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## GREEN TRANSITION AND REGIONAL INEQUALITIES: AN ANALYSIS OF THE VULNERABILITY OF URBAN AND RURAL REGIONS IN SERBIA

### ЗЕЛЕНА ТРАНЗИЦИЈА И РЕГИОНАЛНЕ НЕЈЕДНАКОСТИ: АНАЛИЗА РАЊИВОСТИ УРБАНИХ И РУРАЛНИХ ПОДРУЧЈА У СРБИЈИ

**Summary:** The green transition, as a conceptual and strategic approach aimed at decarbonizing national economies, reducing social inequalities, and preserving natural capital, entails numerous economic and social effects in both developed and developing countries. These impacts are particularly pronounced at lower territorial levels, meaning that regions characterized by energy- and carbon-intensive activities, as well as those with lower economic diversification and unfavourable demographic characteristics, face greater vulnerability to the structural changes associated with the green transition. Taking these considerations into account, this paper examines regional inequalities in the context of the green transition in the Republic of Serbia. Its main objective is to assess whether differences in vulnerability exist between more and less developed regions, as well as between urban and rural areas, and to identify the potential drivers of such disparities. The analysis is based on the construction and application of a composite Regional Green Transition Vulnerability Index for Serbia at the NUTS 3 level. The index is developed using Principal Component Analysis (PCA) and draws on sectoral indicators covering energy, housing, transport, mining, agriculture, and tourism for 2023. The findings reveal pronounced territorial disparities and underscore the need to design green transition policies in a way that best reflects identified regional specificities.

**Keywords:** green transition, regional vulnerability, urban regions, rural regions, NUTS 3, Serbia.

**JEL Classification:** R58, O18, Q56

**Резиме:** Зелена транзиција, као концептуални и стратешки приступ усмерен ка декарбонизацији националних економија, смањењу социјалних неједнакости и очувању природног капитала, има за последицу бројне економске и друштвене ефекте како у развијеним, тако и у земљама у развоју. Поменути утицаји посебно су изражени на нижим територијалним нивоима, тако да регионима у којима су заступљене енергетски и карбонски интензивне делатности, као и онима са слабијом економском диверзификацијом и неповољним демографским карактеристикама, прети већа рањивост на промене које са собом доноси зелена транзиција. Имајући све наведено у виду, предмет рада је анализа регионалних неједнакости у контексту зелене транзиције у Републици Србији. Циљ рада је да се утврди постојање разлика у рањивости између развијених и неразвијених региона, односно између урбаних и руралних подручја, те да се идентификују њихови потенцијални узроци. Анализа се заснива на примени композитног Регионалног индекса рањивости на зелену транзицију у Републици Србији на NUTS 3 нивоу. Поменути индикатор је конструисан применом методе главних компоненти (Principal Component Analysis – PCA), на основу секторских показатеља (енергетика, становање, саобраћај, рударство, пољопривреда и туризам) за 2023. годину. Резултати истраживања указују на присуство значајних територијалних диспаратитета и упућују на потребу дизајнирања мера у оквиру зелене транзиције на начин који ће одговарати утврђеним регионалним специфичностима.

**Кључне ријечи:** зелена транзиција, регионална рањивост, урбана подручја, рурална подручја, NUTS 3, Србија

**ЈЕЛ класификација:** R58, O18, Q56

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## INTRODUCTION

One of the greatest challenges facing almost all countries today is the fight against climate change. The prevailing view is that global warming is a direct consequence of anthropogenic influence and the resulting greenhouse gas (GHG) emissions. Therefore, decarbonisation is emerging as an imperative for contemporary society as a whole, with Europe standing out over the last two decades in its efforts to reduce harmful gas emissions and become the first climate-neutral continent (European Commission 2019).

The green transition, that is, the shift towards a cleaner economy and behavioural models more generally, entails a deep structural transformation of production systems, labour markets and spatial patterns of development. In this regard, the expected effects of its implementation go beyond the environmental sphere and extend deeply into socio-economic and spatial relations. The results of recent studies indicate that measures aimed at implementing the green transition do not affect all regions equally; rather, there are substantial differences in the “vulnerability” of different types of areas. It is precisely this uneven resilience to the changes and new circumstances brought about by the green transition that may deepen existing regional inequalities, particularly in territorial units dominated by carbon-intensive activities (Rodríguez-Pose and Bartalucci 2024). Bearing in mind that one of the fundamental objectives of the EU is balanced regional development and the reduction of spatial disparities, there is now a clear understanding that territorial specificities must be taken into account when designing green-transition measures and instruments. Existing differences between urban and rural areas, between developed and lagging regions, as well as between regions with different sectoral structures, point to the need for a territorially sensitive approach (Rodríguez-Pose and Bartalucci 2023; OECD 2025). Analysing these differences is an important first step towards understanding the potential risks and opportunities that the green transition brings at lower territorial levels.

In Serbia, territorial differences between urban and rural areas contribute to regions’ varying capacity to absorb the effects of green economic transformation. It is necessary to examine how specific sectoral factors related to energy, mining, agriculture, transport and tourism affect regional vulnerability. This type of analysis points to the possibility of classifying regions according to the type of vulnerability and the potential effects of economic decarbonisation measures.

## 1. LITERATURE REVIEW

Contemporary literature on the green transition increasingly emphasises its spatial dimension. Lars Coenen, Paul Benneworth, and Bernhard Truffer (2012) note that sustainable transitions are not spatially neutral processes; rather, their effects are strongly conditioned by regional institutional, economic and innovation capacities. A spatial perspective makes it possible to better understand how local specificities influence the dynamics of structural change.

In this regard, Rodríguez-Pose and Bartalucci (2024) indicate that the green transition may generate “territorial discontent” if its costs and benefits are not evenly distributed. Regions with a high concentration of energy-intensive industries, weak diversification of the economic structure and limited innovation capacities face a greater risk of job losses and economic stagnation. These and similar findings warn that the green transition may deepen existing regional disparities.

The institutional framework of the European Union recognises these challenges. The 2021 European Commission report (European Commission 2021) on the impact of the

European Green Deal emphasises that climate and energy policies have different effects depending on the regional structure of employment, energy dependence and the level of economic development. In addition, a study also prepared for the European Commission (Rodríguez-Pose and Bartalucci 2023) developed a methodological framework for measuring regional vulnerability and opportunities in the process of the green transition, combining economic, social and technological indicators. This approach leads to the conclusion that some regions have the potential to benefit from green industrial transformation, whereas others are exposed to greater structural risks.

OECD (2025) introduces the concept of regional resilience in the green transition, emphasising the capacity of regions to adapt to shocks and make use of new development opportunities. According to this approach, the key factors of resilience are economic diversification, the quality of human capital and functional institutions. Regions that lack some of these key elements generally face increased vulnerability.

A particularly important place in the literature is occupied by the analysis of differences between urban and rural areas. József Benedek, Tihamér-Tibor Sebestyén and Blanka Bartók (2018) indicate that rural regions, especially peripheral ones, have potential for the development of renewable energy sources and sustainable forms of production, but that their institutional and financial capacities are generally limited. At the same time, the European Parliament report on lagging regions highlights the most important structural weaknesses that may limit their ability to make use of the advantages offered by the green economy (European Parliament, 2020, 46). The first of these is an increasingly pronounced decline in industrial production, which leads to mass emigration, including brain drain. There are also various challenges related to accepting structural changes, especially in the most represented sectors, resulting in low productivity (e.g. agriculture and tourism). Less developed regions do not have appropriate conditions and prerequisites for business innovation and necessary investment, primarily because of the lack of the infrastructure required to support larger-scale production. Finally, less developed and lagging regions face a deficit of managerial capacities and quality, which significantly limits their ability to improve their research and innovation systems.

Analysing the development of green industries in different types of regions, Markus Grillitsch and Teis Hansen (2019) show that metropolitan areas and industrially diversified regions have more favourable conditions for attracting investment and developing innovation in the field of green technologies. By contrast, peripheral and rural regions often remain dependent on primary activities, which may deepen regional differences under the conditions of the green transition. Less developed regions do not possess adequate capacities to absorb and integrate green technologies, which constrains their efforts to adapt their economic or industrial structure to new requirements.

The importance of a place-based approach in the implementation of green policies is emphasised by Andrea Testi et al. (2023), who develop a participatory and territorially sensitive analytical framework for applying the European Green Deal at the local level. Their approach starts from the assumption that uniform policies cannot produce equal results in different spatial contexts. Similar views are advanced by the European Commission (McCann and Soete 2020) in the document “Place-based innovation for sustainability”, which argues that sustainable innovations must be aligned with local resources and specificities.

The strategic document “Blueprint for the development of transition pathway” (European Commission 2022) points to the need to coordinate industrial policy and regional development in order to ensure a just transition. This approach implies synergy between sectoral policies and cohesion instruments in order to avoid the concentration of benefits in already developed centres.

Summarising these contributions, it may be concluded that the literature identifies three key aspects of the green transition: (1) its strong spatial dimension and uneven effects across regions (Rodríguez-Pose and Bartalucci 2024; Rodríguez-Pose and Bartalucci 2023), (2) the risk of deepening regional inequalities, particularly in less developed and rural areas (European Parliament 2020; OECD 2025), and (3) the need for a territorially sensitive, place-based approach to public policy design (Testi et al. 2023; European Commission 2022). The green transition is more than a technological or energy-related process. It is a complex territorial transformation that requires the mobilisation of local resources, respect for existing economic, demographic and social characteristics, as well as tailored policies and innovation strategies for different types of regions.

Although the cited studies are mostly focused on European Union countries, their findings have broader implications and point to the need for an empirical analysis of regional vulnerability in national contexts marked by pronounced spatial disparities. It is precisely within this framework that the analysis of regional inequalities in Serbia is positioned, with the aim of applying theoretical concepts and institutional frameworks to the specific territorial and economic context of the country.

## 2. DESCRIPTION OF VARIABLES

The objective of this research is to identify the direct and indirect impacts of the green transition in the Republic of Serbia at the NUTS 3 level, and to construct a composite Regional Green Transition Vulnerability Index. The basic research question is: What is the extent of the differences in vulnerability to the green transition between developed and underdeveloped regions, i.e. between urban and rural areas in Serbia? Based on the research results, the following hypothesis was tested: If there are significant differences in vulnerability to the green transition between urban and rural areas in Serbia, then there are key preconditions for designing green-transition measures in a way that corresponds to the identified regional specificities.

The Regional Green Transition Vulnerability Index is a summary indicator that reflects the multidimensionality of the green transition by encompassing its direct and indirect impacts. The green transition will have a significant effect on sectors that contribute the most to greenhouse gas emissions, namely energy, the agri-food sector, manufacturing industry, housing and transport (European Commission 2018). Following studies that have analysed vulnerability to the green transition in EU countries, the composite index was constructed on the basis of variables that quantify regional specificities and can be grouped into six pillars (Rodríguez-Pose and Bartalucci 2024): dependence on fossil fuels, industry, agriculture and land use, tourism, energy and transport.

Variables associated with the first two pillars quantify direct impacts, whereas variables covered by the remaining pillars quantify the indirect impacts of the green transition. Regions characterised by high emissions of harmful gases, the presence of heavy industry (such as mining) or significant dependence on agriculture are the most vulnerable to the green transition because of the need to ensure a gradual shift from fossil fuels to renewable energy sources and introduce a carbon dioxide (CO<sub>2</sub>) emissions tax and an emissions trading system. The need for sustainable land use, as well as the use of land for renewable energy production, may have a negative impact on the tourism sector. The construction of renewable energy infrastructure may significantly reduce the tourism attractiveness of rural areas with exceptional natural and overall environmental amenities.

Data were collected for 25 areas in Serbia, with 2023 selected as the year of observation. The statistical data used were available in the database and publications

(“Municipalities and Regions in the Republic of Serbia” and “Regional Gross Domestic Product, Regions and Areas of the Republic of Serbia”) of the Statistical Office of the Republic of Serbia (SORS), as well as in the Meteorological Yearbook - Climatological Data of the Republic Hydrometeorological Service of Serbia (RHMS).

*Table 1. Descriptive statistics of the initial variables for assessing vulnerability to the green transition for 25 areas in Serbia at the NUTS 3 level, 2023*

Variable	Mean	Min.	Max.	Std. dev.
CO2 emissions (agriculture, energy, transport) per capita, kt (Gg)	0.0044	0.0020	0.0131	0.0025
CO2 emissions (agriculture, energy, transport) per km2, kt (Gg)	0.3966	0.1099	3.3978	0.6398
Change in CO2 emissions (agriculture, energy, transport) per capita, 2012-2023, kt (Gg)	-0.0002	-0.0146	0.0016	0.0031
Change in CO2 emissions (agriculture, energy, transport) per km2, 2012-2023, kt (Gg)	-0.0180	-0.7629	0.4180	0.1833
Total annual gross wages in the mining sector as a share of the area's GVA	1.0393	0.0032	6.4981	1.4973
Agricultural sector GVA in relation to total area GVA	8.2788	0.6216	17.1331	4.1128
Share of employees in agriculture, forestry and fishing in total employment, %	1.6275	0.3075	4.7510	1.0850
Number of cattle per km2	9.7475	2.4468	20.2541	4.8843
Tourist arrivals/area GVA	0.7615	0.1412	3.4240	0.8129
Annual cooling degree days (CDD)	220.64	138	307	41.7412
Total registered motor vehicles and trailers	82206.88	20882	558063	103932.8

Source: Authors' research

Overall, the descriptive statistics confirm that the selected indicators capture different channels of territorial exposure to the green transition, including emission intensity, sectoral dependence, agricultural structure, tourism activity, transport pressure and climate-related demand for cooling. The observed dispersion across minimum and maximum values points to pronounced regional differences, which justifies the use of these variables in the subsequent assessment of vulnerability at the NUTS 3 level.

### 3. METHODOLOGY AND RESULTS

In order to test the initial hypothesis, following studies that analyse vulnerability to the green transition at the regional level, a composite index was constructed using Principal Component Analysis (PCA). As a special case of factor analysis, PCA consists of constructing new variables, expressed as linear combinations of the original independent variables, which are mutually orthogonal (Jovičić and Dragutinović Mitrović 2011, 87).

Since the selected variables are expressed in different units of measurement, all variables were standardised before applying PCA using z-scores. Two initial models were estimated, each comprising the nine variables shown in Table 1. The difference between the two models lies in the different way of measuring CO2 emissions. In the first model, two variables were used as measures of CO2 emissions: CO2 emissions (agriculture, energy, transport) per capita and change in CO2 emissions (agriculture, energy, transport) per capita. In the second model, these two variables were replaced by CO2 emissions (agriculture, energy, transport) per km2 and change in CO2 emissions (agriculture, energy, transport) per km2. A preliminary analysis of the correlation matrix for both models found that two variables - the number of cattle per km2 and tourist arrivals in relation to the area's GVA -

were not statistically significantly correlated with any of the other observed variables. Therefore, they were excluded from further PCA-based analysis. This is additionally justified by the fact that tourism in Serbia is not a primary target of decarbonisation, unlike energy, mining and livestock farming.

In order to select the better model for applying PCA - Model 1, in which emissions and changes in CO<sub>2</sub> emissions are observed per capita, or Model 2, in which these variables are expressed per km<sup>2</sup> - the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were applied, with the results presented in Table 2.

*Table 2. Tests of sampling adequacy and sphericity*

Test	Model 1 Value	Model 2 Value
Kaiser-Meyer-Olkin (KMO)	0.4172	0.6045
Bartlett: Chi-square (Pearson's $\chi^2$ )	90.15	122.70
Bartlett: Degrees of freedom (df)	21	21
Bartlett: Probability (p-value)	0.0000	0.0000

Source: Authors' presentation

Based on the results presented in Table 2, it can be concluded that both models satisfy Bartlett's test of sphericity (the p-value is below 0.05), while the KMO test results indicate that Model 2 should be selected (the calculated value is above the threshold value of 0.5). The advantage of Model 2 over Model 1 also stems from the fact that, for analysis at the regional level, it is more appropriate to observe the level of activity per unit of area rather than per capita. In this way, the influence of population size on the results is eliminated (for example, the Belgrade Area has the highest CO<sub>2</sub> emissions when observed per unit of area, whereas this is not the case when emissions are observed per capita, due to its high population density).

*Table 3. Factor loadings of variables used to form the Regional Green Transition Vulnerability Index in Serbia at the NUTS 3 level*

Variable	Weight/Factor loadings
CO <sub>2</sub> emissions (agriculture, energy, transport) per km <sup>2</sup> , kt (Gg)	0.5043
Change in CO <sub>2</sub> emissions (agriculture, energy, transport) per km <sup>2</sup> , kt (Gg)	0.3143
Total annual gross wages in the mining sector as a share of the area's GVA	-0.01804
Share of agricultural sector GVA in total area GVA	-0.4243
Share of employees in agriculture, forestry and fishing in total employment	-0.3281
CDD	0.3362
Total registered motor vehicles and trailers	0.4959

Source: Authors' research

The composite Regional Green Transition Vulnerability Index was formed using the standardised values of the seven variables of Model 2 and weights based on the first principal component, which explains the largest share of the total variance of the observed independent variables (45.85%). In this way, a summary (synthetic) indicator was formed on the basis of which the observed urban and rural areas can be ranked in terms of their vulnerability to the green transition. The PCA results indicate that two factors have a strong impact on the vulnerability of areas to the green transition: CO<sub>2</sub> emissions per km<sup>2</sup> and total registered motor vehicles and trailers. The factor loadings for these two variables are 0.5043 and 0.4959,

respectively (Table 3). Mining, observed through wages, has a weight close to 0 (-0.018, which implies that it has no effect, i.e. that it is statistically irrelevant for the first component), but remains included through its direct effect in terms of its contribution to total CO2 emissions. Mining is associated with two specific areas, Bor and Kolubara, which are vulnerable due to their economic dependence on mining. Regions dependent on specific sectors of the economy proved to be more vulnerable to the green transition than areas with a higher degree of economic diversification (Rodríguez-Pose and Bartalucci, 2024).

High positive weights for CO2 emissions per km2, registered motor vehicles and trailers, and CDD indicate the vulnerability of urban areas, while negative weights related to agriculture (sectoral GVA and employment share) indicate the vulnerability of rural areas. Variables related to agriculture (GVA and employment) and total gross wages in mining pull the index downwards and form the other extreme.

The first principal component is defined as a linear combination of standardised variables. The composite Regional Green Transition Vulnerability Index in Serbia for 25 areas may be written in the following form:

$$PC_i = w_1x_{i1} + w_2x_{i2} + w_3x_{i3} + w_4x_{i4} + w_5x_{i5} + w_6x_{i6} + w_7x_{i7}, \text{ i.e.} \quad (1)$$

$$PC_i = w_1x_{i1} + w_2x_{i2} + \dots + w_4x_{i4} + w_5x_{i5} + w_6x_{i6} + w_kx_{ik} \quad (2)$$

where:

$PC_i$  – Regional Green Transition Vulnerability Index (the value of the first principal component) for the  $i$ -th area,  $i = 1, 2, \dots, 25$  (25 areas);

$w_1, w_2, \dots, w_k$  – weights calculated using PCA, identical for all units of observation (areas);

$x_{i1}, x_{i2}, \dots, x_{ik}$  – value of the variables for the  $i$ -th area (a total of  $k$  variables,  $k = 7$ );

$x_{i1}$  – CO2 emissions (agriculture, energy, transport) per km2 for the  $i$ -th area;

$x_{i2}$  – change in CO2 emissions (agriculture, energy, transport) per km2 for the  $i$ -th area;

$x_{i3}$  – total annual gross wages in the mining sector in relation to the area's GVA for the  $i$ -th area;

$x_{i4}$  – share of agricultural sector GVA in the total GVA of the area for the  $i$ -th area;

$x_{i5}$  – share of employees in agriculture, forestry and fishing in total employment for the  $i$ -th area;

$x_{i6}$  – annual cooling degree days for the  $i$ -th area;

$x_{i7}$  – total registered motor vehicles and trailers for the  $i$ -th area.

Or, in abbreviated form:

$$PC_i = \sum_{j=1}^k w_j x_{ij} \quad (3)$$

where:

$PC_i$  – Regional Green Transition Vulnerability Index for the  $i$ -th area,  $i = 1, 2, \dots, 25$  (25 areas);

$w_j$  – weight of the  $j$ -th variable;

$x_{ij}$  – standardised value of the  $j$ -th variable for the  $i$ -th area;

$k$  – total number of variables.

Table 4 presents, for each of the 25 observed areas in Serbia, the calculated value of the composite Regional Green Transition Vulnerability Index, as well as the rank assigned to each area on the basis of the index value.

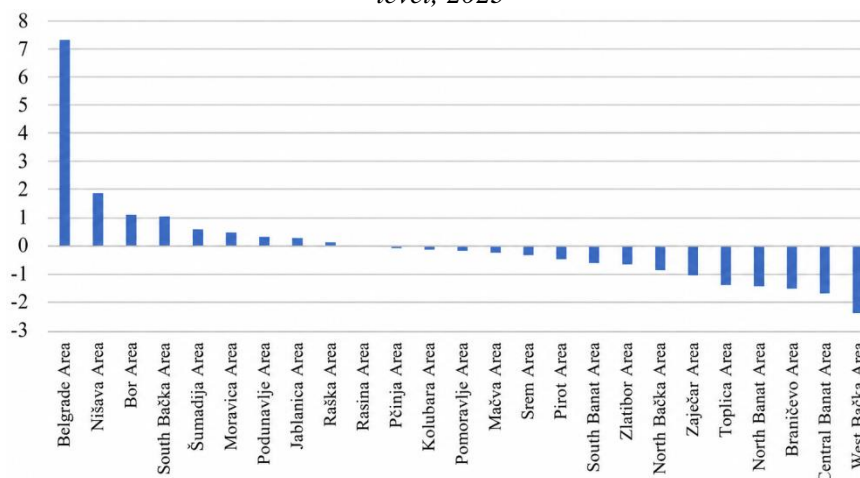
Table 4. Regional Green Transition Vulnerability Index in the Republic of Serbia at the NUTS 3 level, 2023

Area	Index	Index on a 0-1 scale	Rank
Belgrade Area	7.272456	1	1
Nišava Area	1.846271	0.4364811	2
Bor Area	1.076805	0.3565708	3
South Bačka Area	1.048227	0.3536029	4
Šumadija Area	0.589429	0.3059559	5
Moravica Area	0.4700401	0.2935572	6
Podunavlje Area	0.3207836	0.2780566	7
Jablanica Area	0.271982	0.2729885	8
Raška Area	0.0831896	0.2533821	9
Rasina Area	-0.0196919	0.2426976	10
Pčinja Area	-0.0755845	0.2368931	11
Kolubara Area	-0.132066	0.2310274	12
Pomoravlje Area	-0.1745722	0.226613	13
Mačva Area	-0.2573198	0.2180196	14
Srem Area	-0.3358077	0.2098684	15
Pirot Area	-0.5285755	0.1898492	16
South Banat Area	-0.5905026	0.1834179	17
Zlatibor Area	-0.6216182	0.1801865	18
North Bačka Area	-0.8468361	0.1567973	19
Zaječar Area	-1.038039	0.1369405	20
Toplica Area	-1.356691	0.1038479	21
North Banat Area	-1.435979	0.0956137	22
Braničevo Area	-1.509657	0.0879622	23
Central Banat Area	-1.699589	0.0682374	24
West Bačka Area	-2.356654	0	25

Source: Authors' research

The results of mapping regional vulnerability to the green transition in Serbia at the NUTS 3 level confirm the initial hypothesis, namely that there are significant differences in vulnerability to the green transition between developed and underdeveloped regions, i.e. between urban and rural areas in Serbia. Two groups of areas stand out: the first with index values above 1, and the second with index values below -1 (Figure 1). The Belgrade Area is an outlier in the statistical sense, i.e. an area whose index value is significantly higher than that of the other observed areas (7.27). Its index is considerably higher than the others due to the high concentration of vehicles and CO<sub>2</sub> emissions. Areas with large cities are the most vulnerable.

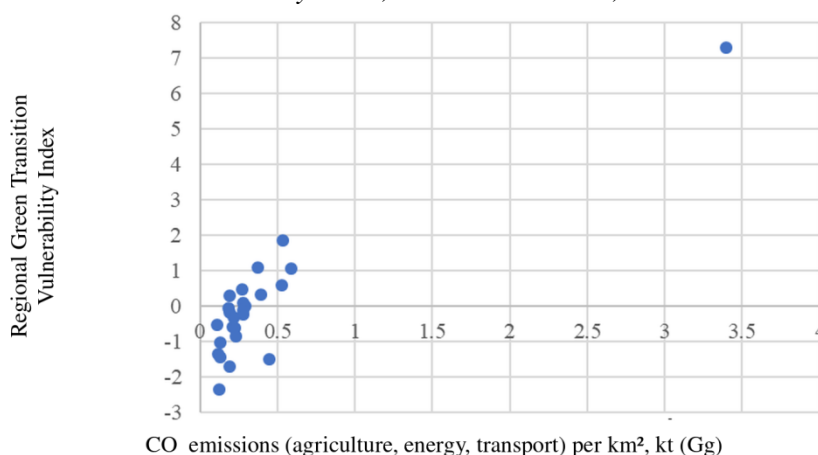
Figure 1. Regional Green Transition Vulnerability Index in the Republic of Serbia at the NUTS 3 level, 2023



Source: Authors' presentation

Given that the weights for mining and agriculture are negative, it can be concluded that there are two types of vulnerability. The green transition affects different areas differently, as confirmed by the positive weights (emissions and changes in CO2 emissions per km2, CDD and registered motor vehicles and trailers) and negative weights (wages in the mining sector and GVA and employment in the agricultural sector) of the first PCA component. The highest-ranked areas have the highest pollution and energy-intensive industry, while the lowest-ranked areas are most dependent on the primary sector (insufficient economic diversification) and have lower CO2 emissions per km2 and fewer registered vehicles.

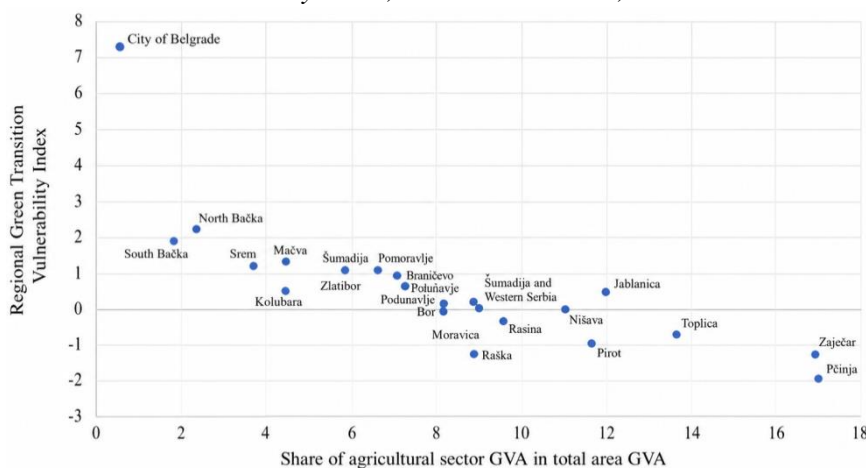
Figure 2. CO2 emissions (agriculture, energy, transport) per km2 and the Regional Green Transition Vulnerability Index, 25 areas in Serbia, 2023



Source: Authors' presentation

Two groups of areas with different types of vulnerability can be identified. The first group consists of four areas with index values greater than 1: the Belgrade, Nišava, Bor and South Bačka areas, which are characterised by urban-carbon vulnerability (the highest CO2 emissions) (Figure 2). Although decarbonisation affects urban areas most strongly, their advantage is reflected in the fact that they possess the preconditions for more efficient “greening” of economic activity, including developed infrastructure, significant human capital and solid economic diversification (Jakobsen et al. 2022; Rodríguez-Pose and Bartalucc, 2024).

Figure 3. Share of agricultural sector GVA in total area GVA and the Regional Green Transition Vulnerability Index, 25 areas in Serbia, 2023



Source: Authors' presentation

The second group consists of five areas with index values below -1: Toplica, North Banat, Braničevo, Central Banat and West Bačka, which are characterised by agrarian-structural vulnerability (high dependence on agriculture, observed through the share of agricultural GVA in total area GVA) (Figure 3). Weaker economic diversification and unfavourable demographic characteristics make these rural areas vulnerable to the changes brought by the green transition.

## CONCLUSION

The green transition, that is, the shift towards a cleaner economy and new behavioural models, entails numerous economic and social effects. A particularly important place in the literature is occupied by the analysis of differences in vulnerability to the green transition between developed and underdeveloped regions, i.e. between urban and rural areas. Therefore, analyses often examine how sectoral factors such as energy, mining, agriculture, transport and tourism affect regional vulnerability. The results of recent studies, mostly focused on European Union countries, indicate the existence of significant differences in the “vulnerability” of different types of areas. Unlike urban and industrially diversified regions, which have favourable conditions for attracting investment and developing innovations in green technologies, rural regions, especially peripheral ones, often cannot make use of the advantages offered by the green economy due to structural weaknesses. Unfavourable demographic characteristics, weak diversification of the economic structure, a decline in industrial production and limited innovation, institutional and financial capacities make rural regions more vulnerable to the changes brought by the green transition.

The results of the analysis of regional inequalities in the context of the green transition in the Republic of Serbia at the NUTS 3 level indicate that there are significant differences in vulnerability to the green transition between urban and rural areas. Following studies that examine vulnerability to the green transition at the regional level, a composite Regional Green Transition Vulnerability Index for Serbia was formed using PCA. Based on its values by area, as a summary (synthetic) indicator that reflects the multidimensionality of the green transition by encompassing its direct and indirect impacts in Serbia at the NUTS 3 level, the 25 observed areas were ranked. Regions characterised by high emissions of harmful gases, the presence of heavy industry (such as mining) or significant dependence on agriculture proved to be the most vulnerable to the green transition. In addition, two groups of areas with different types of vulnerability were identified. The first group consists of areas characterised by the highest pollution (emissions and changes in CO<sub>2</sub> emissions per km<sup>2</sup>) and energy-intensive industry, while the second group consists of areas whose economic structure is weakly diversified and based predominantly on agricultural activities.

As a complex territorial transformation, the green transition requires the mobilisation of local resources, respect for existing economic, demographic and social characteristics, as well as the design of policies, measures and strategies in a way that corresponds to identified regional specificities. Sectoral factors such as production structure, applied technology, employment, resources and infrastructure determine whether a region will be a “loser” or a “winner” of the green transition, or whether it will experience mixed effects. The experience of other countries shows that, globally, the greatest beneficiaries of the green transition will be regions with a developed economic structure based on the use of high human potential and energy predominantly derived from renewable sources. On the other hand, so-called mono-sectoral, non-diversified regions, dependent on concentrated activities with high GHG emissions and faced with limited innovation capacity, appear to be in a serious economic problem when it comes to designing a successful exit strategy.

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