ecosystems on low-carbon economic development



Theoretical background, which emphasizes green innovations, green growth and decarbonization of the economy, and describes the role of digital economy in green transition



Methodology

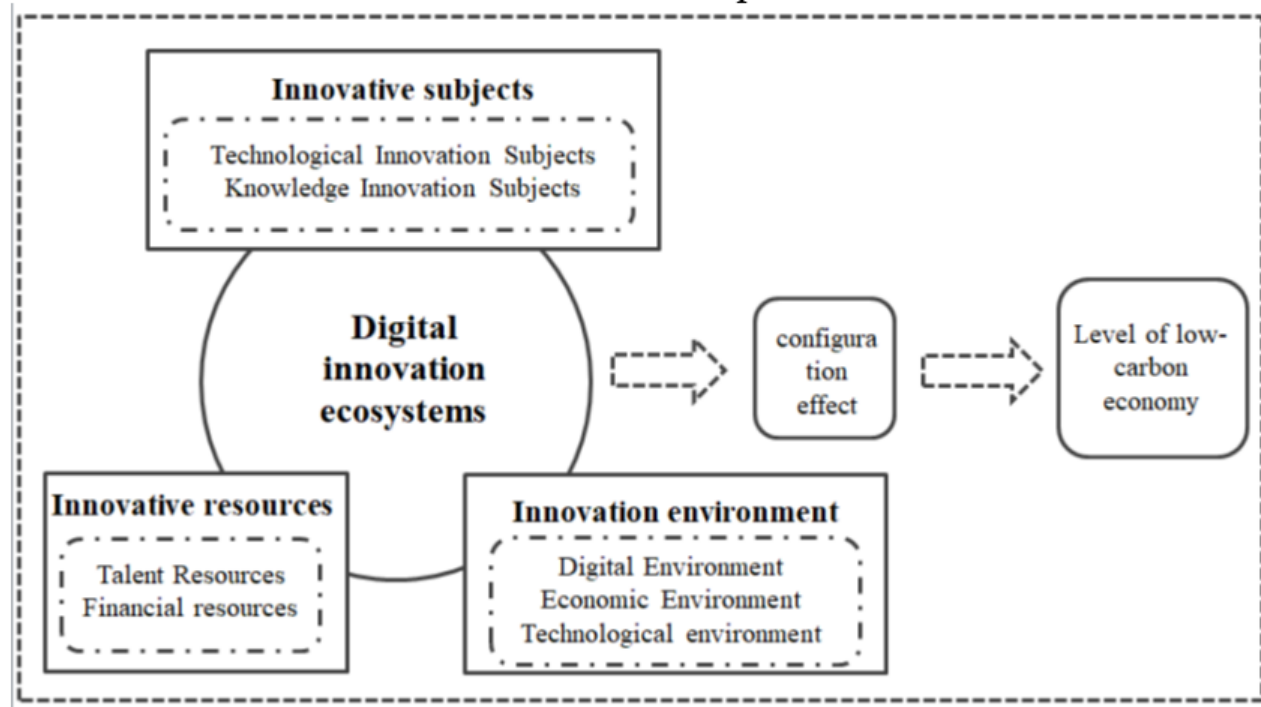


Research results and discussion



Conclusions

Figure 1. Analytical framework for digital innovation ecosystems affecting low-carbon economic development



Source: Zhang et al., 2024a, p. 5.

- A favorable technological environment strengthens the information links within the ecosystem, which is a necessary condition for the efficient generation of digital innovations.
- GHG emissions can be effectively reduced through the development and implementation of clean energy technologies, technologies to improve energy efficiency, and technologies for carbon capture and storage.
- This will lead to industrial modernization, the construction of a green financial system that will attract investments in low-carbon technologies and lead to the promotion of the transformation of green consumption and new patterns of production in society.

# Methodology



The research hypotheses are structured as follows:

- H<sub>1</sub>: Western Balkan countries that have more developed innovation ecosystem measured by the AI Preparedness Index (API), achieve greater Green Growth measured by GGI.**
- H<sub>2</sub>: Western Balkan countries that have more developed innovation ecosystem measured by the AI Preparedness Index (API), achieve and lower Global Greenhouse Gas (GHG) total emissions and GHG per GDP emissions.**
- H<sub>3</sub>: In the long run, all WB countries converge when measuring the value of GGI and GHG emissions.**

- This study is based on quantitative research methods to investigate the convergence trends in WB countries in relation to the level of development of the innovation ecosystem. The analysis is based on a panel dataset covering Western Balkan countries, which maintain close relationships with the EU.

Table 1. Target Variables

Variable	Measurement	Range Performance Level	Source
Green Growth Index (GGI)	2023 Index scores (0-100)	80–100 Very high performance 60–80 High performance 40–60 Moderate performance 20–40 Low performance <20 Critical underperformance	GGI Report 2023
AI Preparedness Index	2023 Index scores (0-1)	Higher scores represent more favorable AI preparedness	International Monetary Fund
Global Greenhouse Gas (GHG) per GDP emissions	t CO <sub>2</sub> eq/1k\$	Lower scores represent more favorable environment	European Commission, EDGAR - Emissions Database for Global Atmospheric Research
Global Greenhouse Gas (GHG) total emissions	<u>Mton</u> CO <sub>2</sub> eq	Lower scores represent <u>more</u> favorable environment	

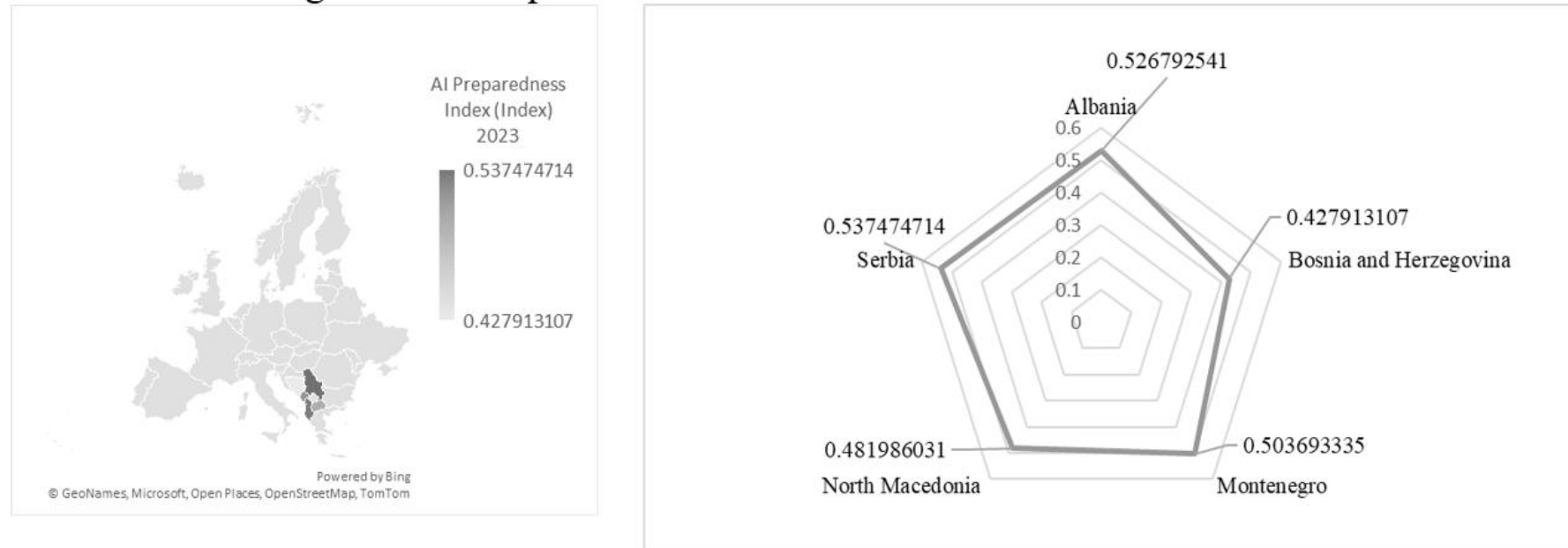
Source: Authors presentation



- **The Green Growth Index (GGI)** evaluates national performance across the following **four dimensions** of sustainable development: 1) Efficient and Sustainable Resource Use: Energy productivity, water efficiency, material footprint; 2) Natural Capital Protection: Biodiversity conservation, forest cover, soil health; 3) Green Economic Opportunities: Renewable energy adoption, circular economy investments, green job creation; Social Inclusion and Resilience: Income equality, access to education, healthcare quality. Higher values of the Index represent more favorable AI preparedness.
- **AI Preparedness Index (API)** assesses the level of AI preparedness across 174 countries, based on a rich set of macro-structural indicators that cover the countries' digital infrastructure, human capital and labor market policies, innovation and economic integration, and regulation and ethics. The API is the sum of **four key dimensions**: 1) digital infrastructure, 2) human capital, 3) technological innovation, and 4) legal frameworks. These four dimensions are likely relevant for smooth AI adoption. The index should be seen as an indicative measure, which guiding policymakers in identifying areas for improvements.
- **Global greenhouse gas (GHG)** emissions have followed an increasing trend mainly due to the increase in emissions from emerging economies. As a result, the atmospheric concentrations of greenhouse gases substantially increased, enhancing the natural greenhouse effect. Greenhouse gas emissions include carbon dioxide, methane and nitrous oxide from all sources, including land-use change. They are measured in tons of carbon dioxide equivalent over a 100-year time scale. Carbon dioxide equivalents (CO<sub>2</sub>eq) is a composite indicator that compares the impact of different greenhouse gases on global warming potential by converting the amounts of those gases into an equivalent amount of carbon dioxide with the same global warming potential (European Commission).

# Research results and discussion

Figure 2. AI Preparedness Index in Western Balkans in 2023.



Source: Authors according to IMF database

As shown in Figure 2, **Serbia is the leader in the region due to has the most developed innovation ecosystem among the countries of the Western Balkans**, with an AI preparedness index value of 0.5374. On the other hand, the value of this index is the lowest in Bosnia and Herzegovina (0.4279), which indicates the conclusion that the innovation ecosystem there is at the lowest level of development compared to the Western Balkans.



If we look at the GGI values in the countries of the WB in the period 2010-2023, based on Table 2, it can be concluded that Albania has the best results, followed by Serbia, Bosnia and Herzegovina, North Macedonia and Montenegro, respectively.

Table 2. Values of the Green Growth Index in Western Balkans in the period 2010-2023.

Green Growth Index	Albania	Bosnia and Herzegovina	Montenegro	North Macedonia	Serbia
2010	61.19	55.59	45.37	56.44	58.42
2011	60.7	56.33	45.27	56.5	57.86
2012	60.32	57.07	45.01	56.37	57.12
2013	59.21	58.18	46.26	57.65	57.72
2014	59.83	58.02	45.92	57.99	58.08
2015	59.67	57.97	46.03	58.21	58.76
2016	61.45	56.39	45.73	58.46	58.99
2017	61.97	57.98	46.19	57.93	59.07
2018	62.58	59.31	46.97	58.72	59.36
2019	63.13	59.53	48.01	58.76	59.51
2020	64.25	60.3	47.73	59.08	59.94
2021	65.09	60.69	48.72	59.93	60.45
2022	65.19	61.15	48.91	60.16	60.46
2023	65.16	60.85	48.96	59.9	60.34

Source: Authors presentation based on GGI Report 2023.



- Table 3 shows that the country with the greatest progress in the GGI from 2010 to 2023 is Bosnia and Herzegovina, with an increase of 5.26 index points. Albania shows clear growth, with slight oscillations to stable growth after 2016. Montenegro has the lowest values, with slight growth over the years. Other countries have stable but slower growth.
- Albania has the highest median and the largest range. Montenegro has the smallest variation and the lowest indices. Serbia and North Macedonia are similar in stability and index level.

Table 3. Descriptive statistics for GGI

Country	Mean	Std	Min	25% quantile	Median (50%)	75% quantile	Max	Rank	Variance
Albania	62.12	2.14	59.21	60.42	61.71	63.97	65.19	5.98	4.58
Bosnia and Herzegovina	58.53	1.82	55.59	57.30	58.10	60.11	61.15	5.56	3.30
Montenegro	46.79	1.41	45.01	45.78	46.22	47.94	48.96	3.95	1.99
North Macedonia	58.29	1.26	56.37	57.72	58.34	59.00	60.16	3.79	1.60
Serbia	59.01	1.07	57.12	58.16	59.03	59.83	60.46	3.34	1.16

Source: Authors calculation

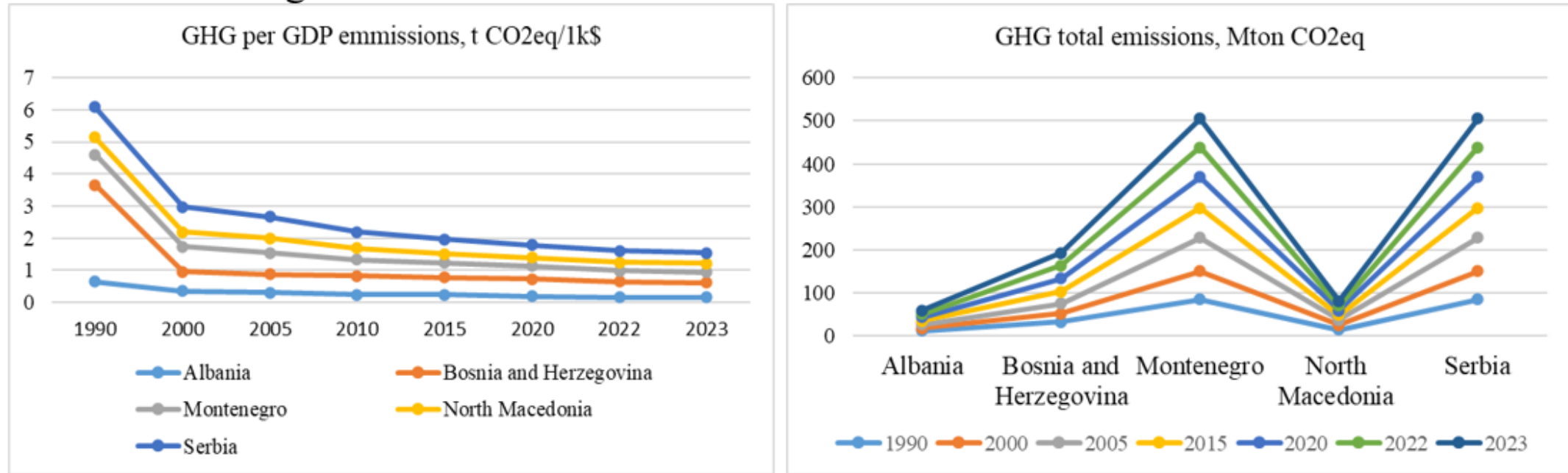
- The distribution of values by country, and how the Green Growth Index has changed over the years for each country. **Albania has the convergence trends with average scores in EU.**
- Range of the performance level indicate that all analyzed countries have moderate performance, except for Albania, which achieves high performance of the GGI in the whole period 2016-2023.

Figure 3. Green Growth Index trendline by WB countries



Source: Authors illustration based on GGI Report 2023.

Figure 4. GHG emissions in Western Balkans from 1990-2023.



Source: Authors based on Eurostat database

- GHG emissions in WB in 1990-2023, measured by two indicators: GHG per GDP emissions and GHG total emissions. **All countries have similar converge trends in the whole period, so it indicates that so significance difference between selected countries.**
- **Serbia is leader with the highest level of GHG emissions while Albania has the lowest scores.**

# Conclusion



- The results of this research confirm the relevance of innovation ecosystems in the context of green growth and decarbonization, although their influence is neither uniform nor exclusive. Digital technologies and innovation ecosystems can directly and indirectly influence the development of a low-carbon economy.
- **Hypothesis H1 is largely confirmed.** Albania, for instance, which ranks high on the AIPI scale, also achieves the highest GGI score among Western Balkan (WB) countries, indicating a positive correlation between innovation capacity and green development.

# Conclusion



- However, **Hypothesis H2 is only partially supported.** While Albania demonstrates both high AIPI and low greenhouse gas (GHG) emissions, Serbia, the country with the most developed innovation ecosystem in the region, still records the highest total GHG emissions and GHG emissions in total and per GDP. This indicates that innovation alone is insufficient to drive decarbonization and must be supported by broader structural, regulatory, and infrastructural reforms.
- **Hypothesis H3, which proposes long-term convergence of WB countries in terms of GGI and GHG emissions, is also only partially confirmed.** A convergence trend is observed in GHG emissions across the region, but not in GGI values, suggesting differing capacities and policy approaches in achieving sustainable development goals.



# Conclusion



- **The key limitation of this study** lies in its focus solely on technological innovations, while ignoring the growing role of financial innovations in enabling green investments and transitions.
- **Future research should explore the financial dimensions of the green transition, including the cost of aligning Western Balkan countries with EU green targets, and the scale of investment needed to develop innovation ecosystems capable of supporting long-term green growth.**
- Research may include an assessment of the required public and private investments for the development of infrastructure, technologies and human resources. Additionally, examining the interaction between financial and technological innovations may offer a more comprehensive view of the drivers of decarbonization in emerging economies.

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# Thank You for Your Attention!

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