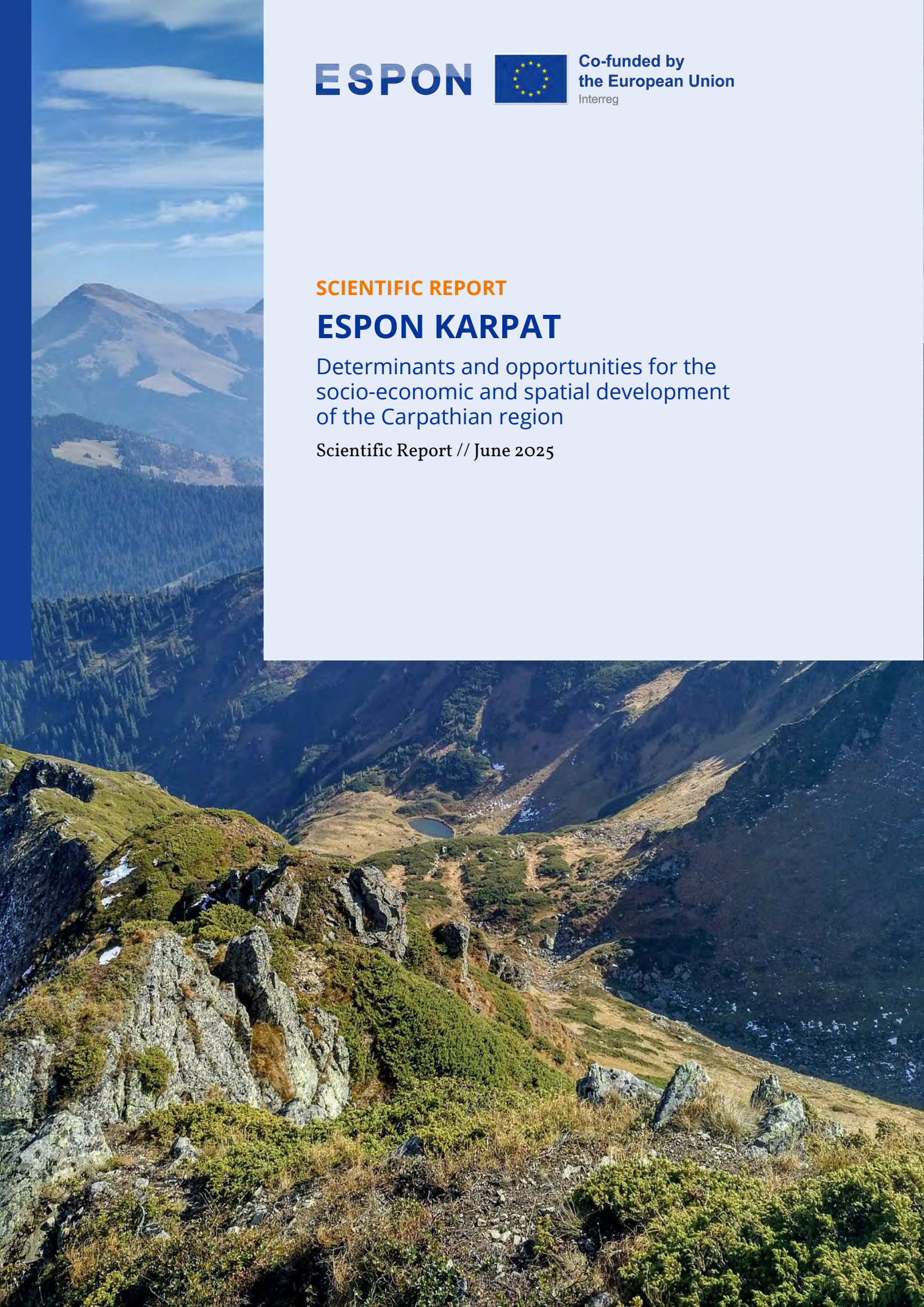




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SCIENTIFIC REPORT

ESPON KARPAT

Determinants and opportunities for the
socio-economic and spatial development
of the Carpathian region

Scientific Report // June 2025

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Abbreviations

ACI	Airport Council International
CBC	Cross-Border Cooperation
CoR	European Committee of the Regions
CORDIS	Community Research and Development Information Service
COVID-19	Coronavirus disease 2019
EDGAR	The Emissions Database for Global Atmospheric Research
EGTC	European Grouping of Territorial Cooperation
ENI	European Neighbourhood Instrument
EORPA	European Policy Research Consortium
EQI	European Quality of Government Index
EPO PATSTAT	European Patent Office Statistical Database
ERDF	European Regional Development Fund
ESF	European Social Fund
ETC	European Territorial Cooperation
EU	European Union
Euromontana	European Association for Mountain Areas
EUROSTAT	Statistical Office of the European Union
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on Research and Development
GVA	Gross Value Added
HEI	Higher Education Institution
IDI	In-depth interview
IEA	International Energy Agency
IPA	Instrument for Pre-Accession Assistance
IUCN	World Conservation Organisation
HRST	Human Resources in Science and Technology
KEO	Carpathian Environment Outlook
LAU	Local Area Unit
NUTS	Nomenclature of Units for Territorial Statistics
OECD	Organisation for Economic and Cooperation and Development
OSM	Open Street Map
OWID	Our World in Data
PCA	Principal component analysis
R&D	Research and development
RIS	Regional Innovation Scoreboards
SNG	Sub-national Government
STRM	Socio-technological roadmap
ToRs	Terms of References
TCP	Transnational Cooperation Programs
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
WHO	World Health Organisation
V4	Visegrad Group: Czechia, Hungary, Poland, Slovakia

Introduction

Mountain areas are of unique characteristics, mainly due to their geography, climate, nature and human influence (**Drexler et al. 2016, Nordregio 2004**). These are often areas of great importance in terms of environmental protection, biodiversity and access to natural resources. The cultural aspect also plays an important role, as mountain regions are often home to unique cultures and traditions that have developed over many generations. Furthermore, the geographical barrier that mountain ranges often represent poses a challenge for the development of transport and economic links. Considering these unique development conditions of mountain areas, a detailed identification of their internal potentials is crucial (**Dax 2018**). A particular difficulty lies in balancing economic development and the preservation of these mountain areas, with new economic trends that promote sustainable development playing a pivotal role. Scientific research conducted in these regions as well as scientific and technological cooperation are indispensable for addressing shared challenges. In doing so, the spatial aspect plays a key role in the context of mountain regions, as it helps to plan and manage the development of these areas, taking into account their geographical, ecological and cultural specificities (**Gløersen et al. 2016**). This often requires territorial cooperation, including transborder collaboration, understood as one of the forms of international cooperation, with particular respect to actions and measures aimed at reducing development barriers created by the presence of state borders (**Medeiros 2018**).

Territorial cooperation in mountain areas takes place at various levels; from local and regional cooperation to international cooperation between countries that share a common mountain border. International organisations, forums and associations, such as the World Conservation Organisation (IUCN), or Euromontana (the European Association for Mountain Areas) are also among key actors promoting cooperation in these areas. In order to tap into transborder potentials and solve problems shared by the neighbouring countries and regions, four macroregional strategies have been formulated at the EU level, three of which concern marine areas or river catchments, i.e. for the Baltic Sea region (2009), the Danube region (2010), the Adriatic and Ionian region (2014), and only one mountain area - the Alpine region (2015) (**Sielker, Rauhut 2018**). To date, efforts have been made to create a similar strategy for the Carpathian Mountains, which are the second largest mountain system in Europe (after the Alps), which covers - with adjoining territories - regions of 5 countries belonging to the European Union (EU): Poland, the Czech Republic, Slovakia, Hungary and Romania, and 3 non-EU members: Serbia, Ukraine and the Republic of Moldova. Despite the support of the European Parliament (**EPRS 2019**) and the activities of the Interregional Group "Carpathians" at the European Committee of the Regions geared at promoting the creation of macroregional strategy for the Carpathian Region, the efforts have not been successful as yet.

In addition to the above-mentioned selected activities at the level of the European Union, there exist developed forms of transnational territorial cooperation in the Carpathians, ranging from top-down in the form of The Framework Convention on the Protection and Sustainable Development of the Carpathians (**Carpathian Convention**) (2003) to a number of bottom-up initiatives associating at all levels of government and self-government, as manifested, among others, by the establishment of the Carpathian Euroregion in 1993, comprising the regions of Poland, Ukraine, Slovakia, Romania and Hungary, as well as the development of The European Territorial Cooperation Groups (EGTCs), which are the transborder cooperation groups in the Carpathians. There are also initiatives aiming to create the EU macroregional strategy for the Carpathian Region supported by the governments of Poland, Ukraine, Slovakia and Hungary, which led to the establishment of The Carpathian Executive Board, as well as the development of a draft Carpathian Strategy. Within the framework of the latter initiative, in addition to the diagnosis of the Carpathian macroregion (**Diagnosis 2017**) and the identification of strategic objectives in the area (**Strategy 2018**), study analyses were carried out for the selection of priority areas of action that can be undertaken in the pilot phase of its implementation (**Smętkowski et al. 2022**).

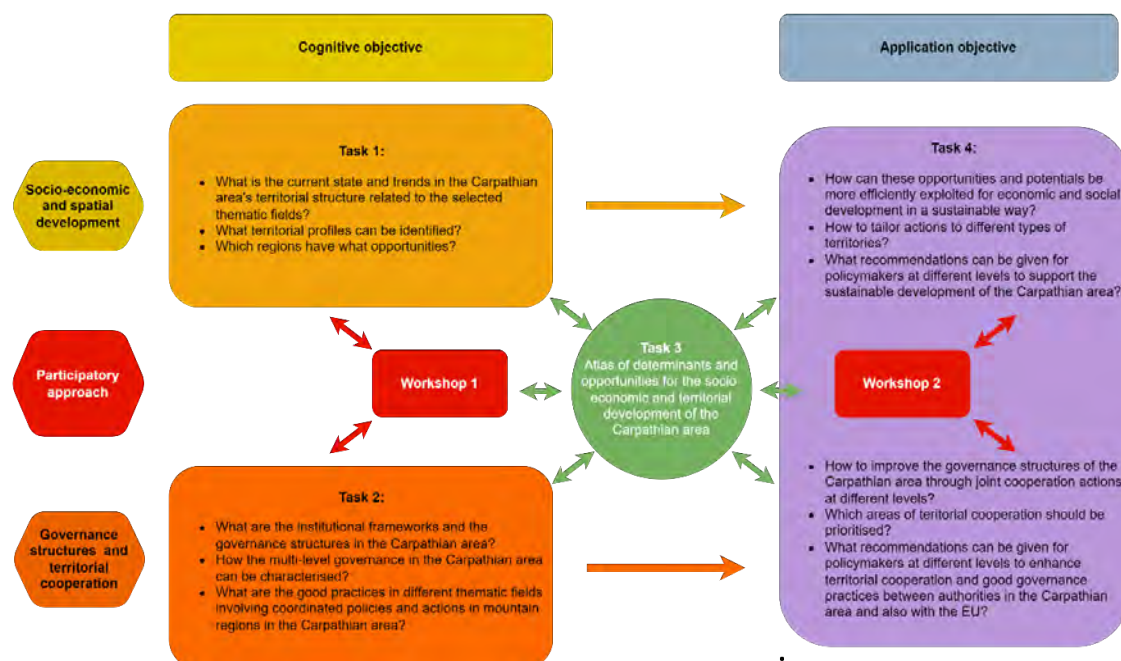
A review of existing studies on the conditions, trends and challenges the Carpathian macroregion is faced with, on the one hand, points to the need to supplement and/or deepen the state of knowledge on the socio-economic processes taking place there, while taking into account their spatial context, and, on the other hand, indicates the need to propose appropriate measures to solve existing problems and take advantage of available development opportunities. This allows us to formulate two general objectives of this research and number of research questions (**Fig. 1.1**):

- 1) **Cognitive objective** is to create new evidence for the Carpathian area by identifying territorial development challenges and opportunities for different types of regions based on multidimensional analysis of selected themes.
- 2) **Application objective** is to provide recommendations for policy makers, taking into account a multi-level governance approach, for joint policy actions considering the territorial specificities of the Carpathians.

Within the framework of the first objective, it should be emphasised that our research took into account the existing state of knowledge of the Carpathian macroregion (e.g. **Diagnosis 2017, Strategy 2018**), which enabled the identification of gaps, as well as the deepening of analyses in particular thematic scopes by exploring the dynamics of development phenomena and trends more extensively than before. Efforts were made to map them at the lowest available level of territorial aggregation, including also the use of point data, e.g. tourist attractions. For the data collected in this way, typologies of regions were developed, taking into consideration both the *a priori* necessity to carry out analyses for specific functional areas as mountainous areas or border areas, as well as comprehensive ones based on indicators attributed to particular development determinants. This provided a basis for assessing the challenges and opportunities pertinent to the distinct types of regions in the context of sustainable socio-economic development.

Within the framework of the second objective we provided relevant, feasible and appropriate recommendations to policymakers at different geographical levels on socio-economic and sustainable territorial development in the Carpathian macroregion and on implementation of joint actions in the thematic areas of cooperation of the Carpathian Convention and other initiatives and activities. Stakeholder participation in the form of two workshops aided by a set of visual materials and heuristic facilitation contributed to territorial foresight and development visions, which provided a basis for recommendations to policymakers at different geographical levels for future joint policy actions at the economic development and sustainable development of the Carpathian macroregion.

Figure 1.1
Conceptual framework of analysis.

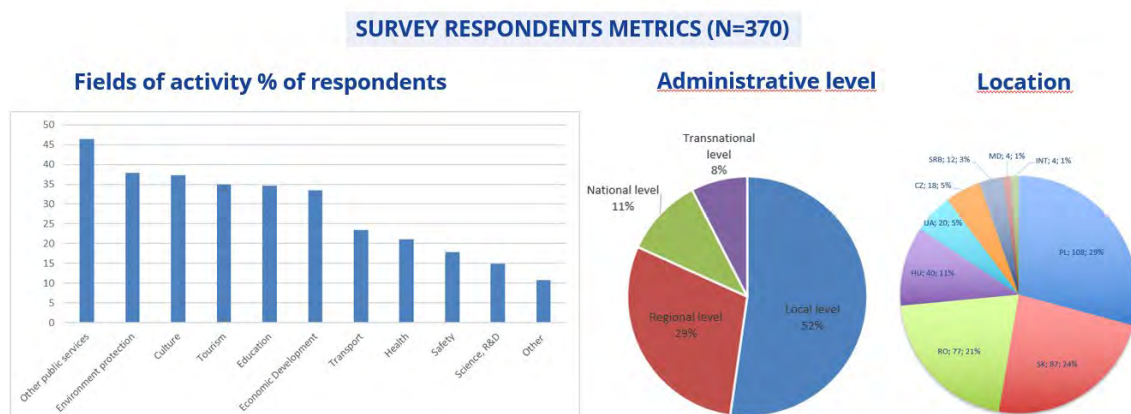


Source: own elaboration.

Data collection for the Carpathian macroregion relied on a comprehensive approach that integrated both standard and non-standard data sources. This ensures a robust and multidimensional dataset to support thorough territorial analysis. The following sources have been identified and utilized to gather the necessary data: (1) Standard Data Sources: EUROSTAT, National Statistical Offices, ESPON Database, European Environment Agency (EEA) (2) Non-Standard Thematic Data Sources: Environment and Climate (World Database on Protected Areas, WHO Ambient Air Quality Database, Global Forest Watch Database, Atmospheric Composition Analysis Group, Environmental Justice Atlas, The Emissions Database for Global Atmospheric Research (EDGAR), Tourism (Google Places API on tourist attractions and OpenStreetMap (OSM)), Transport and Mobility (OpenStreetMap (OSM), RG Road Data, Airport Council International (ACI), Housing (OECD Affordable Housing Database), Human Capital and Education (OECD PISA Programme), Scientific and R&D Activity and Smart Specialisation (Web of Science, EPO PATSTAT, CORDIS Database), Business Incentives (EORPA European Policy Research Consortium, World Investment Report (UNCTAD)) as well as other reports and analyses like 9th Cohesion Report. To illustrate the patterns of transnational cooperation in the Carpathian macroregion, the keep.eu data on European Territorial Cooperation (Interreg) were used.

Data were gathered also through the tools dedicated and developed for the KARPAT project included (1) online survey that reached actors currently involved in the territorial cooperation in the Carpathian area, potentially interested in it, or fit or required to engage in it. Several channels of distribution were used: a) local, regional and national authorities from the Carpathian area were contacted, b) a contact database gathered as part of previous project on the actions under macroregional Carpathian Strategy (Smętkowski et al. 2022), c) project partners from Carpathian macroregion in keep.eu database, d) key networking players in the Carpathian macroregion (e.g. Carpathian Convention, Euroregion, EGTCs) were asked to distribute the survey among their partners / beneficiaries. In total we collected 370 responses (Fig. 1.2). (2) In-depth interviews were conducted with 11 respondents including CoR – representatives of Carpathian interregional group, the Carpathian Convention's secretariat, Euroregions, managing authorities of cross-bordered programmes in Carpathian macroregion and EGTCs.

Figure 1.2
Survey respondents basic metrics



Source: own elaboration

Equally important was the participatory approach, that took the form of two workshops, whose participants were actively engaged in the process of assessing the determinants and opportunities for the development of the Carpathian macroregion, the construction of future visions for its spatial development, as well as drafting recommendation for Carpathian macroregion governance and territorial cooperation.

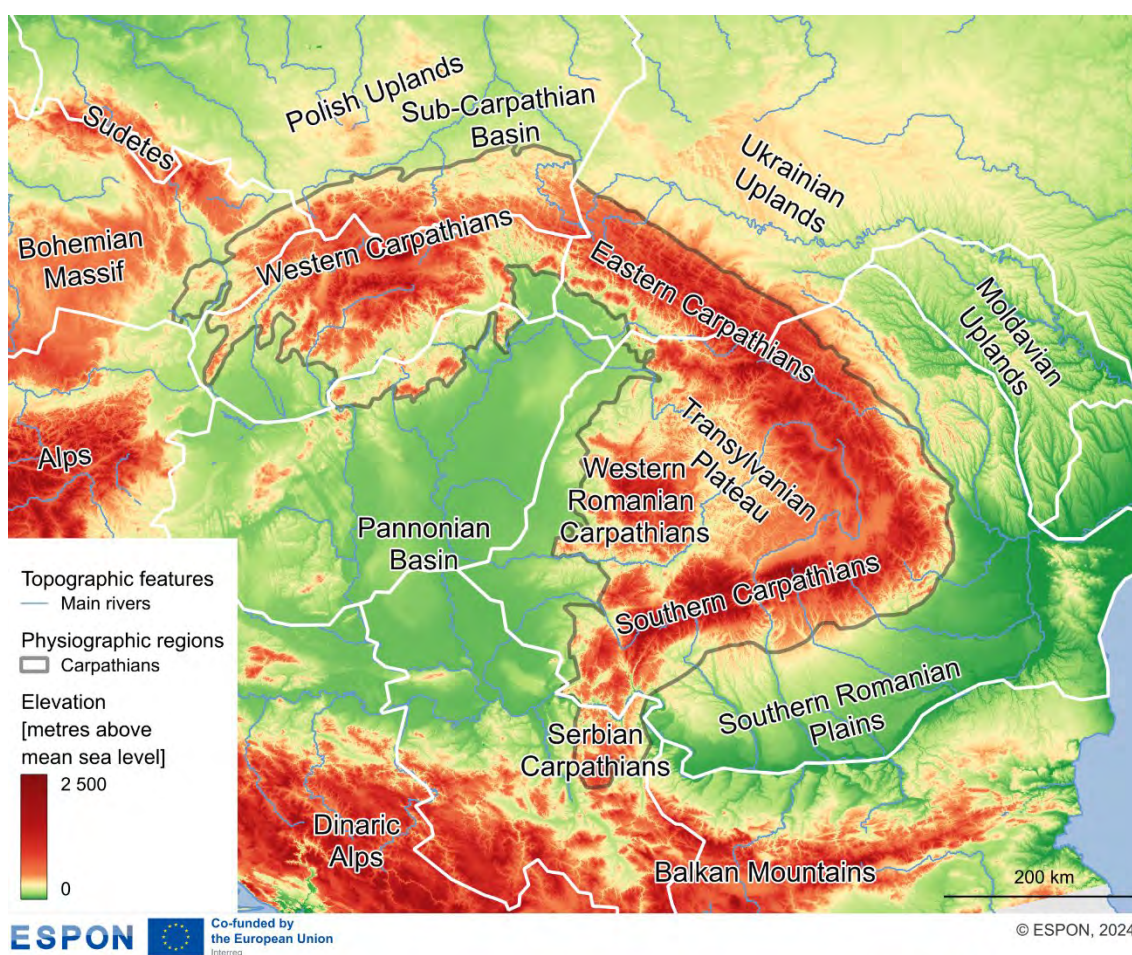
The structure of the report is as follows. The first chapter introduces the Carpathian macroregion and presents its delimitation, defined for the purposes of the study. The second chapter provides a detailed analysis of the current state and trends in the territorial structure of the Carpathian area, focusing on selected thematic

fields. The third chapter serves three purposes: firstly, it presents synthetic regional profiles and offers recommendations related to various forms of territorial capital; secondly, it explores the interactions between these forms of capital, highlighting the development opportunities they create for different types of regions; and thirdly, it examines synergies and conflicts between territorial capitals, including those concerning selected functional areas. Chapter four discusses the governance structure in the context of territorial cooperation, while Chapter five focuses on the outcomes of transnational cooperation, including twinning city agreements and projects implemented under the INTERREG programme, along with an analysis of the barriers to and opportunities for cooperation within the Carpathian macroregion. The seventh chapter outlines spatial development visions for the Carpathian macroregion, based on the findings of Chapters 4 and 5, as well as their implications for selected functional areas, for which appropriate territorial guidance is proposed. These insights form the basis for the recommendations on governance and territorial cooperation, which also take into account the good practices of territorial cooperation summarised in Chapter six.

1 Carpathian Macroregion – Study Area Delineation

The Carpathians are an extensive mountain system in Central and Eastern Europe, stretching approximately 1,500 km across seven countries: the Czech Republic, Slovakia, Poland, Hungary, Ukraine, Romania, and Serbia. They are the second-longest mountain chain in Europe after the Alps, with their highest peak, Gerlach (2,655 m above sea level), located in the Slovak Tatras. The Carpathians are characterized by diverse landscapes, ranging from high mountains with alpine climates to forested ranges and valleys. This region holds significant natural and cultural importance, serving as a refuge for numerous protected species of flora and fauna, as well as being home to various ethnic groups who have preserved unique traditions and folklore.

Map 1.1
Carpathian Mountain Range



Territorial level: NUTS0, 90 metre grid
Source: ESPON KARPAT, 2024
Origin of data: Copernicus GLO-90, Ecrins
© EuroGeographics for administrative boundaries

In physical-geographical terms, the main chain of the Carpathians can be divided into (**Map 1.1**):

- Western Carpathians, located in the Czech Republic, Poland, Slovakia, and Hungary, consisting of the Outer Western Carpathians, Central Western Carpathians, and Inner Western Carpathians, surrounded to the northwest by the Western Outer Subcarpathia and to the north by the Northern Outer Subcarpathia;
- Eastern Carpathians, located in Poland, Ukraine, and Romania, consisting of the Outer Eastern Carpathians and Inner Eastern Carpathians, surrounded to the northeast by the Eastern Outer Subcarpathia;
- Southern Carpathians, located in Romania and Serbia, including the Sub-Carpathians in Romania, as well as the Serbian Carpathians (Karpatsko-Balkanske Planine);
- Western Romanian Carpathians and the Transylvanian Plateau in Romania.

These mountain regions are bordered to the southwest and west by the Pannonian Basin, to the west by the Sudetes and the Bohemian Massif separated by Moravian Gate and Vyškov Gate, to the north by the Polish Uplands separated by the Sub-Carpathian Basins, to the northeast by the Ukrainian and Moldavian Uplands, to the south by the Southern Romanian Plains, and to the southeast by the Dinaric Alps and the Balkan Mountains.

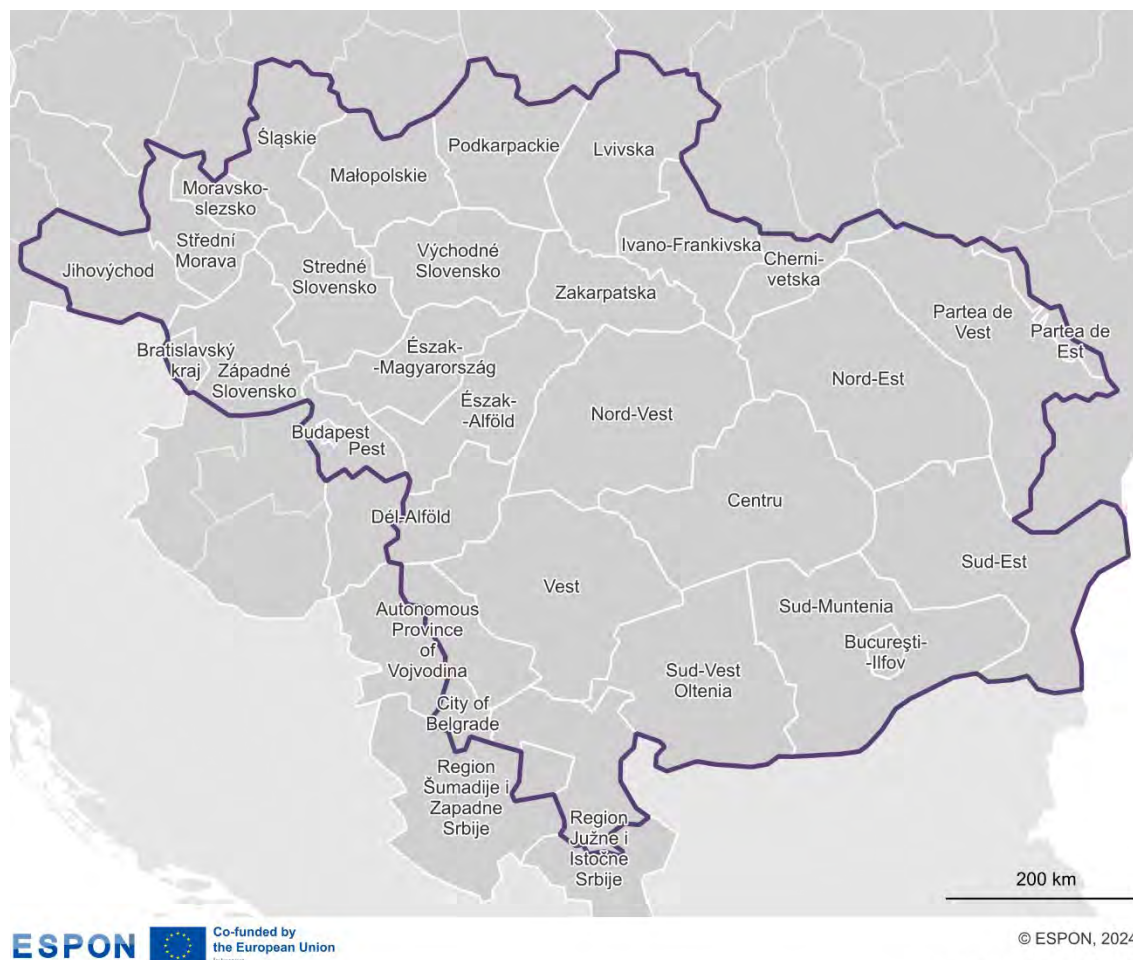
The studied area features a rich river network, with the most significant rivers either originating in the Carpathians or fed by tributaries flowing from the Carpathians, including: Morava (CZ, SK, AT), Vistula River (PL), San (UA, PL), Dniester (UA, MD), Prut (UA, MD, RO), Siret (UA, RO), Mureş (RO, HU), Tisza (UA, HU, RS), Olt (RO) Timiş (RO, RS); Váh (SK), Great Morava and South Morava (RS); Timok (RS, BG). Additionally, the Danube River flows through the macroregion, draining the interior of the Carpathian chain and cutting through it to form the Iron Gates Gorge, which separates the Southern Carpathians from the Serbian Carpathians.

The administrative structure of the Carpathian countries is diverse (**Map 1.2 and Map 1.3**). At the regional level (NUTS2), administrative entities exist only in Poland (voivodeships) and Ukraine (oblasts). In other countries, this level is represented by either planning-statistical units, such as in Romania (macroregiunea) and Hungary (tervezési régió), or purely statistical units, as in the Czech Republic, Slovakia, and Serbia (except of Autonomous Province of Vojvodina). Meanwhile, the Republic of Moldova can be treated as a single NUTS2 region, similar to the Baltic states. In most other Carpathian countries, the primary administrative regional structure is organized at the NUTS3 level. This includes the Czech Republic (kraje), Slovakia (kraje), Hungary (megyék), Romania (judeţe), and Serbia (okruzi). In Poland, however, the NUTS3 level serves exclusively as a statistical function, much like in the Republic of Moldova. In Moldova's case, administrative functions exist only in the autonomous region of Gagauzia, located in the southern part of the country. In Ukraine, following the administrative reform conducted in 2020, the rayon can be considered an equivalent to the NUTS3 level. However, due to the lack of available statistics at this level, especially for the period preceding the reform, Ukrainian oblasts are often treated interchangeably as NUTS2 or NUTS3 units in analyses, including this study, as is common in many other studies.

The delimitation of the Carpathian macroregion is not entirely unambiguous. This is due to different potential approaches to the region, which may be a 'cognition' region - defined by its characteristics and interactions, an 'action' region - as a place of implementation of actions and planning of public authorities, as well as a 'research' region - defined by aggregations of statistical units adjusted to the purpose of conducted analyses.

As a result of the use of physical-geographical and administrative-statistical criteria, we adopted the following delimitation of the Carpathian macroregion (study area), based on the following two main principles:

1. Core regions: NUTS3 regions within boundaries of Carpathian Mountains (elevation above sea level of at least 600 metres and other parts of the Carpathian submountain areas) the in general follow Carpathian Convention area ,
2. Adjacent regions: areas adjacent to the Carpathian Mountains: a) those which are part of NUTS2 regions (in the case of EU countries), that contain NUTS3 in the first category, b) other surrounding NUTS3 regions (or equivalent in non-EU countries) through which rivers originating in the Carpathian Mountains flow.

Map 1.2**Administrative/statistical divisions in Carpathian Countries and the Republic of Moldova – NUTS2 division**

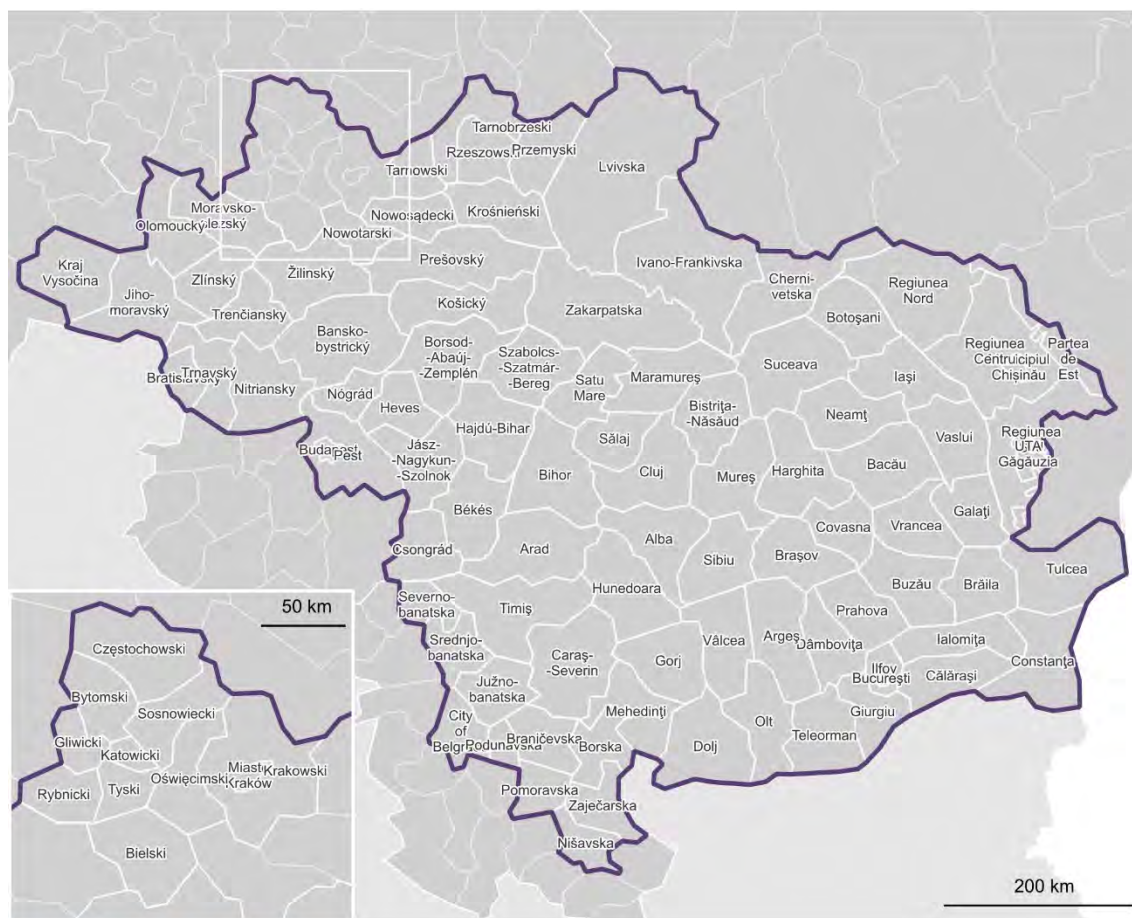
Source: own elaboration based on Eurostat

Thus delimited macroregion¹ comprises 8 countries, including seven signatories of the Carpathian Convention along with the Republic of Moldova (**Map 1.4**). It consists of 102 NUTS3 level regions, which are part of 31 NUTS2 level regions. Among the former, 62 NUTS3 regions constitute the core area of the macroregion and another 40 are adjacent regions (**see full list - Annex 1**).

¹ Within the framework of this study, the use of the term "macroregion" refers to the geographical delineation we adopted, so our study area.

Map 1.3

Administrative/statistical divisions in Carpathian Countries and the Republic of Moldova – NUTS3 division



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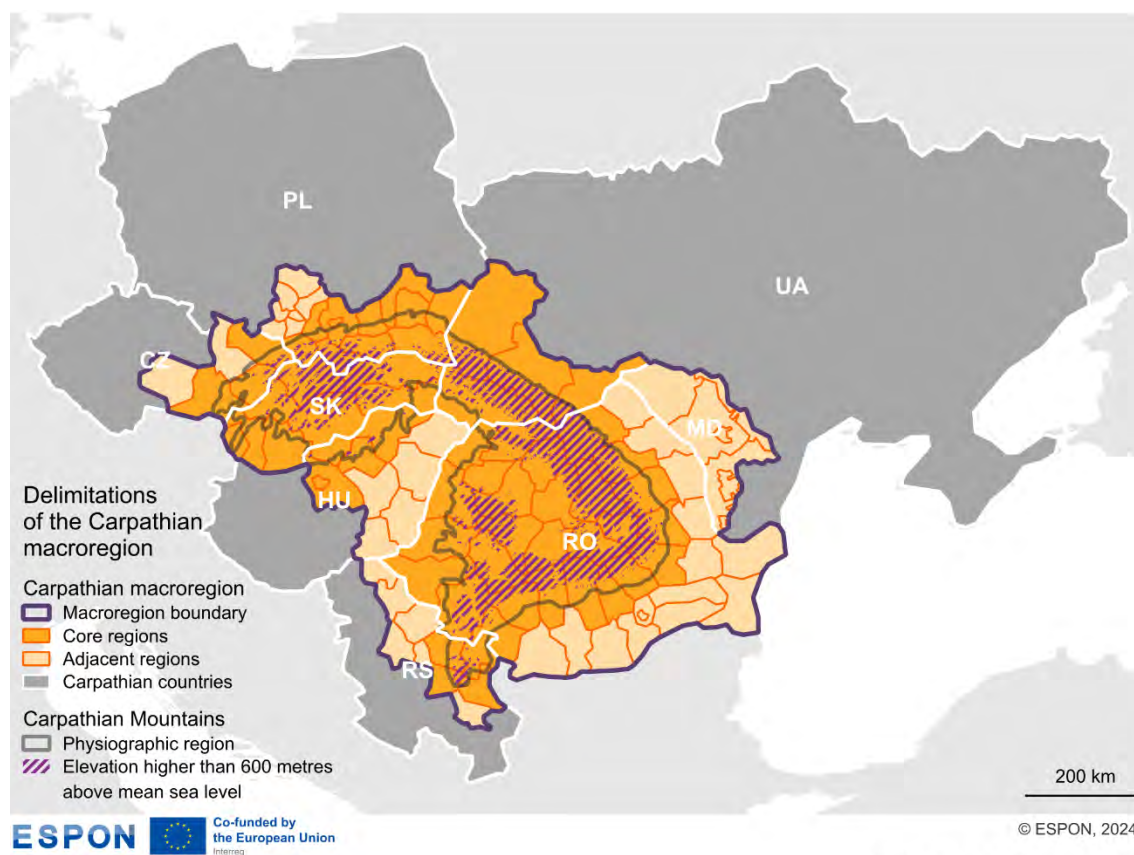
Territorial level: NUTS3

Source: ESPON KARPAT, 2024

© EuroGeographics for administrative boundaries

Source: own elaboration based on Eurostat

The Carpathian macroregion based on the above mentioned criteria has a population of 57 million people, with about two-thirds living in NUTS3 regions classified as core (**Table 1.1**). The large population of the macroregion, accounting for about 40% of the total population of the Carpathian countries, is largely due to the location of large urban centres in the mountain foothills, including capital cities such as Budapest, Bucharest, and Bratislava. The macroregion encompasses the whole of Slovakia and Romania (60% of the population in the core regions) as well as regions with around 65% of the population in the case of Hungary, 50% in Serbia, and 40% in the Czech Republic, but with a much smaller share of the core regions. By contrast, the Polish regions that comprise the Carpathian macroregion are home to around 25% of the country's total population, and the Ukrainian regions to around 15%. In terms of share in the macroregion, Romania's population share is particularly high - about 1/3, followed by Poland (17%), whereas Hungary, Ukraine, and Slovakia have a share of around 10%, and the Czech Republic's share stands at 7%. The shares of Serbia and the Republic of Moldova are much smaller, i.e. at around 5%, and even less for the core regions. Slovakia and Ukraine, in the latter dimension, are growing quite significantly to 15-16%.

Map 1.4**Territorial coverage of Carpathian macroregion – study area**

Territorial level: NUTS 0, NUTS 3
 Source: ESPON KARPAT, 2024
 © EuroGeographics for administrative boundaries

Source: own elaboration

Table 1.1**Population, 2023**

Country	Total	Carpathian macroregion		Core regions		Share %	
	pop. in mln	in mln	% country	in mln	%	of macroregion	of core region
Czechia	10.9	4.2	38.3	3.0	27.7	7.3	8.1
Hungary	9.9	6.4	64.7	4.2	42.8	11.2	11.3
Rep. of Moldova	2.5	2.5	100.0	0.0	0.0	4.5	0.0
Poland	37.8	9.9	26.1	6.2	16.3	17.3	16.5
Romania	19.4	19.4	100.0	11.6	59.9	33.9	31.1
Serbia	6.7	3.3	49.2	0.9	13.3	5.8	2.4
Slovakia	5.5	5.5	100.0	5.5	100.0	9.6	14.7
Ukraine	41.2	6.0	14.5	6.0	14.5	10.5	16.0
Total	133.7	57.0	42.6	37.3	27.9	100.0	100.0

Source: own elaboration.

2 Determinants of Carpathian Macroregion Development

The development conditions of the Carpathian macroregion were analysed comprehensively, addressing 19 key issues grouped into three main categories of spatial differentiation: (1) natural and human geography, (2) demography and society, and (3) economy, science, and investments. To support the analysis, hundreds of indicators were applied, leading to the creation of a series of thematic maps. These maps were incorporated into the Atlas of the Carpathian macroregion. Presented below are the key development determinants of the Carpathian macroregion, accompanied by maps and charts illustrating these aspects.

2.1 Natural and human geographies

2.1.1 Natural environment, protected areas and pollutions

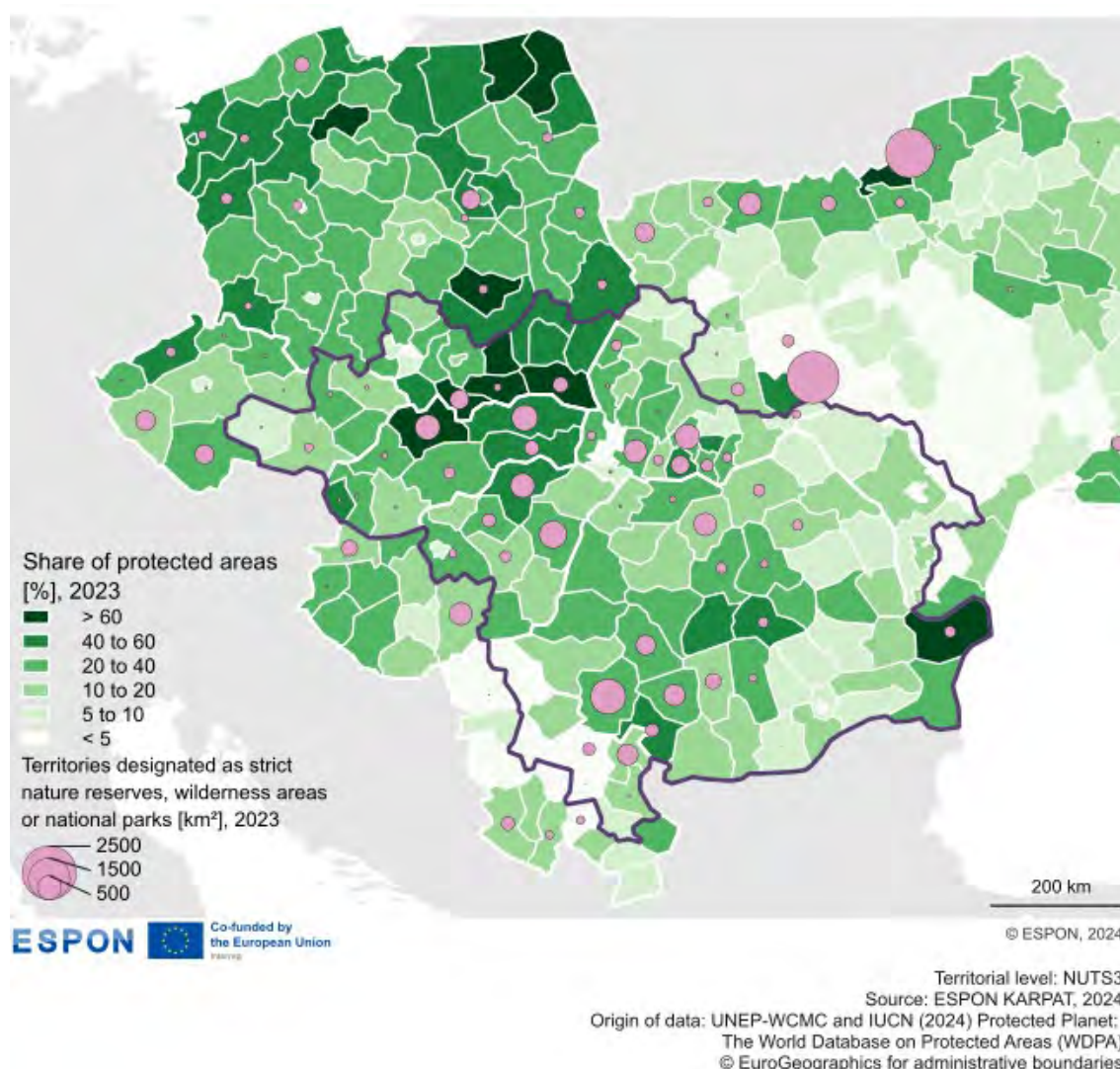
The Carpathian arc stretches over 1500 km across the central and eastern part of Europe, and covers an area of circa 190,000 square kilometres. With highest peaks exceeding 2,600 metres above the sea-level, the Carpathians encompass a broad range of habitats ranging from lowland forests to alpine meadows and small patches of subnival zone. The Carpathian mountains are considered one of the key biodiversity hotspots on the continental scale. The region harbours the largest population of large carnivores (bear, wolf, lynx) in Europe, it also contains significant patches of natural (virgin) forests, i.e. forests that survived till modern times with only minimal human intervention.

The high biodiversity of the Carpathian region necessitates an adequate level of protection. Each country has its unique system of protected areas, encompassing both country-specific forms of protection (eg. National or Landscape Parks), as well as elements of internationally recognized networks (eg. EU Natura 2000 sites or UNESCO World Heritage sites). Crucially, different forms of protected areas entail different protection regimes, and therefore vary in terms of effectiveness. The map below (**Map 2.1**) shows both the **total share of all protected areas** in NUTS3 regions, and the size of **strictly protected areas**. The share of nationally-designated protected areas reaches up to 75% in the regions of Tulcea (RO) (Danube Delta), Krośnieński and Nowotarski (PL) (Carpathian Mountains). However, protected areas that meet the IUCN strict protection criteria are much less common. In total, such areas cover only 9,000 square kilometers² out of the whole Carpathian region, and are concentrated mostly in its Ukrainian and Slovakian part. The limited extent of strictly protected areas in the Carpathian macroregion raises concerns about biodiversity preservation, as the EU Biodiversity Strategy for 2030 sets a binding target of strictly protecting 10% of land and sea surfaces, emphasizing that such protection is a fundamental element for the long-term preservation of natural heritage (European Commission 2020).

The relatively high proportion of protected areas in EU countries can partly be explained by the extensive **Natura 2000 network** (**Map 2.2**). On average, Natura 2000 sites cover 20.0% of NUTS 3 regions in the Carpathian area in EU Member States – slightly above the EU-wide average of 18.6%. This figure has remained stable over time, increasing from 19.5% in 2011. The average extent of Natura 2000 sites in NUTS 3 regions is slightly higher in the Carpathian core regions, reaching 23.9%. However, some NUTS 3 regions (Sibiu, Košický, Krośnieński) have approximately 50% of their area under Natura 2000 protection, and Tulcea – over 70%.

² The data provided here might not include the recently established protected areas, as the IUCN classification is rarely updated.

Map 2.1
Protected areas in NUTS3 regions, 2023



Mapping the biodiversity level is a complex task, and often the data at hand is not comparable between countries, and of a highly limited spatial scope. We use the monitoring data collected for Natura 2000 protected sites, to calculate the spatially-explicit biodiversity index. For each Natura 2000 site, the index takes into account the presence of a permanent population of 5 high-importance species³, and global assessment of the value of a given site for conservation of the species concerned.⁴ The resulting map of **biodiversity hotspots** (**Map 2.2**), overlaid with data on the share of a given NUTS3 region covered by Natura2000 protected sites. The 15 major biodiversity hotspots – with value of the biodiversity index above 7 – are located mostly in Slovakia and Romania (six sites in each country), the remaining sites are in Poland (two), and in Hungary (one). All of them are established in the core of the Carpathian region, but they are not necessarily located on high

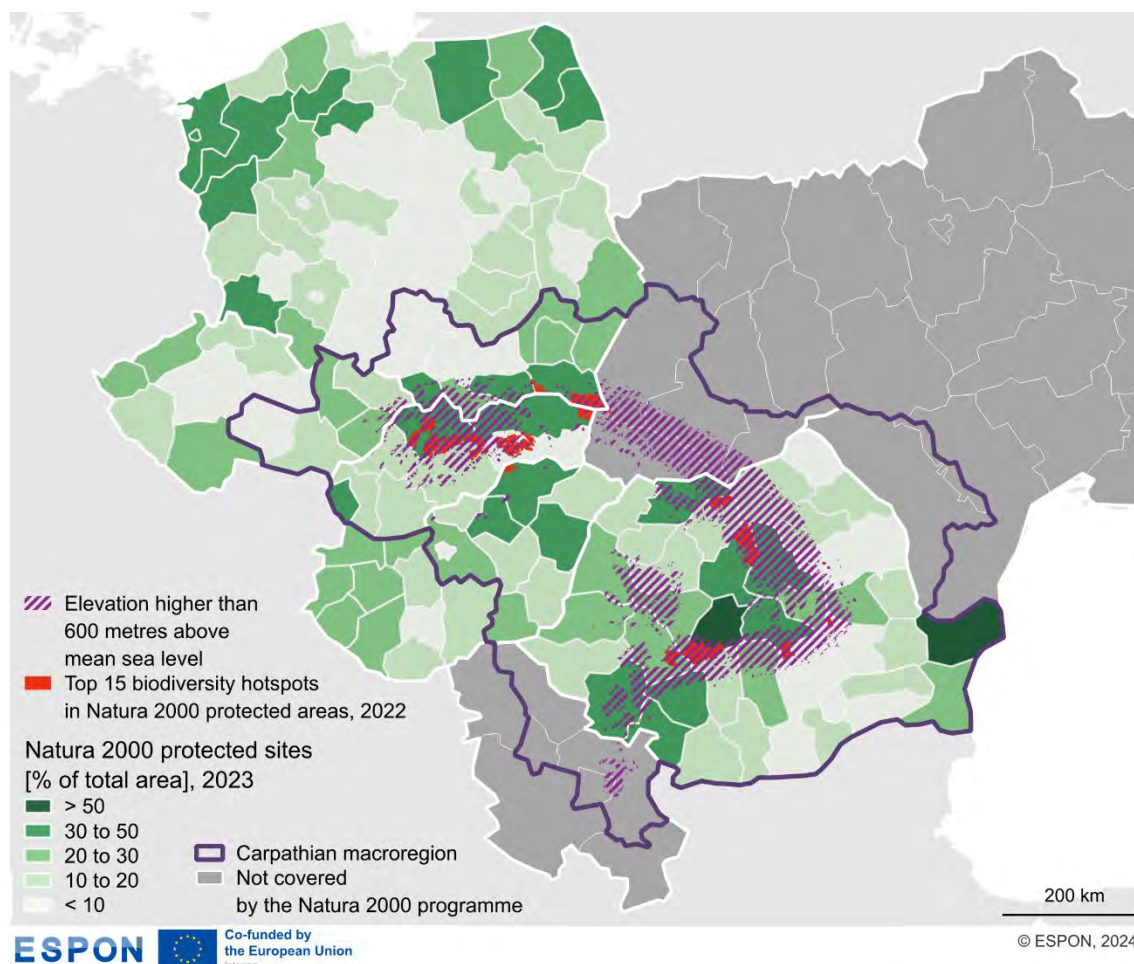
³ These include: *Rosalia Alpina* (EN), *Canis Lupus* (VU), *Aquila chrysaetos* (EN), *Dicranum viride*, and *Bombina variegata* (EN). The criteria applied to select these species were the following: diversity of taxonomic groups; protected and rare species; inclusion in the appendix to the EU Habitat or Bird Directive and/or in the Carpathian Red List of endangered species (exact category provided in parentheses); species typical for natural Carpathian habitats.

⁴ The value of a given site for conservation of the species concerned was translated to numerical value according to the following formula: excellent = 3, good = 2, significant = 1, population not significant or non-existent = 0. The final index was calculated as a sum of individual assessments for 5 species, i.e. it can theoretically range from 0 to 15.

altitudes. A high degree of biodiversity can also be expected to characterize the Carpathian Mountains in Ukraine, which is not covered by this analysis, due to the limited extent of the European Union Natura 2000 network.

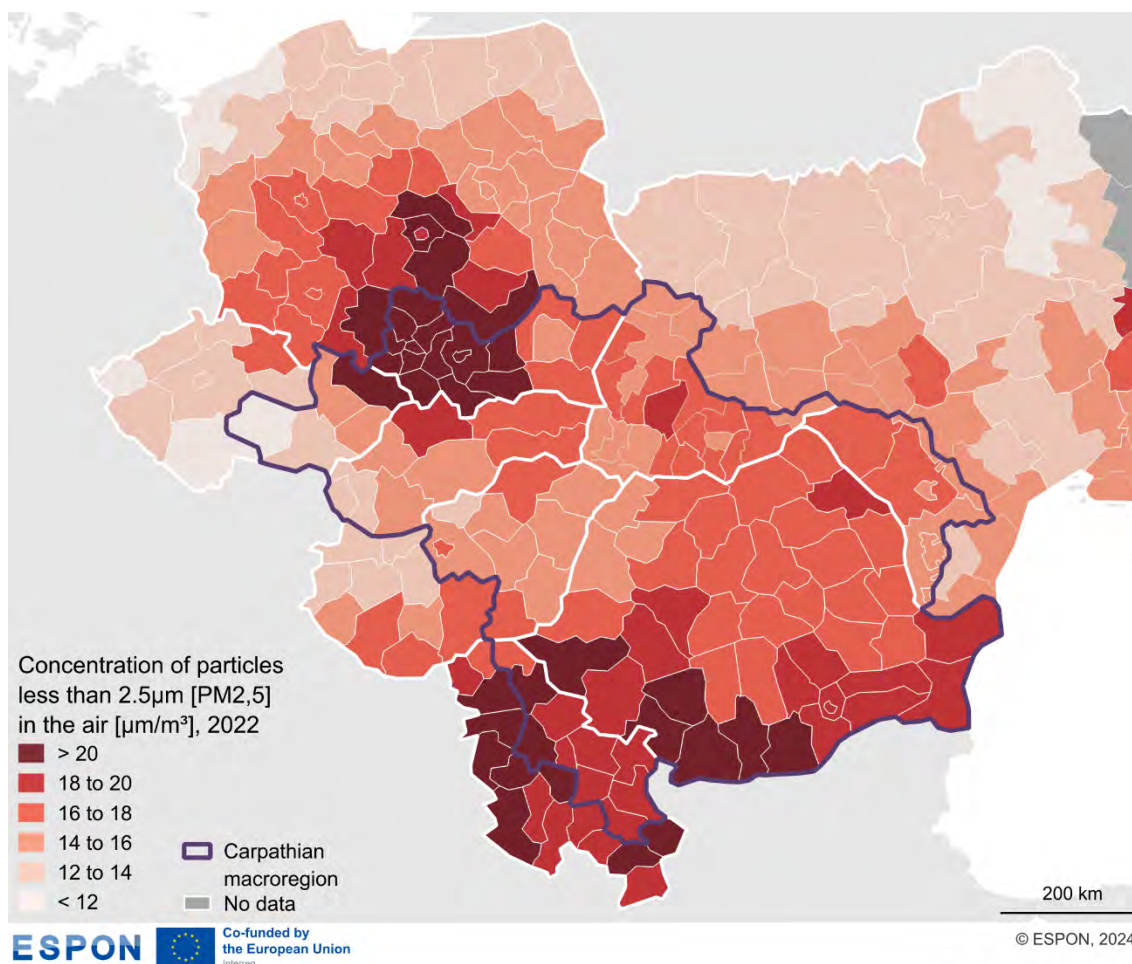
Map 2.2

Biodiversity hotspots in Natura 2000 protected sites, 2023



The quality of the environment is the function of both the state of natural endowment and pressure from anthropogenic pollution. With regard to the latter we focus on two indicators – air pollution and CO₂ emissions from fossil fuels. **Air pollution** remains the leading environmental health risk in Europe, contributing especially to respiratory and cardiovascular diseases. Among various pollutants, the fine particulate matter PM_{2.5} has the widest negative impacts, with over 100 thousands premature deaths attributed to its excessive levels in Czechia, Hungary, Poland, Romania, Slovakia and Serbia combined (EEA 2023). The revised WHO air quality guidelines (WHO 2021) recommended that the annual average PM_{2.5} concentration should not exceed 5 µg/m³ to ensure a safe and healthy environment. The actual PM_{2.5} levels in the Carpathian region range from 10 to 30 µg/m³, with the average for the region equalling 17.6 µg/m³ (**Map 2.3**). The reported values indicate that air pollution remains an unresolved issue in all Carpathian countries. The areas with the highest PM_{2.5} concentrations – southern Poland, northern Czechia, Serbia, southwestern Romania – often overlap with coal-mining regions, where coal is commonly used for heating private homes.

Map 2.3
Air pollution, 2023



Territorial level: NUTS3
Source: ESPON KARPAT, 2024
Origin of data: Atmospheric Composition Analysis Group,
Washington University in St. Louis
© EuroGeographics for administrative boundaries

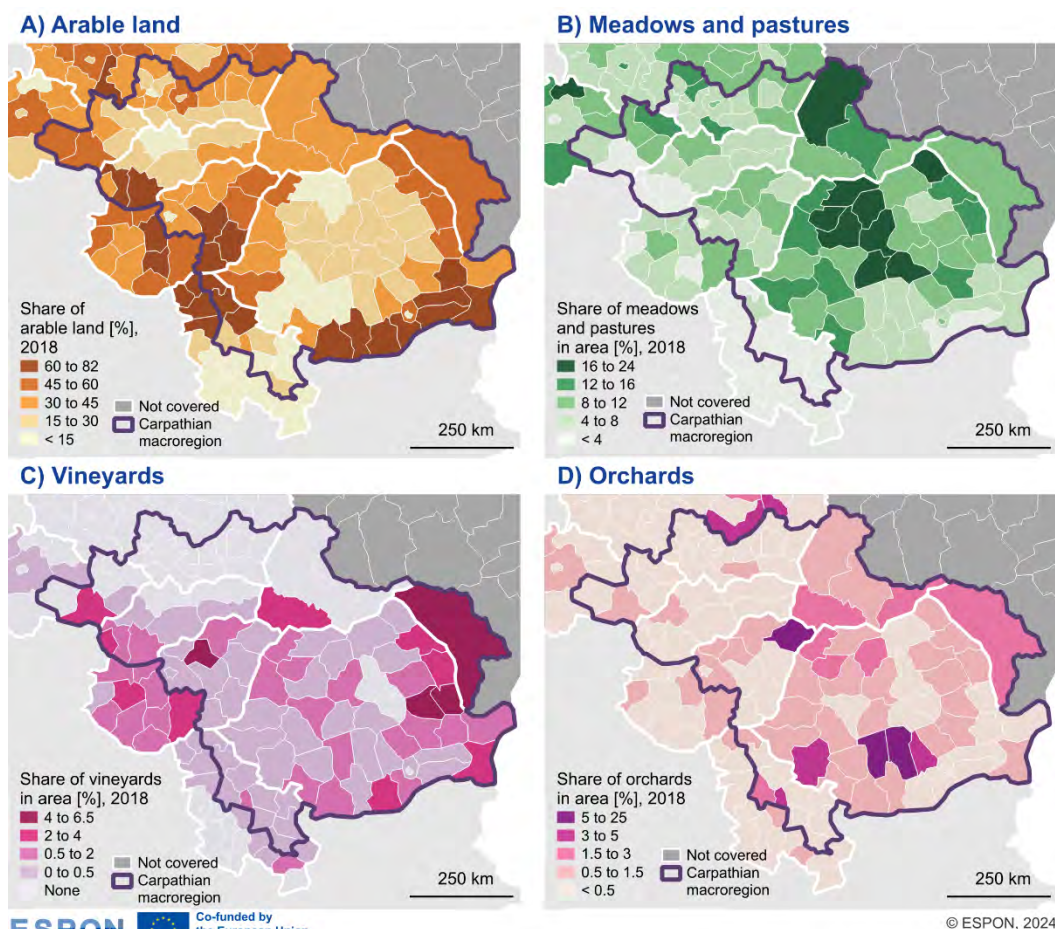
2.1.2 Primary sectors

Agriculture, forestry, and mining are classic examples of primary economic sectors, which played a particularly significant role in the early stages of economic development before the intense industrialisation that began in the 19th century and the subsequent deindustrialisation starting in the second half of the 20th century. Nevertheless, in certain areas of the Carpathian macroregion, these primary sectors remain an important part of the regional economic base and can still influence the specialisation of the regional economy.

Agriculture

Based on land use structure data obtained through satellite observations, one can identify the specialization of specific regions in certain types of agricultural production (**Map 2.4**). A high proportion of arable land, in particular, may indicate the significant role of crop production, which is often linked to the high fertility of soils. In the Carpathian macroregion, the primary areas of intensive crop production include the Danubian regions in Romania (Wallachia), Serbia (Vojvodina), as well as the Pannonian Basin in Hungary and Slovakia. A similar situation is observed along the Prut River in Republic in Moldova and the Romanian part of Moldova, as well as in southern Moravia in the Czech Republic. A significant share of agricultural land also characterizes eastern Hungary and the Satu Mare region in Romania, while in Poland, fertile soils are particularly evident around Kraków, as well as in some parts of the Przemyśl subregion.

Map 2.4
Agriculture land use, 2018



© ESPON, 2024

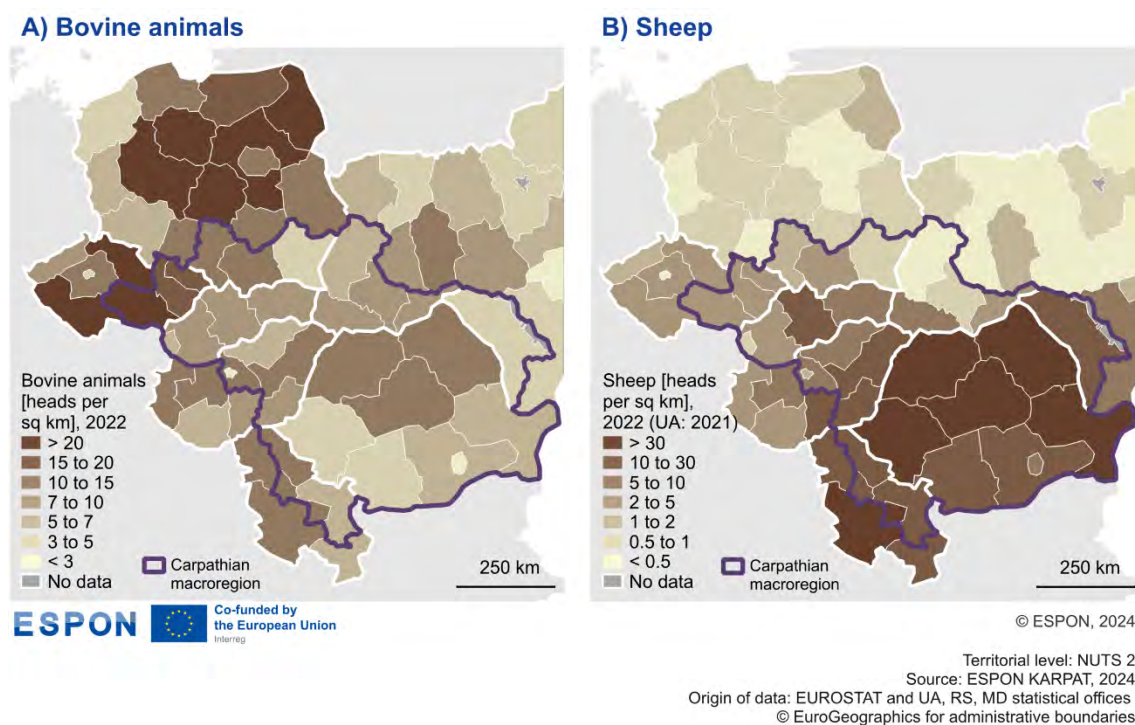
Territorial level: NUTS 3, NUTS 0 (MD)
Source: ESPON KARPAT, 2024
Origin of data: EEA based on Corine Land Cover
Estimations for MD and UA
© EuroGeographics for administrative boundaries

On the other hand, the lowest percentages of arable land are found in some mountainous areas, especially in the Žilina region in Slovakia, the Apuseni Mountains in Romania, and the northern parts of the country such as Maramureş and Bistriţa, as well as the southern Carpathian regions in Serbia. When it comes to the high proportion of meadows and pastures, which can support livestock farming, northern Romania, especially the Transylvanian Plateau, stands out in the macroregion. High proportions of grasslands are also notable in the eastern parts of the country, particularly in the Moldovan regions along the Prut River. Beyond these areas, a high share of grassland was less common, but it was notable in the Nowy Targ subregion in Poland and the Silesian-Moravian region in the Czech Republic, as well as in some parts of eastern Hungary.

The analysis of perennial crops, which represent specialised agricultural production, highlights the main areas of viticulture and orchard farming in the Carpathian macroregion. Moldova, including its Romanian part, shows the highest concentration of vineyards, along with the Danubian Plain in Romania. In Hungary, the Tokaj wine region falls within the macroregion, as does the Nitra region in Slovakia, the South Moravian region in the Czech Republic, and Zakarpattia in Ukraine. The northern boundary of vine cultivation is largely marked by the Carpathian mountain range, especially in the northern parts of the macroregion. Beyond this natural barrier, viticulture becomes more incidental, although the spread of vineyards north of the Carpathians is noticeable—a trend likely facilitated by climate change, which could also support the development of wine tourism.

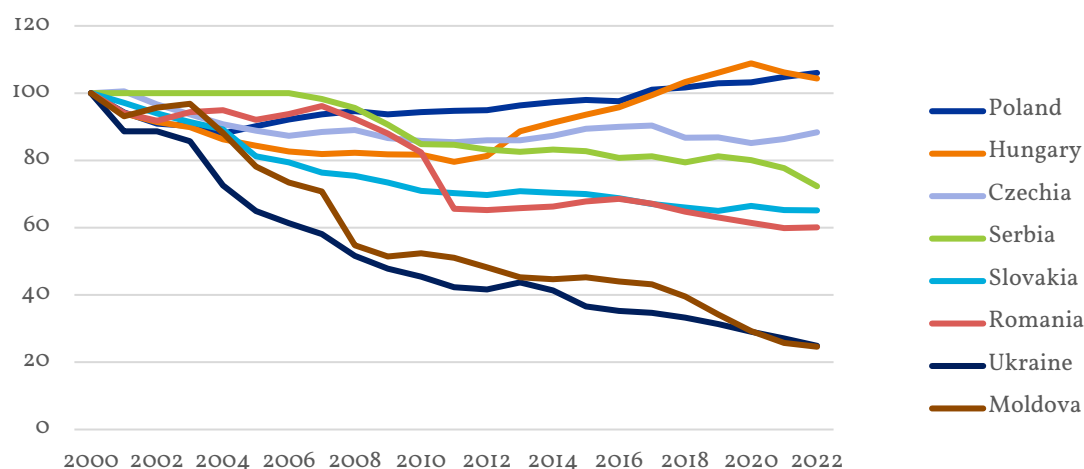
As for orchards, the regions located on the southern slopes of the Carpathians stand out, particularly in Wallachia and northern Romania, as well as parts of Hungary and Ukraine. In Poland, the Nowy Sącz subregion in the Małopolska province is notable for its orchard production within the Carpathian macroregion.

Map 2.5
Livestock population, 2022



Animal husbandry can have a significant environmental impact, especially in areas with high livestock density. It can also lead to considerable greenhouse gas emissions (approx. 15% of the global total), particularly methane, which is notably associated with cattle farming. In the Carpathian macroregion, areas with relatively high concentrations of cattle farming can be identified (**Map 2.5**). These include primarily regions in the Czech Republic, followed by certain regions in Poland, Hungary, Romania, and Serbia. However, in many areas, crop production dominates, resulting in relatively low cattle density. This is particularly evident in Poland's Podkarpackie region, as well as in the Republic of Moldova and the southern regions of Romania.

The cattle population over the last 20 years has shown the greatest stability in Poland (approximately 6.5 million head) and Hungary (0.9 million head) (Chart 2.1). In contrast, there has been a noticeable decline in the Czech Republic (to around 1.4 million head), and more recently, in Serbia (0.9 million head). The reduction in cattle numbers compared to the year 2000 has been around 40% in Slovakia (0.4 million) and Romania (1.8 million), while Ukraine (2.6 million) and the Republic of Moldova (0.1 million) have experienced a dramatic 80% decline in their cattle populations.

Chart 2.1**Dynamics of cattle stock in Carpathian countries 2000-2022***

*2000=100

Source: Own elaboration based on FAO data.

Considering sheep livestock, Romania stands out as the leader among the Carpathian countries, with over 10 million sheep. Sheep farming is also significant in Serbia, which has 1.7 million sheep. Together, these two countries account for around 80% of the total sheep population in 2023, which stands at approximately 14.6 million in Carpathian countries. This dominance is also visible in regional maps, aside from the Romanian and Serbian regions, the importance of sheep farming in southeastern Hungary, central Slovakia, and the Republic of Moldova, and to a lesser extent in other eastern regions of Hungary, Slovakia, and Ukraine's Zakarpattia. The lowest sheep densities are found in the Lviv region of Ukraine and the adjacent Podkarpatie region in Poland, as well as Ivano-Frankivsk in Ukraine.

Romania saw a significant 26% increase in its sheep population, while Serbia experienced a 6% rise in the last 20 years. In the Czech Republic, due to a very low base in 2000, the population has doubled. In other countries, sheep numbers have declined, with slight decreases in Hungary and Slovakia, while in Poland, the population dropped by more than 25%, and in Ukraine and the Republic of Moldova by around 50%.

It should also be noted that the Carpathians are a traditional area for grazing cattle and sheep in the mountainous regions. This practice is typically carried out on seasonal pastures and tends to be quite extensive. Although grazing occurs across all Carpathian mountain ranges, its economic significance today is limited, and livestock farming faces several challenges. However, it remains an important element of the region's cultural heritage, particularly linked to the so-called Wallachian pastoralism, which spread throughout the Carpathians in the 15th century. Today, traditional cheese production, in particular, holds the status of regional products and represents a key aspect of the cultural identity of the Carpathian macroregion.

Forests and Forestry

The forests in the Carpathian region are not only of immense ecological value but serve also as a key resource in the forestry economic sector. The forested areas within the Carpathian Environment Outlook (KEO) area, the core area of the Carpathians, cover over 10 million hectares in total. The largest share (45%) is located in Romania, while Slovakia and Ukraine each account for 18-20%. In terms of the tensions between nature conservation and the economic use of forests, it is important to consider how much of a country's forested area is within the KEO. The share is most significant for Slovakia (where 100% of national forests fall within the KEO) and Romania (72%). Wood removals from the Carpathian forest have a substantial impact on the national timber market in these two countries. In terms of total timber extraction, Poland and Czechia report highest quantities, although data for Romania are widely criticized as unreliable, with estimates suggesting that

actual removals are twice as high. Timber extraction intensity per hectare is by far the highest in the Czech Republic. Total employment in forestry is highest in Poland and Ukraine, but labour intensity (number of workers per 1,000 hectares of forest area) is greatest in Hungary, Slovakia, and Poland. The forestry sector contributes relatively little to national GDPs – ranging from circa 0.2% in Hungary to 1.0% in Slovakia.

Table 2.1
Forestry in Carpathian countries

Country	Forest area in the KEO		Country KEO forest / Total KEO forest	Country KEO forest / Country forest	Roundwood removals	Employment in forestry (2017)	GVA in forestry (2015)
	<i>M ha</i>	%	%	%	<i>thous m3</i>	<i>thous persons</i>	% of total GVA
Czechia	0.31	43.4	3.0	11.7	32,586 (2019)	12.9	0.71
Hungary	0.40	29.6	3.9	20.1	5,985 (2021)	23.1	0.23
Poland	0.76	45.6	7.4	8.4	45,693 (2022)	75.8	0.35
Romania	4.60	59.7	44.7	71.6	17,476 (2022)	32.8	0.40
Serbia	0.43	n.a.	4.2	18.6	n.a.	n.a.	0.32
Slovakia	2.01	57.3	19.5	100.0	7,435 (2022)	20.3	1.02
Ukraine	1.80	48.6	17.5	16.7	18,914 (2017)	61.7	n.da
TOTAL	10.3	59.1	-	-	-	-	-

Source: own calculations based on Hoffmann (2022), Anfodillo et al. (2008), EUROSTAT (2024)⁵, FAO (2024)⁶. Notes: KEO stands for the Carpathian Environment Outlook (KEO) area, as defined by the UNEP-GRID in 2004.

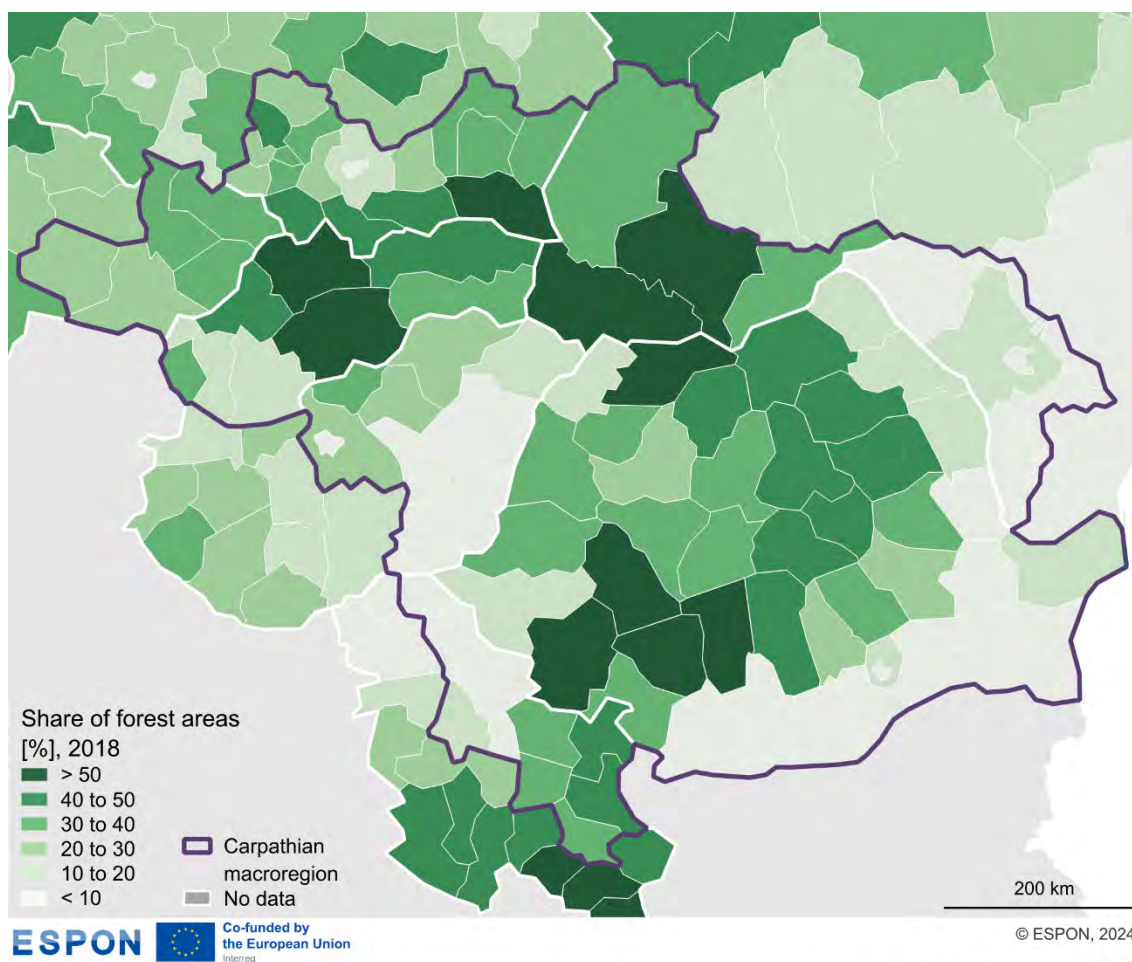
Biodiversity's key habitat, and at the same time an important economic asset, is the forest. The natural forest once covered almost the entire Carpathian region. Initially, it shrank due to pressure from agriculture, animal husbandry, expanding settlements, and the demand for fuelwood. Since the late 19th century, deforestation has either halted or slowed down as forests became managed under modern forestry practices. Commercial exploitation brought about new practices, like clear-cutting, establishing forest plantations, and extending the network of access roads. Currently, **forest cover** in the region varies significantly, with the most forested areas having over 50% forest cover. The least forested regions are located mostly outside of the core Carpathian area, or in the vicinity of major urban centres (Kraków, Bratislava) (**Map. 2.6**).

The **net tree cover change** (**Map 2.7**) illustrates the trend over the last two decades. Forest areas are expanding most rapidly in regions with low initial forest cover (the low base effect) outside the Carpathian core, mostly in Hungary and southeastern Romania. A slight increase is also observed in the Romanian and Polish parts of the Carpathian Mountains, with several regions enlarging their forest cover by 3–5% over the period of 20 years. Conversely, a decline in forest cover is affecting Slovakia and Czechia. The key driver for this loss is climate change-induced die-off of planted spruce forests.

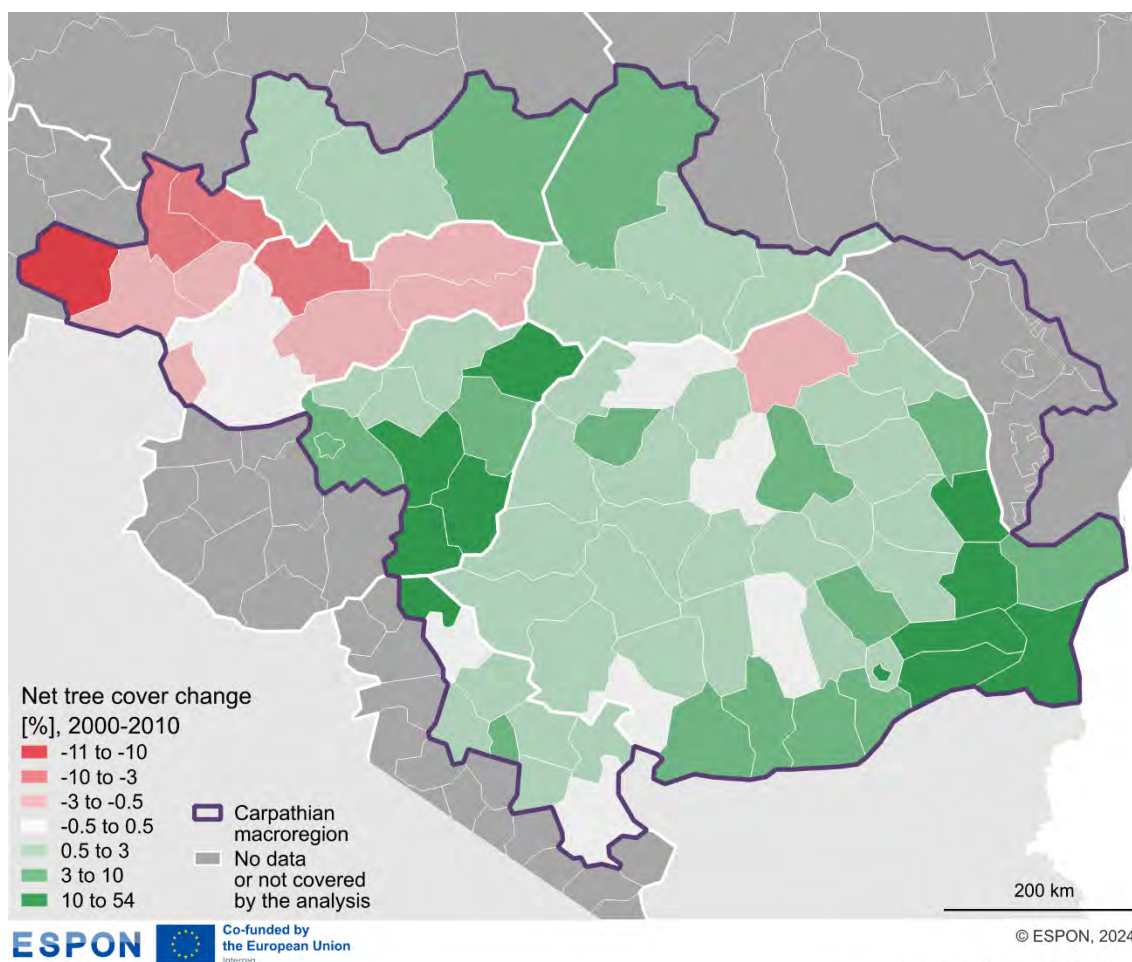
⁵<https://ec.europa.eu/eurostat/databrowser/explore/all/agric?lang=en&subtheme=for&display=list&sort=category>
[for_remov][for_mp_lfs]

⁶<https://fra-data.fao.org/assessments/panEuropean/2020/FE/home/overview>

Map 2.6
Forest cover, 2018



Territorial level: NUTS3
 Source: ESPON KARPAT, 2024
 Origin of data: CORINE Land Cover 2018. UA: Національна інвентаризація лісів. MD: Global Forest Watch, World Resources Institute; © EuroGeographics for administrative boundaries

Map 2.7**Tree cover change, 2000-2020**

© ESPON, 2024

Territorial level: NUTS3, NUTS2 (PL)
 Source: ESPON KARPAT, 2024
 Origin of data: Global Forest Watch, World Resources Institute;
 © EuroGeographics for administrative boundaries
 No data for MD

At the same time when the net change in forest cover is slightly positive throughout most of the core Carpathian area, the loss of primeval forests leads to **growing concerns over insufficient nature protection**. Applying commercial forestry practices to such areas threaten their unique value – biodiversity, intactness, capacity to sequester carbon and to mitigate water runoff. According to conservative estimates, at the beginning of the XXI century primeval forests in Carpathians spanned 3,200 square km (Anfodillo et al. 2008), out of which 65% was located in Romania. Over the next twenty years, the total tree cover loss amounted to 7,780 square km, but the data does not allow to determine how much of this occurred in primeval forests. In the absence of comprehensive data showing the scale of impact of forestry practices on protection of primeval forest, we refer to selected issues that fuelled concerns regarding forest management in the region (see **Box 1**).

DIGRESSION**Insufficient protection of Carpathian primeval forests and their ecosystems**

According to a study by Affek et al. (2017) the Polish part of the Carpathian Mountains has the most dense network of forestry roads out of all comparable studies in the world. There are approximately 13 km of roads and skidding trails per each 1 square km of forest. Such a dense road network has numerous negative consequences, including the de-

struction of soil, fragmentation of habitats, increased deforestation, intensified erosion and a loss of landscape water retention capacity. To overcome this challenge, scientists are proposing that roadless areas should be protected as the last strongholds for vulnerable wildlife. The photo above shows a newly built logging road in the Polish Bieszczady Mountains..



Illegal logging has been revealed as a major obstacle to protecting the primeval Carpathian forests in Romania and Ukraine. Various reports claim that up to 50% of total logging in Romania has been done illegally. The concerns raised by citizens, including during the massive street protests, led to the formal involvement of the European

Commission. In 2020, the Commission launched an infringement procedure against Romania for breaches of EU environmental law in relation to forestry activities.

Source: own elaboration based on: (Affek et al., 2017), (Psaralexi et al., 2017), (Luick et al., 2021)

Mining and quarrying

Mining, particularly open-pit mining, imposes a significant burden on the natural environment (Box 2). In the Carpathian macroregion, the greatest environmental threats related to mining affect specific regions, especially mountainous areas located in the Southern Carpathians of Serbia, as well as in the Southern and Eastern Carpathians of Romania. Northern Hungary and the regions of Silesia and Małopolska in Poland also experience a high percentage of such land use. This is largely due to the presence of valuable minerals, such as copper and gold in Serbia's Bor region, and energy resources like lignite coal mines in northern Hungary, as well as in southern Romania.

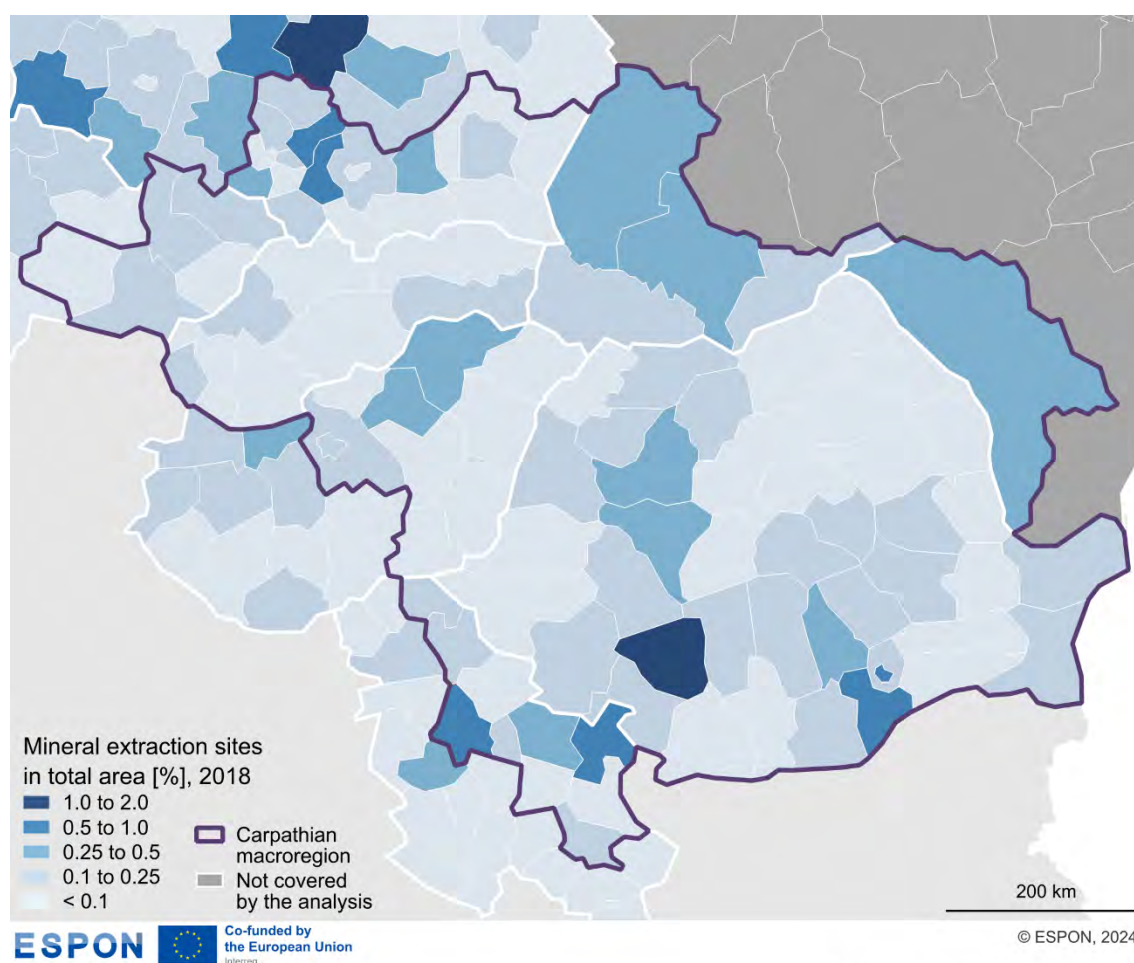
DIGRESSION**Exploitation of natural resources – example of environmental conflict**

The Roşia Montană case refers to the widespread controversy surrounding a planned gold mining project in the Romanian town of Roşia Montană, located in the Transylvania region. The project, which gained international attention, was proposed by Gabriel Resources, a Canadian mining company. Roşia Montană was set to become the largest open-pit gold mine in Europe. The project aimed to extract gold and silver using cyanide-based processing. It was estimated that the site contained around 300 tons of gold and 1,600 tons of silver, making it potentially highly profitable. The project proposed using massive amounts of cyanide in the extraction process, raising serious concerns about contamination of groundwater, rivers, and soil. Critics warned of the possibility of a catastrophic failure of the tailings dam, which could result in environmental contamination across multiple countries. A similar disaster occurred in Baia Mare, Romania, in 2000, when a cyanide spill contaminated rivers and killed aquatic life across several nations. The project faced enormous social resistance, both in Romania and internationally. Massive protests took place in Romania between 2013 and 2014, with tens of thousands of people demonstrating. Protesters opposed environmental destruction, the loss of cultural heritage, and the financial benefits largely flowing to foreign investors rather than local communities. In 2015, the Romanian government rejected the mining project, and in 2021, Roşia Montană was designated a UNESCO World Heritage site, effectively ending the possibility of large-scale industrial mining there.

In Romania, metal ore extraction (including copper and iron) in the mountainous regions, along with limestone and salt mining, are significant. In Poland's Carpathian region, there are numerous open-pit mines for rock materials, and former sulphur extraction sites are currently undergoing reclamation.

Meanwhile, in some agricultural regions of Hungary, Romania, and the Czech Republic, mining activities are marginal and have minimal impact on the natural environment.

Map 2.8
Mineral extraction sites, 2018



Territorial level: NUTS3, NUTS0 (MD)
 Source: ESPON KARPAT, 2024
 Origin of data: EEA based on Corine Land Cover
 Estimations for MD and UA
 © EuroGeographics for administrative boundaries

2.1.3 Energy and climate

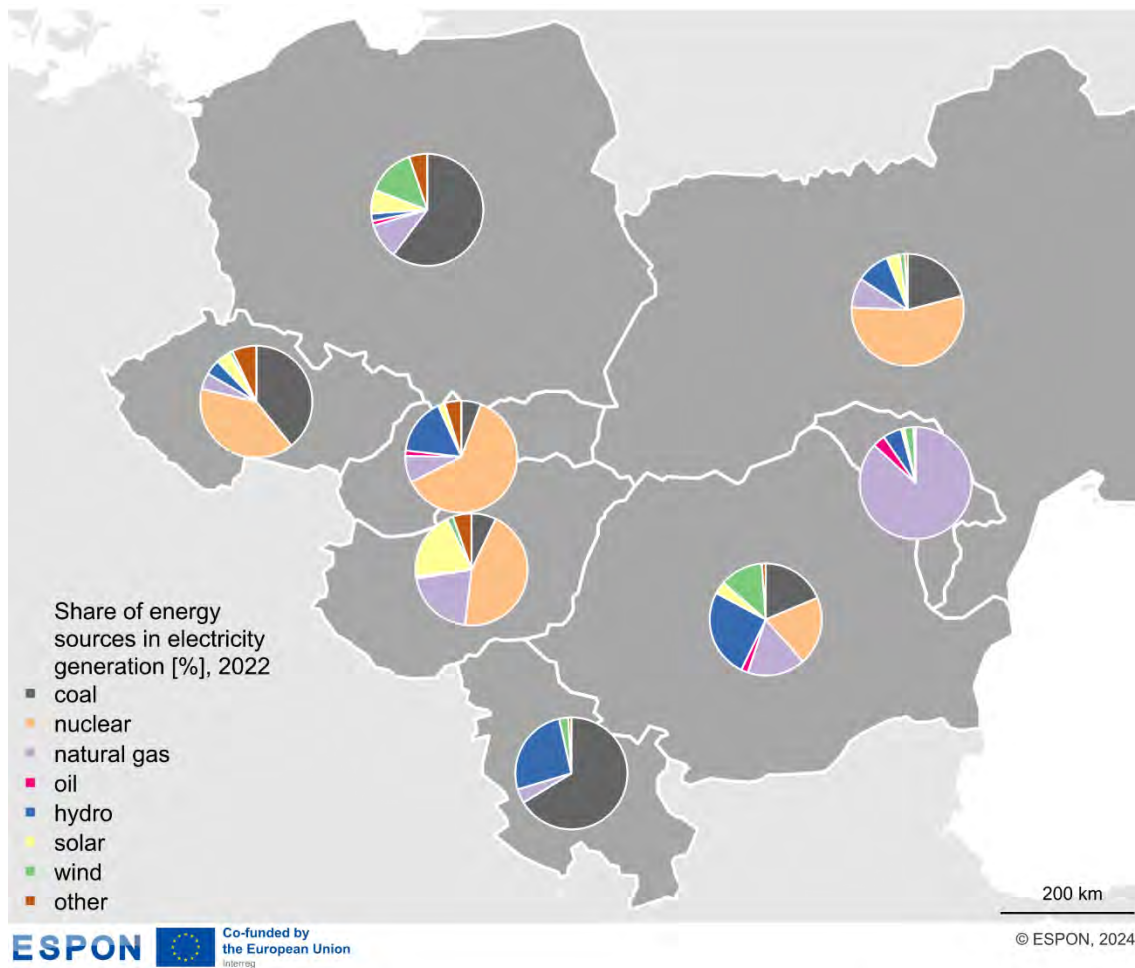
The key task for climate policies is to create a sustainable electricity production system. According to the EU climate target, by 2030 the greenhouse gas emissions would have to be reduced by 55%, as compared to 1990 levels. To be in line with the UN Paris Climate Agreement European countries should quit coal-power by 2030 at the latest. Looking at the current electricity mix at the national level, coal remains a key source of energy for Poland, Serbia, and to a lesser extent Czechia (Table 2.2). The current declarations regarding phasing out of coal-powered electricity generation are different across the region,⁷ with only Hungary and Slovakia pledging to leave coal before 2030. High share of coal translates to high carbon intensity of economy, which is the case of Poland, Serbia, but also the natural gas-reliant Republic of Moldova. The transition to renewable sources is the most advanced in Romania (42% of electricity production derived from renewables) and Serbia, i.e. the countries with large hydropower. Wind and solar, deployed mostly in recent years, have a combined share of up to 21% in Hungary and Poland, and 16% in Romania.

⁷ <https://beyondfossilfuels.org/europes-coal-exit/>

Table 2.2
Electricity production in Carpathian Countries, 2023

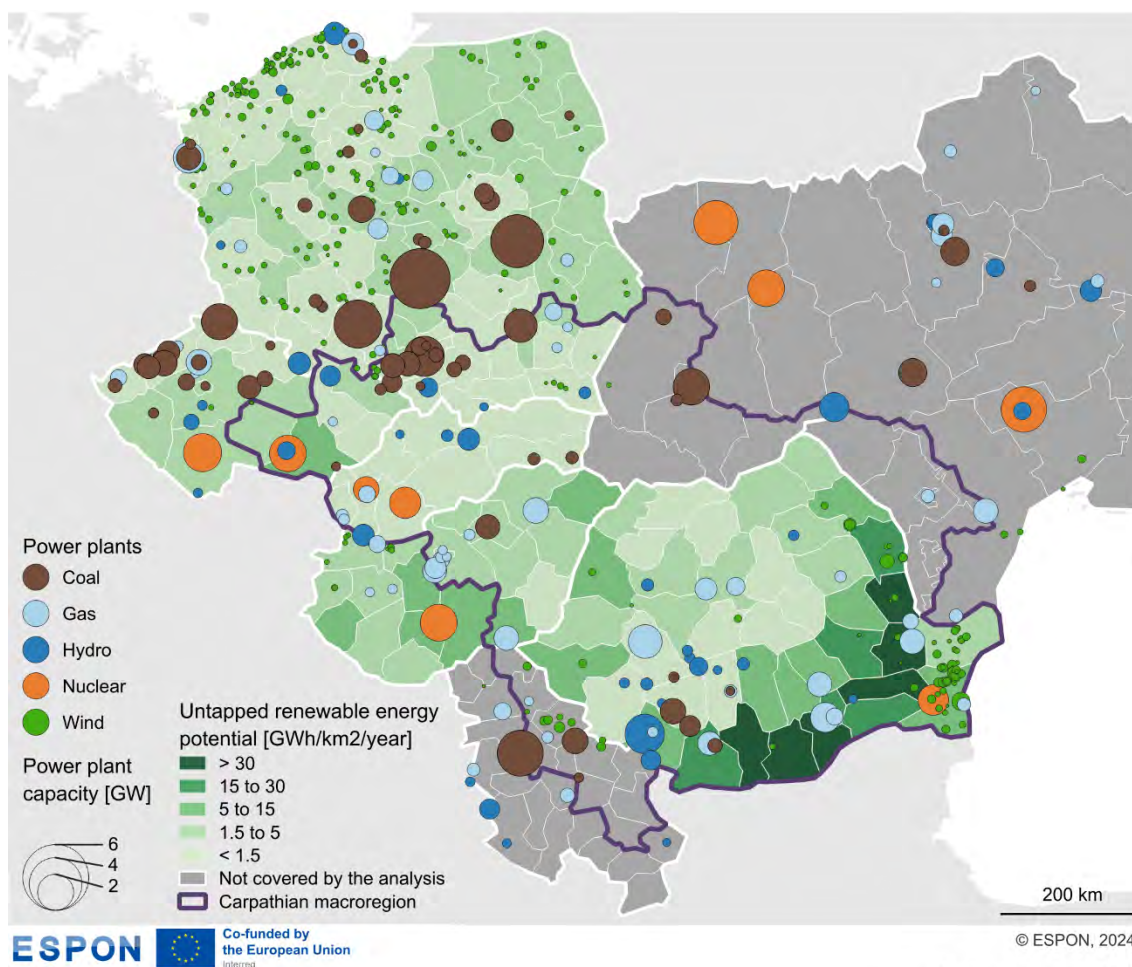
Country	Energy intensity of GDP	Total electricity production per capita	Carbon intensity of electricity production	Electricity production by source						
				Coal	Nuclear	Natural gas	Hydro	Solar	Wind	RE total
	[kWh/\$ of GDP]	[MWh]	[gCO ₂ eq / kWh]	[%]						
Czechia	1.39	8.1	450	39.3	39.4	4.7	4.4	4.2	1	12.8
Hungary	1.04	3.7	204	7.1	44.8	20.5	0.6	19.6	1.8	21.4
Rep. of Moldova	1.94	1.9	643	0	0	86.8	5.4	1	2.6	9.6
Poland	1.04	4.3	662	60.3	0	10.2	2.2	6.8	14	21.1
Romania	0.77	3.0	241	18.7	19.8	16.7	25.6	3.6	12.5	42.4
Serbia	1.77	5.3	636	66.3	0	4.1	26.1	0	2.6	28.7
Slovakia	1.32	4.6	117	5.7	61.8	7.7	16.4	2	0	21.9
Ukraine	2.11	4.3	n/a	21	54.7	8.6	9.6	3.7	1.6	14.3

Source: own calculations based on IEA (2024 - <https://www.iea.org/countries>) and OWID (2024 - <https://ourworldindata.org/explorers/energy>)

Map 2.9**Energy production by source in Carpathian countries, 2022**

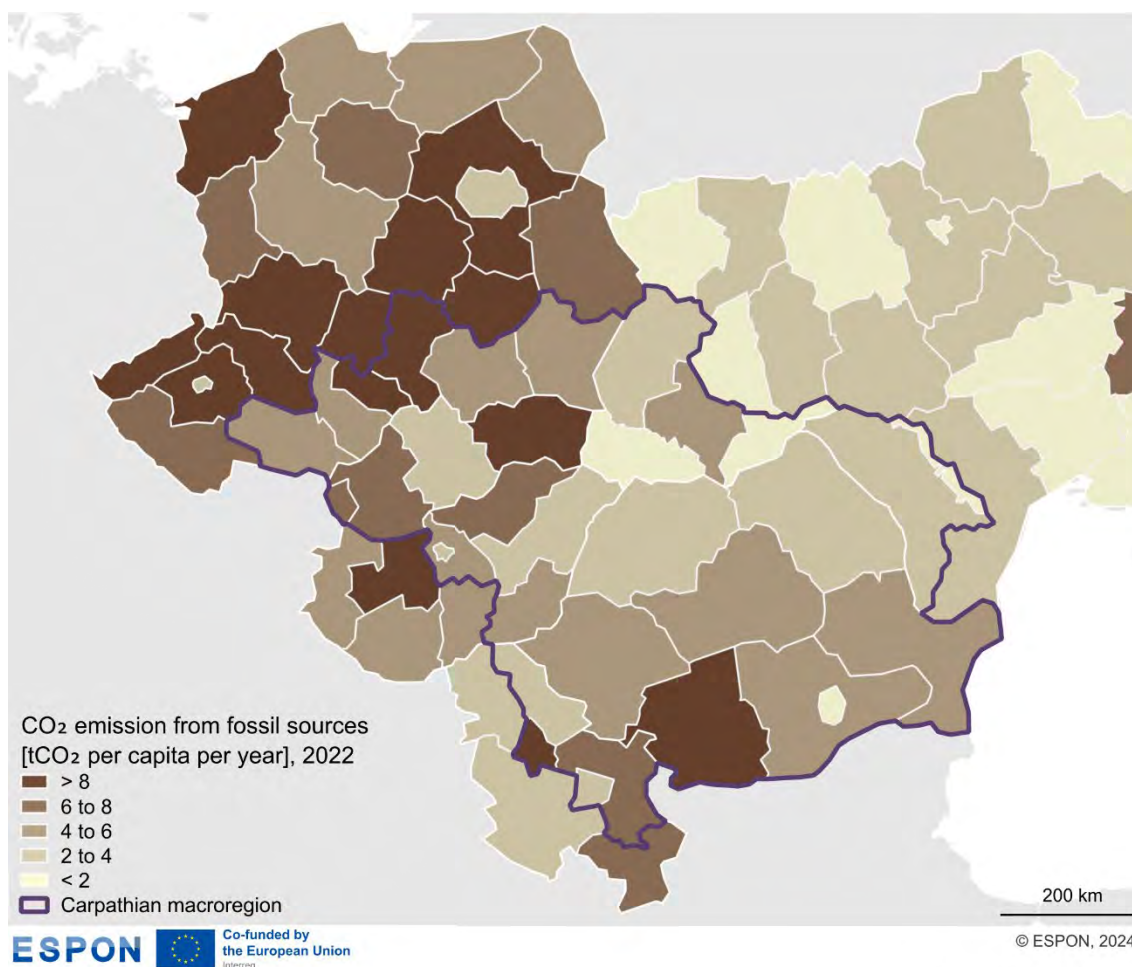
Territorial level: NUTS 0
 Source: ESPON KARPAT, 2024
 Origin of data: International Energy Agency
 © EuroGeographics for administrative boundaries

In terms of spatial distribution of electricity production, there is a notable lack of large power plants in the central Carpathian area, particularly in Eastern Slovakia, Ukraine and northern Romania. The largest power plants in the whole Carpathian region, in terms of capacity, are located in Silesia (coal), on the Czech-Slovak border (nuclear), and on the Serbian-Romanian border (hydroelectric). Wind power is concentrated outside of the mountainous areas, especially along the coasts. The countries of the region did not follow the path of constructing large wind farms in mountainous areas, like e.g. Spain or Germany did. An analysis of the untapped potential for renewable energy conducted by the Joint Research Centre (Perpiña Castillo et al. 2024) highlights opportunities for the region, most notably in southeastern Romania. Additional electricity production could mainly come from ground-mounted solar PV installations in the rural regions. The onshore wind, rooftop solar PV, and hydropower has much less potential in the region.

Map 2.10**Electric energy production: power plants and renewable energy potential, 2023**

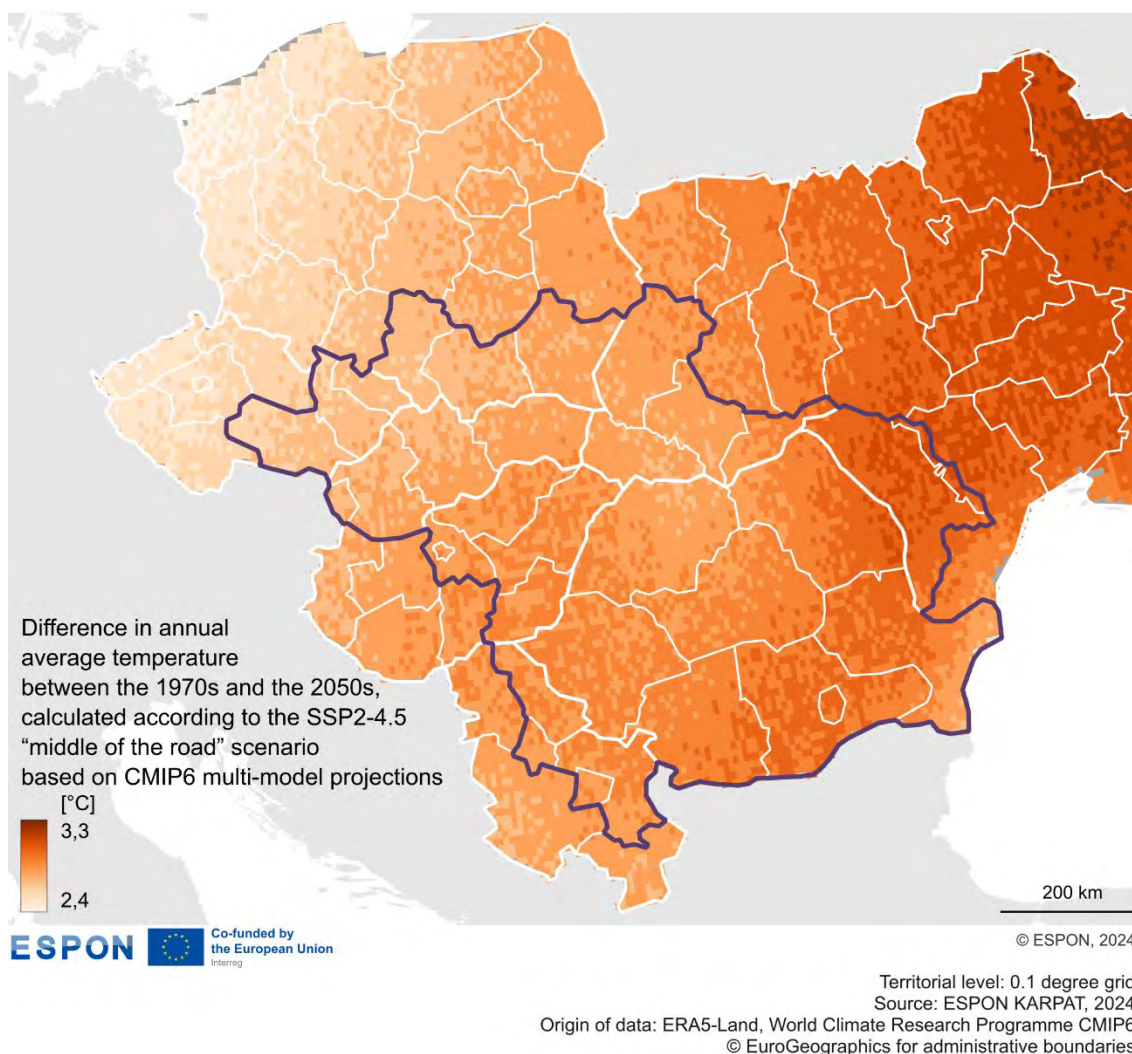
Territorial level: NUTS 0
 Source: ESPON KARPAT, 2024
 Origin of data: Global Energy Monitor for power plants;
 Perpiña Castillo et al. (2024) for the untapped potential
 © EuroGeographics for administrative boundaries

The CO₂ emissions from fossil fuel combustion are the main driver of global climate change, posing significant challenges to the future of human civilization. At the same time, it is an important indication for creation of necessary climate mitigation policies. The CO₂ emissions are presented on the per capita basis (Map 2.11), with the mean value for all regions in the Carpathian macroregion at 5.1 tons of CO₂ per capita, or approximately 2/3 of the EU-27 average. Among main types of fossil fuels, coal is characterized by the highest emissions per unit of energy. And indeed, out of 15 regions that report values of above 8 tons of CO₂ per capita, 14 harbour at least one large coal-fired power plant. Data on sectors with highest contributions to total greenhouse gas emissions (EC 2022, p. 125) shows that among EU NUTS2 regions within the Carpathian area the industry is a leading source for 13 regions, followed by transport (4 regions) and energy generation (3). It should be noted, though, that the emission data is production-based only and as such it does not account for the interregional flows of goods (eg. electricity transported to a neighbouring region).

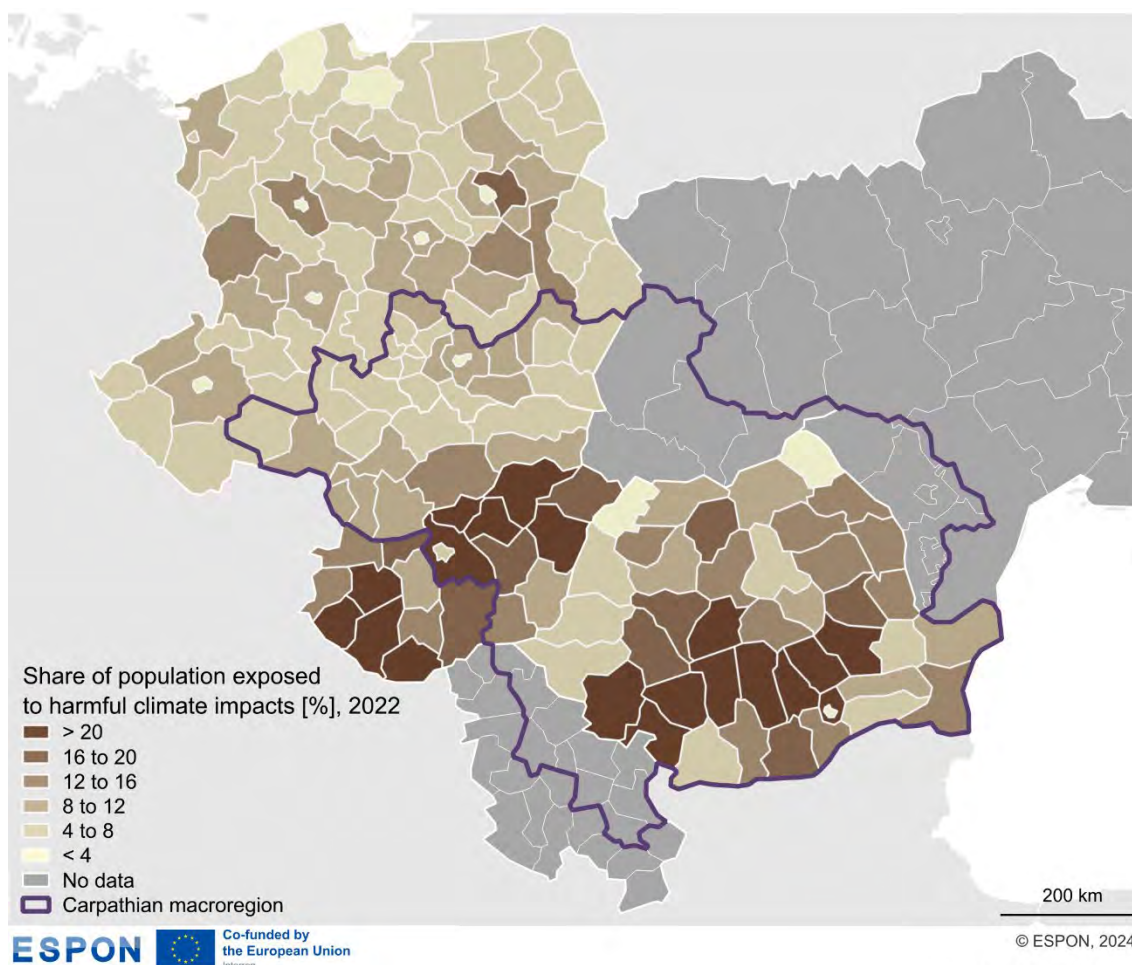
Map 2.11**CO₂ emission from fossil sources, 2023**

Territorial level: NUTS2
 Source: ESPON KARPAT, 2024
 Origin of data: JRC EDGAR Community GHG database
 © EuroGeographics for administrative boundaries

Due to greenhouse gases emissions, by year 2050, the Carpathian macroregion is expected to face significant climatic changes, with temperatures projected to rise by 2.4°C to 3.3°C compared to the 1970s baseline. The temperature variation across the macroregion is relatively small, with the highest increases, exceeding 3°C, observed in the Republic of Moldova and in southern and eastern Romania, while the lowest warming, around 2.6°C, is expected in the northwestern part of Carpathians. The ongoing warming could accelerate snow cover loss, alter hydrological cycles, and heighten the risk of extreme weather events such as heatwaves and heavy rainfall, potentially increasing the frequency of floods and droughts. Additionally, higher temperatures may cause severe disruptions in mountain ecosystems, including shifts in species composition, habitat degradation, and increased vulnerability of endemic flora and fauna. The projections presented here are based on the "middle of the road" (RCP 4.5) scenario, which assumes moderate global mitigation efforts; however, if emissions continue at a high rate, the actual warming and its consequences could be even more severe. As a result, the challenges facing the Carpathian region may be greater than currently anticipated, reinforcing the urgency of strategic mitigation and adaptation.

Map 2.12**Average annual temperature rise until 2050s - “Middle of the Road” scenario, 2024**

The foreseen impacts of changing climate, driven by greenhouse gas emissions, has become a global concern, due to its current and potential consequences for human populations. But the spatial patterns of these impacts are varied. A global temperature rise of just 2°C by 2050 – the very optimistic scenario given current global trends and commitments to reduce GHG emissions – would result in a significant portion of the regional population being affected by the negative consequences of the climate crisis (**Map 2.12**). In assessing the risks of windstorms, flooding, water shortages, and wildfires, the most vulnerable regions are found in Hungary and southern Romania, primarily due to water scarcity. However, the recent floods occurring across Central and Eastern Europe in September of 2024 have shown that even regions with a relatively low share of exposed populations can suffer dramatic consequences, both in terms of human and economic costs.

Map 2.13**Share of population exposed to harmful climate impact in NUTS3, 2022**

Territorial level: NUTS3
 Source: ESPON KARPAT, 2024
 Origin of data: 9th Report on economic, social and territorial cohesion;
 No data on MD, UA, RS
 © EuroGeographics for administrative boundaries

2.1.4 Settlement structure

The settlement system of the Carpathian macroregion can be considered relatively polycentric. This is reflected, among other things, in the large number of functional urban areas (see **Methodology Box**) belonging to the highest size categories, with populations exceeding 250,000 (**Map 2.14a**). Their distribution, while geographically dispersed, is uneven, as the main cities are predominantly located on the peripheries of the macroregion. Similarly, the density of the urban settlement network is not uniform (**Map 2.14.b**). A particularly high concentration of urban centres is found in the northwestern part of the macroregion, within a pentagon defined by the Upper Silesia Urban Area (Poland, with Katowice as the main city), Kraków (Poland), Budapest (Hungary), Bratislava (Slovakia), and Brno (Czech Republic). Additionally, a linear arrangement of major urban centres can be observed along the outer arc of the Carpathians, stretching from Kraków in Poland through Lviv in Ukraine, Iași in Romania, to Bucharest. In contrast, the number of large cities within the inner arc of the Carpathians is relatively small. Among the most significant—besides the capitals Budapest, Bratislava, and Belgrade, which are located on the macroregion's edges—are Cluj-Napoca, the principal urban centre of Transylvania; Braşov in Romania; the Hungarian city of Debrecen; and Košice, the main urban center in eastern Slovakia.

METHODOLOGY

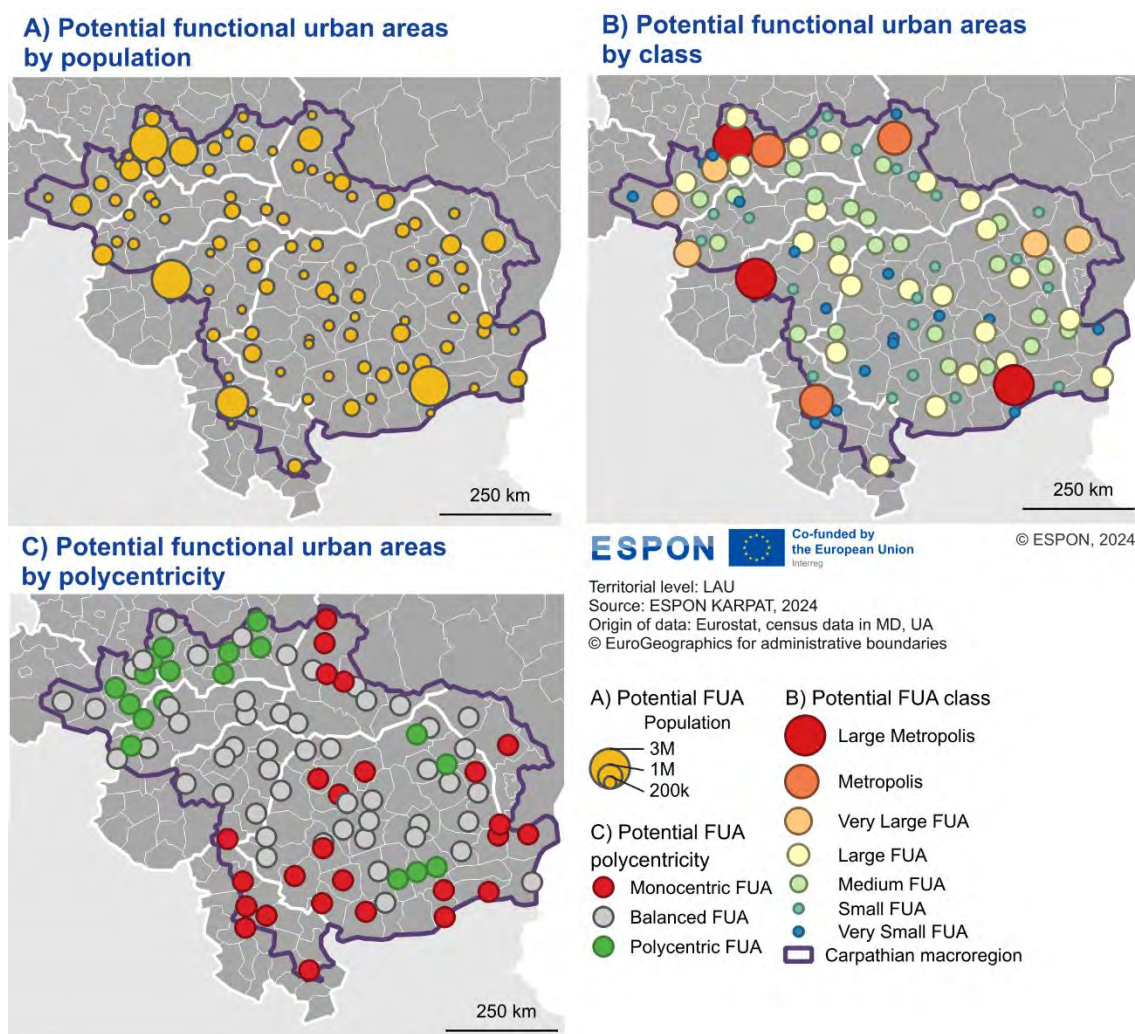
Defining Potential Functional Urban Areas

Potential functional urban areas (FUA) were identified using the following methodology. For urban centres with populations exceeding 50,000, the zone of influence was determined based on physical distance, which varied according to the size of the urban centre: 40 km for 1 million inhabitants, 35 km for 0.5 million, 30 km for 0.25 million, 25 km for 0.20 million, 20 km for 100,000, and 15 km for 50,000 inhabitants. Subsequently, the total population of municipalities within this area was calculated using the centroid method. The advantage of this approach is that it decouples the population count of an urban area from the administrative boundaries of the largest city, thereby improving the comparability of settlement system data. However, the method has drawbacks, including the arbitrary determination of a city's zone of influence and the omission of terrain barriers and transportation infrastructure. For these reasons, the term "potential" was adopted. It is also important to consider the significant limitations of alternative methods based on travel time (e.g., 45 minutes), which can show considerable variability depending on daily traffic patterns (e.g., congestion) and differences in the availability of transport modes. Additionally, travel times may change over time with developments in transportation infrastructure.

The classification of potential functional urban areas by size identified seven primary categories (**Map 2.13b**). At the top of the hierarchy are six urban/metropolitan centres with populations exceeding 1 million, which can be considered key settlement hubs of the macroregion. Additionally, five more cities have populations exceeding 500,000. Their size, combined with their administrative roles, including capital functions (e.g., Bratislava), also qualifies them as metropolises or potential metropolises. Significant manifestations of metropolisation processes, particularly related to the development of higher-order functions (e.g., regional administrative centres) and the advanced service economy, are also expected in large urban areas with populations exceeding 250,000. Within the defined boundaries of the macroregion, there are 23 such areas. This suggests that metropolisation processes, including the growing concentration of population and human capital, could potentially involve at least 34 cities in the region.

The managerial and control roles of these centres are supported by subregional urban areas with populations exceeding 100,000. These areas play a significant developmental role, especially in providing higher-order public services to the surrounding populations. Conversely, small and medium-sized cities with functional areas above 50,000 inhabitants or smaller face the risk of losing some of their functions to the above-mentioned group of metropolises and large urban centres. Nevertheless, this group remains crucial for servicing their functional hinterlands in terms of public and market services, as well as providing employment opportunities, including in sectors with higher value-added activities.

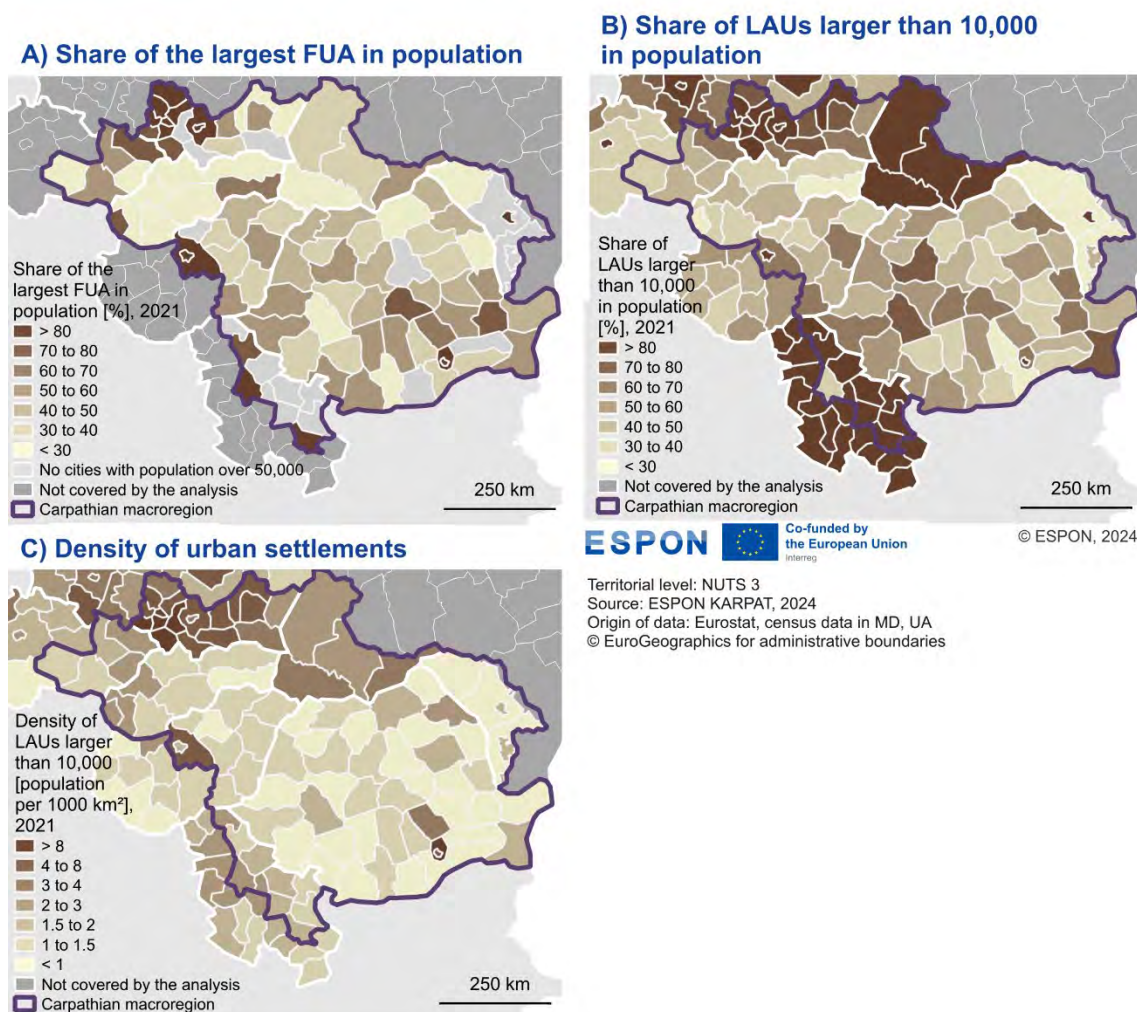
The spatial structure of potential functional urban areas—simplified as the share of the population within the administrative boundaries of the central city relative to the total population of the area—reveals differences in suburban settlement patterns between the northern and southern parts of the macroregion (**Map 2.13c**). In the northern part, encompassing Poland, the Czech Republic, and Slovakia, the surroundings of major urban centres are generally densely populated, often characterized by a network of smaller urban centres. In contrast, in the southern and eastern parts of the macroregion, particularly in Romania, the boundary between urban and rural areas is more pronounced. This results in a higher concentration of the population (above 75%) within the central city. A similar situation is observed in Serbia, although in this case, the high population concentration may largely result from the extensive boundaries of urban municipalities, which often include rural areas as well.

Map 2.14**Major Urban Centres, 2023**

The characteristics of administrative regions (NUTS3) largely depend on the size of the largest urban centers within them. The population size of these cities determines the potential scale of positive agglomeration effects, which typically translate into higher productivity in the regional economy. Significant spatial differences in the share of the functional areas of the largest cities in the total population of NUTS3 regions are evident across the Carpathian macroregion (**Map 2.14a**).

On one hand, there are urban NUTS3 regions, particularly those encompassing the largest cities (including their surrounding NUTS3 regions), such as Budapest, Belgrade, Bucharest, Kraków, and Bratislava. Additionally, there are regions where the majority of the population (over 50%) resides in the largest city or its vicinity. Examples include Rzeszów (Poland), Brno (Czech Republic), Olomouc (Czech Republic), Szeged (Hungary), Debrecen (Hungary), several large Romanian cities, and Chernivtsi (Ukraine). On the other hand, many regions either have no cities with populations exceeding 50,000 or their largest cities account for less than 30% of the total population. This is particularly true for Slovak regions, excluding Bratislava and Košice, as well as parts of Polish subregions in the Małopolskie and Podkarpackie voivodeships, most Serbian regions, and some remote regions in Romania. However, this does not imply that agglomeration effects related to the degree of urbanization⁸ are entirely absent in these regions (**Map 2.14b**).

⁸ The use of a simplified urbanization indicator expressed as the ratio of the population of municipalities with at least 10,000 residents to the total population.

Map 2.15**The important of cities and urban areas in the settlement system, 2021**

It is important to note that these results are influenced by the varying administrative systems and sizes of municipalities across countries. For instance, a particularly high proportion of the population living in municipalities exceeding 10,000 residents is characteristic of Ukraine and Serbia, where urban municipal boundaries often include adjacent rural areas. Similarly, in the Polish part of the macroregion, despite smaller municipal areas, the high population density results in over 80% of municipalities having populations above 10,000. Conversely, lower proportions in this respect (often below 50%) are typical of the Czech Republic, Slovakia, and to a lesser extent Hungary, where municipalities are smaller both in terms of area and population. In Romania, the situation is more varied due to differences among the country's historical regions.

The described pattern is largely reflected in the density of the settlement network, measured by the number of municipalities with populations exceeding 10,000 per 1,000 km² (**Map 2.15c**). The highest values of this indicator are characteristic of Poland and, to a lesser extent, Ukraine, indicating a dense settlement network. Similarly, the settlement network is dense in Serbia, western Slovakia, and selected regions of Romania, suggesting the influence of major urban centres on settlement density. Conversely, there are numerous NUTS3 subregions within the macroregion where fewer than one urban centre (municipality) with over 10,000 residents exists per 1,000 km² (approximately an area with an 18 km radius). This situation can adversely affect the efficiency of delivering public services in certain rural areas. Such conditions are most pronounced in Romania but are also present in individual regions of Hungary and Slovakia within the Carpathian macroregion.

2.1.5 Transport infrastructure and accessibility

Transport plays a key role in the economy by enabling the efficient movement of goods, people, and services, which directly influences regional development. Transport networks, such as roads, railways, ports, and airports, stimulate economic activity by connecting local markets with national and international trade hubs. With well-developed transport infrastructure, it becomes possible to quickly deliver raw materials to industries and finished products to consumers, which lowers production and distribution costs. Investments in transport infrastructure also foster job creation, attract investors, and increase the attractiveness of a region.

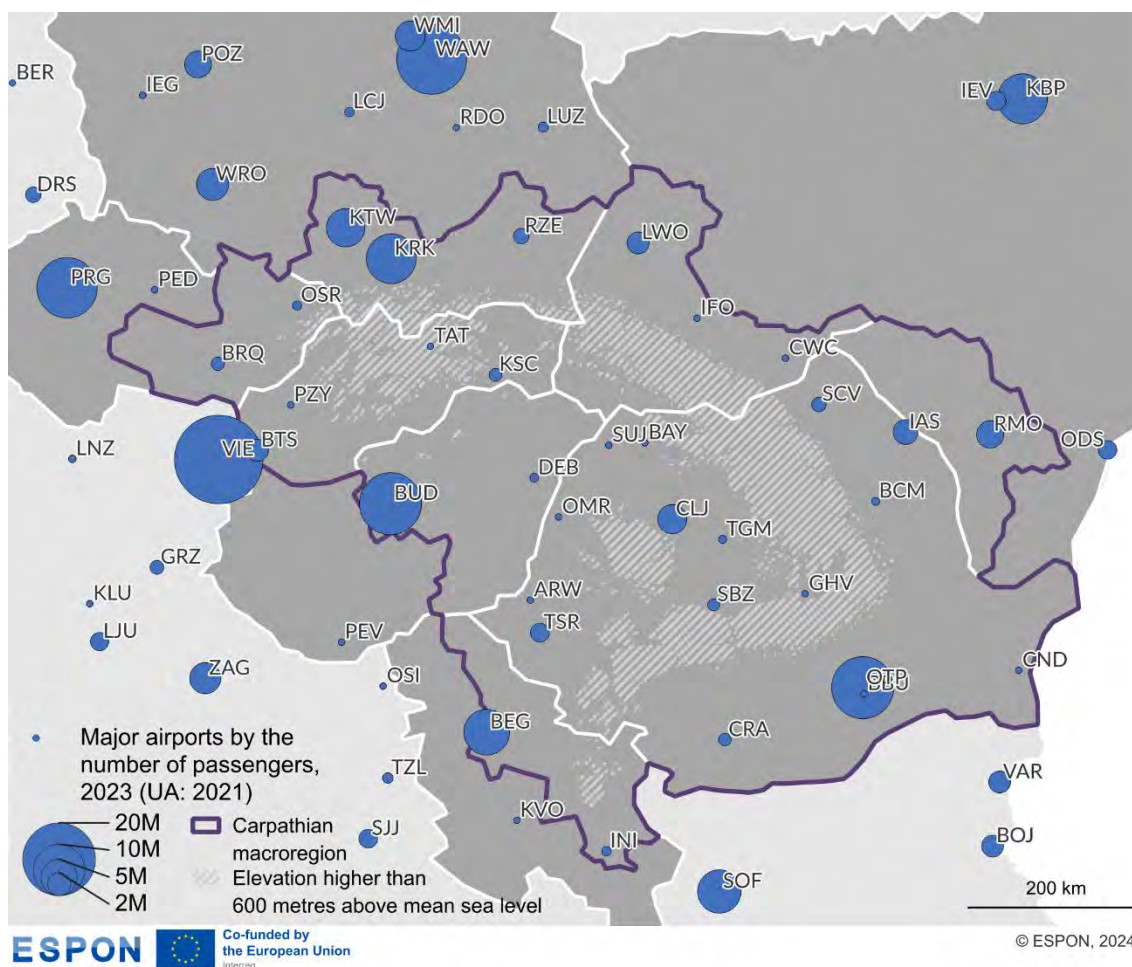
From a societal perspective, transport is crucial for people's mobility and access to essential services such as education, healthcare, and culture. In regions with well-developed transport infrastructure, people have greater opportunities to find employment and improve their quality of life, which helps combat social marginalization. At the same time, sustainable transport development that minimizes negative environmental impacts is an important factor in enhancing the quality of life in regions.

The analysis of transport in the Carpathian macroregion covered air, rail, and road transport, including potential transport accessibility.

Airports

The Carpathian macroregion is served by central national airports, such as Bucharest-Otopeni (OTP), Belgrade (BEG), and Budapest (BUD), as well as regional ones. The role of regional airports is particularly pronounced in Poland, where Katowice-Pyrzowice (KTW) and Kraków-Balice (KRK) airports attract high numbers of passengers (5.6 and 9.4 million, respectively) and serve the north-western part of the macroregion, including parts of Slovakia and Czech Republic. Parts of these countries are also within the catchment area of Vienna Airport (VIE) and Prague Airport (PRG). Therefore, nearby regional airports in Bratislava (BTS) and Brno (BRQ) attract a relatively smaller number of passengers (1.8 million and 671 thousand). Hungarian, Serbian, and Moldovan air traffic is largely dominated by central airports in Budapest (BUD), Belgrade (BEG), and Chişinău (RMO). Romanian and Ukrainian regional airports serving the region, such as Lviv (LWO), Cluj-Napoca (CLJ), Timișoara (TSR), and Iași (IAS) have increased their importance and passenger numbers since the early 2000s. Passenger traffic in Ukrainian airports has been halted since 2022 due to Russian aggression against Ukraine. Rzeszów-Jasionka airport (RZE) has played a key strategic role by taking additional tasks of transporting military equipment and humanitarian aid to Ukraine during this period.

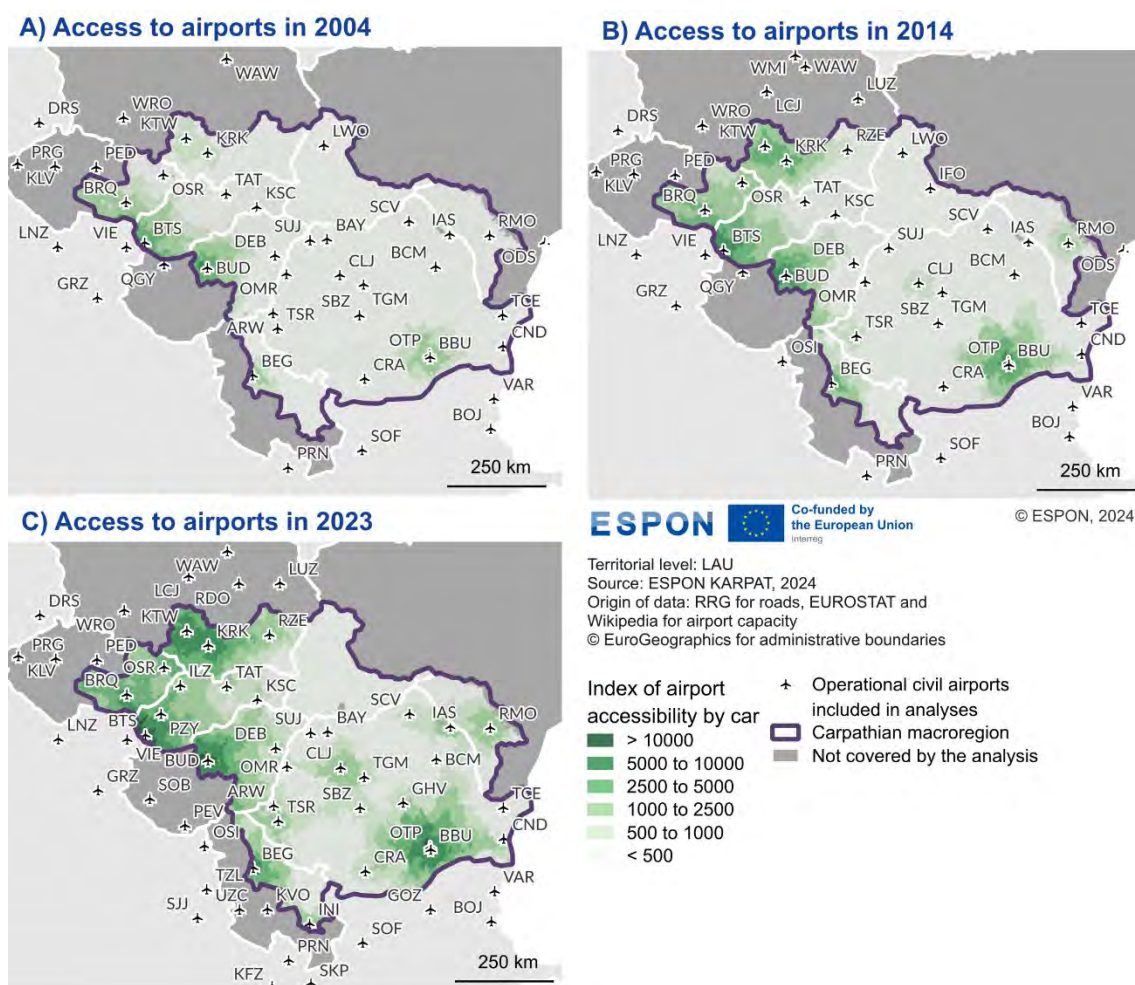
Map 2.16
Location and connectivity of airports, 2023



Territorial level: Points
 Source: ESPON KARPAT, 2024
 Origin of data: Eurostat (avia_paoa), Wikipedia
 © EuroGeographics for administrative boundaries

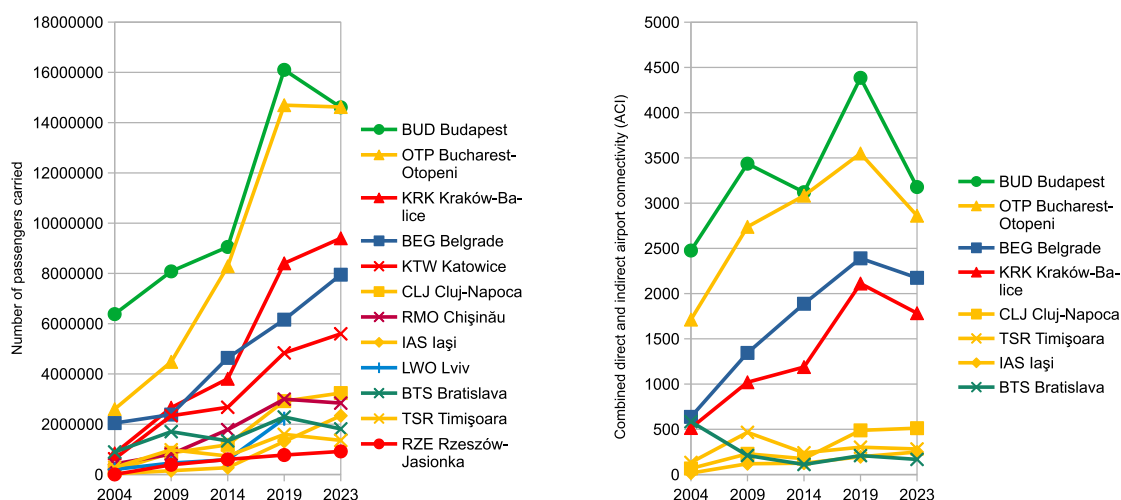
Air traffic in the region has grown rapidly since the early 2000s (**Map 2.17**). Particularly important for stimulating this growth was liberalisation of the aviation market in the mid-2000s (Dobruszkes, 2009; Pijet-Migoń, 2017). It opened the market to foreign traditional and low-cost carriers (LCCs) and stimulated the formation of LCCs based in the region. It reduced the role of national carriers (such as LOT, TAROM) and increased the role of those LCCs that were able to stay in the market, such as Hungarian-based WizzAir. Many of the medium regional airports (e.g., Ostrava, Košice, Iași, Suceava, Craiova, Cluj-Napoca) markedly increased the share of international passengers in their traffic composition. Market opening and public investments developed regional airports, which, together with the development of highways, improved spatiotemporal accessibility of air travel to the region's inhabitants and businesses measured with AAI index (Rosik et al. 2017). The number of passengers served by an airport was used as a proxy of the airport's capacity. The highest rates of accessibility improvement between 2004 and 2023 were observed in areas adjacent to the region's main airports that lie at the periphery of the macroregion. Access to air connections has also notably improved in the central part of the region thanks to the Cluj-Napoca (CLJ) airport development. Higher spatiotemporal and financial accessibility and affordability of air travel in the region has generally facilitated inbound and outbound international tourism, international business connections, and economic migrations out of the region (Dobruszkes, 2009; Pijet-Migoń, 2017). Cargo air transportation comprises a small share (<1%) of cargo transportation in the region and its role is limited to electronics, pharmaceuticals, and perishable goods. However, recent growth and future predictions suggest an increasing role of air cargo in the upcoming decades.

Map 2.17
Airport accessibility by car, 2004-2023



The COVID-19 pandemic strongly reduced the number of air passengers and connections in 2020 and 2021. However, the recovery to pre-pandemic levels in the region has been particularly swift, with multiple airports reporting higher numbers of passengers in 2023 than in 2019 (**Chart 2.2a**) and recovery in terms of airport connectivity has been somewhat slower (**Chart 2.2b**). Accessibility benefits thanks to increased airport connectivity come with a cost of rising greenhouse gas emission levels. Continuing growth and increasing dependence of local economies and vacationing practices on air travel will make reducing these emissions in the years to come particularly challenging.

Chart 2.2
Number of passengers at airports, 2004-2023



Source: own calculations based on EUROSTAT and Wikipedia for the number of passengers, Airports Council International Europe for airport connectivity.

Railway network

The railway network in the Carpathian macroregion and its surroundings was shaped historically and was linked to the need to improve transport, which was very underdeveloped in terms of infrastructure in the 19th century. In Austria-Hungary, the construction of a railway network began in the mid-19th century with the aim of integrating the various regions of the state. In the Carpathian Mountains, one of the most important projects was the construction of the so-called Galician Iron Railway, which was to connect Vienna to Lviv and further to Krakow, as well as to Przemyśl, which was of enormous strategic and economic importance.

The Carpathian Mountains, as a mountain range, represented a major barrier both geographically and technically. Delineating railway lines in mountainous terrain required a great deal of effort and an accumulation of engineering structures, such as tunnels bridges, viaducts and sections with steep gradients.

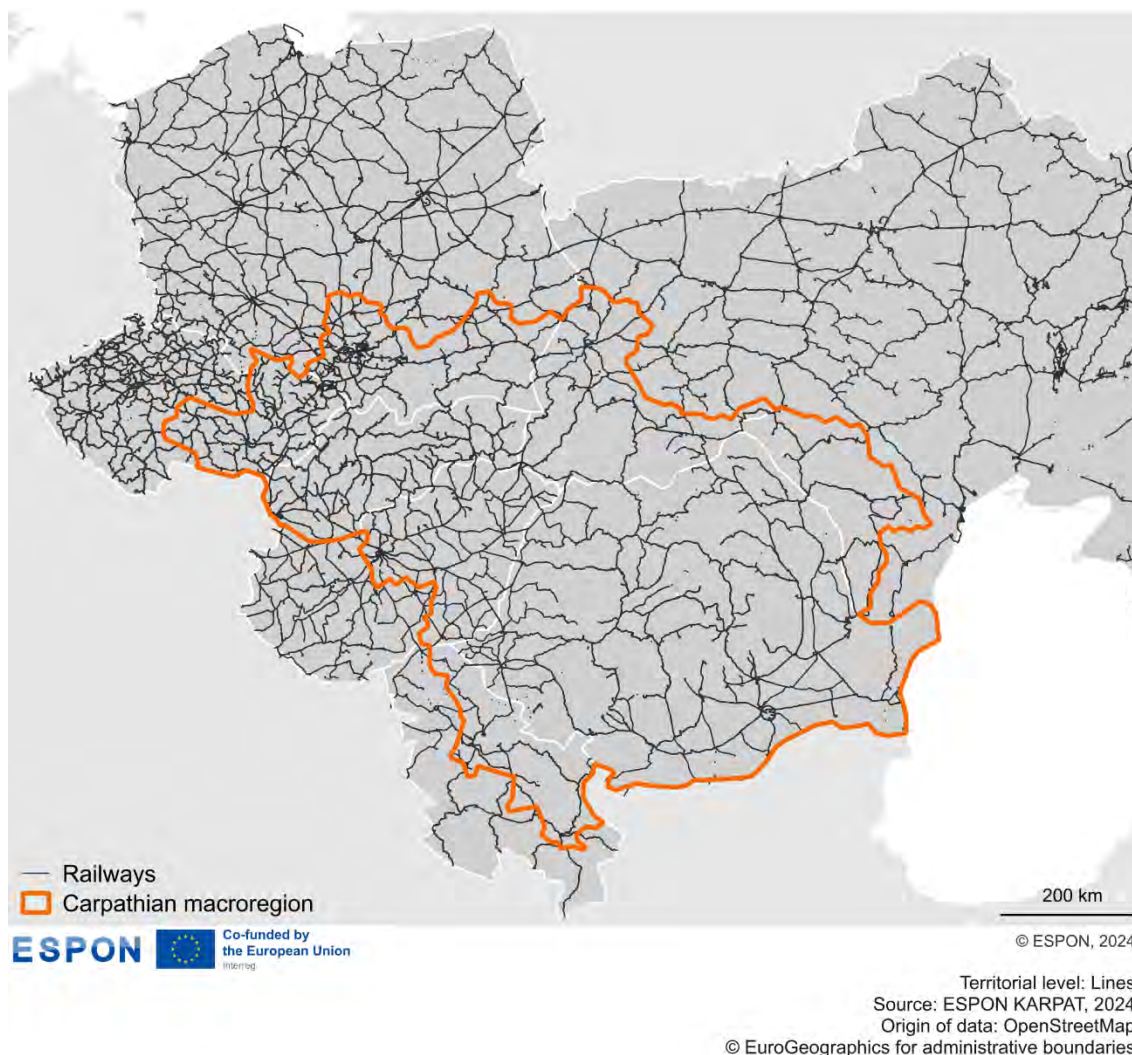
The current shape of the railway network is centred around latitudinal transport corridors (**Map. 2.18**). To the north, it is formed in large part by the upgraded E30 trunk line in the North Sea-Baltic Sea corridor running from Silesia to the Ukrainian border and having its broad-gauge continuation towards Lviv. To the south is the Rhine Danube Corridor running from Vienna, via Bratislava, Budapest to further via Oradea, Cluj, Braşov Bucharest and Constanta. Between these two main corridors is also the Rhine Danube Corridor Ostrava - Zilina - Kosice.

The basic element connecting the above-mentioned ranges in a meridional arrangement is the Baltic Sea-Adriatic Sea corridor and the E65 line bypassing the Carpathian Mountains from the west, through the Moravian Gate. The mountain range itself, on the other hand, is crossed by lines with much lower parameters. Filling the Katowice - Žilina - Bratislava and Tarnow - Kosice - Oradea - Timişoara corridors (variants of the Baltic Sea - Adriatic Sea corridor).

As part of the 2021 TEN-T revision, a new Baltic-Black-Aegean Seas TEN-T Corridor was planned. This is a route designed to connect southern and northern Europe, the Greek Aegean coast with the Polish Baltic coast. The Rail Carpathia, which is described in more detail at the end of this chapter, would be its rail filling.

Rail transport in the Carpathians, despite the many railway lines, does not look satisfactory. Rail traffic is mainly carried out on trunk and first-class lines, and these are mainly running in the foothills in flat or foothill terrain. There is a conspicuous lack of north-south railway crossings in the Carpathians that are open all year round.

Map 2.18
Railway network, 2023



The layout of railway lines located latitudinally from west to east is as follows. In the north, the main trunk line built between 1856 and 1861 is the Karol Ludwig Galician Railway, which runs mostly through flat areas and connects large urban centres such as Krakow - Tarnow - Rzeszow - Przemyśl - Lviv. This line has been extensively modernised and has very good parameters in terms of infrastructure and commercial speeds in the Krakow - Przemyśl section. From Przemyśl it is a broad gauge line, but with passenger services there are good connections in the direction of Lviv, Kyiv and Odesa. Passengers at Przemyśl Główny station change from standard gauge trains to broad gauge trains and continue their journey.

The next line is the Galician Transversal Railway, built between 1872 and 1884. It is a typical mountain line crossing basically the whole Carpathian Mountains from west to east. The 620-kilometre-long line runs from Chadeč (Slovakia) - Żywiec - Sucha Beskidzka - Chabówka - Nowy Sącz - Jasło - Krosno - Sanok - Zagórz - Chyrov (Ukraine) - Sambor - Stryi - Ivano-Frankivsk (Stanislavov). From Chyrov to Ivano-Frankivsk this is a broad-gauge line. Unfortunately, in many sections the parameters of this line are not good due to the winding sections, high gradients and lack of modernisation. Recently, however, there have been attempts to improve the track and even, in the case of the Chabówka - Nowy Sącz section, to build the line from scratch and connect it with Kraków.

Another line located latitudinally is the Košice-Bohumin railway, built between 1869 and 1872. It is a 370-kilometre long trunk line running through slightly mountainous and undulating terrain. It is entirely a normal-gauge line. It runs from BohuminBogumin (Czech Republic) - Český Těšín - Čadca (Slovakia) - Žilina - Poprad - Kysak - Košice. This line has good technical parameters as well as satisfactory commercial speeds. It

is the main line in Slovakia connecting both Košice with Bratislava via Žilina and Košice with Prague via Ostrava. It also plays a significant role in connections between Slovakia and Poland as the fastest connections are via Bogumin or Ostrava. On the other hand, there are no year-round connections via Łupków and Muszynę on the north-south axis. The continuation of this line is a 105 kilometre long section between Košice - Michalany - Čop (Ukraine) where a normal gauge track runs. The change to broad gauge trains only takes place within Ukraine at Czop, where there are also normal gauge trains from Záhony in Hungary.

The last significant west-east transport line is the Brzeclaw (Czech Republic) - Bratislava (Slovakia) - Budapest (Hungary) - Arad (Romania) - Bucharest - Constanta section, consisting of several normal-gauge lines. Trains on these routes run frequently, with good line performance and good commercial speeds. In Romania, due to the dense rail network, shorter journey times are often obtained by taking a longer route in kilometres that avoids the mountains. Unfortunately, in the case of mountain lines, journey times increase rapidly and commercial speeds decrease.

As far as south-south railway lines are concerned, this is as follows. One of the main lines is the Katowice - Rybnik - Bohgumin (Czech Republic) - Ostrava - Przera - Breclav - Vienna (Austria) railway line which runs through the Moravian Gate separating the Carpathian Mountains from the Sudetenland. It is a first-class main line with very good technical parameters and high commercial speeds. A large number of trains of all categories, both passenger and freight, run on it. The line connects the three countries of Poland, the Czech Republic and Austria.

The next line is the Katowice - Bielsko Biala - Żywiec - Zwardoń - Čadca (Slovakia) line. In this case, the section from Katowice to Bielsko Biala over flat terrain runs relatively quickly for the distance. However, even though the line has been partially modernised, it continues through mountainous terrain where trains slow down considerably on winding curves and hills, as a result of the line's profile. However, it is possible to travel here all year round by passenger train with a change of trains in Zwardon and on to Čadca or Žilín in Slovakia.

Another line is the Tarnów - Stróże - Nowy Sącz - Muszyna - Pławiec (Slovakia) - Prešov - Košice line. In the Polish section from Tarnów to Muszyna and then a branch line to Krynica, the line is undergoing extensive modernisation, which will allow for improved operating parameters and higher commercial speeds in the future. Unfortunately, at the moment this line, although it has great potential and could be the shortest connection between Krakow and Kosice, is not sufficiently used for international passenger traffic. A few years ago, Slovak railways launched two pairs of tourist trains from Muszyna via Pławiec to Poprad, running only on Saturdays and Sundays from June to September. A clearly inadequate offer given that the season in the mountains lasts almost all year round. On the Slovakian side, from Plávec to Lipana, passenger train traffic is limited to two pairs per week. As a result, it is not possible to cross the border from Muszyna to Lipana and on towards Košice all year round.

To the east of this line we have another example of a line that is completely unused in border traffic between Poland and Slovakia. Namely the Zagórz - Komańcza - Łupków - Medzilaborce - Humenne - Trebiszów - Michalany line. This is a typically mountainous, winding line with low operating parameters and low commercial speeds especially on the Polish side. There is no freight traffic and trains from Zagórz to Medzilaborce only run on Saturdays and Sundays from June to September. On the Slovakian side it is much better, with trains from Medzilaborce to Humenne running every two hours and convenient transfers to Kosice, among other destinations.

In Ukraine, the trans-Carpathian line of local significance is the fully broad-gauge Lviv - Sambor - Sianki - Veliky Bereznyj - Uzhhorod line. Passenger and freight traffic is carried on it and the line has the parameters of a mountain line with a large number of hills. It is very winding, has tunnels and bridges, which are very well guarded and no unauthorised person can get close to them. There are also frequent checks on the trains as well as along the tracks. Journey times are very long and the line is waiting to be upgraded.

The main Trans-Carpathian line in Ukraine is the first-class Lviv - Stryi - Mukachevo - Chop trunk line. This line has good technical parameters and good commercial speeds despite its mountainous nature. It is Ukraine's main connection to southern Europe via the border crossing at Chop with Slovakia and Hungary. It is a broad gauge line along its entire length, and from Čop on a normal track it is possible to reach Košice in Slovakia and Debrecen in Hungary. It is also a connection to Budapest as well as to Bucharest in Romania.

From Ukraine, international traffic is mainly via Medyka to Poland and Czop to Slovakia and Hungary. There are no connections between Ukraine and Romania. In 2023, there was a newly opened connection between

Dilovo and Valia Vysheului, which was discontinued in 2024. In Romania, due to the dense rail network, a shorter journey time is often obtained by a longer route in kilometres. The Budapest - Subotica - Novi Sad - Beograd main line is still under reconstruction. Serbia is cut off from Europe by rail with the exception of the section from Hungary (Segedin - Roszke - Subotnica), which was reactivated in 2023. There is a distinct lack of north-south rail border crossings in the Carpathians that are open all year round. There are basically only two main lines where there is non-stop year-round traffic with passenger trains of all categories and goods trains. The first is Katowice - Ostrava - Vienna, the second is Lviv - Stryi - Čop - Kosice - Budapest or Čop - Miskolc - Budapest.

Density of railways infrastructure

The density of the railway network in the Carpathian Mountains is generally low and the railway infrastructure facilities are not able to meet the needs of businesses, residents and tourists, especially in the more remote, mountainous parts of the region (**Map. 2.19**). Exceptions are selected areas, the main ones located on both sides of the mountain chain and in the western part of the study area, where rail is one of the main means of transport.

In Poland, in the Carpathian Mountains, especially in Eastern Małopolskie and Podkarpackie, the density of the railway network is not lower than in the rest of these regions. Most of the railway lines through the Carpathians are of regional or tourist nature, connecting smaller ones and complementing the main network. Some of the lines also terminate blindly in mountain towns.

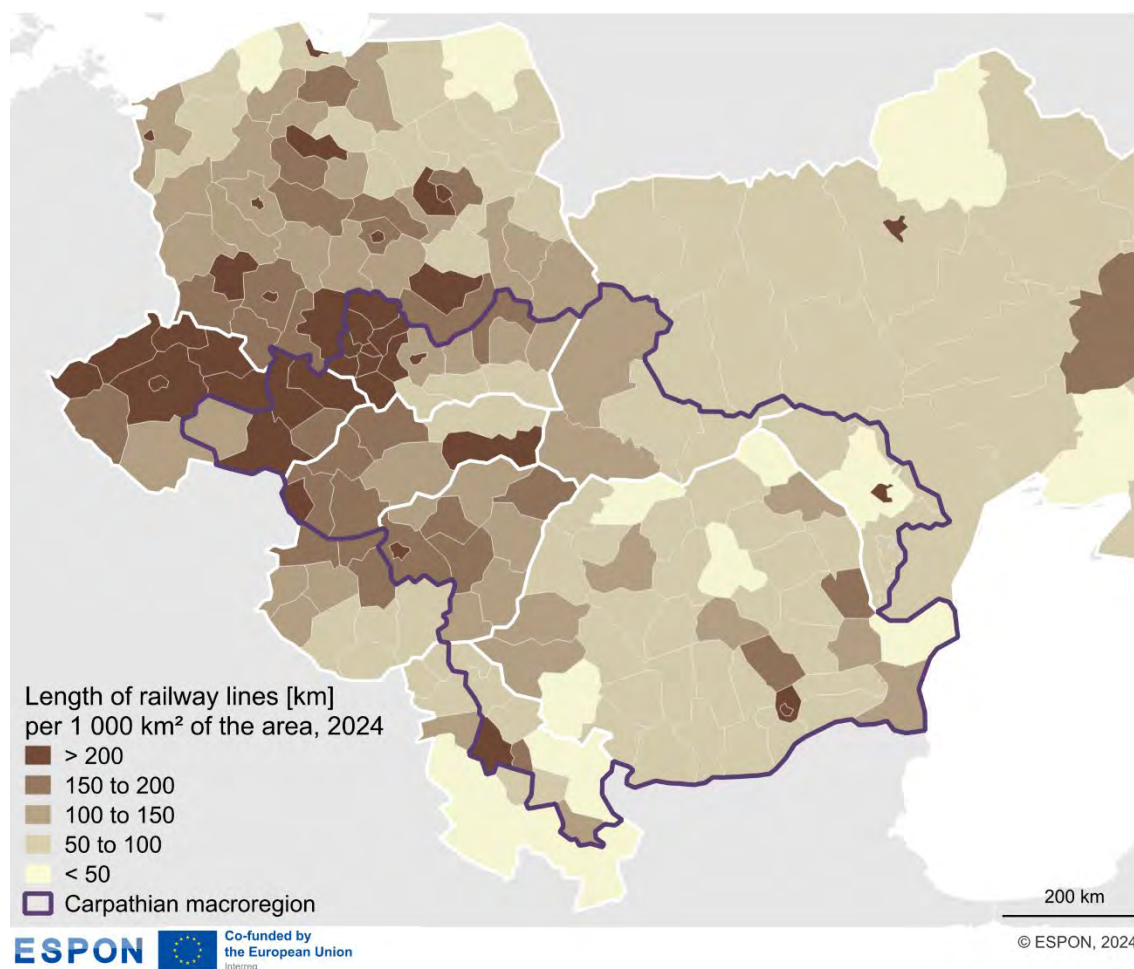
Slovakia, like Poland, has a dense railway network in the Carpathians, especially in the Tatra Mountains, where rail is one of the main means of transport among tourists. Railways there are also used to transport goods, including natural resources mined in the region. The Slovak Carpathians, with their narrow valleys and high altitude differences, pose challenges for railway construction, and the railway network itself is relatively sparse compared to other regions of the country.

The railway infrastructure in the Ukrainian Carpathians is also relatively underdeveloped, although some lines have been modernised in recent years. There are several important routes connecting the mountain regions to major cities, but their density is low. The rail network in Ukraine is struggling with infrastructure problems, including a small number of tracks and difficulties in maintaining old rolling stock.

In Romania, the Carpathian Mountains are challenging for rail transport, but some lines, especially in Transylvania, connect larger cities to smaller centres. The density of the rail network in this region is also quite limited.

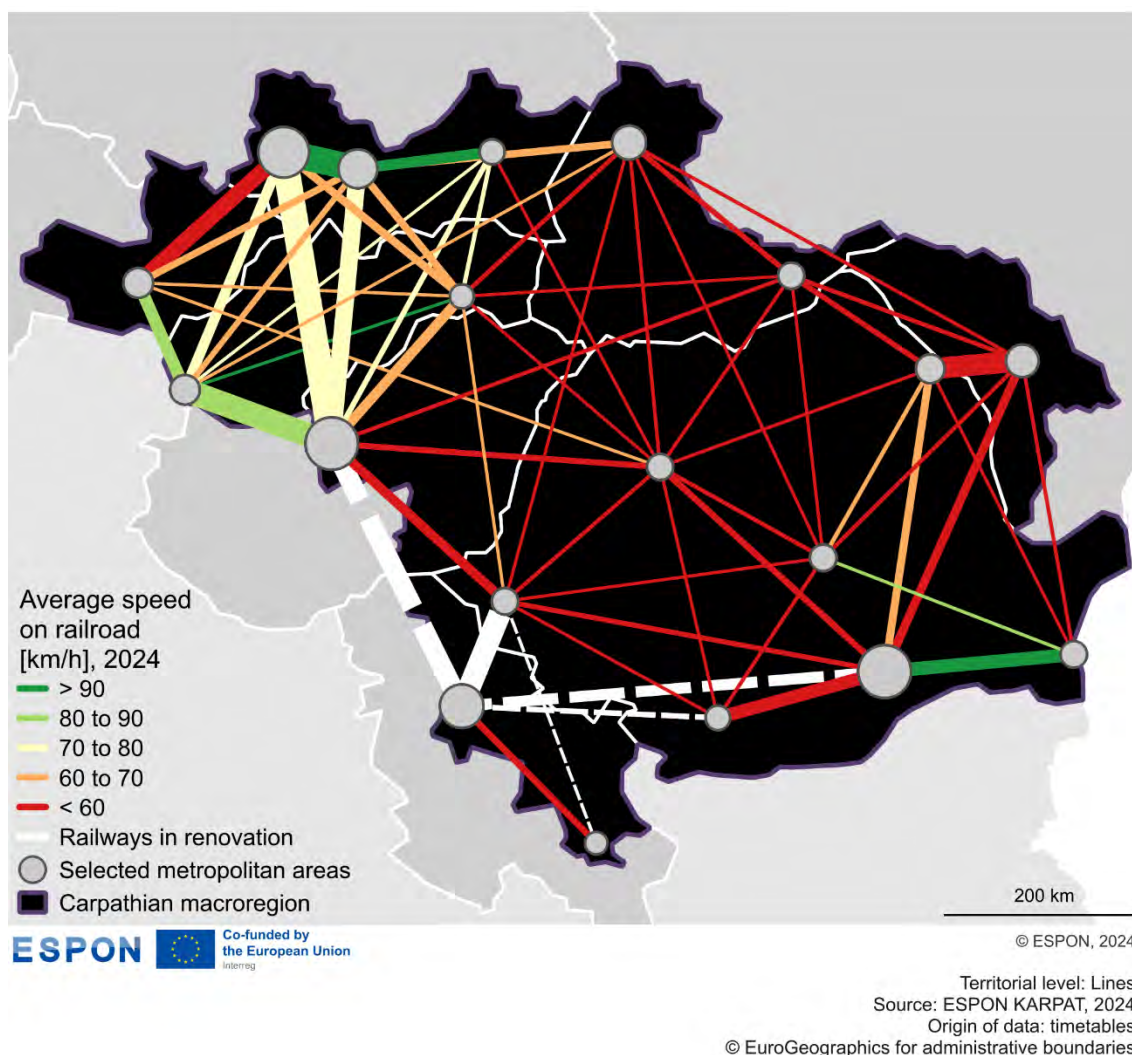
Map 2.19

Density of railway infrastructure, 2023



Territorial level: NUTS 3
Source: ESPON KARPAT, 2024
Origin of data: OpenStreetMap
© EuroGeographics for administrative boundaries

Map 2.20
Intermetropolitan connectivity by train, 2024



The layout of the transport network described above is clearly reflected in travel times between the main urban centres of the Carpathian macroregion (**Map 2.20**). It is worth noting that the railway network is better developed in the western part of the macroregion, especially within the polygon formed by the Upper Silesian and Zagłębie Metropolis (Katowice), Ostrava, Bratislava and Budapest. However, in terms of travel time relative to physical distance, access to trunk lines generally circumnavigates the mountains..

The phenomenon described in the Box is similar when considering the wider rail network, including national and regional (level 2) connections. The rail network is generally underdeveloped, with increasing density to the south and west. Notwithstanding these differences, the number of lines crossing the main mountain chain is significantly lower than in the lowland areas and a significant part of the study area is not reached by rail at all.

A consequence of the layout and condition of the infrastructure is the availability and quality of connections. In the eastern part of the macro-region, travel times between major urban centres are considerably longer, mainly due to gaps in infrastructure combined with the natural barrier of the mountain range. A similar challenge exists in the southern part of the macroregion, affecting connections between Serbian and Romanian cities, as well as in the northern part, affecting routes between Polish and Slovak cities. As a result, the mountainous regions face significant travel time challenges due to both physical and infrastructural constraints.

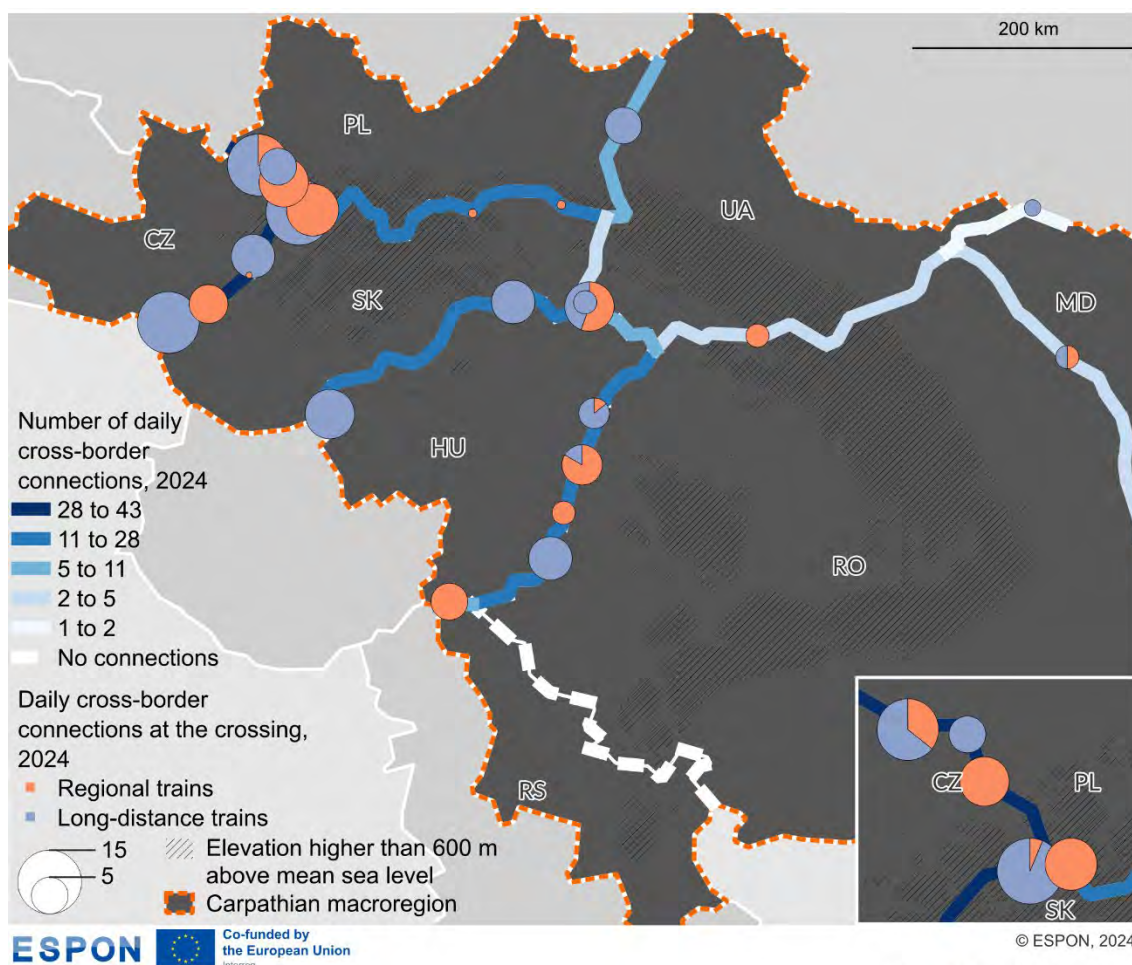
DIGRESSION**Examples of transmountain railway connection: Rzeszów - Koszyce**

An example of a connection between two provincial cities is how to take the shortest route through the Carpathians and the fastest route around the Carpathians. Take the two cities of Rzeszów in Poland and Košice in Slovakia. These are two cities of around 200 000 inhabitants which are important urban centres for south-eastern Poland and eastern Slovakia. The straight line distance is 156 kilometres, the road distance 200 kilometres with the fastest driving time by car being about 3.5 hours. Let us now see how it looks like with a railway connection, assuming that it would be possible to travel the shortest route by passenger train in the section Rzeszów - Jasło - Zagórz - Łupków - Medzilaborce - Humenne - Košice. The railway distance on this section is 340 km and can be covered by train with many changes in 7.5 hours. This is the shortest rail connection, but unfortunately it can be used only on weekends from June to September. So we are left with the year-round connection Rzeszów - Tarnów - Kraków - Ostrava - Žilina - Poprad - Košice. In this case, bypassing the Carpathian Mountains all around, the railway distance is as much as 635 kilometres with travel time of 8 hours and 40 minutes.

Due to the topography of the terrain and the fact that they belong to different countries, the Carpathians represent a serious barrier for railways not only in terms of infrastructure but also in terms of organisation. Cross-border railway connections in the Carpathians are limited to only a few lines crossing the main mountain chain (**Map 2.21**). Due to the winding route, severely limited technical parameters, capacity problems and a significant degree of depletion, the speeds achieved are low. In addition to the problems caused by the differences between the railway networks of the individual countries, including different safety systems, transport organisation, electrification or tariff policy, there are few crossborder connections and in some cases cross-border sections are not served at all. This situation applies to both regional and long-distance services.

A similar situation also exists in freight transport. Limits on train length and axle load mean that hauliers opt for circular routes, which have better performance and therefore significantly higher productivity. The mountain barrier is particularly pronounced in travel times between urban centres located on opposite sides of the Carpathian range (**Map 2.22**). This barrier affects virtually all the links analysed, but is particularly pronounced in the Eastern Carpathians, followed by the Southern Carpathians, while it is relatively less significant in the Western Carpathians. Nevertheless, in all cases this transport barrier is expected to have a limiting effect on socio-economic interactions between neighbouring towns.

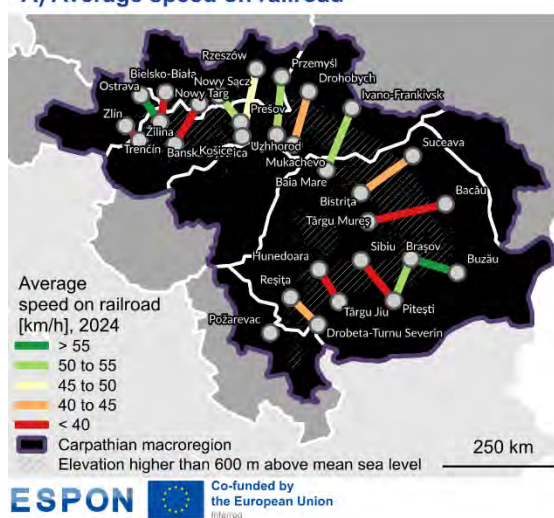
Map 2.21
Interborder connectivity by train, 2024



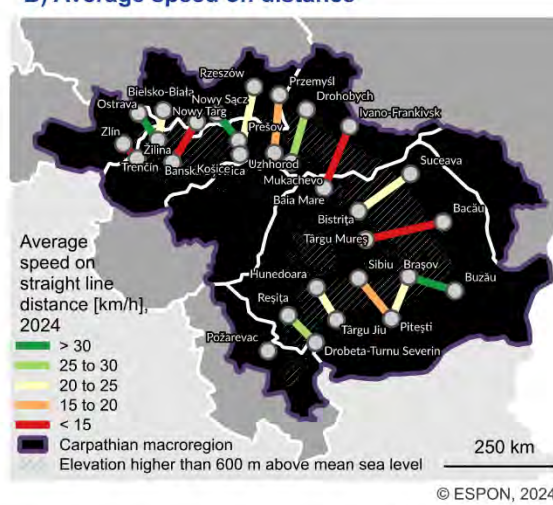
Territorial level: NUTS0, points
 Source: ESPON KARPAT, 2024
 Origin of data: Timetables
 © EuroGeographics for administrative boundaries

Map 2.22
Transcarpathia rail accessibility, 2024

A) Average speed on railroad



B) Average speed on distance



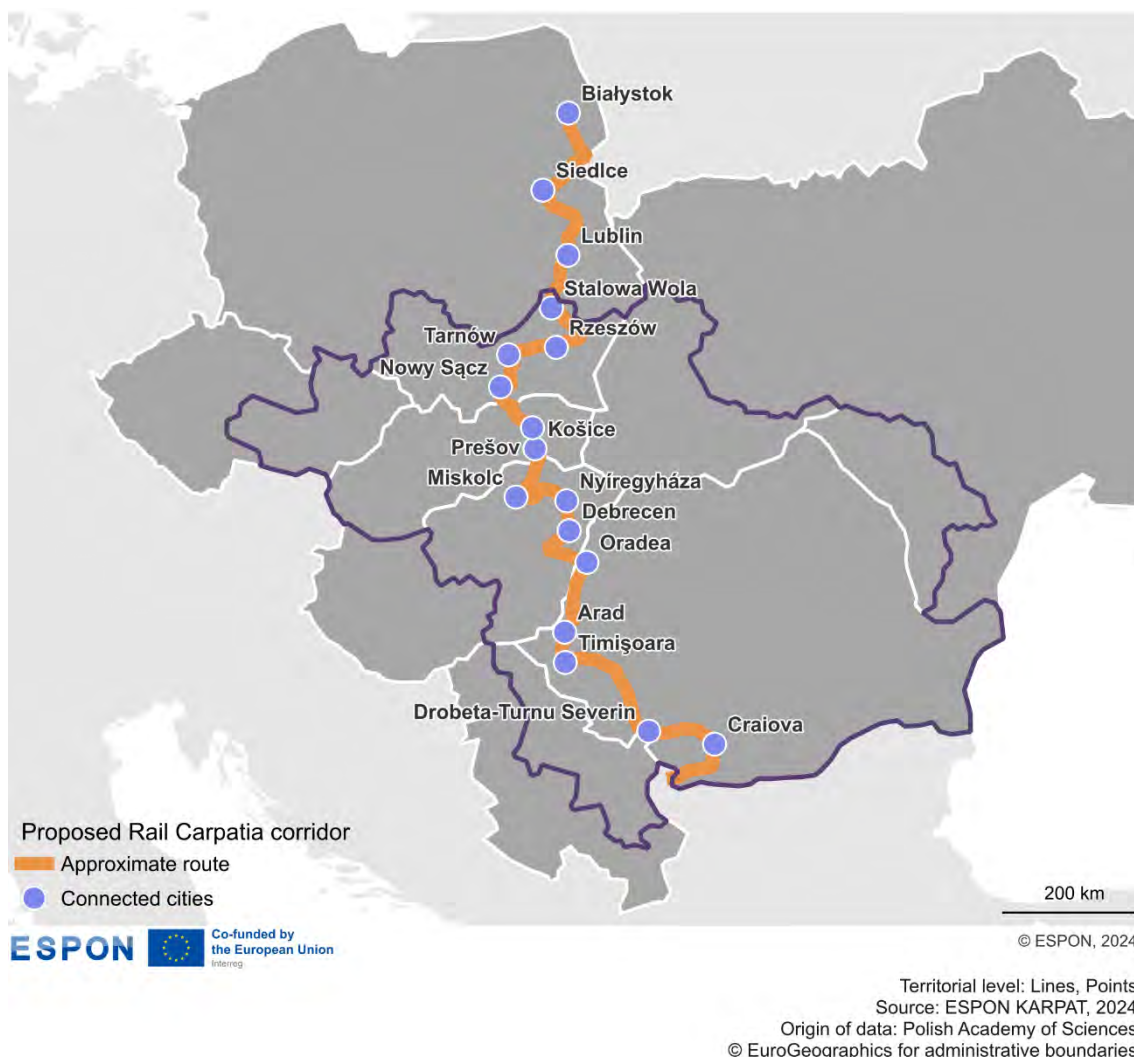
Territorial level: Lines
 Source: ESPON KARPAT, 2024
 Origin of data: Timetables
 © EuroGeographics for administrative boundaries

DIGRESSION**Rail Carpatia**

Currently, Rail Carpatia is a concept for a trunk line that should run between the Baltic Sea and the Aegean Sea, connecting regions close to the EU's external border. The line is intended to be an element of a coherent and interoperable multimodal transport network with unified, high technical parameters. In parallel, it is intended to play an important military role as a year-round route along the eastern borders of NATO countries. Preparing the infrastructure for this role is a major challenge, as the Rail Carpatia rail corridor currently consists of many sections, the technical condition of which varies greatly from country to country. The investment and modernisation plans of individual countries are also different. Meanwhile, along its entire length, the line should maintain the parameters specified for sections of the comprehensive network, i.e. - full electrification, minimum axle load of 22.5 t (221 kN), design speed of freight trains 100 km/h and passenger trains 160 km/h, the possibility of running trains of 740 m in length, equipment with the European Rail Traffic Management System. The preparation and launch of the new Rail Carpatia trunk line would provide an opportunity to integrate the transport system of the EU's eastern borderlands and at the same time complement the modernisation of the railway network of countries such as Poland, Slovakia and Romania, which has been ongoing for several years. Rail Carpatia would also have an impact on the integration of the railway network of the EU and neighbouring countries, especially Ukraine, Serbia and Turkey. At the same time, it should be borne in mind that in the international system Rail Carpatia runs through peripheral areas of both Europe and the individual member states. The route is dominated by medium and economically underdeveloped regions, which at the same time have high natural and tourist values. In this situation, the success of the project depends on the link to other rail corridors and, through them, to metropolitan areas in the route countries and neighbouring countries. The different sections of the Rail Carpatia corridor have different socio-economic and demand justifications. The northern and southern sections may have an integration role (functional links to the EU core and to the Baltic and Aegean seaports), while the central section may have a developmental role related to the search for endogenous potentials in peripheral areas and their integration with major metropolises on a European scale. As a route connecting peripheral areas, Rail Carpatia will also have a significant impact on improving the transport accessibility of certain regions and regional centres. Rail Carpatia, like the parallel Via Carpatia, would be an infrastructural response to the positive effects of cohesion policy. In the long term, it will connect cities and regions whose potentials have been strengthened by structural aid following the enlargement of the European Union. It could also be a response to the problems of medium-sized cities losing socio-economic functions, which are noted in some CEE countries, inter alia, as a result of depopulation.

In the mountainous areas of the Carpathians, the railway network is sparse and underdeveloped. None of the existing lines meet the standards set for the TEN-T network. The only development projects with an international or even continental dimension are the as yet (1) proposed construction of a high-speed railway from Warsaw to Budapest (emerging declarations suggest a route via Katowice, Ostrava and (2) the concept of a railway line Rail Carpatia (**Box, Map 2.23**) parallel to the long-proposed Via Carpathia road. This line would use extensively upgraded sections of the existing infrastructure, but in some variants there is also talk of a new route.

Map 2.23
Rail Carpathia, 2024



Road network

The road network in the macroregion and its surroundings indicates a greater potential for developing economic connections in areas neighbouring the main Carpathian range (**Map 2.24**). This applies to regions located to the north (the A4 motorway corridor from Silesia to the Ukrainian border) and the west (the motorway routes from Silesia to Brno, Brno to Bratislava, Bratislava to Budapest, Budapest to Belgrade, and further to Niš and the Bulgarian border). It also partially includes the south (the Craiova-Bucharest-Constanța transport corridor) and the east (the under-construction A7 motorway from Bucharest to Suceava), extending outward from the Carpathian range. These developments are linked to the existing and expanding network of motorways and expressways. Breaking away from this “around Carpathian” scheme are motorways in eastern Hungary and Romania's Transylvania region, which form distinct infrastructural patterns.

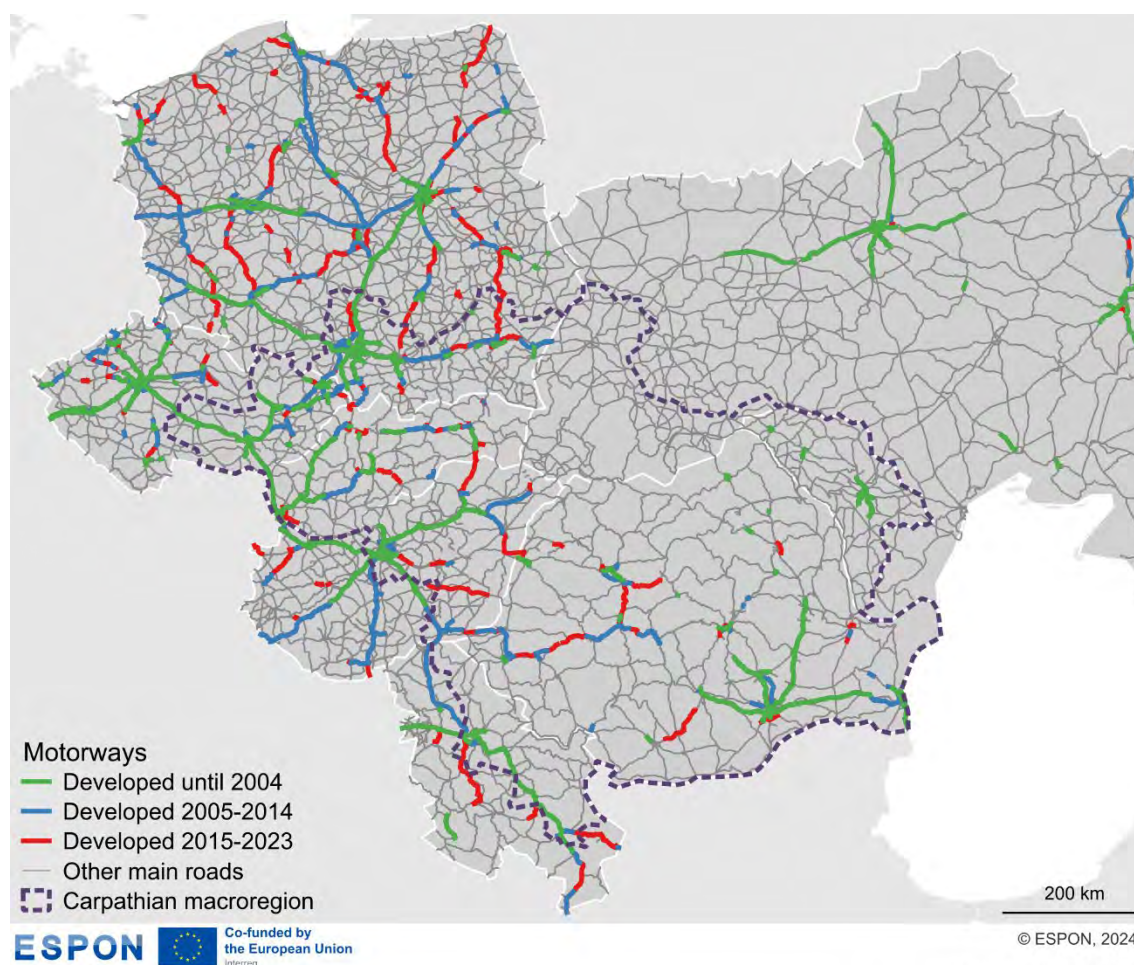
In the mountainous Carpathian areas, the most significant transport projects to date—still incomplete—are the A1 motorway in Slovakia (Bratislava–Košice) and the A1 motorway in Romania (Timișoara–Alba Iulia–Bucharest). It is worth noting that neither of these has a direct cross-border function. However, the Slovak A1, through its connections with Poland, Ukraine, and Hungary, holds cross-border potential, while the Romanian A1 links Bucharest with the Hungarian border. The remaining projects are at varying stages of progress, including the connections between Bielsko-Biała and Žilina, and Rzeszów and Prešov, or are still in the

planning phase, including those related to the development of trans-European transport corridors discussed below.

In addition to the evident gaps in the road transport system connecting EU member states within the Carpathian macroregion—partly due to the mountainous barrier of the Carpathian arc—even more significant shortcomings exist in connections with candidate countries, particularly Ukraine and the Republic of Moldova, where the motorway and expressway networks remain very poorly developed. The situation is somewhat better in the case of Serbia, although improvements are largely limited to connections with Hungary, while links with Romania remain weak.

Map 2.24

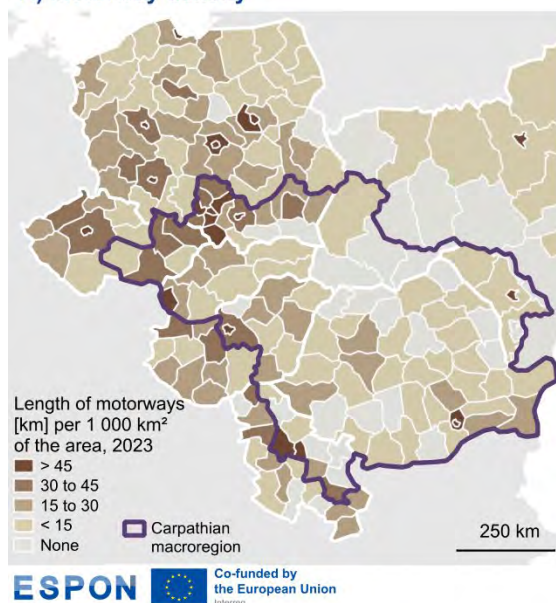
Road infrastructure development, 2004-2023



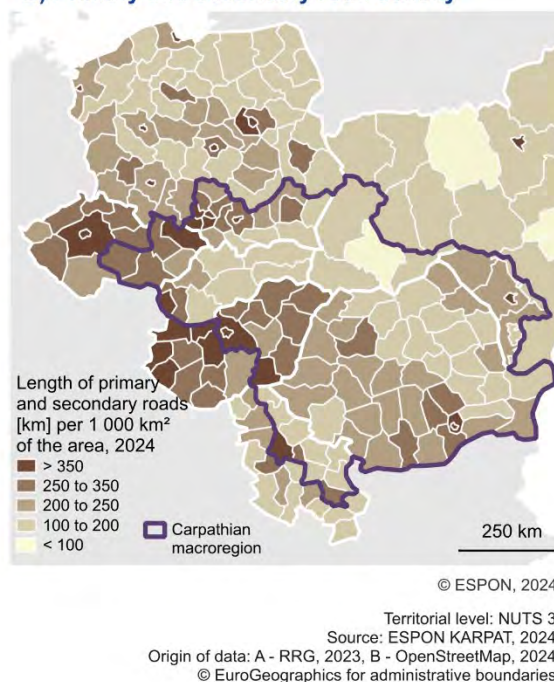
Territorial level: Lines
 Source: ESPON KARPAT, 2024
 Origin of data: RRG, 2024
 © EuroGeographics for administrative boundaries

Map 2.25
Density of road network, 2024

A) Motorway density

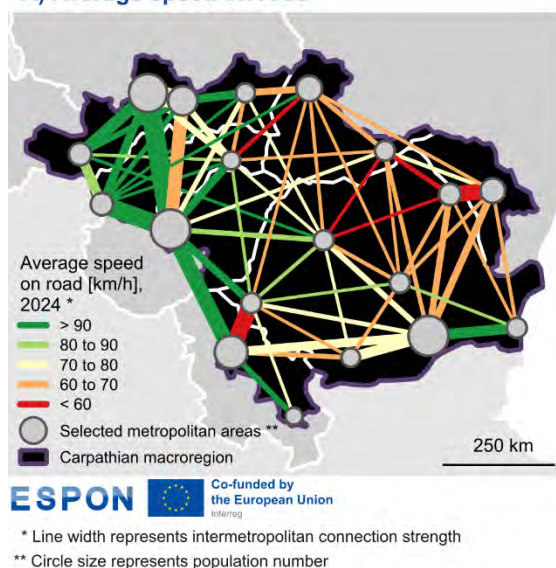


B) Primary and secondary road density

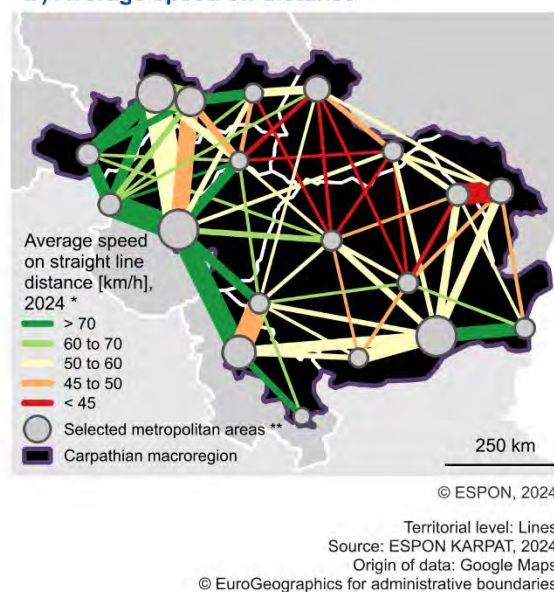


Map 2.26
Intermetropolitan connectivity by car, 2024

A) Average speed on road



B) Average speed on distance



The layout of the main existing transport corridors described above is reflected in the density of motorways and expressways per 1,000 km² across NUTS3 regions (**Map 2.25**). This density is particularly high in the northern and western edges of the Carpathian macroregion, while many NUTS3 regions in the eastern and, to

some extent, southern areas remain unconnected to the motorway network. This results in lower transport accessibility, potentially impacting their developmental opportunities.

To some extent, this spatial pattern is similar when considering the broader road network, including national and regional roads (level 2). The road network is generally more developed in the western parts of individual countries, a trend particularly evident in Romania. Hungary and the Czech Republic also feature dense road networks at this level. However, differences between countries partly stem from variations in the classification of regional roads, as seen, for example, in comparisons between the Republic of Moldova and eastern Romania.

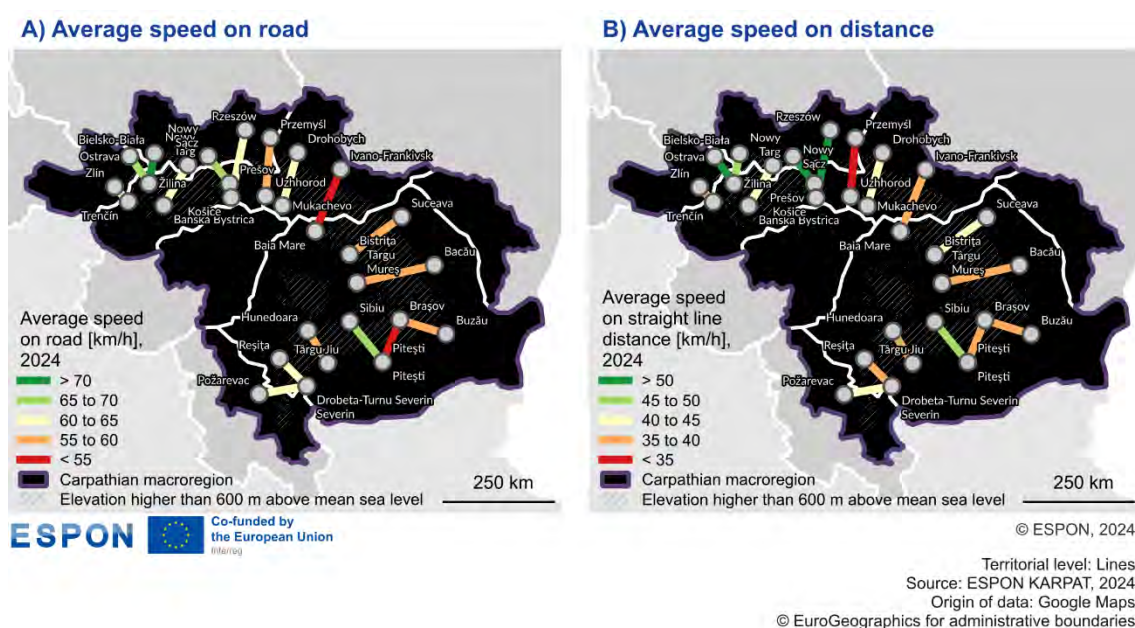
Regardless of these differences, it is clear that the road network density in mountainous regions is significantly lower than in lowland areas. This is illustrated by the example of Poland, where a pronounced contrast exists between upland/mountainous regions and lowland areas.

This transport network layout is clearly reflected in travel times between the major urban centres of the Carpathian macroregion (**Map 2.26**). Notably, the road network is better developed in the western part of the macroregion, particularly within the polygon formed by the Upper Silesian Metropolis (Katowice), Brno, Bratislava, and Budapest. However, considering travel time relative to physical distance reveals that accessing high-speed roads often requires significant detours. This is particularly evident in connections between the Upper Silesian Conurbation and Budapest.

In the eastern part of the macroregion, travel times between major urban centres are significantly longer, primarily due to infrastructure gaps combined with the natural barrier of the Carpathian mountain range. This issue is especially pronounced in Ukraine, the Republic of Moldova, and eastern Romania. A similar challenge exists in the southern part of the macroregion, affecting connections between Serbian and Romanian cities, as well as in the northern part, impacting routes between Polish and Slovak cities.

In lowland areas, this issue is partially mitigated by shorter road routes, as observed in the Republic of Moldova and the adjacent Romanian regions. However, mountainous regions continue to face considerable travel time challenges due to both physical and infrastructural limitations.

Map 2.27
Transcarpathian road accessibility, 2024



The mountain barrier is particularly evident in travel times between urban centres located on opposite sides of the Carpathian range (**Map 2.27**). This barrier affects all analysed connections, but it is especially pronounced in the Eastern Carpathians, followed by the Southern Carpathians, while it is relatively less

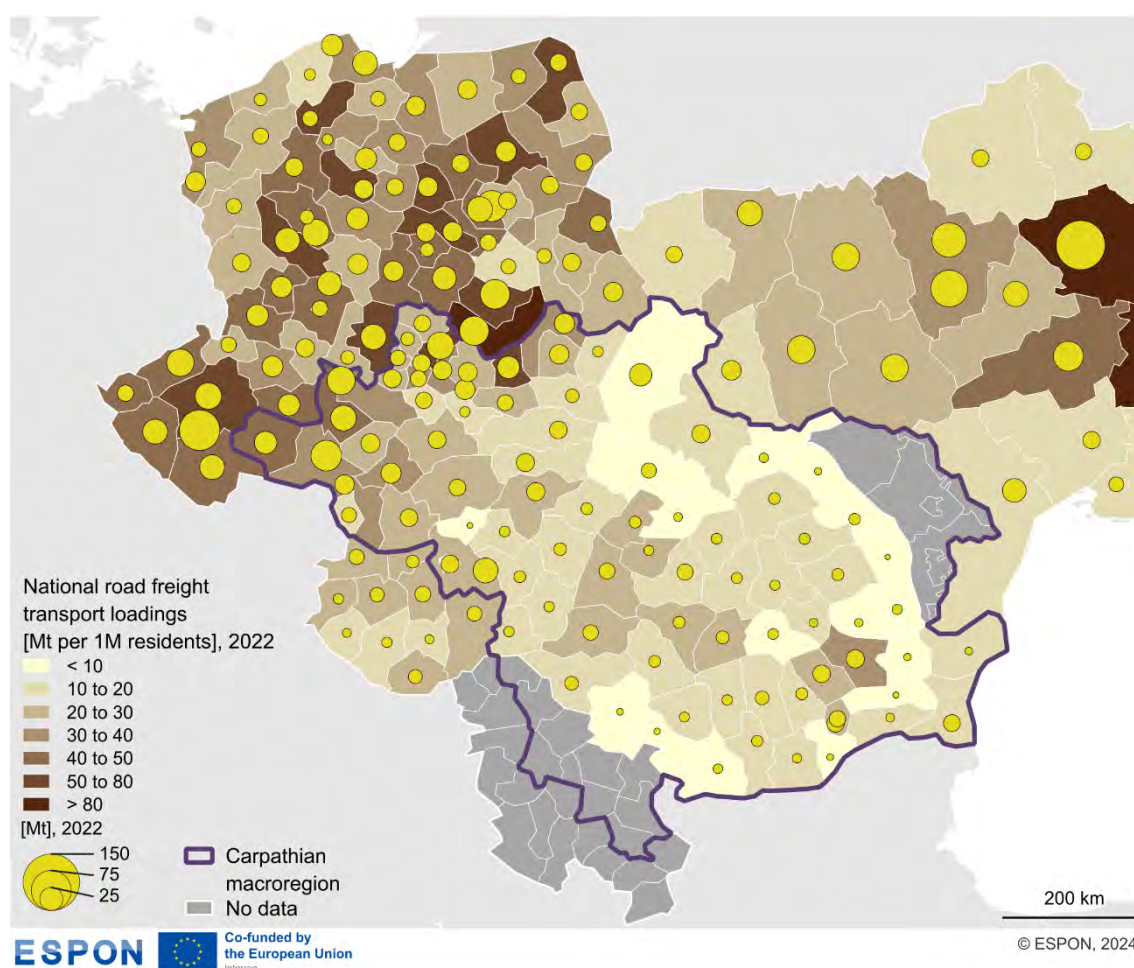
significant in the Western Carpathians. Nevertheless, in all cases, this transport barrier is expected to have a reducing effect on the socio-economic interactions between neighbouring cities.

Road freight transport

The existence of transport barriers may affect the scale of economic connections measured by road freight transport. In recent years, freight transport by road has been growing rapidly, driven by the development of warehouse logistics and changes in trade and transport service models. The volume of national freight transport, measured in terms of cargo per capita, varies significantly across the NUTS3 regions within the macroregion (**Map 2.28**).

Map 2.28

National road freight transport loadings, 2022



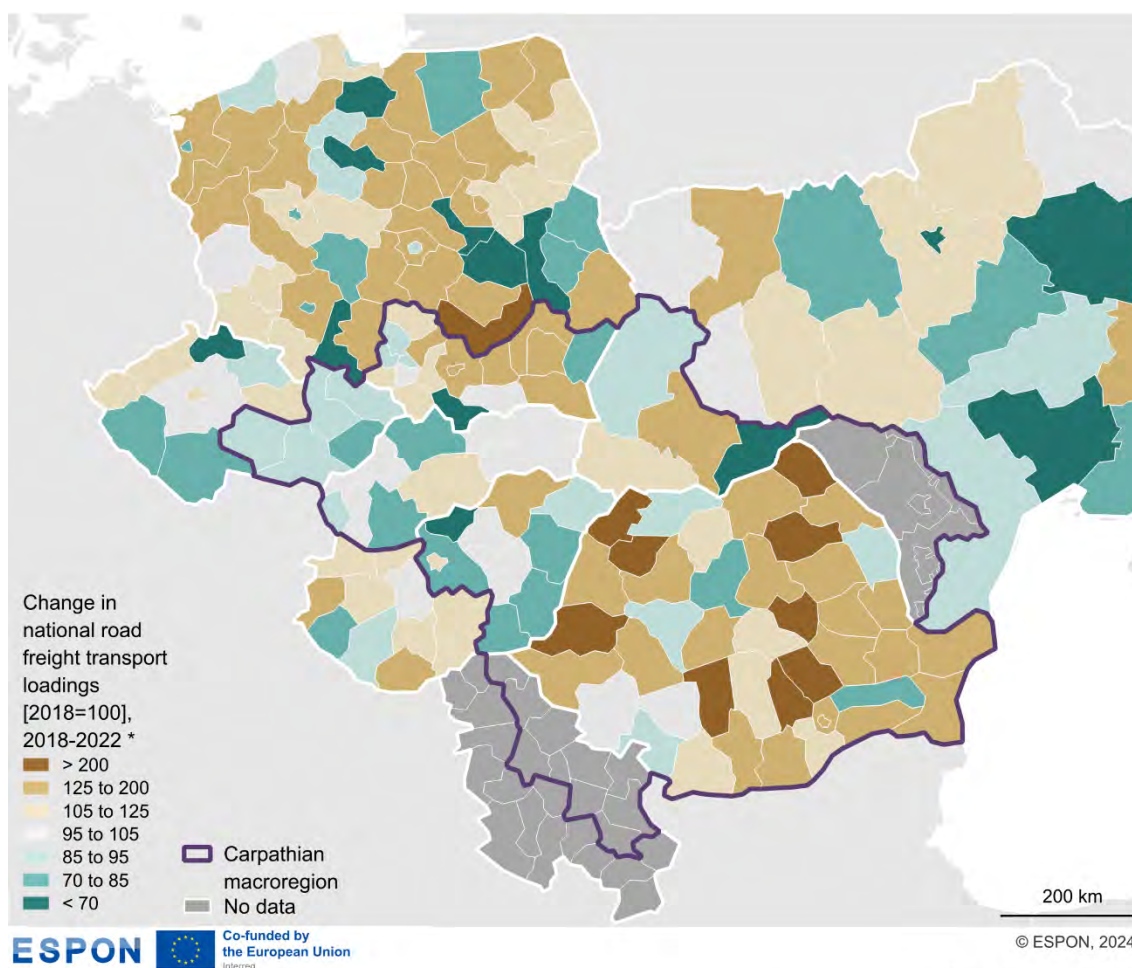
Territorial level: NUTS3
 Source: ESPON KARPAT, 2024
 Origin of data: EUROSTAT and UA statistical office
 No data for RS and MD
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Generally, the western regions of most countries, with the exception of Ukraine, tend to experience higher volumes of road freight shipments compared to the typically more peripheral eastern regions. This is largely due to established trade connections and the main destinations for foreign direct investment. This trend is particularly noticeable in the northwestern regions of Romania and western Slovakia. Similar disparities between the western and eastern parts of the country are also evident in the Czech Republic and Hungary. In Poland, the situation is more mixed, but the Carpathian regions remain among the most peripheral in terms of road freight transport. Meanwhile, the western regions of Ukraine play a much smaller role in freight shipments compared to the central and eastern parts of the country.

Between 2018 and 2022, for which data on this category of transport was available, there was a marked increase in freight shipments, particularly in the Polish and Romanian regions (**Map 2.29**). However, this growth did not occur uniformly across all regions. Some mountainous regions of Lesser Poland, for instance, experienced noticeable declines or stagnation in freight volumes. Similar decreases were observed in the Czech regions, as well as in most eastern regions of Hungary, excluding the Miskolc region. In Slovakia, declines were also recorded, with the exception of the Banská Bystrica region. The situation in Ukraine was more varied, with freight volumes increasing in the Zakarpattia and Ivano-Frankivsk oblasts, while declines were noted in the Lviv and Chernivtsi regions.

Map 2.29

Change in national road freight transport loadings, 2018-2022



Territorial level: NUTS3
 Source: ESPON KARPAT, 2024
 Origin of data: EUROSTAT and UA, MD statistical offices
 * For Ukraine change 2018-2021; No data for RS and MD
 © EuroGeographics for administrative boundaries

TEN-T network and selected infrastructural projects

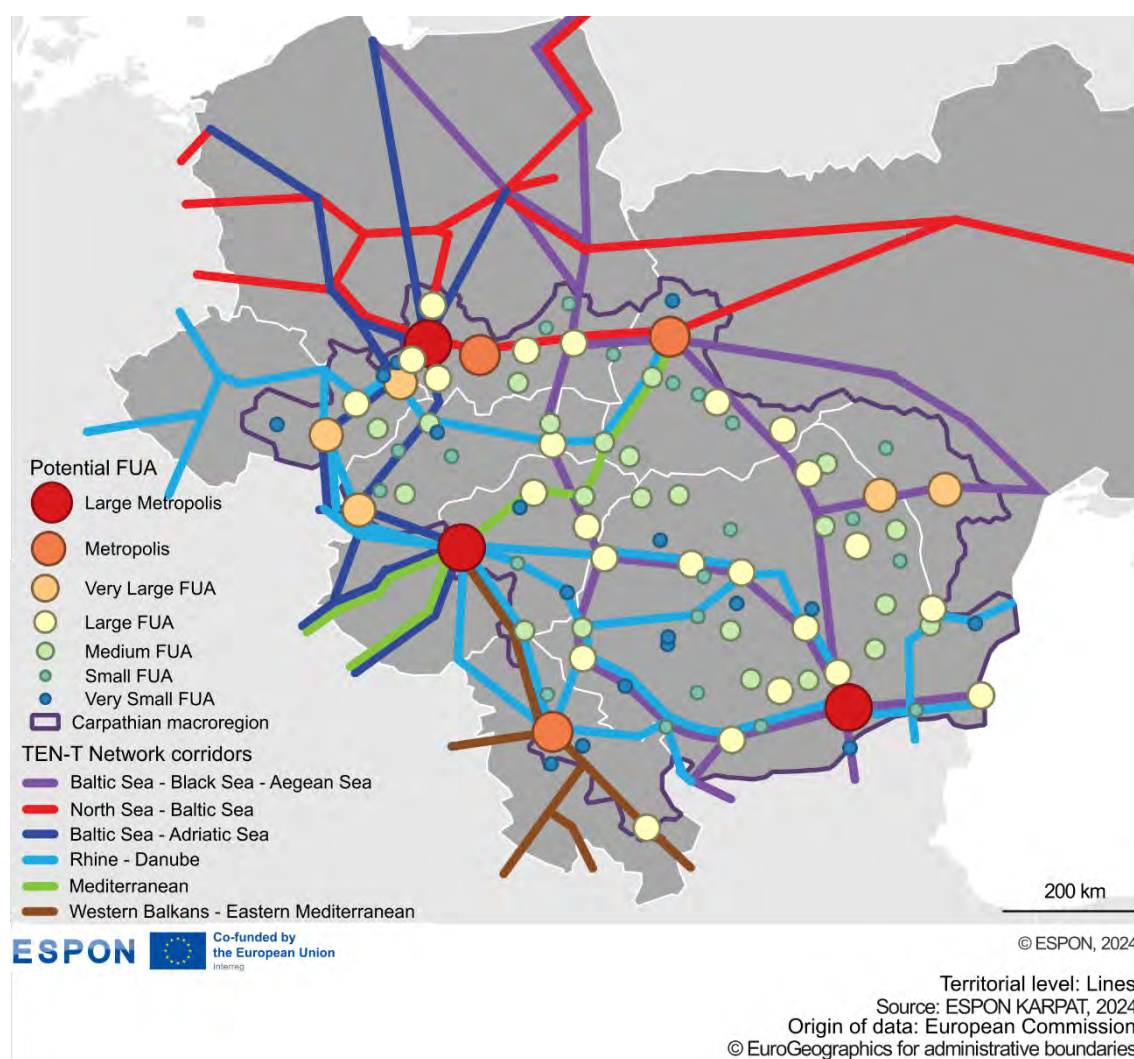
The Trans-European Transport Network (TEN-T) is a strategic initiative aimed at developing a unified, efficient, and sustainable transport infrastructure across Europe. It encompasses road, rail, air, and waterway networks, facilitating seamless connectivity between EU member states and neighbouring countries. The TEN-T network is structured into a core network, prioritizing major economic corridors, and a comprehensive network, ensuring regional accessibility that should be accomplished by 2050.

The latest revision of the TEN-T network in Europe (EU 2024/1679) addressed the evolving economic and geopolitical conditions in the region, including plans for the EU enlargement. Following the European Commission's proposal, transport corridors linking the European Union with Ukraine, the Republic of Moldova, and

the Western Balkans macro-region were integrated into the TEN-T network. This inclusion significantly reshaped the layout of corridors within the Carpathian macroregion (**Map 2.30**).

Broadly, these corridors can be categorized into two types: those crossing the Carpathian range longitudinally, such as the Scandinavian–Mediterranean (Via Adriatica) and Baltic Sea–Black Sea–Aegean Sea (Via Carpathia), and those with a latitudinal trajectory, such as the Mediterranean corridor (with a branch through Budapest to Lviv) and the Rhine–Danube corridor. Additionally, two other corridors skirt the Carpathian range: the North Sea–Baltic Sea (including a branch to Ukraine – Lviv, Kyiv, Mariupol) and the Western Balkans–Eastern Mediterranean corridor..

Map 2.30
TEN-T network, 2024



For comparing transport corridors within the Carpathian macroregion, in addition to analysing the road network's elongation coefficient, population numbers and GDP in the subregions traversed by these corridors can also be utilized. Relevant indicators were calculated for the four main corridors and their various variants, including measures that relate their demographic and economic potential to the lengths of the respective corridors (**Table 2.3**). For road distance, the elongation coefficient averaged 1.37, indicating that the actual distance travelled is approximately 40% longer than the straight-line distance. Against this backdrop, corridors that do not cross the Carpathian range stand out positively. These include the transport corridor between the Silesian Voivodeship (PL) and the South Moravian Region (CZ), and to a lesser extent, the corridor between Brno and Budapest. Among the corridors that do cross the Carpathian range, the lowest elongation coefficients were observed in the Budapest–Lviv and Budapest–Craiova corridors

Table 2.3
Characteristics of the selected sections of TEN-T Corridors

TEN - T corridor	Start	By	End	Dis- tance [km]	Distance road [km]	Route elonga- tion coef- ficient	NUTS3 number	EUR bln 2021	Popula- tion M 2022	M EUR per km	Popula- tion per km ('000)	GDP per capita
Baltic - Adriatic V1 PL - CZ	Katowice	Ostrava	Brno	210	242	1.15	7	99.7	5.4	412.0	22.3	18.5
Baltic - Adriatic V2 PL - SK	Katowice	Zilina	Bratislava	275	360	1.31	7	84.4	4.1	234.5	11.3	20.7
Baltic - Black/Aegean V1 - PL-SK-HU-RO	Rzeszow	Timișoara	Craiova	650	948	1.46	11	72.9	6.0	76.9	6.3	12.2
Baltic - Black/Aegean V2 - PL - SK - HU - RO	Rzeszow	Oradea	Bucharest	700	1062	1.52	15	155.7	9.6	146.6	9.0	16.2
Baltic - Black/Aegean V3 - PL - UA - RO	Rzeszow	Lviv	Bucharest	700	975	1.39	12	49.7	9.0	50.9	9.3	5.5
Mediterranean Corridor HU - UA	Budapest	Uzhhorod	Lviv	450	576	1.28	7	101.4	8.4	176.0	14.6	12.1
Rhine - Danube V1 CZ - HU	Brno	Bratislava	Budapest	260	327	1.26	4	140.2	5.9	428.8	17.9	24.2
Rhine - Danube V2 CZ - SK - UA	Ostrava	Kosice	Lviv	420	679	1.62	6	64.1	7.2	94.4	10.6	8.9
Rhine - Danube V3 HU - RO	Budapest	Oradea	Bucharest	645	910	1.41	13	192.1	9.7	211.1	10.7	19.7
Rhine - Danube V4 HU - RO	Budapest	Timișoara	Craiova	510	654	1.28	8	105.0	5.6	160.6	8.5	18.8

Source: own elaboration (EUROREG).

Conversely, the Ostrava–Lviv corridor, which passes through Slovakia, performs the worst. This corridor faces competition from an alternative route passing through Poland. Similarly, the Rzeszów–Bucharest corridor, which traverses Slovakia and Hungary, faces competition from an alternative route through Ukraine, which offers a potentially more favourable option. However, this alternative is constrained by the necessity of crossing borders with countries that are not part of the European Union or the Schengen Area, potentially impacting its efficiency.

In terms of population in the regions through which a corridor passes, relative to its length (which is partially influenced by the road network layout and the population density at starting and ending points), the average population per kilometre of transport corridor in the Carpathian macroregion is approximately 12,000 people. The highest values for this ratio are observed in the corridor connecting the Silesian Voivodeship in Poland with the South Moravian Region in the Czech Republic, where the figure exceeds the average by more than double. High values are also noted for the Brno–Budapest corridor via Bratislava and the Budapest–Lviv corridor. A significant portion of corridors running through the macroregion exhibit values close to the average. However, the transport corridors with the lowest population-to-length ratios are Rzeszów–Craiova, and to a lesser extent, Budapest–Craiova.

In terms of the average economic potential of transport corridors (calculated as the ratio of regional GDP (NUTS3) to corridor length), the rankings largely mirror those based on population potential, with the exception of the Budapest–Lviv corridor. In economic terms, this corridor ranks below the Katowice–Bratislava corridor. While the first two corridors, Katowice–Brno and Brno–Budapest, accumulate over EUR 400 million of GDP per kilometre, the Budapest–Lviv corridor averages around EUR 230 million per kilometre. This figure is only slightly above the average of approximately EUR 200 million per kilometre. At the lower end of the spectrum, significant deviations are observed for corridors such as Rzeszów–Bucharest via Lviv, Rzeszów–Craiova via Timișoara, and Ostrava–Lviv via Košice⁹.

The development of transport corridors is a crucial element of cross-border cooperation. Particular attention is drawn to the collaboration focused on the longest corridor passing through the core areas of the Carpathian macroregion i.e. Via Carpathia - the section from Rzeszów to Bucharest (approximately 700 km in a straight line and over 1,000 km via the road network). This initiative, launched in 2006, aims to create a modern transport corridor connecting the northern and southern parts of Central and Eastern Europe. The Via Carpathia, as part of the TEN-T network, begins in Klaipėda, Lithuania, and passes through Poland, Slovakia, Hungary, Romania, and Bulgaria, terminating in the Greek port of Thessaloniki. The project seeks to link the Baltic region with the Aegean and Black Seas, significantly enhancing transport and mobility in this part of Europe.

Beyond streamlining freight transport, increasing capacity on major trade routes, and reducing transit times between Northern and Southern Europe, the project is set to improve the accessibility of peripheral regions, fostering their economic development. Enhanced mobility will also benefit the tourism sector, facilitating travel between countries. Moreover, Via Carpathia has the potential to attract new investments in infrastructure, logistics, and industry, which could generate new jobs and strengthen the region's competitiveness on the international stage. In addition to numerous international agreements at the governmental level, cooperation is also carried out at the subnational level. An example is the Via Carpathia EGTC, which comprises two members: the Košice Self-governing Region and the county of Borsod-Abaúj-Zemplén, located along the Slovak-Hungarian border. This group operates in a territory covering just over 14,000 km² and home to more than 1.4 million residents.

Additionally, various transport-related projects, including those focusing on public transport and mobility, are implemented under cross-border cooperation programs. In the Carpathian macroregion, during the

⁹ It is important to emphasize that these potentials are calculated exclusively for the Carpathian Macroregion and selected segments of the main transport corridors. A broader context that includes international or transit perspectives could highlight the significance of these corridors, but such an analysis would require a different approach. This would involve among others considering factors such as the size and developmental potential of seaports, which lies beyond the scope of this study.

2014–2020 INTERREG programming period, 322 partners (approximately 9% of the total) participated in transport-related projects.

A notable characteristic of most such projects is their focus on transport infrastructure and mobility elements dispersed across various parts of the cross-border area. While they successfully meet their specific objectives, their impact tends to remain localised due to limited funding, addressing targeted issues rather than the broader strategic challenges of the cross-border region. These broader challenges are typically addressed by other EU programs focused on developing core transport infrastructure.

DIGRESSION

Example of transport and mobility project within framework of INTERREG programme

An example of integrating different types of infrastructure is the project carried out under the INTERREG Hungary-Slovakia-Romania-Ukraine ENI CBC 2014–2020 program, titled “Overcoming barriers: improving the mobility of residents of the border region of Transcarpathia (Ukraine), Maramures (Romania), and Szabolcs-Szatmar-Bereg (Hungary)” (approx. EUR 1.5 million, including EUR 1.3 million of EU funding). The project involved partners such as the Vynohradiv City Council of the Transcarpathian region (UA), Maramures County Council (RO), the Municipality of Barabás (HU), and the Municipal Enterprise “Center of Investment and Development” under the Vynohradiv City Council (UA). Its goal was to improve transport infrastructure and mobility in Vynohradiv city, Maramures County, and Barabás village by implementing several initiatives: (1) Construction of a road with bicycle paths in Vynohradiv (UA), (2) reconstruction and modernization of public transport stops at the international border in Vynohradiv (UA), (3) modernisation of the public transport network in Maramures, including the construction of bus stops and equipping them with information technology (RO), (4) modernization of car parking in Barabás, ensuring better access to the border and facilitating daily mobility of people and goods (HU).

2.1.6 Cultural heritage and tourism

Cultural heritage and tourism, including nature-based tourism, play a vital role in developmental processes by fostering economic growth, preserving traditions, protecting natural landscapes, and enhancing social cohesion. Cultural heritage, encompassing historical landmarks, traditional practices, and local arts, serves as a foundation for identity and pride within communities, attracting both domestic and international tourists. Similarly, nature-based tourism leverages the appeal of unique ecosystems, biodiversity, and scenic landscapes, contributing to sustainable economic growth while emphasizing environmental preservation. Tourism linked to cultural and natural heritage not only generates significant economic benefits through job creation and infrastructure development but also promotes sustainable development by valuing and protecting local traditions, natural resources, and ecosystems. Furthermore, cultural and nature-based tourism fosters intercultural understanding and collaboration, contributing to more inclusive and resilient societies. By integrating cultural and natural heritage into tourism strategies, regions can develop holistic approaches that balance economic progress with the preservation of both cultural identity and natural assets.

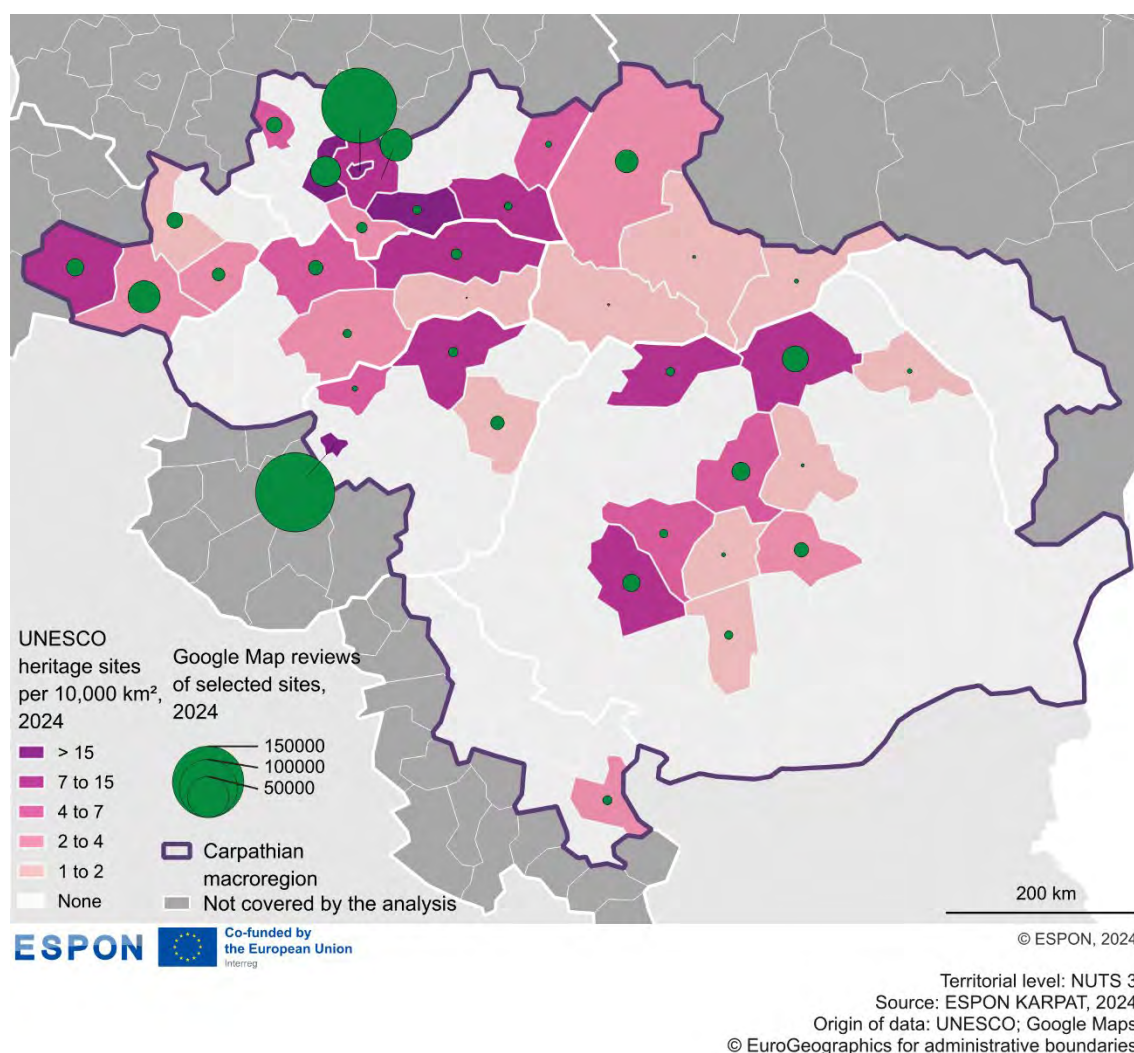
Cultural heritage

The UNESCO World Heritage status serves as an internationally recognised seal of cultural, historical, or natural significance, attracting both domestic and international tourists. The UNESCO brand directly accelerates the visibility of heritage objects and locations thereby generating an influx of visitors, which often translates into economic benefits for local communities, as it stimulates demand for accommodations, restaurants, transportation, and other services. UNESCO designations often induce a boost in small-scale

entrepreneurship, such as handicrafts, guided tours, and cultural events, helping to create jobs and diversify local economies.

UNESCO status also fosters community pride and identity. This recognition mobilises local communities and authorities to protect and celebrate their cultural or natural heritage by improving infrastructure and investing in material preservation with support of governments and external funding to safeguard the unique characteristics for future generations. Additionally, the designation often encourages knowledge transfer and skills related to heritage conservation, creating opportunities for education and cultural exchange.

Map 2.31
UNESCO heritage sites, 2024



The Carpathian macroregion showcases a diverse territorial pattern in the distribution and recognizability of UNESCO World Heritage sites (**Map. 2.31**). In total, 42 such sites were recognized in the macroregion by 2024, including three area-based sites valued not only for their cultural but also for their natural and landscape features: Hortobágy National Park (HU), Tokaj Wine Region Historic Cultural Landscape (HU), and Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe (including PL, SK, RO, UA). Some of them have a network character, meaning they consist of multiple sites located in different locations, which, excluding the above-mentioned area-based sites, amounts to 90 individual locations.

There is a visible presence of these objects in all NUTS3 regions all along the Carpathian mountain range, which is particularly due to the recognition of various forms of wooden sacred architecture (Wooden Churches of Southern Małopolska (PL), Wooden Tserkvas of the Carpathian Region in Poland and Ukraine

(PL, UA), Wooden Churches of the Slovak part of the Carpathian Mountain Area (SK), and Wooden Churches of Maramureş (RO), which collectively include 38 sites). This in itself indicates a potential for a trans-Carpathian trail of UNESCO sites as a possible macroregional tourist product.

Regions with the highest total numbers of UNESCO objects include Maramureş (8) and Suceava (7) in Romania, Nowosądecki (7) in Poland, Borsod-Abaúj-Zemplén (7) in Hungary, Prešovský kraj (7) in Slovakia, and Lvivska (6) in Ukraine. These areas serve as UNESCO hubs within the macroregion, but only some are able to attract significant tourist attention with their rich historical and cultural heritage.

In terms of UNESCO site concentration, regions such as Nowosądecki, Kraków, Oświęcimski, and Budapest stand out as prominent clusters of UNESCO-recognized heritage, supported by urban proximity and well-developed tourism infrastructure. Other areas with high concentrations include Vysočina, Krakowski, Krośnieński, Prešovský kraj, Banskobystrický kraj, Maramureş, Suceava, and Hunedoara. This clustering reflects the strategic importance of these regions in regional tourism networks.

Public recognisability, measured through Google reviews, further underscores these patterns. Budapest and Kraków lead with over 150,000 reviews, followed by 2 other subregions in Małopolska (Krakowski, Oświęcimski) and regions of Brno, Suceava and Lviv. The recognisability is high also in Transylvania especially in regions like Mureş and Hunedoara. This data highlights a mix of heritage hubs with dense clusters of UNESCO objects and singular iconic sites that draw significant attention. However, peripheral areas, especially in the eastern and southeastern Carpathians, experience lower densities of heritage sites and limited visibility, often struggling with inadequate infrastructure and promotion. To bridge this gap, targeted strategies are needed to enhance accessibility, preserve cultural assets, and bolster the international profile of underrepresented regions, ensuring more equitable development of the Carpathian macroregion's heritage tourism.

Other main cultural heritage sites

While the Carpathian macroregion includes numerous UNESCO-listed sites presented above, it is also home to many other historically significant objects. However, the lack of comparable international statistics makes it difficult to directly assess the cultural wealth and resources of the Carpathian countries. Therefore, to evaluate the importance of material cultural heritage, particularly as tourist attractions, this analysis focuses on a selection of the region's most important historical sites i.e. castles, selected palaces (often transformed from older structures or following the style of original castles) and other prominent fortifications. These structures, scattered across the Carpathians, reflect the political, military, and cultural changes that have shaped these parts of Central and Eastern Europe over centuries.

These sites have often become cultural landmarks offering tourists a glimpse of historic architecture, exhibits, and cultural landscapes. In addition to preserving the region's past, they are crucial to the economic and cultural development of the local tourism industry. Beyond their historical and touristic significance, these objects function as iconic landmarks within the Carpathian landscape. Their architectural prominence often distinguishes them, both in urban centres and rural areas, telling a broader story of regional development and indicating former centres of political and economic power. Furthermore, these castles and other prominent objects are often enduring visual symbols of the region's historical identity, influencing the collective memory and cultural narrative of the Carpathians.

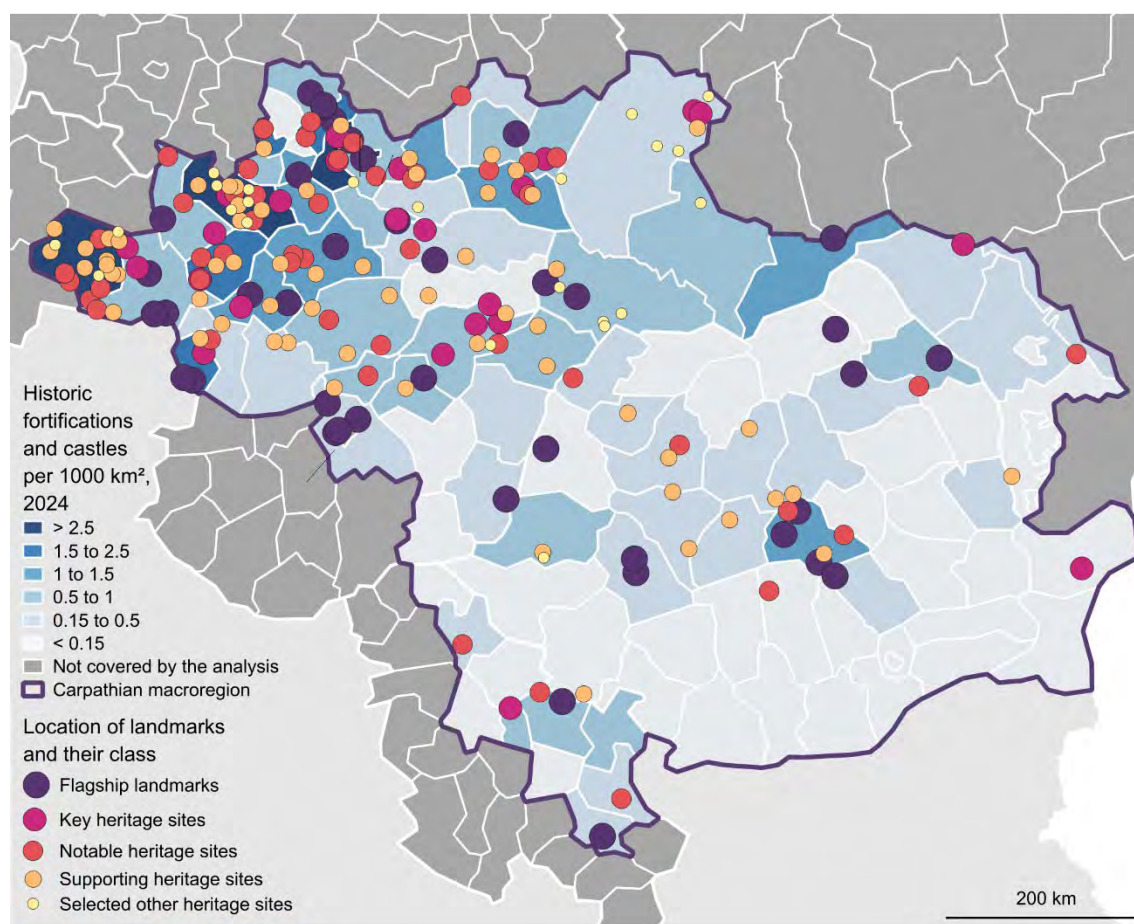
To assess the significance and attractiveness of these sites, their popularity can be evaluated based on the number of reviews submitted by visitors and locals on platforms like Google Maps. While this method has certain limitations—such as the dependence of the number of reviews on the local context (e.g., the location of sites within larger urban areas, competition from other tourist attractions, the state of preservation, usage, and accessibility rules)—it can still serve as a useful indicator for gauging their appeal to some extent.

The distribution of historic fortifications and castles shows clear clustering in the northern and western parts of the Carpathian macroregion (**Map 2.32**). The highest density of historic castles and fortifications per 1,000 km² (over 2.5) occurs in the Czech regions (especially Vysočina and Moravskoslezsko) as well mountain regions of Slovakia, Poland and Hungary as well as in some regions of Romania (especially region of Brasov). Lower densities are observed in some eastern and southern parts of the Carpathian mountain range. There is a prominent lack of recognisable historic fortifications and castles in the southern and eastern parts of the macroregion. Spatial patterns of concentration of historical landmarks reflect historical patterns of wealth, trade routes, strategic defence locations, and administrative centres.

The Carpathian region contains almost 200 identified fortifications and castles with Google reviews of which 145 exceed 1,000 reviews, 41 exceed 10,000 reviews of which 12 surpass 20,000 reviews (**Map 2.32**). The most recognizable sites include Wawel Royal Castle in Kraków, three Romanian castles/palaces – Bran, Peleş as well Corvin Castle in Hunedoara, Buda Castle in Budapest and Bratislava Castle. Accessibility and metropolitan location significantly influence recognisability of fortifications and castles. Majority of “flagship landmarks” are situated in highly urbanized areas, whereas sites in mountainous regions are markedly less recognizable, mostly classified as “supporting heritage sites.” Despite their number, sites in Ukrainian regions tend to have relatively lower recognizability. Conversely, sites in Romania, particularly in Braşov, exhibit relatively higher recognizability.

Map 2.32

Heritage sites related to defensive architecture, 2024



ESPON Co-funded by the European Union

* castles, ruins, selected palaces, fortresses

© ESPON, 2024

Territorial level: NUTS 3
Source: ESPON KARPAT, 2024
Origin of data: OpenStreetMap; Google Maps
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Tourism – general statistics

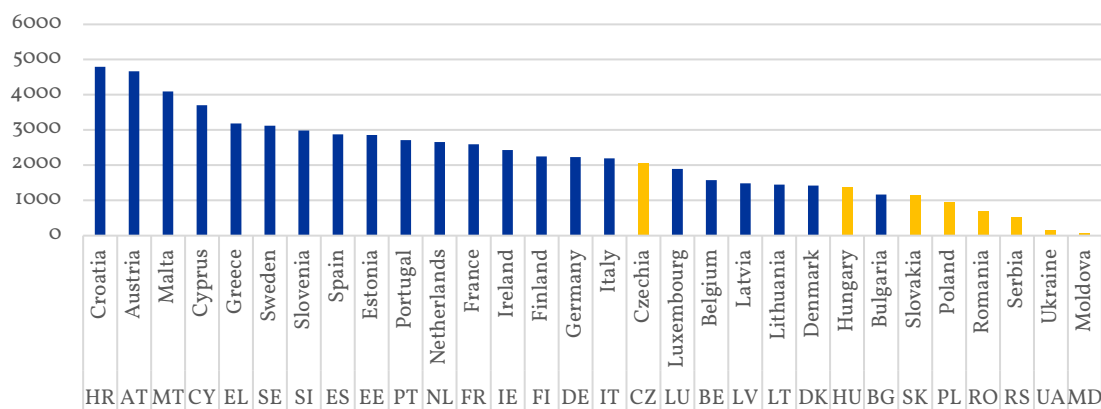
When discussing the significance of tourism in the Carpathian macroregion, it is important to note that in 2022, the countries within this region ranked among the European nations with the lowest intensity of tourist activity (measured by the number of overnight stays per 1,000 residents) (**Chart 2.3**). This was particularly true for countries neighbouring the EU, especially Ukraine and the Republic of Moldova. In contrast, the Czech Republic stood out with a significantly higher intensity of tourism, though it still fell short of the

European average and lagged behind not only select Mediterranean countries (Croatia, Malta, Cyprus, Greece) but also Austria.

On the other hand, the low intensity of tourism in these countries contributed to the highest growth rate in tourist numbers in the decade preceding the COVID-19 pandemic (**Chart 2.4**). Ukraine, despite the disruptions caused by the initial phase of Russian aggression in 2014, saw particularly strong growth, followed by Romania, which experienced nearly a 2.5-fold increase in tourist numbers. This indicates that these countries were catching up after a notable delay, driven largely by increasing wealth and the development of domestic tourism.

Chart 2.3

The number of tourists per 1,000 inhabitants, 2022

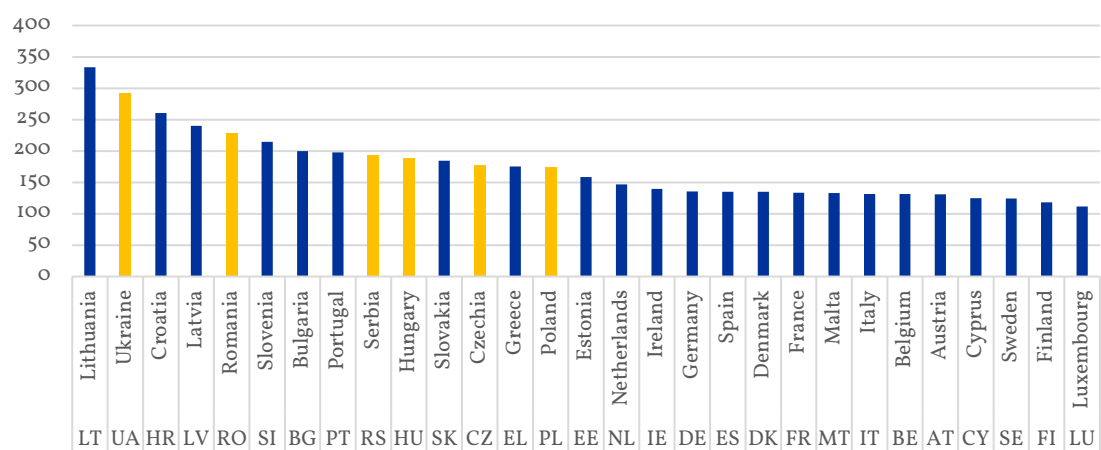


Source: own elaboration based on Eurostat

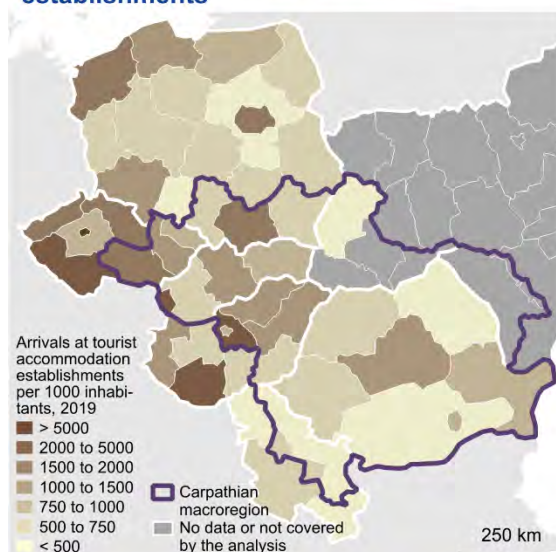
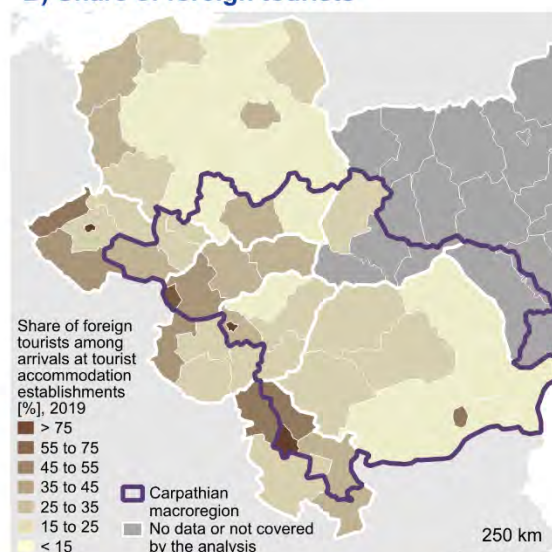
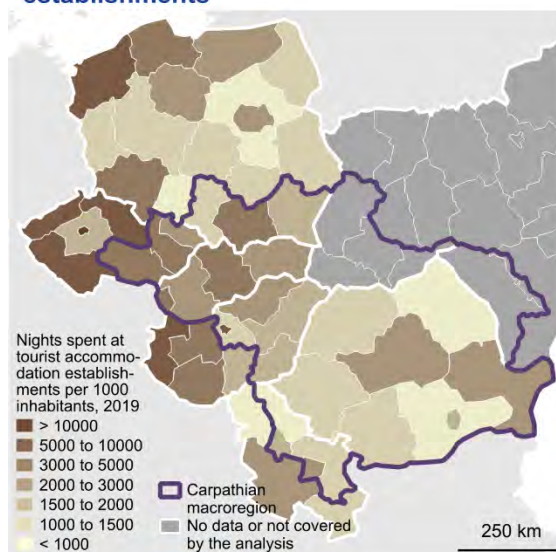
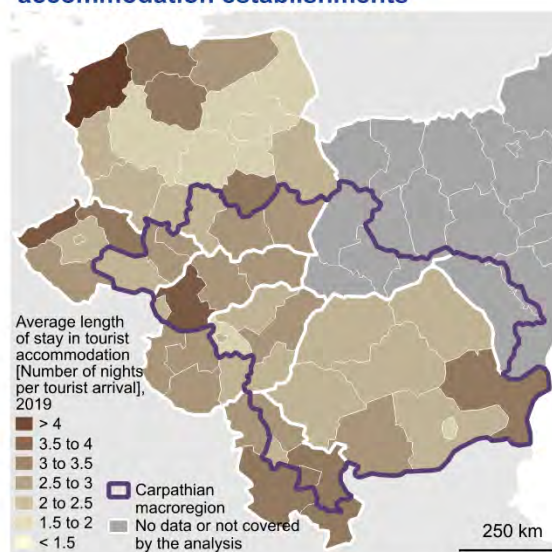
* for Ukraine data from 2021

Chart 2.4

Change in the number of tourists, 2010-2019 (2010=100)



Source: own elaboration based on Eurostat

Map 2.33**Tourist arrivals, 2019****A) Arrivals at tourist accommodation establishments****B) Share of foreign tourists****C) Nights spent at tourist accommodation establishments****D) Average length of stay at tourist accommodation establishments****ESPON**

Co-funded by
the European Union
Interreg

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Territorial level: NUTS 2
Source: ESPON KARPAT, 2024
Origin of data: Eurostat, MD Statistical Office,
UA: Regional Statistical Offices
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A tourism boom, resulting in a doubling of the number of tourists using overnight accommodations, was also observed in Serbia, Hungary, and Slovakia. Significant increases in tourist activity were also recorded in the Czech Republic and Poland, with growth of approximately 75%. It is worth noting that the actual increase in tourist numbers was likely much higher than officially reported, due to the growing importance of booking platforms, which facilitated the rental of urban apartments and rural tourist accommodations.

The intensity of tourist activity in the Carpathian macroregion was quite spatially diverse, but generally did not fall below—and in some cases even exceeded—the average values recorded in other regions of the respective countries (**Map 2.31a**). High intensity, measured by the number of overnight stays per 1,000 residents, was typically observed in major urban centres and their metropolitan areas. In these regions, the annual average was approximately two tourists per resident. This was particularly evident in the urban areas of

Bratislava and Budapest, as well as the metropolitan regions of Kraków in Poland and Brno in the Czech Republic. This trend was driven not only by the growing popularity of year-round weekend tourism, such as "city breaks," but also by the development of business tourism.

In the latter two regions, high tourism intensity was also largely due to the rich natural and cultural resources of the surrounding metropolitan areas. Central Slovakia, north-eastern Hungary, and Romanian Transylvania were also characterized by significant tourist activity. This highlights the appeal of mountain and foothill areas, as further demonstrated in the following analyses of various types of tourism, including spa, skiing, and specialized hiking tourism.

In contrast, the attractiveness of the lowland areas of Romania and the Republic of Moldova proved to be relatively low, especially when compared to Romania's coastal regions and even Poland's. This pattern was also observed in other non-EU neighbouring countries. In these cases, one of the barriers to the development of cross-border tourism was likely related to border formalities.

In some regions of the Carpathian countries, the proportion of foreign tourists in overall tourism activity was relatively high, approaching or exceeding 50% (**Map 2.33b**). This was true not only for the major metropolitan areas (Budapest, Bratislava, Bucharest) but also for western Slovakia (likely influenced by its proximity to Vienna and Austria) and Vojvodina in Serbia. In both cases, however, this could be attributed to the relatively low overall intensity of tourist activity, meaning that even small streams of foreign tourists (e.g., transit tourists in the case of Serbia) may have significantly influenced these percentages.

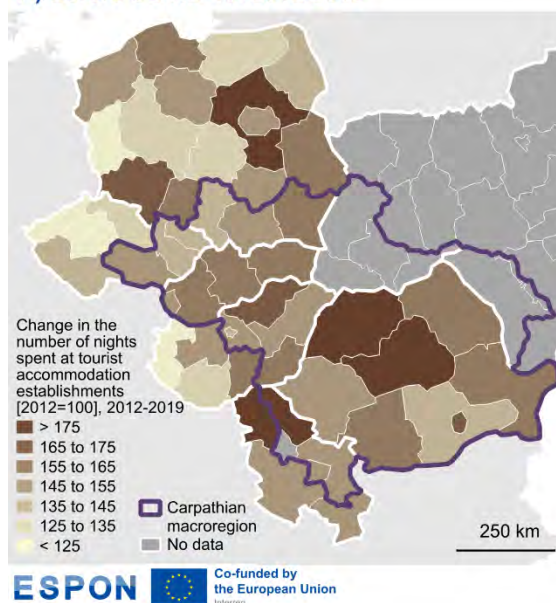
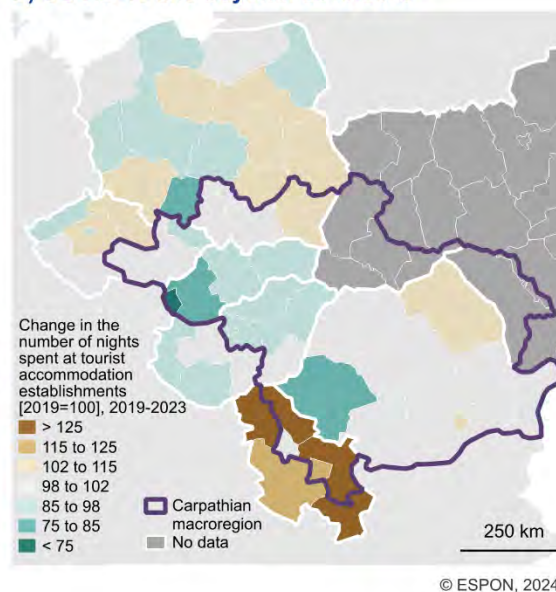
In the remaining regions of Slovakia, one in three tourists came from abroad, which could be a result of well-developed cross-border tourism with Poland and Hungary. A similar trend was observed in the Małopolskie region of Poland, likely due to the development of low-cost airline services combined with the region's high tourist appeal. In contrast, the proportion of foreign tourists did not exceed 15% in other Carpathian regions of Poland, as well as in the Republic of Moldova, Wallachia in Romania, and northern Hungary.

Tourism intensity, measured by the number of nights, further highlights these interregional differences, indicating that a higher number of tourists generally correlates with longer stays (**Map 2.33c**). However, this perspective also reveals lower tourism intensity in the Carpathian regions compared to the western regions of the Czech Republic and Hungary, as well as Poland's coastal areas.

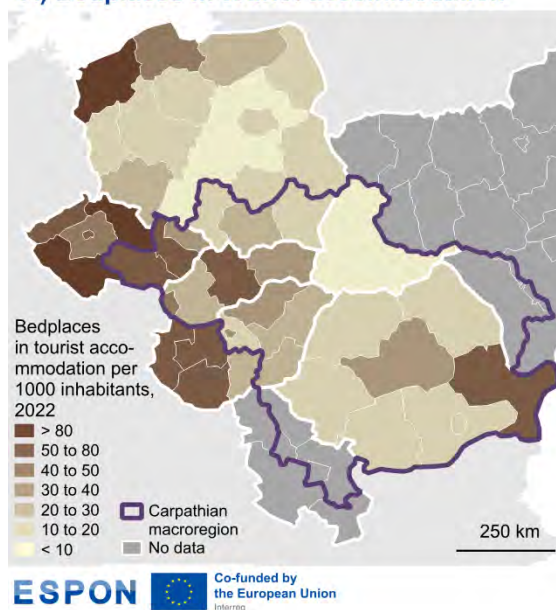
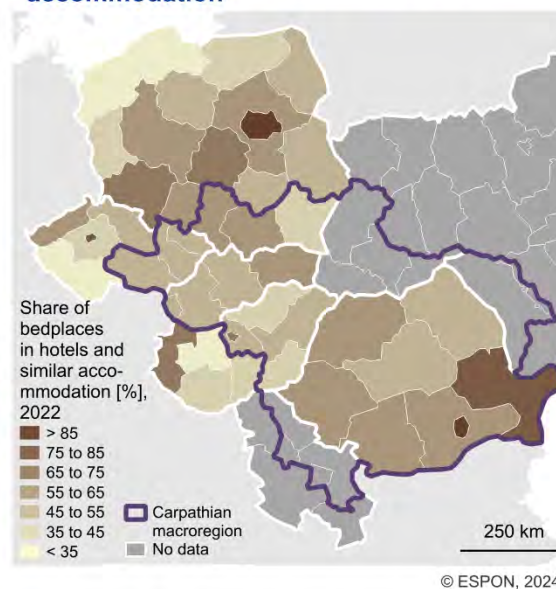
Within the Carpathian macroregion, the longest stays were observed in the Czech regions, central Slovakia, the Małopolskie region in Poland, and Transylvania. However, only in Romania's coastal Constanța region did the average tourist stay exceed three days (**Map 2.33d**). In most Carpathian regions, stays were typically shorter than 2.5 days, and in Bucharest and northeastern Moldova, tourists stayed for less than two days on average.

Tourism in the Carpathian macroregion grew rapidly between 2012 and 2019, the pre-pandemic period (**Map 2.34a**). On average, the number of nights increased by around 50%, with particularly high growth (over 65%) in central and northwestern Romania, as well as northern Serbia and northern Hungary. The smallest increases in overnight stays were recorded in the Silesian region of Poland and the Czech Republic, in central Moravia, and around Bucharest, but even in these cases, the growth exceeded 25%.

The tourism boom in the Carpathian macroregion was halted—similar to the rest of Europe and the world—by the COVID-19 pandemic. Although the decline was severe, it was short-lived, and by 2023, tourism activity generally returned to 2019 levels (**Map 2.34b**). In the case of Serbian regions, the situation is even better than before. However, Slovak regions performed worse (particularly Bratislava, which may be linked to changes in business tourism patterns). Lower levels of tourism intensity were also observed in northeastern Hungary and the Timișoara region of Romania.

Map 2.34**Change in number of nights spent at tourist accommodation establishments, 2012-2023****A) Before COVID-19: 2012-2019****B) COVID-19 and beyond: 2019-2023**

Territorial level: NUTS 2
Source: ESPON KARPAT, 2024
Origin of data: EUROSTAT
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Map 2.35**Tourist accommodation capacity, 2023****A) Bedplaces in tourist accommodation****B) Share of bedplaces in hotels and similar accommodation**

Territorial level: NUTS 2
Source: ESPON KARPAT, 2024
Origin of data: EUROSTAT, UA: Regional Statistical Offices
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Similarly to tourism activity, the distribution of accommodation facilities in the Carpathian macroregion was also uneven. In some regions, the number of beds per 1,000 residents exceeded 50, while in others it was below 20 (**Map. 2.35a**). The first group included regions like Moravia in the Czech Republic, central Slovakia, and, most notably, the coastal Constanța region in Romania. In contrast, the second group comprised other Romanian regions, excluding Transylvania, and most Polish regions except for Małopolska. The accommodation infrastructure was weakest in the Ukrainian regions, offering fewer than 10 tourist beds per 1,000 residents.

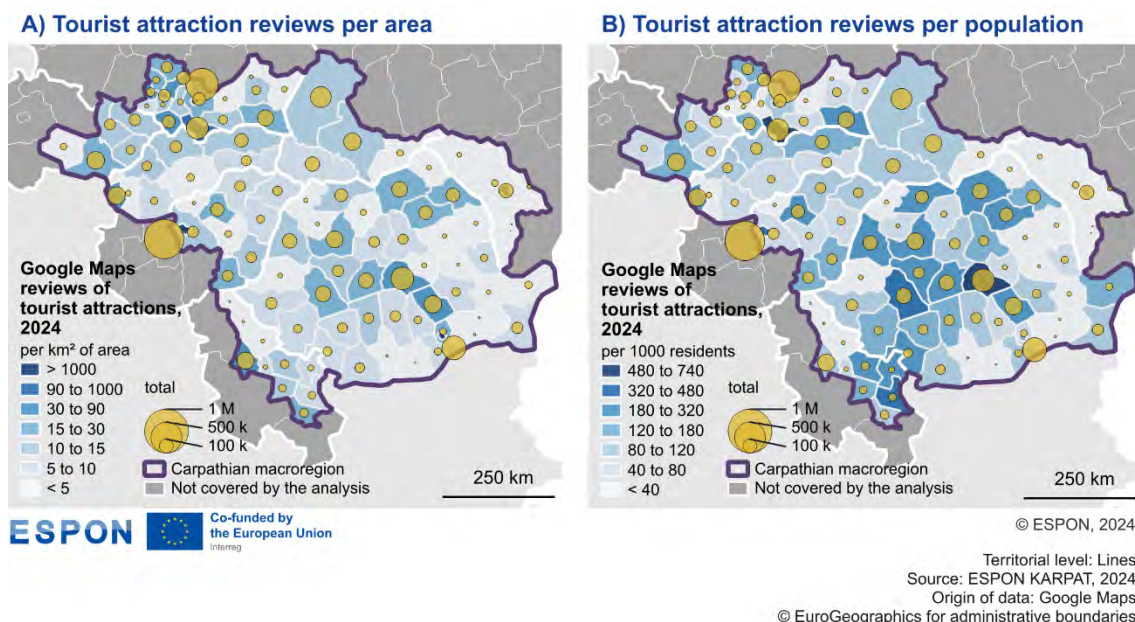
Hotel establishments typically dominated the official accommodation statistics, approaching or exceeding a 50% share (**Map. 2.35b**). Their role was particularly significant in regions with a lower density of accommodation facilities, especially in Romania (including Constanța) and Poland (excluding Podkarpacie), as well as eastern Slovakia. It's important to note the potential impact of alternative accommodations, most of which are not reflected in official statistics. These include tourist lodgings in attractive mountain areas, agritourism facilities, and rental apartments in popular tourist cities, supported by the rise of booking platforms like Airbnb and Booking.com.

Tourist attractiveness based on the number of reviews on Google Maps

The use of objects marked as "tourist attractions" in Google Maps for analysing the general tourist attractiveness of NUTS3 regions in the Carpathian macroregion provides valuable insights due to the extensive spatial coverage and user-generated content available through the Google Maps API (for detailed methodology see **Annex 2**). This dataset captures a wide range of attractions, reflecting both historical and contemporary sites, and incorporates user interactions such as reviews and ratings, which serve as proxies for visibility and popularity. Taking this into consideration, this approach also has its limitations, including potential biases toward urbanised and easily accessible locations, underrepresentation of less digitalised or rural areas, and inconsistencies in the categorisation of attractions across regions. Nevertheless it provides a useful insight in the context of more detailed and robust analyses presented in this chapter.

Map 2.36

Tourist attractions - and their recognisability, 2024



The distribution and concentration of tourist attraction reviews across the Carpathian macroregion, highlights major cities and areas with high tourist engagement (**Map 2.36a**). Number of tourist attraction reviews per 100 km², is the highest in metropolitan areas of Kraków, Budapest, Bucarest, Bratislava, Belgrade, Chisinau and Upper-Silesia metropolis. However, also some mountain regions are characterised by high density

of reviews like Nowotarski, Bielski and Krośnieński in Poland, Braşov and Prahova, Sibiu and Hunedoara in Romania that to large extents are related to location of key heritage sites.

Recognisability of the tourist attractions in absolute terms reflected by the total number of tourist attraction reviews confirms that Budapest (814,979 reviews), Kraków (546,078) and Bucarest (298,996) are dominant tourist centres. These cities lead in both total reviews and relative reviews per 100 km², suggesting they are not only major tourist destinations but also well-frequented by visitors who actively engage with the local attractions. Other notable regions with significant total reviews include Nowotarski (248,553), Lvivska (224,469), Brasov (270,096), and Belgrade (152,365). The highest-rated regions based on average reviews per region above 100,000 reviews include Nowotarski (4.69), Iasi (4.66), Belgrade (4.6), Hunedoara (4.6), and Lvivska (4.6).

The density of reviews relative to the local population, as shown by reviews per 1,000 inhabitants, also highlights areas like Nowotarski (734 reviews per 1,000 inhabitants) and Kraków (680) as regions with particularly high tourist engagement relative to their population size (**Map 2.36b**). These high ratios indicate that these regions attract a concentrated level of tourism, driven by both local and international visitors. Other regions with high review densities per capita include Brasov (488), Budapest (460), Hunedoara (353), Heves (315), Sibiu (312), and Krośnieński (289). This dataset highlights higher scores of south-central parts of the macroregion, especially southern Romania and Transylvania.

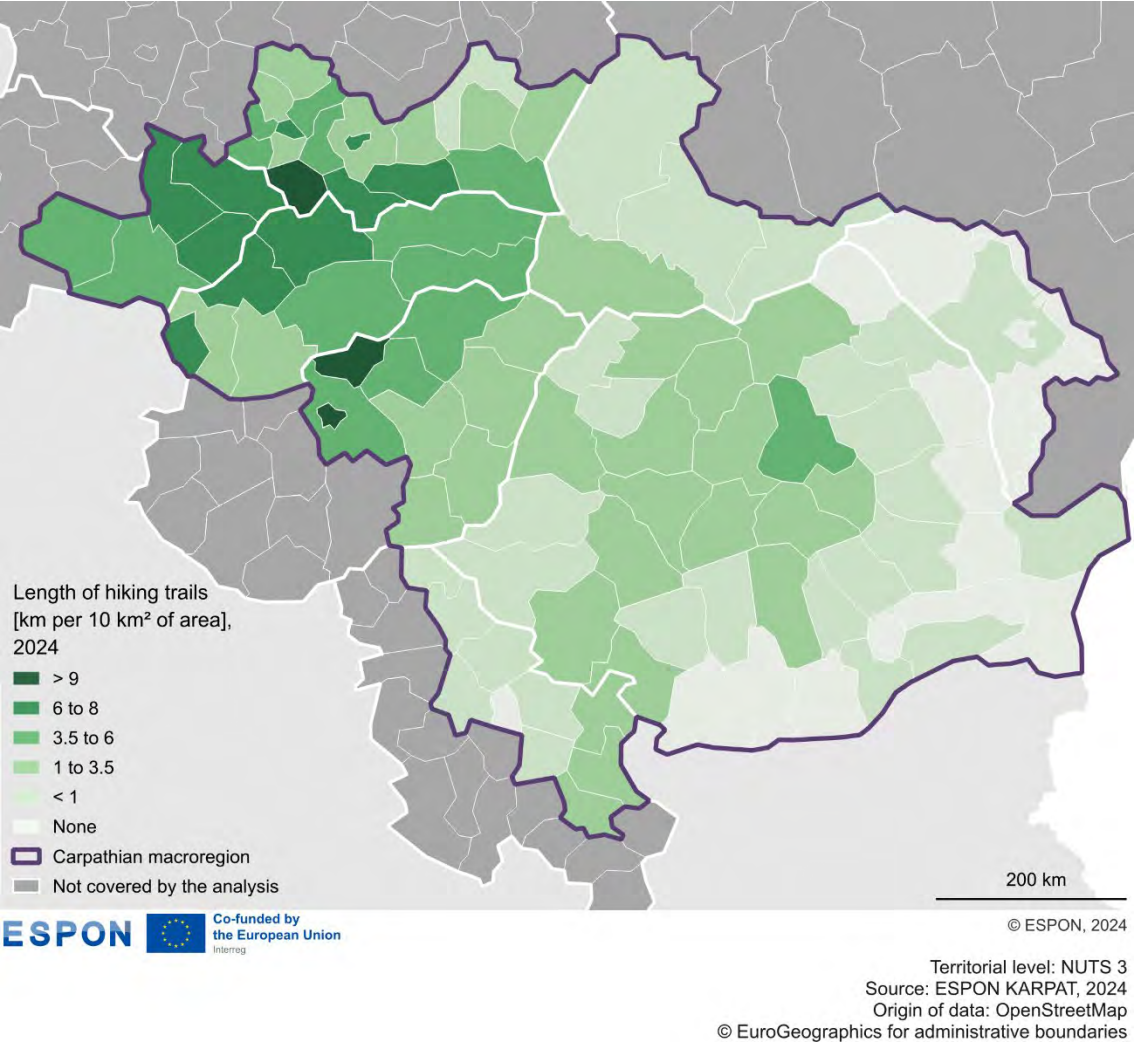
Selected elements of tourist infrastructure: Hiking trails

The Carpathian macroregion demonstrates distinct patterns in the distribution of hiking trails, with a clear concentration of longer trail networks in the western Carpathians.

The core regions, especially within the northwestern area, feature the densest trail systems and robust integration into hiking tourism infrastructure (**Map. 2.37**).

The highest cumulative number of hiking trails is found in three Slovak regions: Banskobystrický (5160 km), Žilinský (4915 km), and Prešovský (4824 km), as well as in two Czech regions: Jihomoravský (4185 km) and Moravskoslezský (4125 km). The greatest density of trails is observed in two key areas near major urban centers—Budapest and the nearby Nógrád in Hungary, as well as Bielsko-Biała in Poland. A consistent network of trails extends across the northwestern Carpathians, from Nowosądecki in the east through Nowotarski and Bielski in Poland, to Žilinský, Trenčiansky in Slovakia, and the Zlínsko, Moravskoslezsko, and Olomoucko regions in the Czech Republic, with a southwestern extension leading towards Bratislava. The central-eastern part of the Carpathians, spanning across Ukraine (Zakarpatska, Ivano-Frankivska) and the Romanian border (Maramureş, Suceava, Bistriţa-Năsăud), is characterized by a low-developed network of hiking trails. These areas feature small, local trail systems on individual mountain ranges, often separated by “bottlenecks.” In the southern part of the macroregion, in Romania, there are isolated clusters of trails with moderate to low density, particularly in the Harghita region, the Bucegi Mountains near Braşov, and the Bihor Massif. In other areas, the hiking trail network is fragmented.

Map 2.37
Hiking trails, 2024



DIGRESSION**European long distance trails in Carpathian macroregion**

The Carpathian Long Distance Trail is an extensive hiking route spanning approximately 2,000–2,500 kilometers across the Carpathian Mountains, covering countries such as Poland, Slovakia, Ukraine, and Romania. It features diverse landscapes, including the forested ridges of the Beskids, the open meadows of the Bieszczady, and the rugged peaks of Romania's Rodna and Făgăraș Mountains. The trail offers significant challenges, with daily elevation gains ranging from 500 to 1,500 meters and average hiking distances of 20–30 kilometers. While some sections, like Poland's 500-kilometer Main Beskid Trail, are well-marked, others require advanced navigation skills. The route's varied segments allow hikers to experience both the natural and cultural richness of the Carpathians, making it a rewarding challenge for long-distance trekking enthusiasts.

The Carpathian macroregion is traversed also by three European long-distance hiking trails: E3, E4, and E8. These trails highlight the Carpathians' connectivity with different geographic entities across Europe. The E3 route in Poland consists of two sections: the Sudetes and the Carpathians, offering stunning landscapes and rich cultural history. In Hungary, it primarily follows the Great Plain Blue Trail. Upon entering Romania at the Borș Border Crossing Point, the E3 runs through the Apuseni Mountains, Poiana Ruscă, Banat, and the Mehedinți Mountains, ultimately reaching Serbia at the Iron Gates. The route traverses through two national parks and offers an easy to medium level of difficulty.

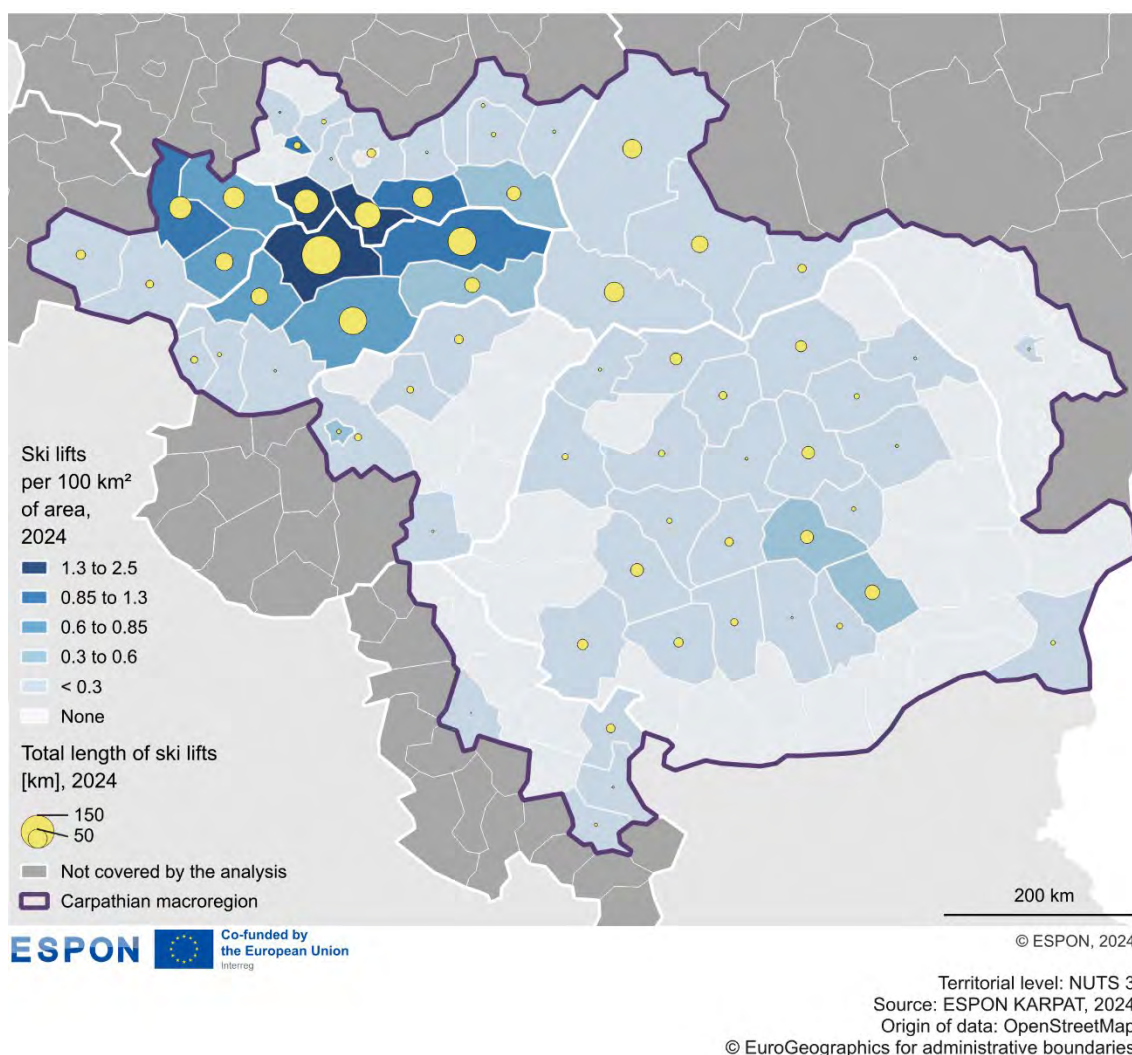
The E4 is a prominent European long-distance walking trail, spanning from Spain to Cyprus and crossing diverse landscapes and rich cultural regions. It links the Carpathian Mountains to the Alps, running through France, Switzerland, Austria, Bratislava, and Budapest, and stretches across the Hungarian Great Plains. In Romania, the E4 route is not clearly defined, and there is no dedicated organization for its maintenance.

The E8 is a vast European long-distance walking trail that stretches from Ireland to Bulgaria, connecting diverse landscapes across Europe's most picturesque regions. It passes through countries like the UK, Germany, Austria, and others, linking the Atlantic coast to Eastern Europe. The trail runs along the southern border of the Czech Republic in South Moravia and traverses Slovakia from southwest to northeast, including the Malé Karpaty, Biele Karpaty, and Nízke Tatry mountains. In Poland, the route follows the Beskid Niski and Bieszczady regions of the Main Beskid Trail. The E8 enters Romania at the Sighetu Marmăției Border Crossing Point and runs for 1270 km through multiple mountain ranges, showcasing the natural and cultural landscapes of the Carpathian highlanders. This section also passes through remote areas where hikers may not encounter other people for several days. The E8 enters Serbia at the Iron Gates border. This section also passes through remote areas where hikers may not encounter other people for several days. There is also a problem with upkeeping trails to the international standards in Romania.

Selected elements of tourist infrastructure: Ski infrastructure

Ski tourism might play a significant role in fostering local and regional economic development, particularly in mountainous areas of the Carpathian macroregion. As a high-value segment of the tourism industry, it provides economic opportunities through employment, infrastructure development, and the attraction of domestic and international visitors. However, its potential to drive sustainable and inclusive growth is often undermined by inherent shortcomings related to environmental impacts, the connectivity of ski resorts, and seasonality.

Map 2.38
Ski infrastructure, 2024



At scale, ski tourism has the capacity to boost local economies significantly, with well-developed resorts acting as engines for regional prosperity. Yet, Carpathian ski resorts are usually fragmented, even in most popular skiing areas, lacking modern solutions like regional ski passes or ski-related public transport infrastructure, limiting their ability to compete with well-established hubs. Lack of interconnected resorts with integrated ticketing systems, restricts the fluid movement of tourists across areas, preventing the emergence of a cohesive and competitive regional ski network. This fragmentation often stifles cross-border collaboration and the ability to create a unified tourism brand.

Seasonality further exacerbates these challenges. Ski tourism is highly concentrated in the winter months, leading to periods of economic stagnation in off-peak seasons. While some destinations have successfully diversified their offerings to attract visitors year-round, many struggle to overcome this dependence on seasonal demand, resulting in underutilized infrastructure and unstable local economies.

While ski tourism offers economic benefits, its environmental and social impacts are significant and increasingly concerning. The heavy reliance on artificial snowmaking strains local water resources, particularly in regions already prone to water shortages, while deforestation and land clearing for ski slopes disrupts ecosystems and biodiversity. Climate change poses a growing risk, with rising temperatures threatening snow reliability and the long-term viability of ski resorts. Additionally, ski tourism can lead to seasonal congestion, overwhelming local infrastructure. The industry's development often polarizes local communities, as benefits may disproportionately favour ski enterprises, sidelining smaller businesses and residents. Furthermore, ski

enterprises, due to their economic influence, can become powerful political actors, shaping local policies in ways that prioritize profit over long-term sustainability and community welfare.

The Carpathian macroregion's ski tourism is dominated by a dense and diverse network of resorts, primarily located in Slovakia, Poland and Czechia, but also in certain regions in Ukraine and Romania (**Map. 2.38**). The region's primary ski hub lies along the border of Poland and Slovakia, encompassing regions such as Nowotarski (65 km), Bielski (56 km), and Żilinský (146 km), which together offer 267 km of ski infrastructure with density reaching almost km per 100 km² on average. This concentration of resorts, which extends from Prešov and Nowosądecki in the east, Banskobystrický in the south, through Trenčiansky, Zlínský, Moravskoslezský, and Olomoucký in the west, and then transitions into the Sudety ski resort network, provides tourists with a range of skiing options within convenient travel distances, catering to both advanced skiers and beginners. Worth mentioning are Slovakia's well-connected resorts, including Jasná Nízke Tatry – Chopok, Tatranská Lomnica, Donovaly (Park Snow), and Štrbské Pleso, which offer a balanced mix of expansive infrastructure, terrain diversity, and quality services, which cater to a wide range of tourists. Similarly, Poland's Szczyrk Mountain Resort and Białka Tatrzańska provide a range of options for less experienced skiers. Despite significant number of ski infrastructure in Zakopane the fragmentation of ownership and lack of universal branding takes this ski resort off the main ski resort websites. The density and diversity of these resorts, including FIS-quality slopes and smaller, local resorts, ensure flexibility and adaptability in meeting the needs of various skier types, as well as accommodating high volumes of tourists during the winter season and on weekends. This area could however benefit from this density even more by interconnecting the resorts, improving collective transport systems and offering shared ski passes, enhancing accessibility and enabling tourists to customize their skiing experience, thus reducing congestion at individual sites.

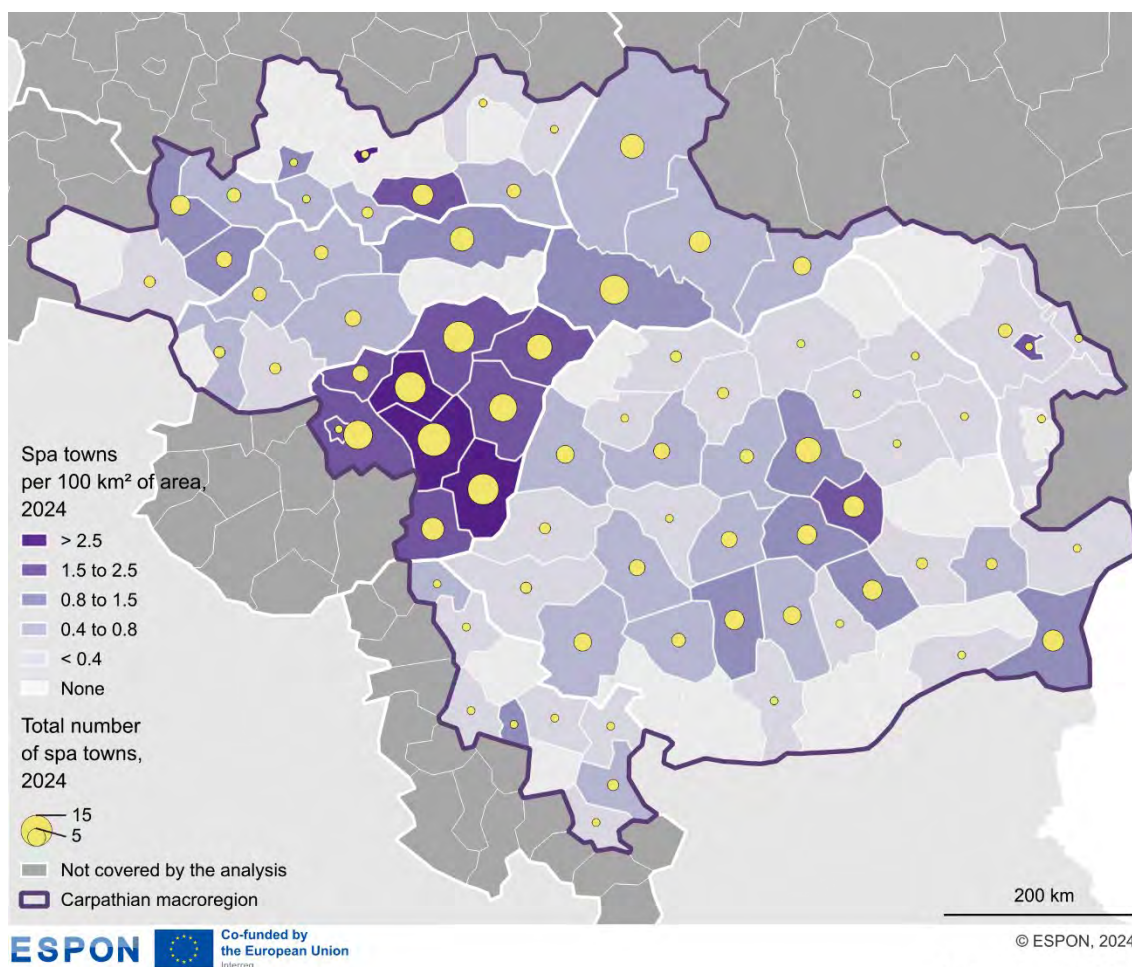
Other ski resorts are fragmented all along the Carpathian mountain range and although it might seem like a more sustainable structure, it does not provide competitive advantages described above. For example, isolated mega-resorts like Bukovel in Ukraine, although offering the largest ski infrastructure in the region with 68 km of slopes, are limited by their geographic isolation. This lack of integration with nearby resorts constraints tourists' ability to experience diverse skiing environments, potentially leading to overcrowding and an overall diminished visitor experience. Romanian resorts like Straja and Sinaia contribute to the region's ski portfolio, their infrastructure remains less developed.

Selected elements of tourist infrastructure: Wellness and health tourism

Wellness and health tourism has substantially grown in the Carpathian macroregion in recent years as European tourists travel from richer countries like the United Kingdom, Sweden, Germany and the Netherlands, to seek affordable healthcare and wellness in other countries, primarily in Eastern Europe. Medical and spa tourism stimulates regional economies by generating income and creating jobs in hospitality, healthcare, transport, and related sectors, boosting both regional and local employment. Investments in medical and wellness facilities often lead to improved infrastructure, including roads, public amenities, and healthcare systems, which benefit both tourists and local residents. For peripheral or rural regions, spa tourism offers opportunities to counteract depopulation and economic stagnation by attracting visitors and fostering small business creation. Despite that, spa tourism may suffer from seasonal fluctuations, creating economic instability for communities reliant on tourism as their primary income source. Dependency on external visitors can also leave regions vulnerable to global economic downturns or crises, while increased tourist activity can strain local ecosystems particularly in fragile areas with geothermal or mineral water sources. Development of spa facilities may prioritize tourist needs over local interests, leading to rising property prices, commercialization, and potential displacement of residents.

The map reveals that Carpathian macroregion indeed has a distinct wellness tourism potential, with the densest clusters located predominantly in Hungary (**Map 2.39**). The regions of Jász-Nagykun-Szolnok (17), Heves (15), and Békés (15) stand out as central hubs, each with a density of over 2.5 spa resorts per 100 km². These areas, along with the broader eastern half of Hungary, which includes Borsod-Abaúj-Zemplén (15), Szabolcs-Szatmár-Bereg (10), Hajdú-Bihar (12), Bács-Kiskun (17), as well as capital region of Budapest and Pest (14) form a comprehensive network of very evenly distributed spa towns. This clustering aligns with favourable natural conditions such as geothermal springs, thermal waters, and a historically developed spa infrastructure, which have long positioned Hungary as a key destination for health and wellness tourism.

Map 2.39
Spa towns, 2024



Territorial level: NUTS 3
 Source: ESPON KARPAT, 2024
 Origin of data: National Tourist Boards (CZ, PL, SRB, SK, HU),
 Government Pages (UA), Wikipedia (MD), Silisteanu et.al, 2020 (RO)
 © EuroGeographics for administrative boundaries

Outside of Hungary, notable concentrations include the Vysoké Tatry in Slovakia, which hosts Starý and Nový Smokovec, Tatranská Polianka, and Tatranské Zruby, as well as the Beskid Sądecki area in Poland, Covasna (7) in Romania, and Zakarpatska (13) in Ukraine. In Romania, there is a visible "chain" of spa towns along the inner eastern axis of Carpathian mountains. Southern Romania, around Braşov, along with regions such as Vâlcea (6) and Covasna (7), also serve as important spa centres. Moreover, the Constanţa region (7), hosts a series of Black Sea resorts. In Ukraine, the local concentration of spa towns is located to the north of Mukachevo in the Zakarpattia region (5).

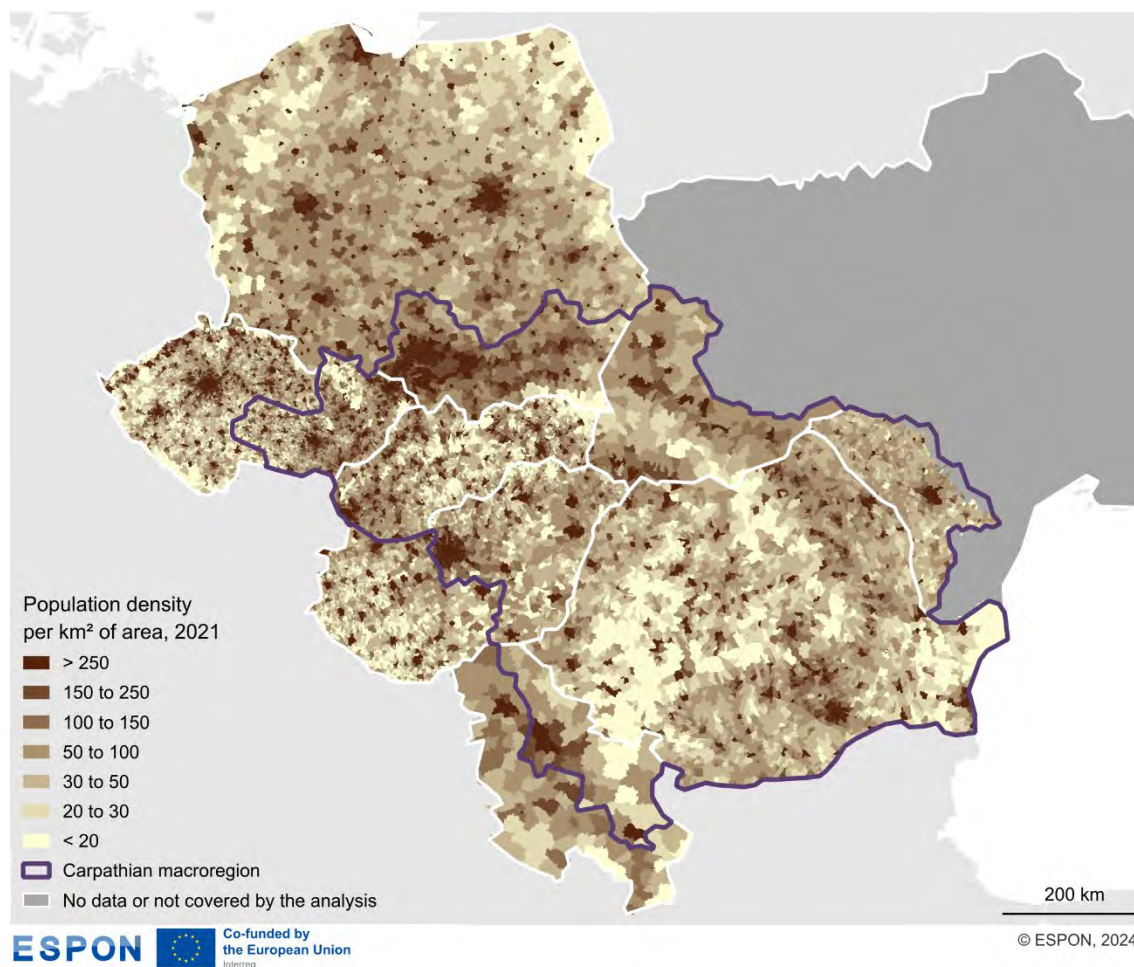
Many spa towns are deeply integrated with urban tourism, offering visitors a blend of wellness, history, and culture. For instance, Budapest, with its iconic thermal baths like Széchenyi and Gellért, combines spa experiences with a wealth of cultural and historical landmarks. Similarly, Sinaia in Romania merges health tourism with the Peleş Castle, while Eger in Hungary integrates its spa offerings with wine tourism. Carpathian spas placed in mountainous areas are often co-located with eco- and nature-based tourism, like Hévíz in Hungary, with its thermal lake, and Băile Tuşnad in Romania, Jaremce in Ukraine. These links also include active, outdoor and ski tourism particularly in Krynica-Zdrój and Szczawnica in Poland, Jaremce in Ukraine, and Sinaia in Romania. Moreover, some spa towns, such as Rajecské Teplice in Slovakia and Sárvár in Hungary, have developed wellness tourism infrastructure that includes luxury resorts, spas, and wellness centers, attracting tourists seeking relaxation and rejuvenation in a more exclusive environment.

2.2 Demography and society

2.2.1 Population density and demographic structure

The Carpathian macroregion has a population of 57 million people that is largely due to the location of large urban centres in the mountain foothills, including capital cities such as Budapest, Bucharest and Bratislava. However, it should be noted that within the Carpathian macroregion there is a very high variation in population density, which is particularly well visible at the lower levels of population data aggregation (**Map. 2.40**).

Map 2.40
Population density, 2023



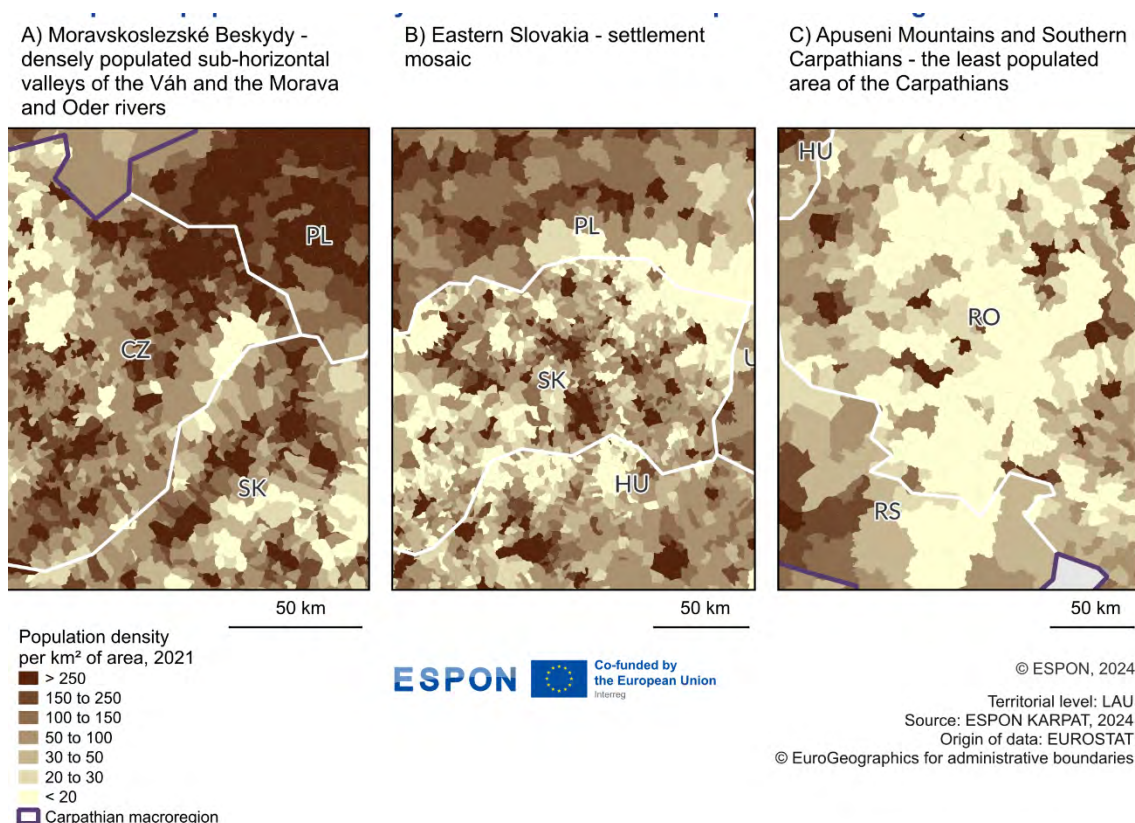
Territorial level: LAU
Source: ESPON KARPAT, 2024
Origin of data: EUROSTAT 2024, National censuses
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In particular, the shape of the Carpathian mountain chain is very visible, which is due to the fact that many municipalities of mountainous areas are characterised by low population densities of no more than 20 persons per sq km. Such municipalities are characteristic especially for Romania (especially the Apuseni Mountains) (**Map. 2.41a**), but even in countries where the size of municipalities is much higher, i.e. Serbia and Ukraine, for example, mountain municipalities clearly stand out against the foothills. The situation is somewhat different in Poland, where the low population density of some of the Carpathian municipalities is due to historical reasons. This is evident only in the eastern part of the Polish Carpathians, while the western part is one of the most densely populated areas of the country. In Slovakia, on the other hand, despite the low

population density in many mountain municipalities, it is possible - especially in the eastern part of the country - to indicate the presence of densely populated areas in mountain valleys, including former mining settlements and towns, as well as Roma settlements (**Map. 2.41b**). The mountainous border areas of the Czech Republic and Slovakia are also relatively densely populated, with the exception of municipalities covering the highest parts of the border mountain range (**Map. 2.41c**). The highest population density, on the other hand, characterises the foothill areas located on the outer part of the Carpathian arc from Moravia through Silesia, Lesser Poland, Podkarpacie in Poland and Ukraine, as well as Romanian Moldavia and Wallachia. In contrast, on the inner part of the Carpathian arc, the highest density is found in the Pannonian Basin, which applies to Hungary, Slovakia, Ukraine, Romania and Serbia, as well as in some parts of the Transylvanian Highlands.

Map 2.41

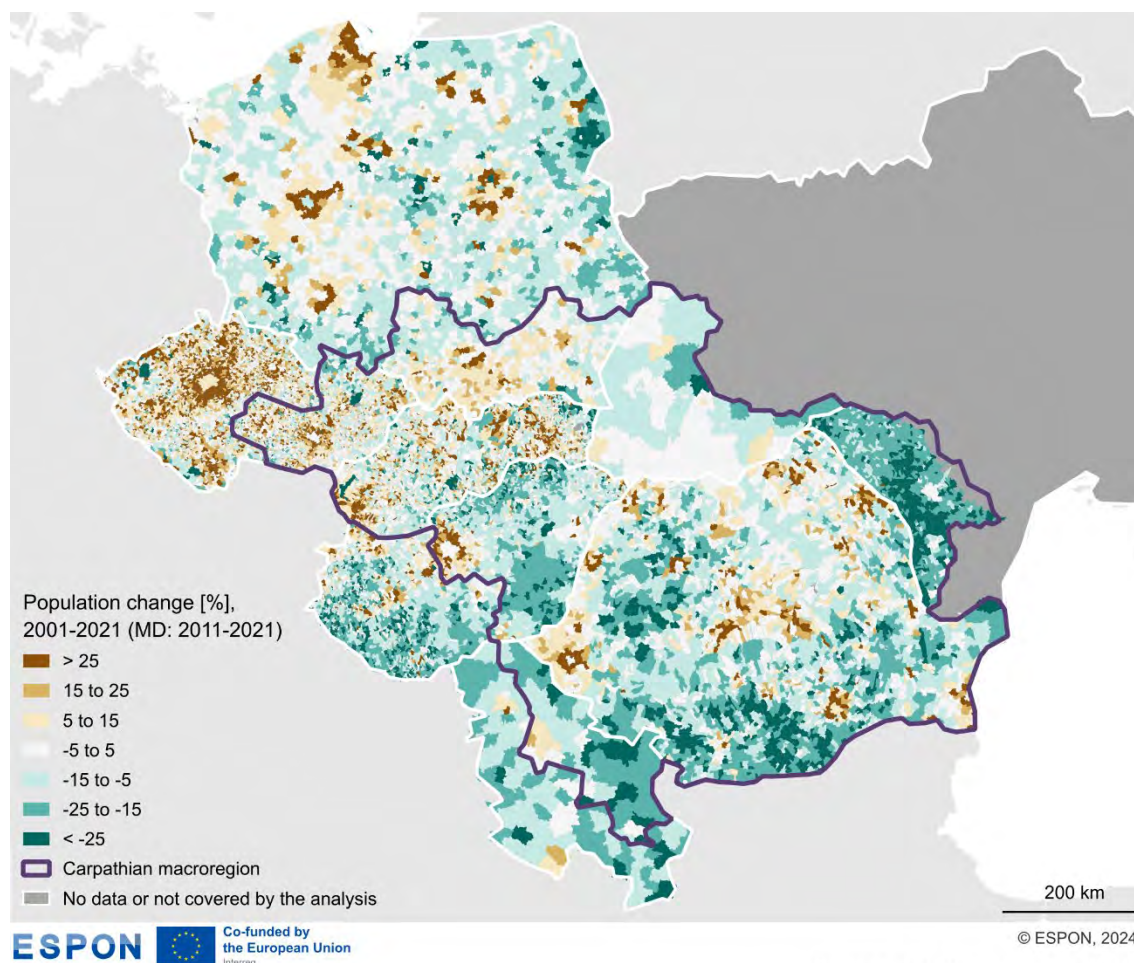
Examples of population density differentiation



Although population density does not generally change rapidly, an analysis of the population change in the macroregion's municipalities over the past two decades shows, on the one hand, clear depopulation processes and, on the other, areas that are maintaining demographic vitality or even experiencing demographic expansion (**Map. 2.42**). Among mountain areas, the fastest population decline was in the Apuseni Mountains in Romania. In addition to these, significant declines also occurred in the Southern Carpathians in Romania and in Serbia. The Eastern Carpathians in Romania did not experience such large losses, but were also undergoing depopulation. Such declines were also recorded in the Eastern Carpathians in Poland and Slovakia. Depopulation - albeit unevenly - also occurred in the mountainous areas of northern Hungary. It should be noted, however, that significant population declines also affected some foothill areas, which was particularly true of Wallachia (excluding the surroundings of the large cities i.e. Bucharest, Krajowa and Pitesti) and especially its western part. The second such area was southern Hungary excluding Szeged and its surroundings. In contrast, the Romanian part of the border region with Hungary was one of the areas where the population was growing very significantly, especially in the surroundings of the big cities, i.e. Timișoara, Oradea and Satu Mare. The situation was similar in Romanian Moldova, but with a greater contrast between population growth in the surroundings of cities such as Suceava, Iași and Bacău and a decline in most other areas of the region. There was also a clear demographic increase in eastern Slovakia, especially in the surroundings of Košice and

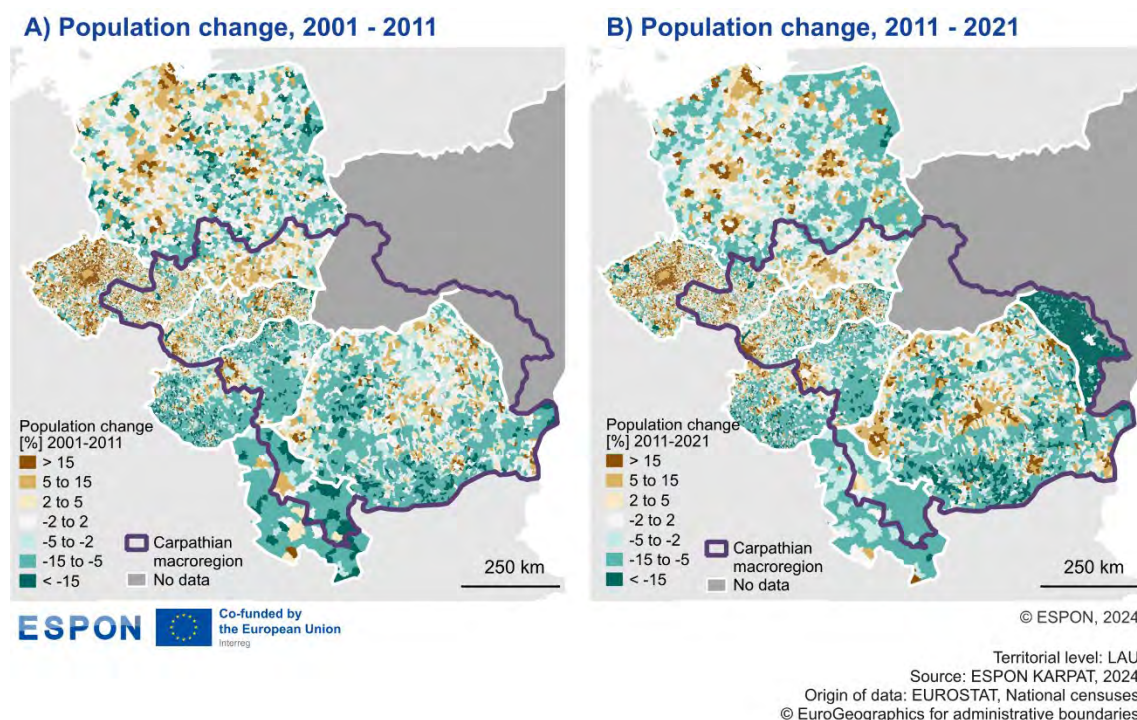
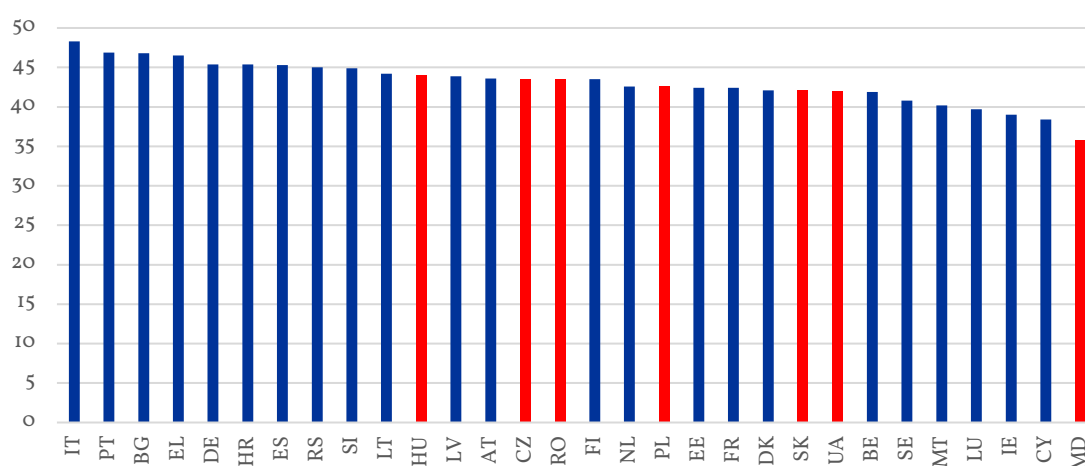
Prešov, but also in the Poprad valley. In Poland, the majority of municipalities recorded either population increases or maintained population levels. In contrast, the most pronounced increases were in the surroundings of large cities, especially Krakow and Rzeszow, but also Nowy Sącz, Bielsko-Biała and the Nowotarska Basin. A slight depopulation affected the mountainous areas of the Czech-Slovak border region, while the suburban areas of the largest cities, i.e. Brno, Ostrava Olomouc and Zlín, recorded a clear increase in population. Bratislava, Budapest and Belgrad also experienced significant suburbanisation.

Map 2.42
Population change, 2000-2021



Territorial level: LAU, pre-2020 rayons for UA
Source: ESPON KARPAT, 2024
Origin of data: EUROSTAT 2024, National censuses
© EuroGeographics for administrative boundaries

The observed processes of population change over the last 20 years have been relatively stable in spatial terms (**Map. 2.43**). However, an increase in polarisation can be observed between areas of depopulation and areas of population growth, which was particularly evident in Romania. In particular, the population growth dynamics intensified in the border area with Hungary, as well as in the Transylvanian Highlands. On the other hand, depopulation processes intensified slightly in the Krosno sub-region in Poland, the eastern part of the Banská Bystrica region in Slovakia and the Czech-Slovak border region. In contrast, some deceleration in the rate of depopulation processes occurred in Serbia, which also affected mountainous areas.

Map 2.43**Change in population between census periods (%)****Chart 2.5****Median age of population in Europe, 2023**

Source: Own elaboration based on Eurostat.

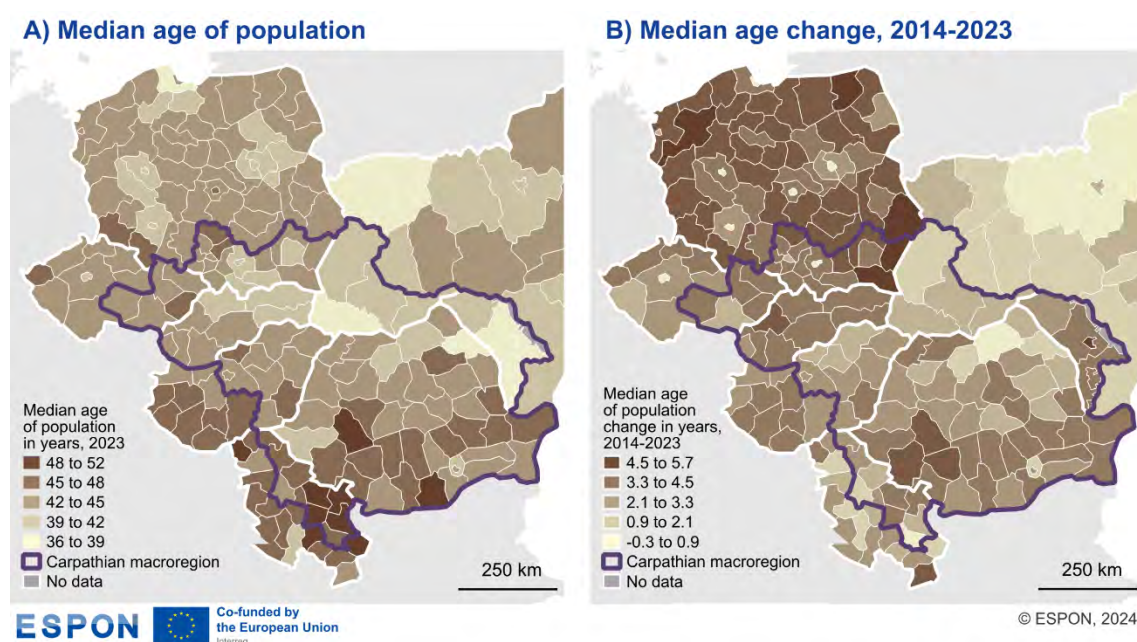
The situation of border areas in terms of population density and its changes was diverse. Particularly in cases where the border did not run through mountainous areas, high population density could be expected, as seen in the Polish-Czech, Polish-Ukrainian, and Romanian-Moldovan border regions, as well as in the unique border junction between Ukraine's Zakarpattia region, Slovakia, Hungary, and Romania. At the same time, the peripheral location of some border areas contributed to noticeable depopulation processes, which were evident along the Romanian-Moldovan border and in the border regions of Hungary.

Changes in population size may result from both the aging of society and migratory movements. In the Carpathian macroregion, as in most European countries, the former process was prevalent. Still, the Carpathian countries, except for Hungary and, to a lesser extent, the Czech Republic and Romania, were part of a group of countries with a younger population than the European average. This was especially visible in the Republic of Moldova, where the median age, meaning the age that divides the population into two equal halves, only slightly exceeded 35 years, and was relatively low in Slovakia and Ukraine, although it surpassed 42 years in these countries.

Regionally, the median age in the Carpathian macroregion showed a pronounced north-south gradient and, to a lesser extent, an east-west divide (**Map 2.44**). The oldest communities (in some cases, every second resident was over 47) were found in the southern Carpathians in Serbia and Romania, the Danube Plain (excluding Bucharest and Constanța), as well as the southern part of Romanian Moldova. The median age also exceeded 43 years in selected western areas of the macroregion, including Silesia in Poland and the Czech Republic, Moravia (excluding Brno), and western regions of Hungary and Slovakia (except Bratislava and its surroundings). Conversely, the youngest populations were in Moldovan and Ukrainian regions, as well as eastern Slovakia and the Nowy Sącz subregion in Poland. The Timișoara region in Romania, as well as the Kraków and Rzeszów subregions in Poland, though to a lesser degree, also stood out with younger populations, partly due to an influx of new residents, including from nearby rural areas.

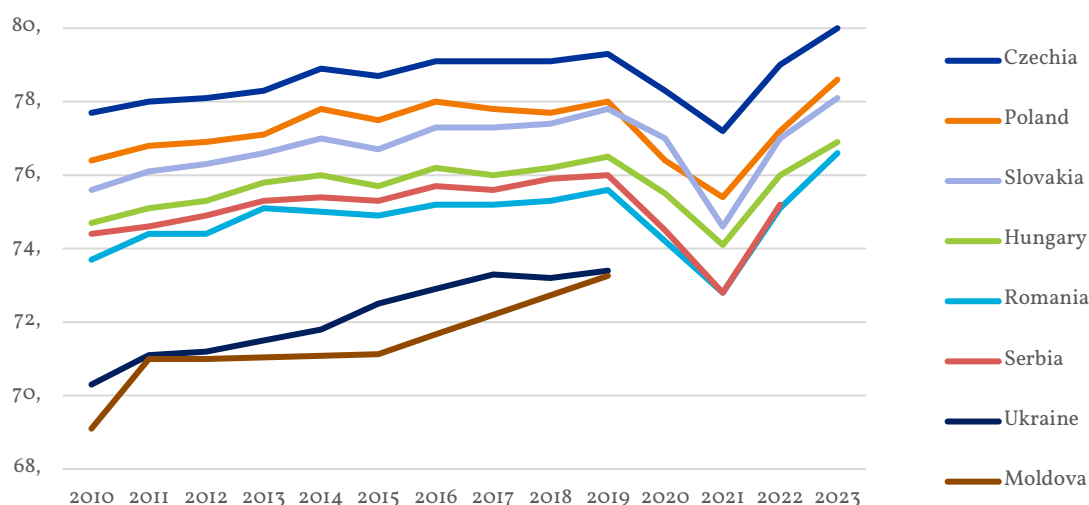
Map 2.44

Median age of population, 2023



In the last decade, the median age of the population increased significantly in almost all regions, due in part to a decline in birth rates and an increase in average life expectancy. Population aging was especially visible in two subregions of Poland's Podkarpackie Voivodeship, where the median age rose by over 5 years between 2014 and 2023. Median age increased by over 3 years in other regions of Poland, the Czech Republic (excluding Brno), Slovakia, as well as in the southern Carpathian regions of Serbia and Romania, and in the Republic of Moldova and the Maramureș region of northern Romania. Meanwhile, in the mountainous regions of northern Hungary, Ukraine, and the northern part of Romanian Moldova, there was no significant change in residents' median age.

Chart 2.6
Life expectancy at birth, 2010-2023

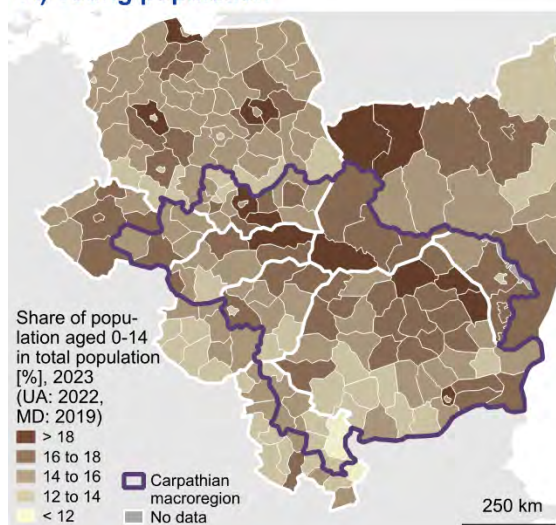
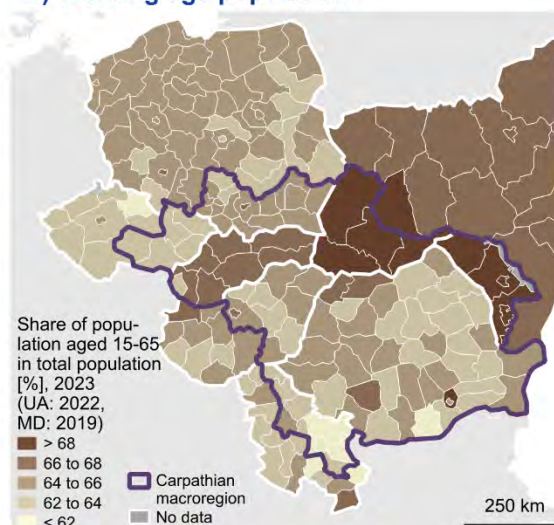
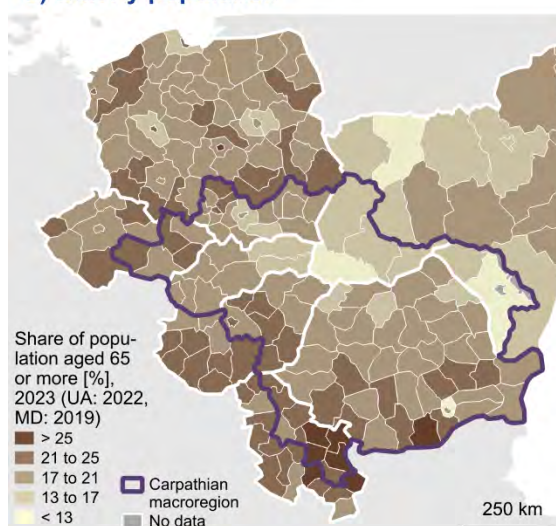
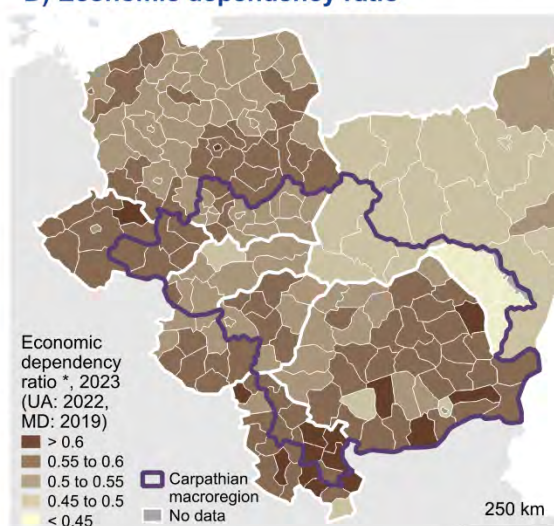


Source: Own elaboration based on EUROSTAT data and WHO for the Republic of Moldova.

This affected the age structure of the population (**Map 2.45**). In some regions, the share of youth under 15 years did not exceed 13%, while the proportion of the 65+ population exceeded 24%, especially visible in regions located in the Eastern Serbian Mountains. Conversely, in some Carpathian regions, the share of youth reached about 20%, including the Małopolskie Voivodeship, eastern Slovakia, Transcarpathia, and the Romanian parts of Moldova and certain Transylvania regions. This typically correlated with a low share of the post-working-age population, below 17%. This low share was especially visible in Moldovan and Ukrainian regions, possibly due to lower life expectancy compared to other Carpathian countries (around 73.5 years in 2019, about 2 years less than Romania and over 6 years less than the Czech Republic, the leader in this respect). Nonetheless, in all Carpathian countries, average life expectancy increased significantly compared to 2010. The decrease in life expectancy due to the COVID-19 pandemic was temporary. In contrast, differences between countries were more lasting, exemplified by the fact that while life expectancy in the Czech Republic exceeded 80 years in 2023, it remained below 77 years in Hungary, Romania, and Serbia, maintaining the gap from 2010.

Population aging and the growth in the 65+ population have resulted in an increasing demographic burden on the working-age population. In this regard, Carpathian countries and regions vary: Serbia, Romania, Hungary, and the Czech Republic bear a higher burden (including children and youth) than the Republic of Moldova, Ukraine, and to a lesser extent Slovakia and Poland, where the burden remains visibly lower.

Future demographic trends, aside from international migration, depend primarily on the fertility rate, which needs to exceed approximately 2.1 to ensure natural generational replacement. However, in the Carpathian countries, fertility rates are well below this level, with considerable spatial variation. This trend became apparent in recent years, as in 2013 fertility rates were similar (except for the Republic of Moldova), ranging from 1.3 in Poland to 1.45 in the Czech Republic and Romania. In subsequent years, some countries saw notable improvement, especially the Czech Republic and Romania (rising to about 1.8 in 2021), and to a lesser extent Slovakia, Hungary, and Serbia, all surpassing 1.6. Meanwhile, Poland peaked in 2017 (1.5) before declining to the level of the early period. Ukraine also saw a sharp fertility decline to a very low 1.2. During the pandemic, fertility rates did not decline significantly; however, the impact on reproductive decisions was delayed. As a result, 2022 saw a marked fertility decrease across all Carpathian countries (except Serbia). In summary, this negative demographic situation, particularly under conditions of negative migration balance, points to a likely and progressive population decline in the Carpathian countries in the coming years.

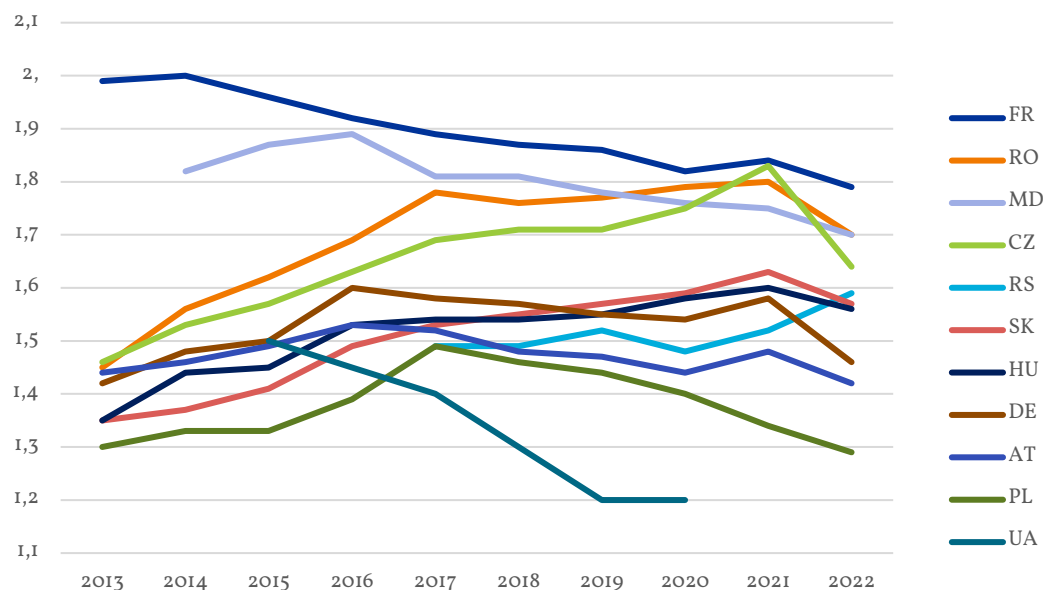
Map 2.45**Population age structure, 2023****A) Young population****B) Working age population****C) Elderly population****D) Economic dependency ratio ***

ESPON Co-funded by the European Union

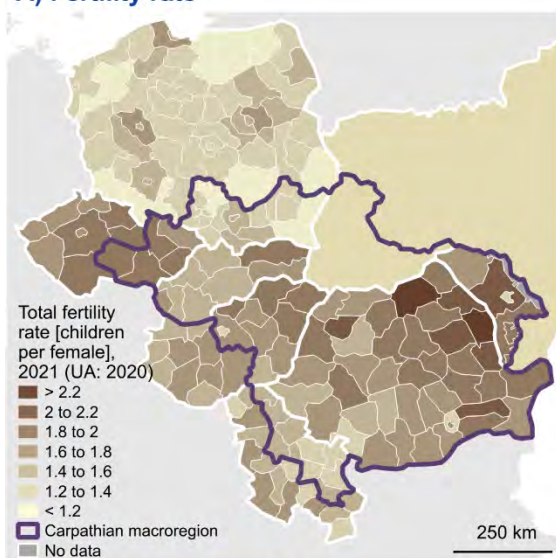
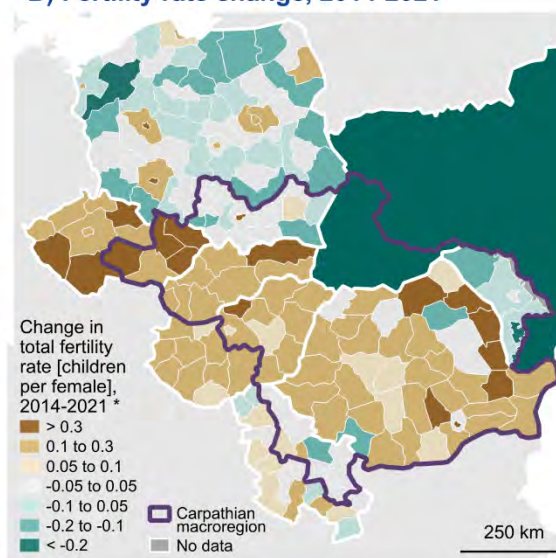
* The ratio of those typically not in the labour force (ages 0 to 14 and 65+) and those typically in the labour force ("working age population", ages 15 to 64)

© ESPON, 2024

Territorial level: NUTS 3
Source: ESPON KARPAT, 2024
Origin of data: EUROSTAT, MD and UA Statistical Offices
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Chart 2.7**Total fertility rate in Carpathian Countries, 2013-2022**

Source: own elaboration based on Eurostat

Map 2.46**Total fertility rate, 2021****A) Fertility rate****B) Fertility rate change, 2014-2021***

ESPON Co-funded by the European Union Interreg

* RS: 2017-2021, UA: 2015-2020

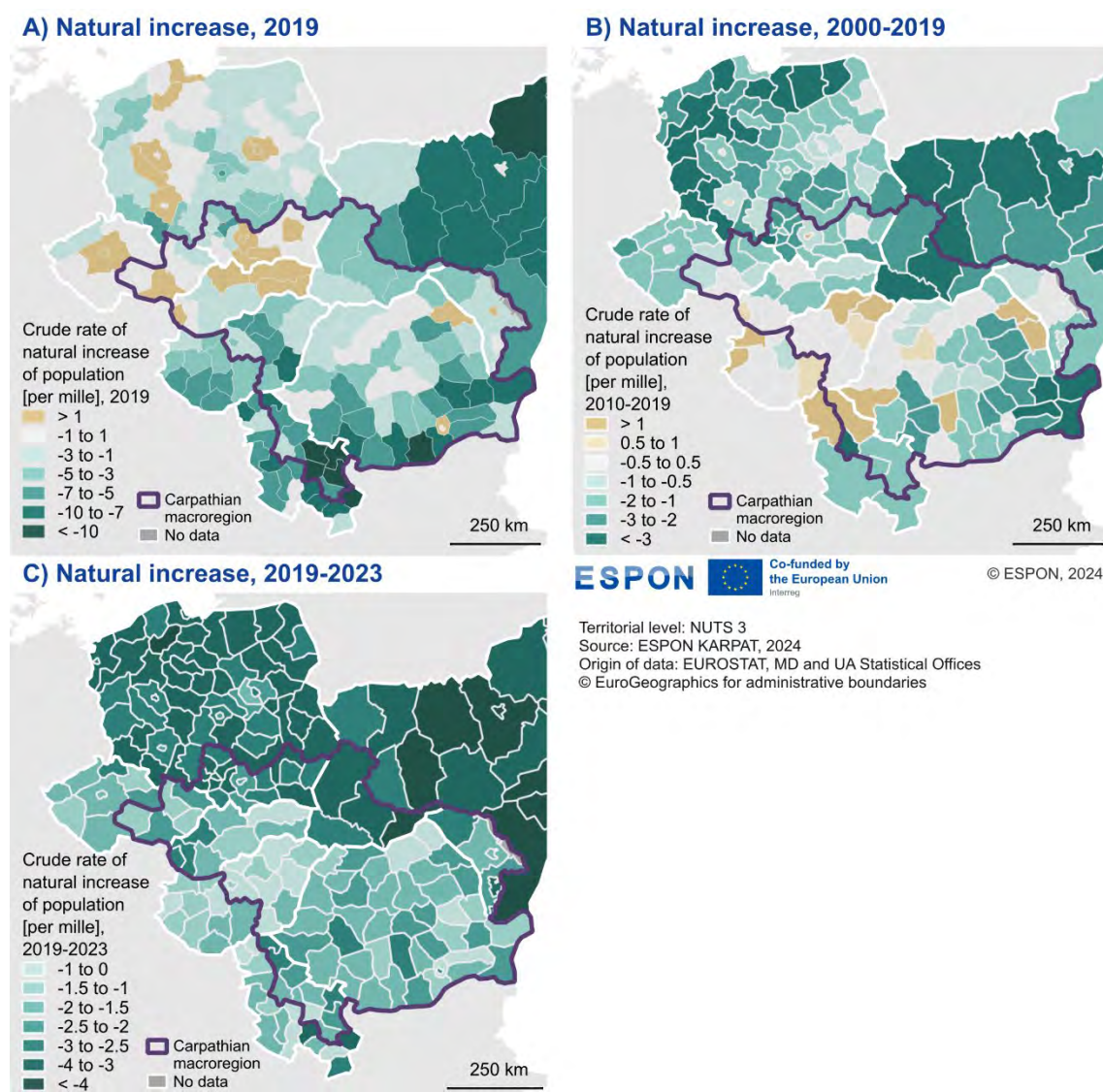
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Territorial level: NUTS3, NUTS0 for UA
Source: ESPON KARPAT, 2024
Origin of data: EUROSTAT, MD and UA Statistical Offices
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Spatially, fertility rates largely reflected the national situation (**Map 2.46**), but the range of variation was even greater. Some Polish subregions (with a rate below 1.2) diverged sharply from Romanian Moldova, where the

rate exceeded 2.1. Within each country, eastern Slovakia and Hungary had higher fertility rates, while in Serbia, eastern Carpathian regions had lower rates than the national average. A notable improvement occurred across all regions of the Czech Republic, Slovakia, and Hungary, as well as most regions in Romania. In contrast, the dynamics in Moldovan, Polish, and Serbian regions were notably weaker, with only the largest urban centres showing a positive trend.

Map 2.47
Natural increase, 2010-2023

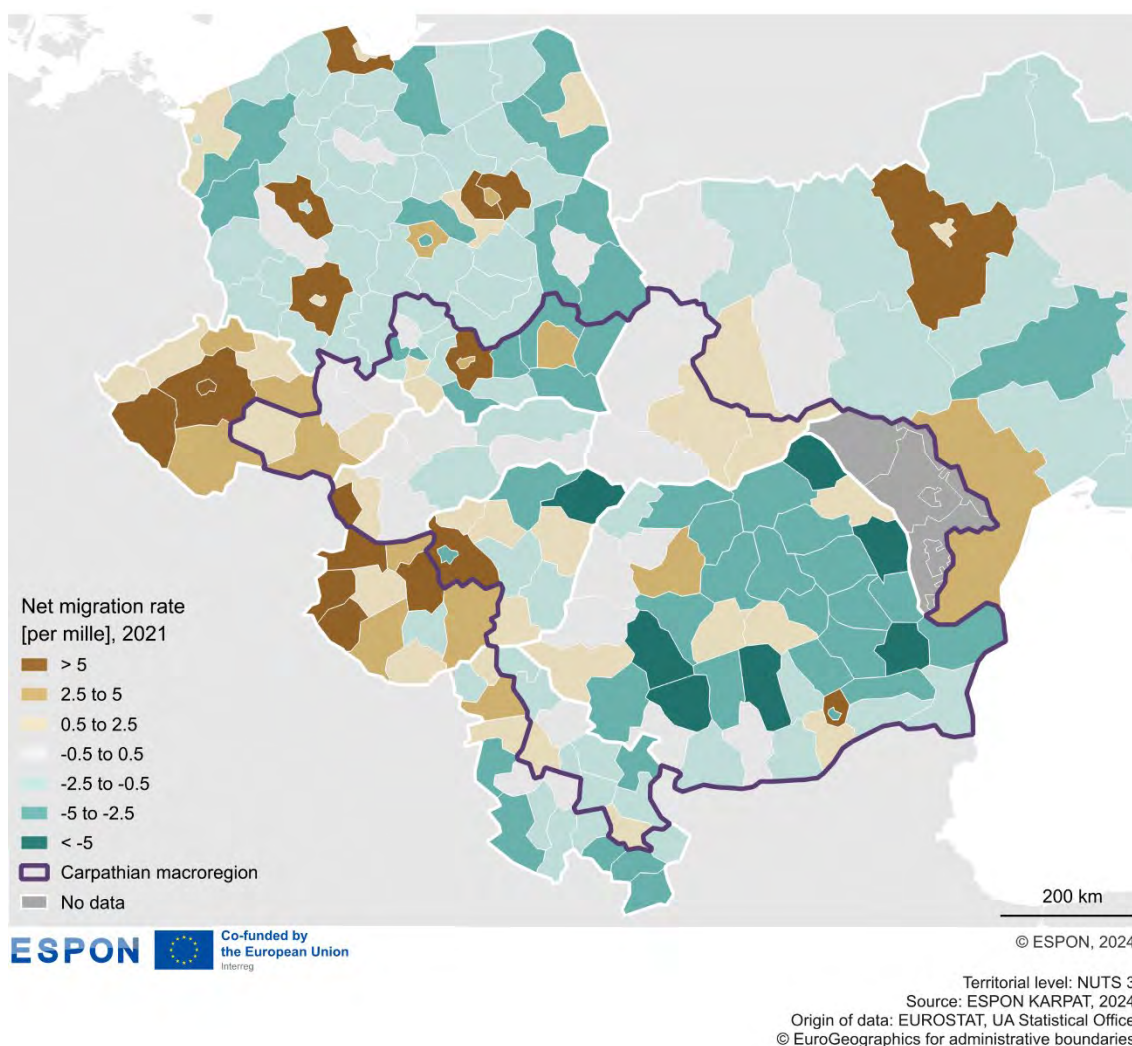


Natural population movement in most Carpathian countries and regions shows a clear excess of deaths over births (**Map 2.47**). In 2019, exceptions included eastern and northern Slovakian regions, the Bratislava metropolitan area, Małopolskie and Podkarpackie Voivodeships in Poland, selected regions in Romanian Moldova (e.g., Iași), and Transylvania, as well as the Bucharest metropolitan area. On the opposite end, Serbian regions, as well as non-Transylvanian regions of Romania, especially in the south, experienced significant natural population decline. This trend did not significantly worsen from 2010, except for Ukrainian regions, southern Romania, and the Krosno subregion in Podkarpackie, Poland. In some regions, particularly north-eastern Hungary and parts of Transylvania, there was a slight improvement. However, the post-pandemic period brought a natural decrease, especially visible in Ukraine, Poland, western Slovakia, and selected regions in Romania and Serbia.

2.2.2 Migrations

In light of minimal natural growth, migration flows are crucial for changes in population size. Migration includes both domestic relocations and net international migration. Domestically, two processes dominate: suburbanization within metropolitan areas and an outflow from peripheral areas to major metropolitan regions. Internationally, there is an influx of immigrants from both developing and developed countries, mostly heading to major urban centres, which can help mitigate the population loss from suburbanization. International outflows primarily target EU labour markets and can exacerbate depopulation in economically weaker peripheral regions.

Map 2.48
Net migration rate, 2021



In the Carpathian macroregion, a positive migration balance was observed only in selected areas, primarily in the largest cities, especially in capital centres (**Map 2.46**). Nevertheless, in the case of the latter, suburbanization processes were the most pronounced, particularly evident in Budapest and Bucharest. The largest migration outflows occurred in peripheral regions, which was especially visible in Romania, as well as in the eastern part of Poland (excluding the Rzeszów region) and the Hungarian part of the macroregion (excluding the Debrecen region).

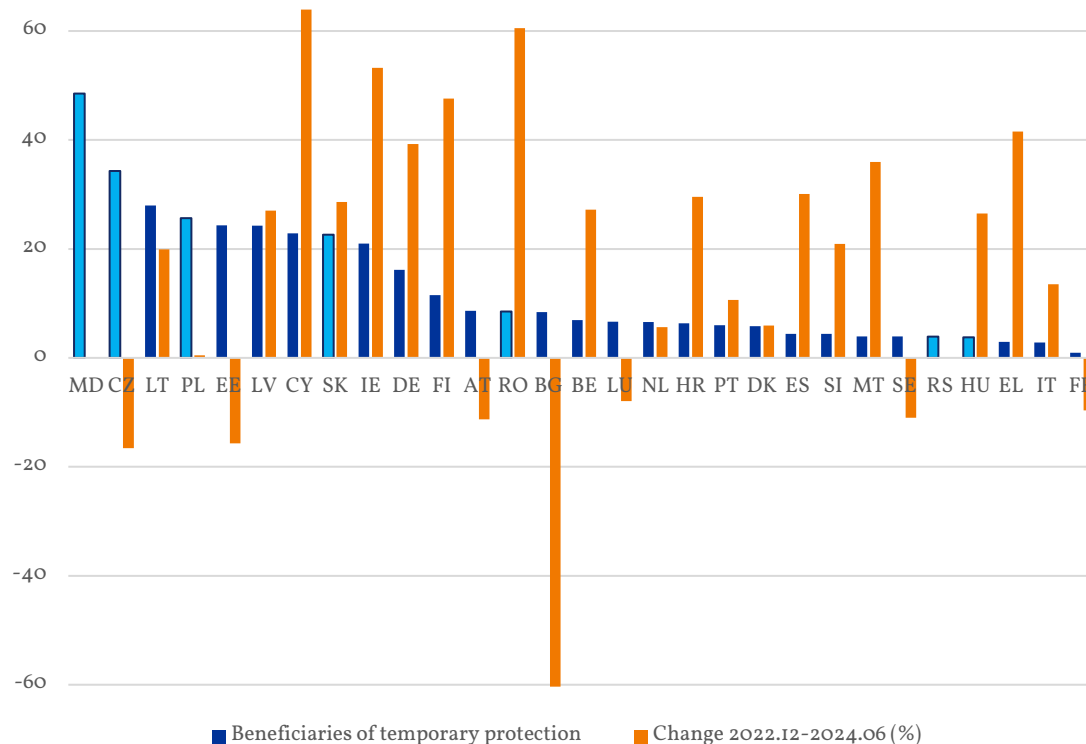
Unprovoked Russia's invasion of Ukraine, launched on February 24, 2022, has led to thousands of civilian casualties, extensive wartime destruction, and forced or prompted millions to relocate. According to

EUROSTAT data, as of June 2024, about 4.3 million Ukrainians in EU countries were under temporary protection. The majority were reported in Germany (1.35 million), Poland (0.95 million), and the Czech Republic (around 350,000). Per capita, the Republic of Moldova was the leader, with around 50 refugees per 1,000 residents, followed by the Czech Republic, Lithuania, and Poland (**Chart 2.8**). The Carpathian countries, excluding Ukraine, provided refuge to 1.65 million people. Apart from the countries mentioned, Slovakia also had a significant per capita share, with over 20 refugees per 1,000 residents. Conversely, Hungary and Serbia had relatively fewer Ukrainian refugees, with about 4.0 per 1,000, while Romania had 8.5 per 1,000.

Most migration to the EU occurred in the first months of the war, and by 2023, the number of those receiving assistance stabilized. However, there were changes in each country's share of aid to Ukrainian citizens. In particular, the number of Ukrainians in Germany rose by 40%, as well as in Romania by 60%, and also in Cyprus, Ireland, Finland, and Greece, and among the Carpathian countries, in Slovakia. In contrast, the largest decrease in Ukrainians was observed in Bulgaria, with noticeable declines in the Czech Republic, Estonia, and Austria.

Chart 2.8

Ukrainians as beneficiaries of temporary protection*, 2022-2024



* per '000 population and change 2022/12-2024/06 (%)

Source: Own elaboration based on Eurostat.

War operations also led to significant internal migration within Ukraine. By mid-2023, the Carpathian regions of Ukraine had received around 530,000 internally displaced persons, amounting to approximately 10% of their 2021 population. The Lviv region received the most, around 273,000 (UN Migration 2023).

The long-term impact of war-related migration on the socio-economic situation of the Carpathian countries, particularly Ukraine, is difficult to predict and depends on the war's progression and resolution. The longer the war, the more likely that those who left Ukraine or relocated within its borders will remain permanently in their temporary residences. This may significantly affect the demographic situation of Carpathian

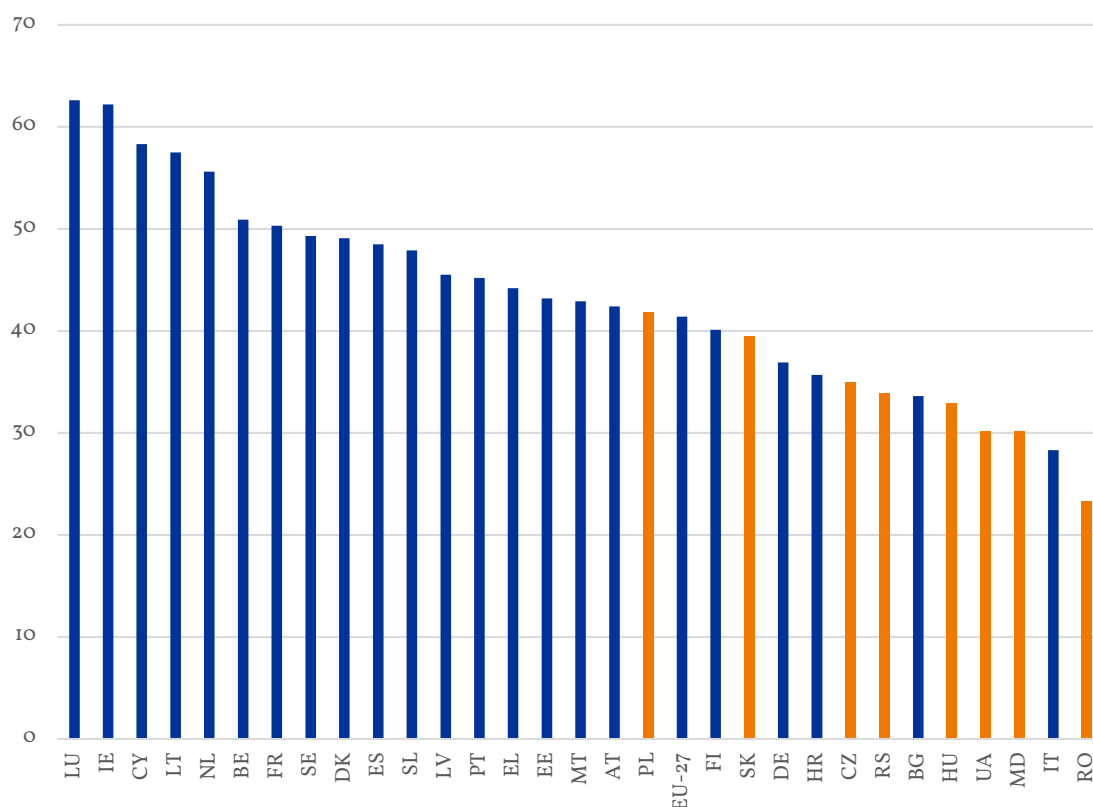
countries that received the most refugees and also lead to an increase in the population of Carpathian regions in Ukraine.

2.2.3 Education and human capital

Human capital is an important development factor because it serves as the foundation for innovation, productivity, and economic growth. The skills, knowledge, and creativity of individuals drive technological advancements and efficient resource utilization, which are key to sustainable development. Furthermore, investing in human capital through education, training, and health not only enhances individual potential but also strengthens the competitiveness of entire societies and economies. By fostering a well-educated and skilled workforce, communities can better adapt to changing economic landscapes and secure long-term prosperity.

Chart 2.9

Percent of population aged 25-34 who have successfully completed tertiary studies, 2021

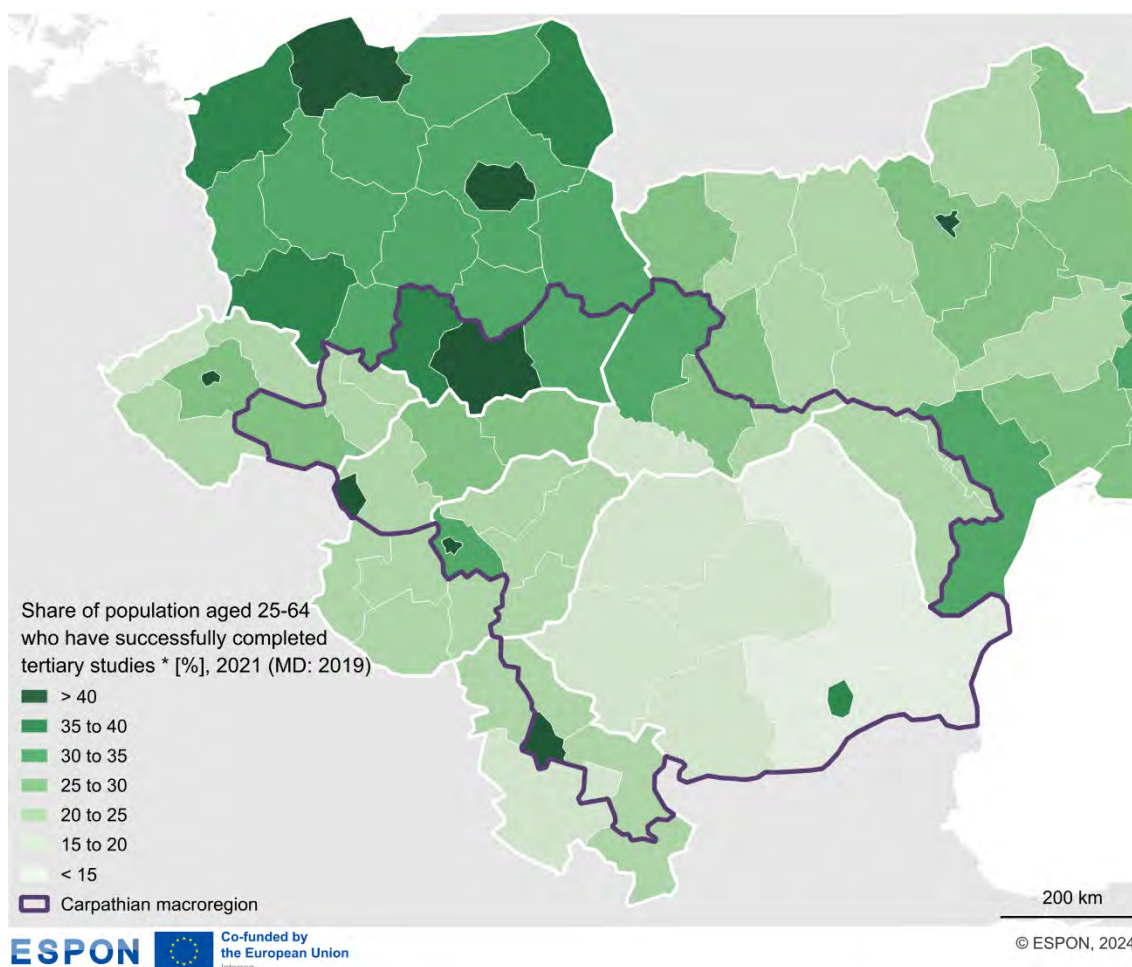


Source: Own elaboration based on Eurostat.

Compared to the average values in European Union countries, the Carpathian countries exhibit relatively low human capital potential, though it is highly varied both between and within these countries. With the exception of Poland, all countries in this region have a lower percentage of the population completing higher education than in the EU (**Chart 2.9**). The lowest percentage of higher education graduates is observed in Romania, where this rate, measured in the 25-34 age group, does not exceed 25%.

Metropolitan regions, centered around the largest cities in the region, play a particularly significant role in the accumulation of human capital. Areas around Budapest, and Bratislava have notably high shares of the population with higher education, exceeding 50%. In contrast, in most regions of Romania, the share of educated people does not exceed 17% (**Map. 2.49**).

Map 2.49
Highly qualified population, 2021

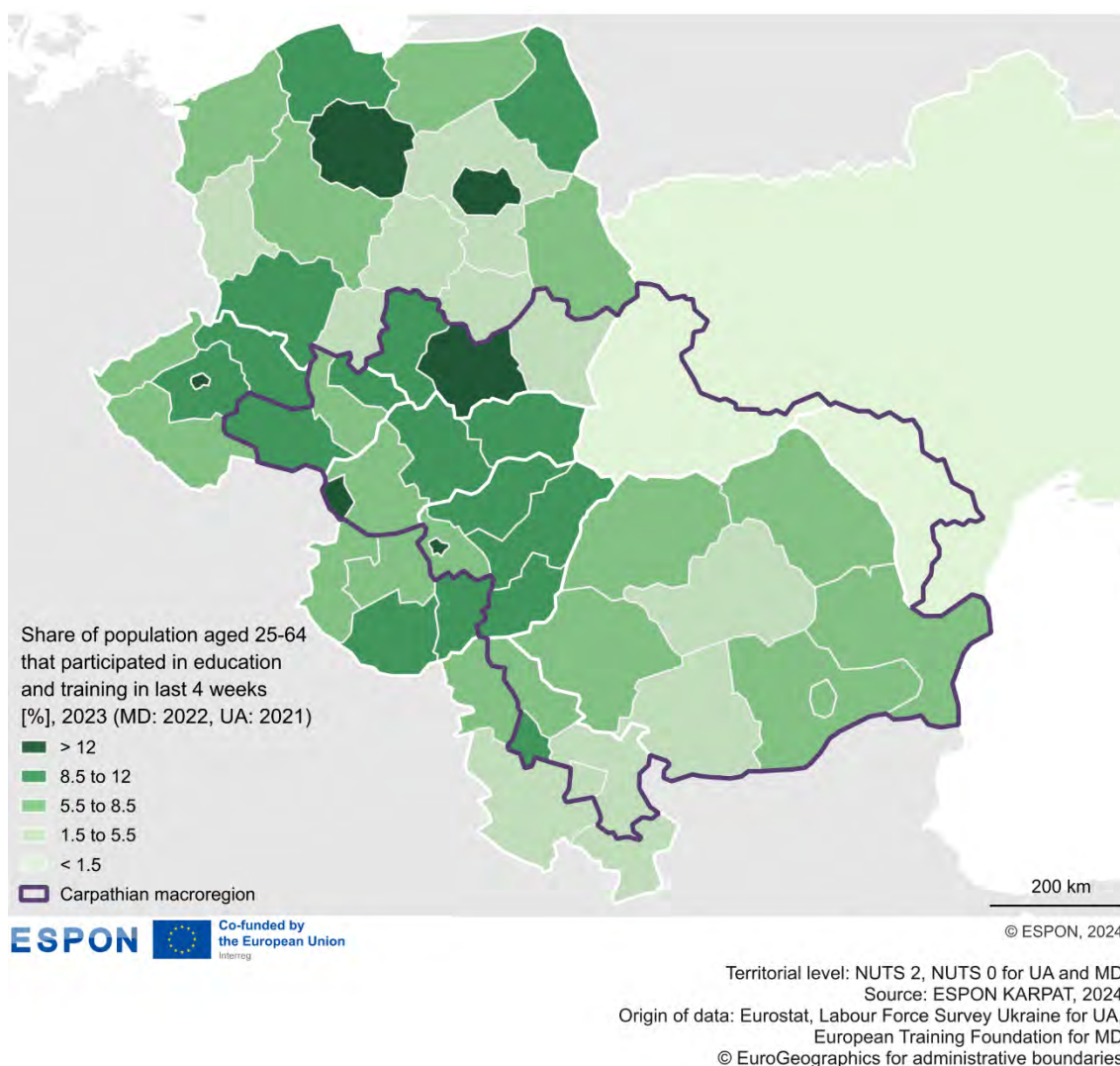


* higher education degree

Territorial level: NUTS 2
 Source: ESPON KARPAT, 2024
 Origin of data: EUROSTAT, UA LFS, UA Census, UNESCO Institute for Statistics
 © EuroGeographics for administrative boundaries

There is also significant territorial variation, though with a different geographical distribution, regarding adult participation in education in the Carpathian region. While the strong position of capital areas (Warsaw, Bratislava, Prague) is evident in this regard as well, particularly low – about 1% – adult education participation rates are notable in Ukraine and the Republic of Moldova (**Map. 2.50**). These two countries stand out negatively in terms of adult education not only compared to current EU member states but also in comparison to Serbia.

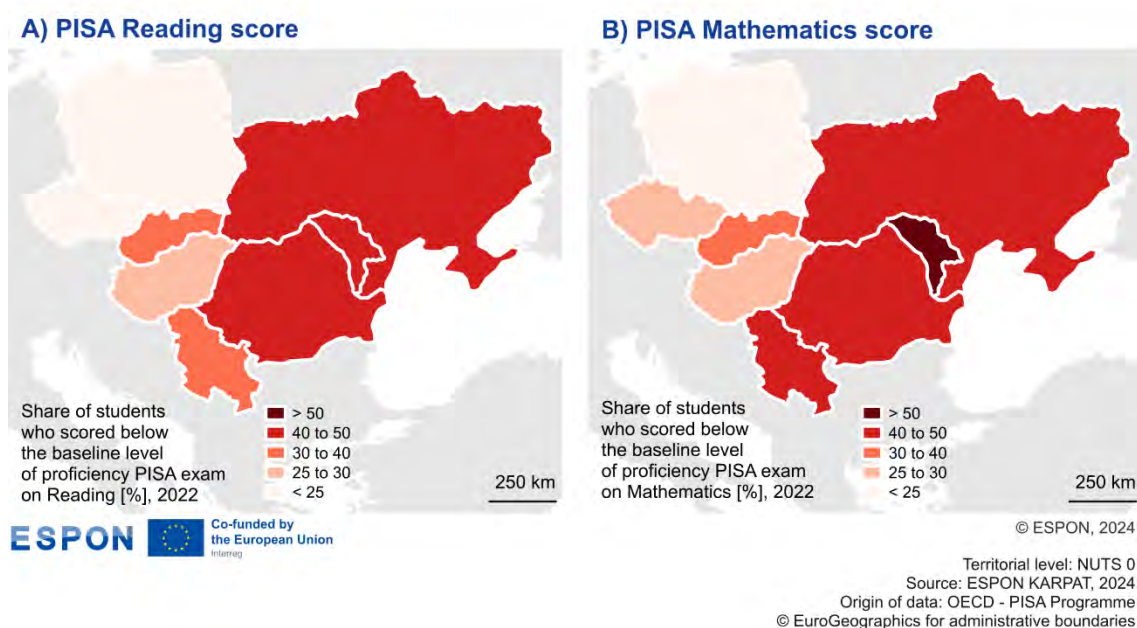
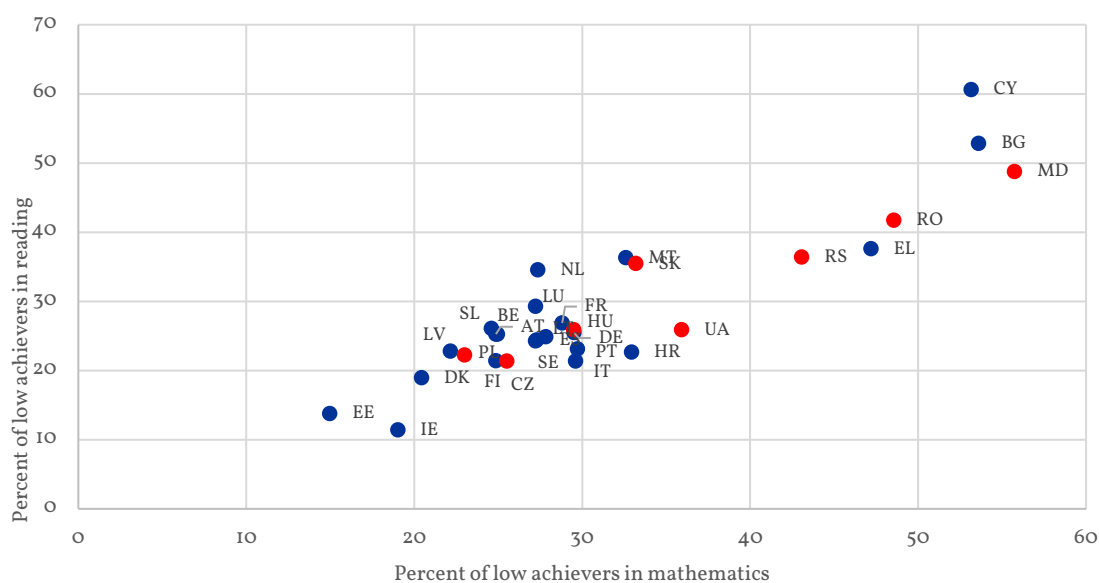
While the education structure of residents or the participation of adults in education provides valuable information about the effects of past educational policies, the academic achievements of students currently attending school can be a predictor of future human capital quality. Such data is provided by the OECD's Programme for International Student Assessment (PISA), which aims to measure the skills of 15-year-old students in a way that allows for international comparisons. An important feature of the PISA program from the perspective of analysing the Carpathian region is that all Carpathian countries currently participate in it. One of the valuable pieces of information provided by PISA is the percentage of students who achieve skills below the "baseline proficiency" level. PISA defines the basic level of proficiency as allowing for effective participation in society and further education. Therefore, a significant number of students possessing skills below this level indicates a critically low level of human capital in the young generation and poses a threat to social cohesion.

Map 2.50**Participation rate in education and training, 2023**

Map. 2.51 shows how varied the share of students achieving results below the basic level in mathematics and reading is in the countries belonging to the Carpathian region. The best results in this regard are achieved by students in Poland and the Czech Republic, where low-skill students constitute less than 25% of all students. The situation is particularly unfavourable in the Republic of Moldova, where 55% of students do not meet the basic proficiency requirements in mathematics.

As shown in the data presented in Chart 2.10, the school system in the Republic of Moldova, but also in two other Carpathian region countries, is characterized by a significant number of students with poor results not only compared to other countries in the region but also compared to all countries participating in the PISA program. Against this backdrop, the achievements of students in Ukraine, Hungary, and Slovakia are quite average, while the Czech Republic and Poland are marked by relatively low percentages of students with poor achievements.

Over the past decade, the proportion of the population who successfully completed tertiary education has increased across nearly all Carpathian regions, though the extent of this growth varied significantly (**see Map 2.52**). The most notable improvement—exceeding 10 percentage points—was observed in southern Poland and Slovakia. In contrast, educational attainment rates remained largely unchanged in parts of Romania and Ukraine within the Carpathian region.

Map 2.51**Percent of students who scored below the baseline level of proficiency PISA exam, 2022****Chart 2.10****Percent of low achievers in mathematics and reading: Carpathian countries compared to other countries participating in PISA programme, 2018**

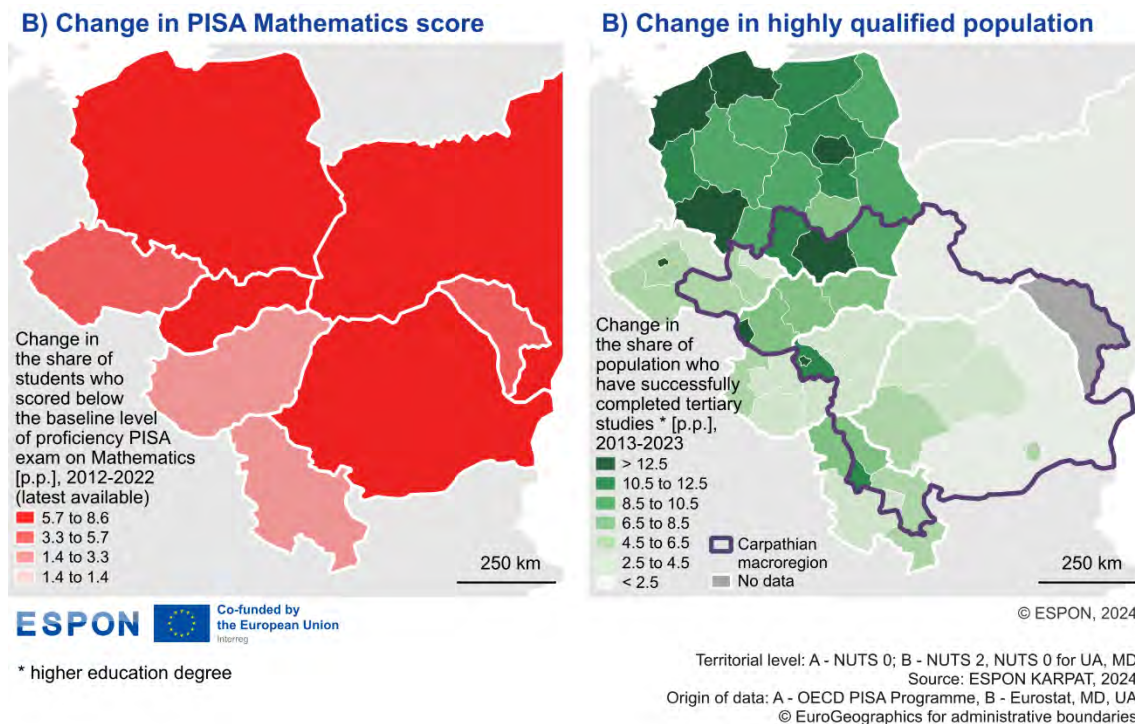
Source: Own elaboration based on PISA.

Regarding student performance in mathematics under the PISA program, the share of low-achievers rose markedly between 2012 and 2022. While the primary driver of this negative trend was the disruptive impact of the COVID-19 pandemic on education, the growing educational inequalities are nonetheless a cause for

concern. The largest rise in the proportion of low-achieving students occurred in Poland and Romania, while the figures remained relatively stable in Hungary and Serbia.

Map 2.52

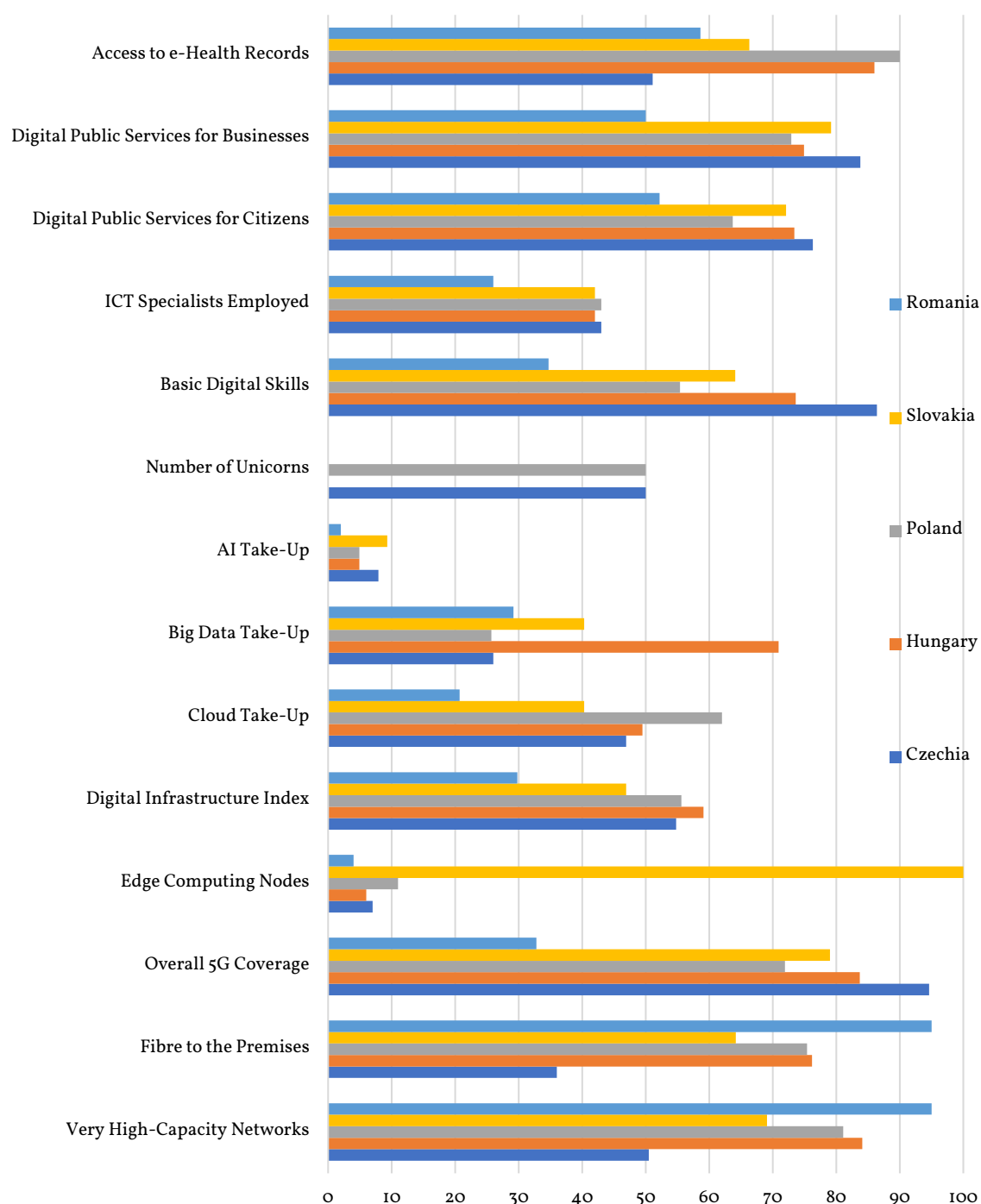
Human capital change, 2013-2023



2.2.4 Information society

Digital transformation is key in shaping contemporary society, offering new opportunities for development, education, work, and social integration. The essence of digitalisation is not limited to the technological dimension, although it is a critical element. Digitalisation is a horizontal process – adopting and using digital technologies redefines how people build relationships, make business decisions, and access public services, knowledge, and culture. In the Carpathian macroregion, digitalisation becomes a fundamental prerequisite for inclusive and sustainable development due to its specific characteristics. The macroregion can draw inspiration from the principles of the European Digital Decade, which sets directions for actions in four key areas: digital infrastructure, transformation of enterprises, digital public services and digital skills. Although the data presented in **Chart 2.11** do not cover the entire macroregion and represent only national-level results, they provide a clear picture of the disparities characterising the macroregion and identify areas requiring attention.

In terms of digital infrastructure development, Romania excels in Very High-Capacity Networks (VHCN) and Fibre to the Premises (FTTP), achieving the highest scores in the region (95% for both). The Czech Republic leads in 5G coverage (94.6%), while Slovakia stands out with a significant number of Edge Computing Nodes (100). However, Romania struggles with the lowest 5G coverage (32.8%), highlighting the uneven distribution of infrastructure advancements. In enterprise digital transformation, Poland performs strongly in cloud adoption (62%), while Hungary leads in big data analytics (70.9%).

Chart 2.11**Digital agenda Key Performance Indicators (% of EU target), 2023**

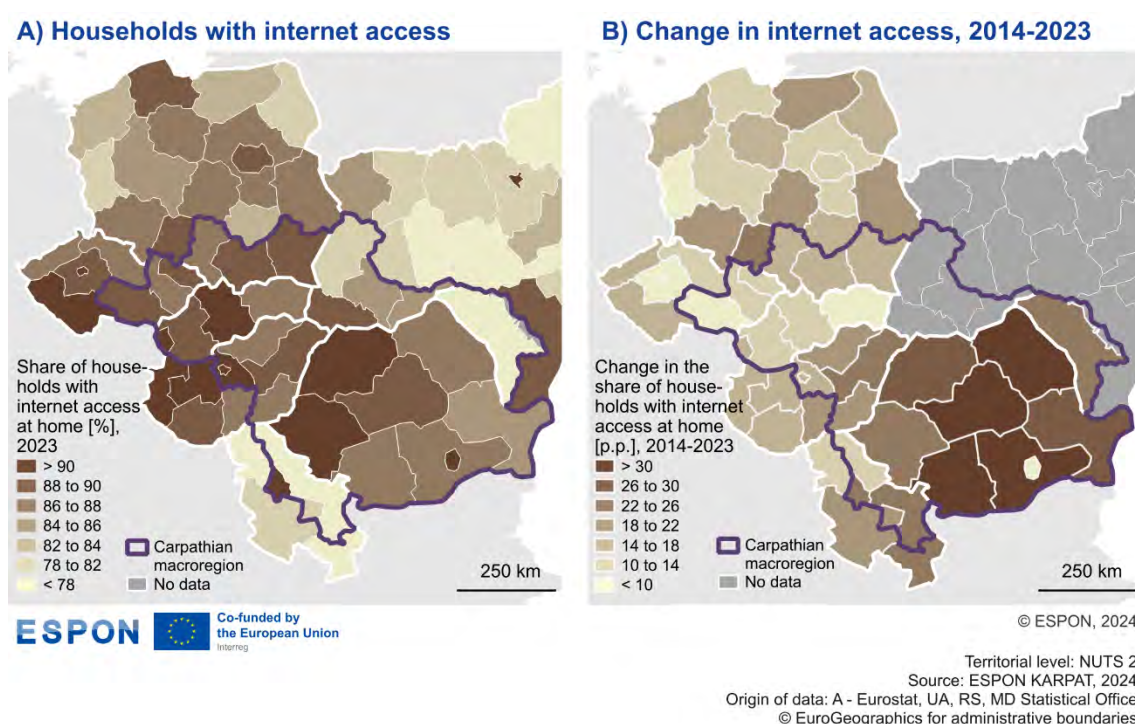
Source: Own elaboration based on:

<https://digital-strategy.ec.europa.eu/en/factpages/digital-decade-2024-report-country-fact-pages>

Adoption of artificial intelligence is low across the region, with Slovakia achieving the highest but modest score (9.3%). The Czech Republic and Poland are notable for their number of unicorns – privately held startups (new company) valued at \$1 billion or more – contrasting with the lack of such firms in Hungary, Slovakia, and Romania. Regarding digital skills, the Czech Republic achieves the highest scores in the region (86.4%), reflecting its advanced digital education system. Hungary also performs well (73.6%), while Romania lags significantly (34.7%). Similar disparities are evident in the employment of ICT specialists – the Czech Republic, Poland, Hungary, and Slovakia demonstrate stable employment levels (42–43%), while Romania falls behind (26%). The Czech Republic leads in digital services for citizens (76.3%) and businesses (83.8%), with Slovakia closely behind. Poland demonstrates strong performance in access to e-health records (90%), the highest in the region. Despite its robust infrastructure, Romania scores the lowest in digital public services (52.2% for citizens and 50% for businesses), indicating underutilisation of its technological capacity.

Map 2.53

Households with internet access, 2014-2023

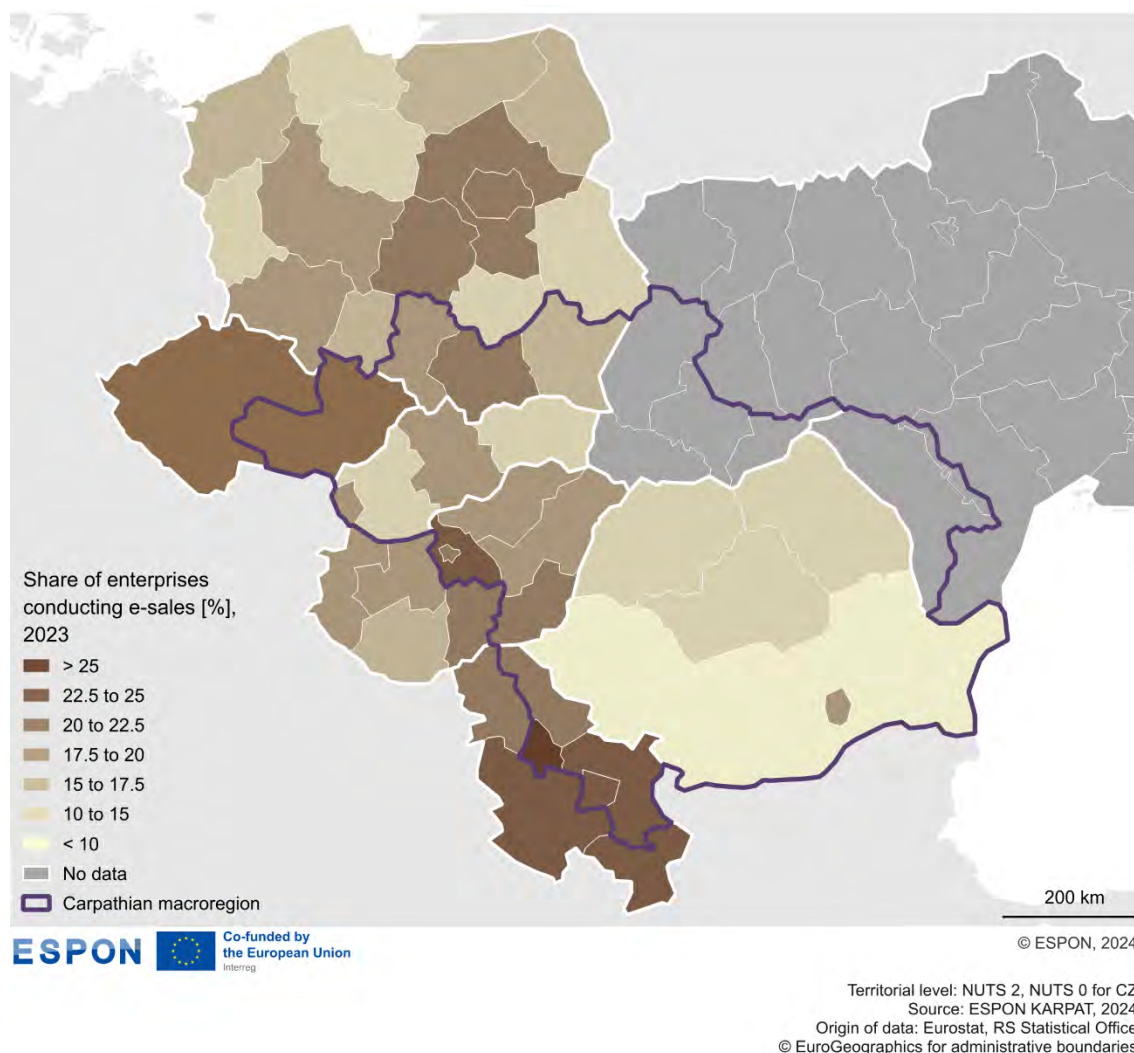


A closer look will focus on two indicators highlighting the information society's entrepreneurial dimension and the critical factors enabling Carpathian citizens to leverage these opportunities. On the one hand, we observe that the Carpathian macroregion exhibits high rates of household internet access. Regions with very high levels of access in 2023 (exceeding 90%) are primarily concentrated in highly urbanised areas characterised by advanced digital infrastructure. These include the capitals of the Carpathian states—Budapest, Bratislava, București-Ilfov, and Belgrade—as well as Vest, Centru, and Nord-Vest in Romania and Zakarpattia in Ukraine. In some less developed regions, the access rates are noticeably lower, although still relatively high, especially considering the significant increases observed in recent years. The lack of modern telecommunication infrastructure is evident in Western Ukraine and the Republic of Moldova. In these regions, internet development is hindered by lower investment levels, which in EU countries are partially mitigated through Union programmes (**Map. 2.53.a**).

Over the past few years, Romanian regions, except for București-Ilfov, have achieved the most significant increases in internet access rates, exceeding 30 percentage points, as they worked to catch up in accessibility and modernised their infrastructure rapidly. However, these increases are likely to slow in the coming years as more developed regions approach the saturation threshold. Northern Serbia and western Slovakia face the most concerning indicators, with relatively low internet access. Despite some progress, these regions have not

increased access quickly enough to close the gap with metropolitan areas, primarily due to geographical constraints and insufficient investment (**Map. 2.53.b**).

Map 2.54
E-commerce, 2023



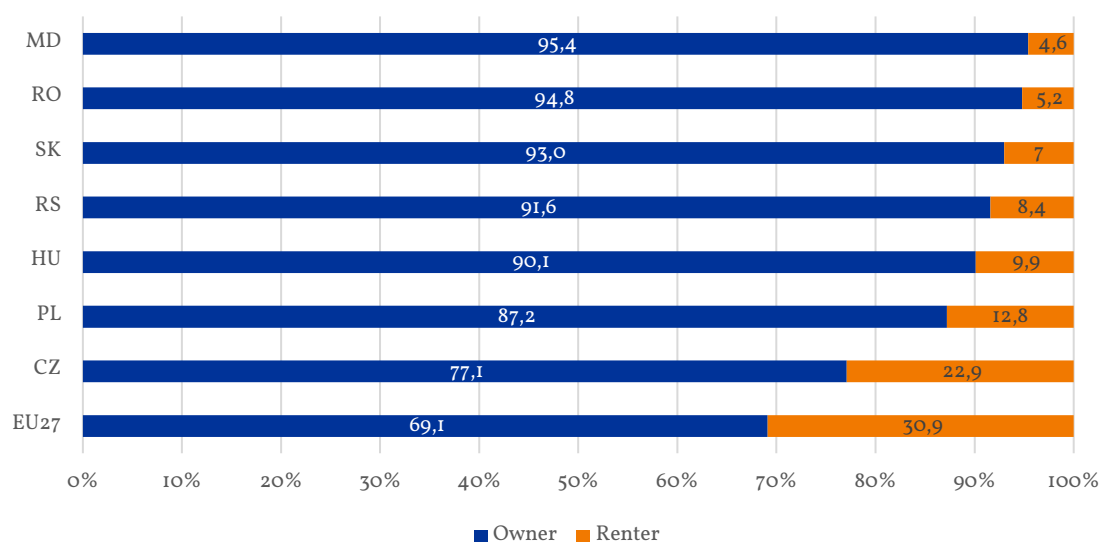
The proportion of entities engaging in web sales remains relatively low across the Carpathian macroregion, with a noticeable west-east pattern. Belgrade leads the way, and Serbia stands out as the leader, achieving the highest share of companies conducting sales via websites, apps, or marketplaces (35.2%). The metropolitan area of Budapest also achieves high results, comparable to other Serbian regions but not to Belgrade. Czech regions and Poland's Małopolskie region reach 20%. Following them are the capitals of Bratislava and Bucharest, Stredné Slovensko in Slovakia and Śląskie in Poland, recording approximately 18%. In contrast, most other regions in Romania and Slovakia show underdeveloped e-commerce services, reflecting their nascent stage of digital business adoption. (**Map. 2.54**).

Challenges for the Carpathian macroregion remain in developing digitalisation in mountainous, agricultural, and peripheral areas, where dispersed settlements and low population density significantly increase the costs of infrastructure investments. Monitoring digital indicators is further hindered by the lack of consistent methodologies and differences in data standards, requiring greater coordination between countries.

2.2.5 Housing

The situation of housing within Carpathian macroregion reflect broader trends typical of Central and Eastern Europe¹⁰. A defining feature of the CEE countries is their tenure structure, shaped significantly by the mass privatization of public housing during the 1990s (Lux and Sunega 2014). The privatization led to a decline in both public housing and rental housing sectors more generally contributing to the emergence of what are often termed “super-homeownership societies” (Stephens, Lux, and Sunega 2015).

Chart 2.12
Distribution of population by tenure statuses, 2022*



* for the Republic of Moldova 2020

Source: own elaboration based on Eurostat EU-SILC survey and National Bureau of Statistics of the Republic of Moldova

Accordingly, homeownership rates in the Carpathian countries often exceed 90% of the total housing stock (**Chart 2.12**). For instance, in 2022, the Republic of Moldova reported a homeownership rate of 95.4%, Romania 94.8%, and Slovakia 93%. The Czech Republic exhibited a higher proportion of renters compared to the rest of Carpathian countries, with 22.9% of the population living in rented housing. These figures contrast with the EU average, where 69% of individuals lived in owned homes, and 31% in rented housing.

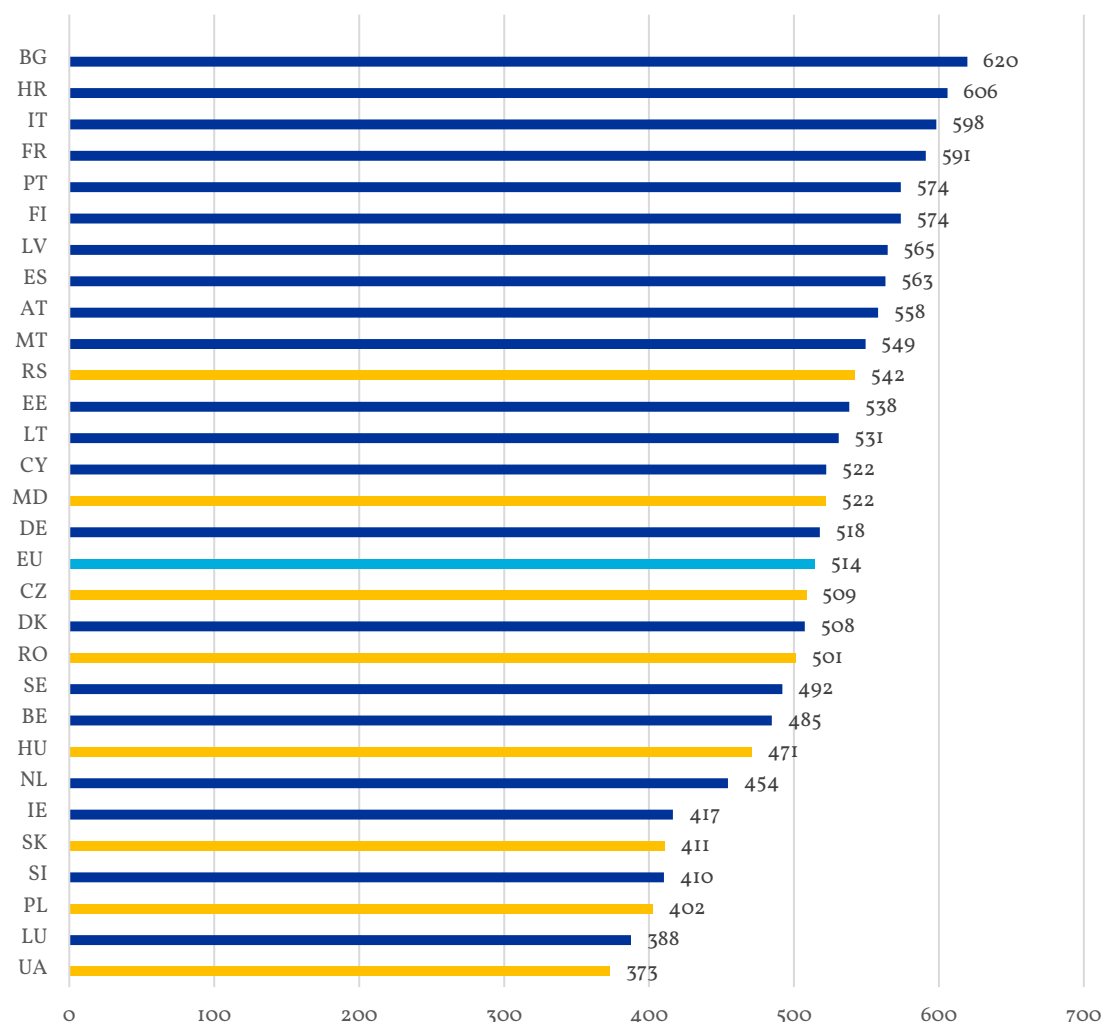
The proportion of renters tends to be higher in cities and highly urbanized regions of the Carpathian macroregion. For instance, the Moravian-Silesian Region of the Czech Republic reported a rental rate of 24.54%, Budapest 14.2%, Chisinau 12.7%, and Belgrade 9.06%. Conversely, rural areas or regions with lower population density show significantly higher rates of homeownership. In the Vysočina and Zlín Region of the Czech Republic, homeownership rates stood at 82.1% and 82.2%, respectively. Southern Republic of Moldova recorded the highest homeownership rate in the region at 99.1%.

Another characteristic feature of the CEE countries is the relatively low number of dwellings per 1,000 inhabitants. In almost all Carpathian countries, except the Republic of Moldova and Serbia, this number falls below

¹⁰ Comparative housing data at the regional level in the Carpathian Macroregion is limited. While Eurostat provides national-level indicators for EU member states, reliable quantitative secondary data for Moldova, Serbia, and Ukraine is scarce. Some data presented in this chapter have been sourced from the statistical offices of the respective countries. However, it is important to note the limitations of this approach due to differences in data collection methodologies, definitions, and reporting standards. Additionally, there is a general lack of regional-level data on housing affordability.

the EU average of 514 dwellings per 1,000 people (Chart 2.13). The lowest figures were recorded in Ukraine (373) and Poland (402).

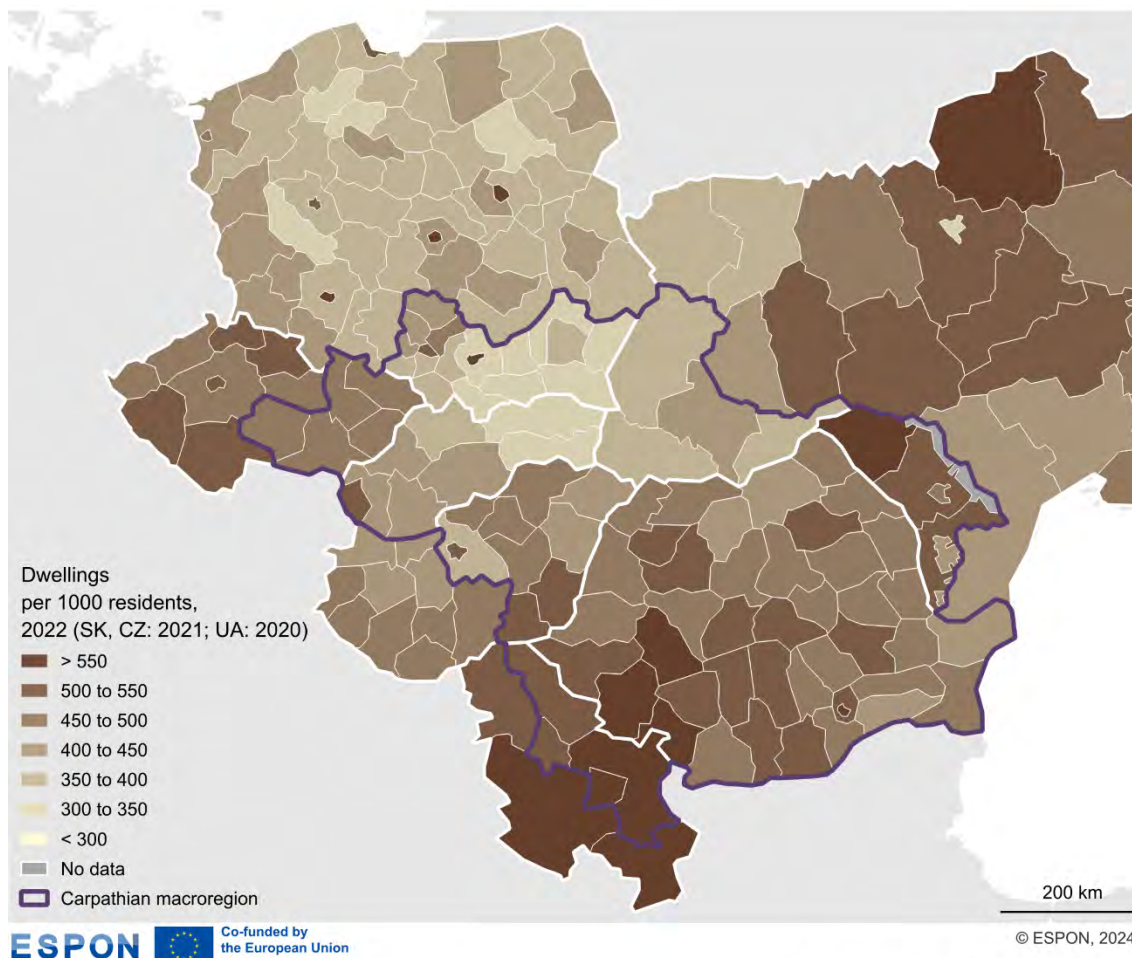
Chart 2.13
Dwellings per 1000 inhabitants, 2022*



* for Ukraine 2021

Source: Own elaboration based on OECD Affordable Housing Database, State Statistics Service of Ukraine, National Bureau of Statistics of the Republic of Moldova and Statistical Office of the Republic of Serbia.

In some Carpathian regions, the numbers are lower than the national averages (**Map 2.55**). Higher dwelling densities per 1,000 inhabitants are typically found in major cities and agglomerations, such as Budapest (521), Cracow (546), and the Bratislavský region (528). In contrast, lower densities are observed in peri-urban areas like Pest (378) and the Krakowski region (331), as well as in rural or mountainous regions such as the Prešovský region in Slovakia (325) and the Nowosądecki region in Poland (301). Higher dwelling stock per 1,000 inhabitants is concentrated in the southern part of the Carpathian macroregion, including south-western Romania and north-eastern Serbia. In contrast, lower dwelling densities are observed in the northern areas, such as the Polish and Ukrainian Carpathians and eastern Slovakia. At the same time, it should be noted that the housing situation is influenced not only by the number of dwellings but also by their quality and overcrowding, as presented below.

Map 2.55**Dwellings per 1000 residents, 2022**

Territorial level: NUTS3, NUTS2 for RS
 Source: ESPON KARPAT, 2024
 Origin of data: Eurostat; Ukrainian Statistical Office; ECB Data Portal
 © EuroGeographics for administrative boundaries

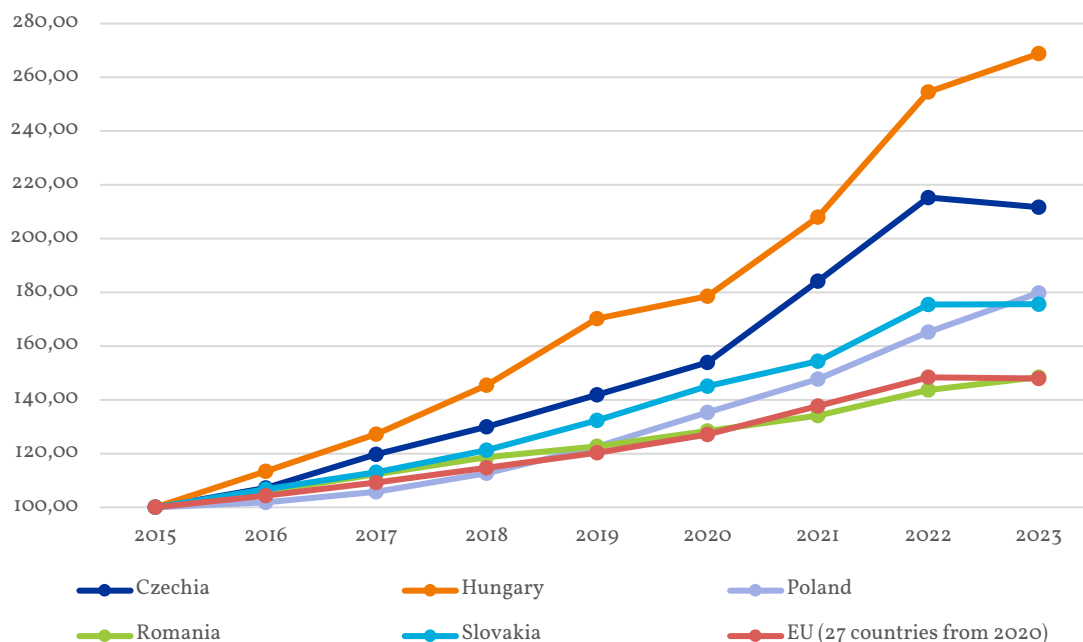
A low number of rooms per 1,000 inhabitants, coupled with relatively high vacancy rates, may contribute to the shortage of affordable housing in the Carpathian macroregion. In certain areas, vacancy rates exceed national averages. For instance, the Vysočina region in the Czech Republic has a vacancy rate of 20.1%, compared to the national average of 16.1%, while the Banská Bystrica region in Slovakia shows a rate of 24.2%, compared to the national average of 13.7%. These rates may indicate not only permanently empty houses but also those serving as recreational homes. The presence of second homes is a significant feature of the Carpathian region and has become a major factor in tourist urbanization (Mika and Faracik, 2008). However, the extent of this phenomenon remains unclear, as these homes are often registered as regular houses. It is estimated that around 12,000 to 15,000 second homes existed in the Polish Carpathians around 2010, with this number likely much higher today. The increasing number of issued building permits in these regions suggests a growing trend in the development of second homes.

Housing prices in Carpathian countries have been increasing over the past decade, a trend observable across most EU and OECD countries. According to the Eurostat Annual House Price Index, increases from 2015 to 2023 in the five covered Carpathian countries have generally been higher than the EU average of 47% over this period (**Chart 2.14**), with an acceleration at the onset of the COVID-19 pandemic. Hungary experienced the largest increase (168.81%), followed by the Czech Republic (111.7%), while Romania saw a slower rise (48.43%). Although 2022 witnessed a slight decrease in prices in the Czech Republic and Slovakia, they did not revert to pre-pandemic levels. The sharp increase in prices in the CEE compared to the rest of the EU may

result from high rates of homeownership, limited availability of properties in the private rental market, and a residualised public housing sector in this region.

Chart 2.14

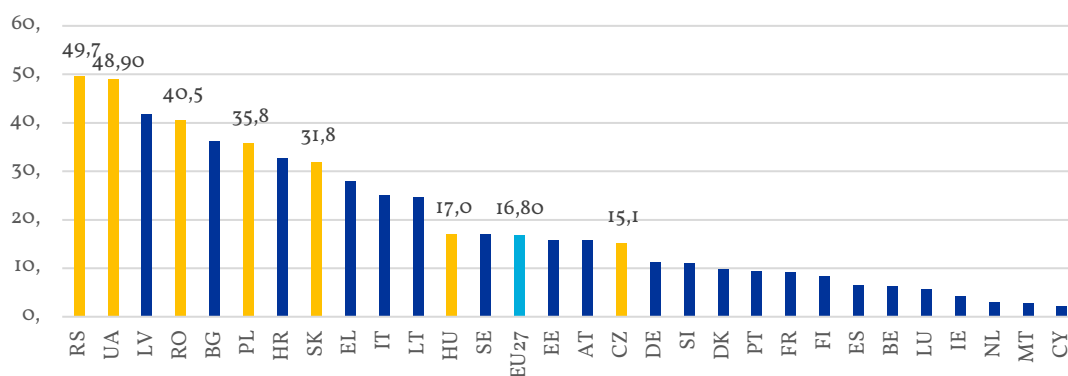
Annual house price index (2015 = 100), 2015-2023



Source: own elaboration based on Eurostat data.

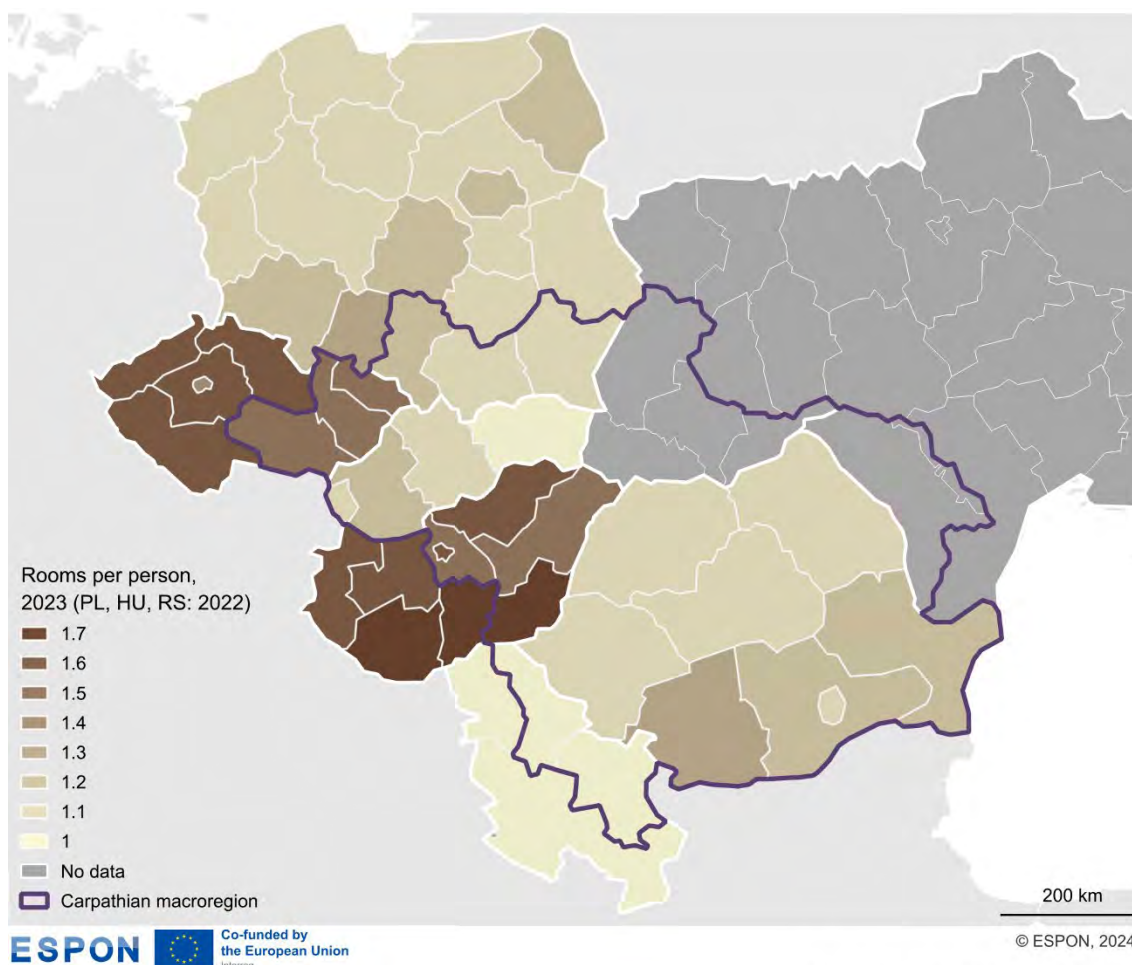
Chart 2.15

Overcrowding rate, 2022



Source: Own elaboration based on the Eurostat EU-SILC survey and Ukrainian Statistical Office.

Map 2.56
Rooms per person, 2023



Territorial level: NUTS2, NUTS1 for RS
 Source: ESPON KARPAT, 2024
 Origin of data: Eurostat; Ukrainian Statistical Office
 © EuroGeographics for administrative boundaries

An essential aspect of housing conditions is quality, one measure of which is overcrowding. In the EU, 16.8% of the population lived in overcrowded homes in 2022, down from 19.1% in 2010. Carpathian countries have some of the highest overcrowding rates in Europe, with Serbia at 49.7%, Ukraine at 48.9%, and Romania at 40.5% (**Chart 2.15**). However, regional disparities exist. The Czech Republic, the most economically developed country in the macroregion, has the lowest share of overcrowded households at 15.1%, which is below the EU average, followed by Hungary at 17%.

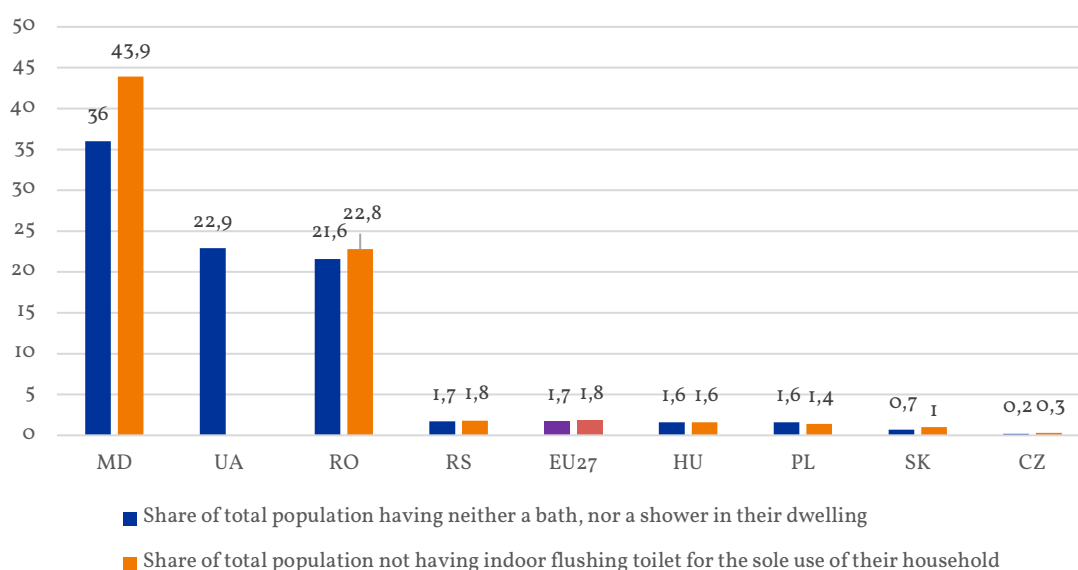
This regional disparity within the Carpathian macroregion is also reflected in the measure of housing size, specifically the average number of rooms per person (**Map 2.56**). Among the Carpathian regions, Hungary recorded the highest numbers, with between 1.7 rooms per person in the Southern Great Plain and 1.5 in the Northern Great Plain and Pest. The Czech Republic followed closely with 1.5 rooms per person. Conversely, Serbia had the lowest average with 1 room per person, while Romanian regions ranged from 1 room in the Central Region to 1.3 in South-West Oltenia. Slovakian regions varied between 1 room in Eastern Slovakia and 1.2 rooms in Western and Central Slovakia. Polish regions had similarly low averages, with Subcarpathian and Lesser Poland at 1.1 rooms and Silesia at 1.2 rooms per person.

The quality of housing is also influenced by access to amenities such as indoor flushing toilets, showers, and baths. While the share of households with these amenities is generally increasing across Europe, it remains relatively high in the Carpathian macroregion. In 2020, this problem was most pronounced in the Republic of Moldova, with 43.9% lacking indoor toilets and 36% without a bath or shower in their homes. Romania also reported significant deficiencies, with 21.6% lacking both a bath or shower, and 22.8% lacking an indoor toilet

(**Chart 2.16**). In contrast, Poland, Hungary, Serbia, the Czech Republic, and Slovakia have shares closer to or lower than the EU average of 1.7%.

Moreover, significant disparities exist between different Carpathian regions. In Southern and Eastern Serbia, for instance, 18.1% of the population lacks indoor flushing toilets, and 17.3% lack a bath or shower. In Poland, certain southern regions such as Przemyski and Katowicki have nearly 9% of the population without these amenities. These disparities are predominantly due to the rural nature of the Carpathian region (Maleszka 2020), where access to amenities is often lower than in urban parts of the respective countries. For example, in the Republic of Moldova, 10.5% of households in urban areas do not have a bathroom or shower within the dwelling. In the case of rural areas, this number goes up to 53.2%.

Chart 2.16
Access to sanitation, 2020*



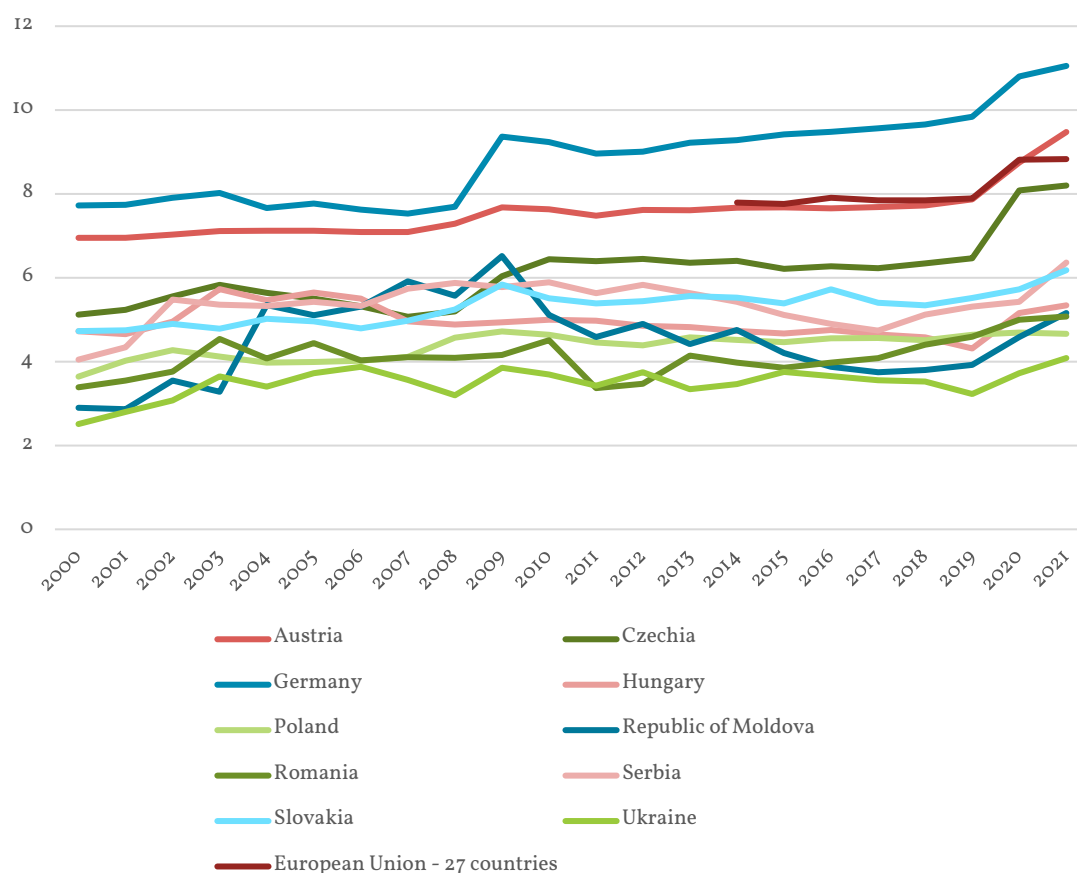
* for Ukraine 2018

Source: Own elaboration based on the Eurostat EU-SILC survey, National Bureau of Statistics of the Republic of Moldova, and State Statistics Service of Ukraine.

Despite the paucity of comprehensive regional-level data on housing for the Carpathian macroregion, some general trends can be identified, reflecting broader CEE housing patterns. First, the region's high homeownership rates, coupled with a low number of dwellings per thousand inhabitants, may contribute to rising housing unaffordability. This is further supported by data showing a persistent rise in housing prices in Carpathian countries. However, due to data limitations, these findings need further confirmation. Second, the quality of housing in the Carpathian macroregion, in terms of overcrowding and access to sanitation, remains a significant challenge. The share of the population without access to a bath, shower, or toilet in their dwellings surpasses EU averages, particularly in rural and lower-density areas. Finally, significant disparities within the region exist. Urban areas generally enjoy better access to amenities and exhibit higher quality housing, while rural areas often lag in these aspects. Broader inequalities within the region also include disparities between EU and non-EU countries.

2.2.6 Health

The starting point for analysing health system performance in Carpathian Countries is the level of financing. The graph shows the dynamics of public health expenditure as a percentage of GDP from 2000 to 2021 in the Carpathian countries, selected neighbouring countries (Austria and Germany), and the EU-27 average (**Chart 2.17**).

Chart 2.17**Government schemes and compulsory contributory health care financing schemes as % of GDP, 2000-2021**

Source: Own elaboration based on WHO (country data) and Eurostat (EU-27 average).

Except for the Czech Republic, the Carpathian countries spend significantly less public funds on health care than the average for members of the European Union. In terms of the percentage of GDP spent on government schemes and compulsory contributory health insurance schemes, other Carpathian countries spend at least 2-3 percentage points less than the EU average (27 countries), which fluctuates around 8% and has approached nearly 9% in recent years.¹¹ In 2021, Ukraine allocates around 4.09% of GDP, Poland 4.67% of GDP (the lowest in the EU), Romania, the Republic of Moldova and Hungary over 5%, and Slovakia and Serbia over 6% of GDP. In the case of Ukraine and Poland, there has been a multi-year trend of public health expenditure remaining below 5% of GDP, in Poland not even affected by the increase in health expenditure related to the COVID-19 pandemic that occurred in other European countries. This level differs significantly from neighbouring countries such as Germany (over 11% of GDP in 2021 - more than double the share) or Austria (9.48% of GDP in 2021).

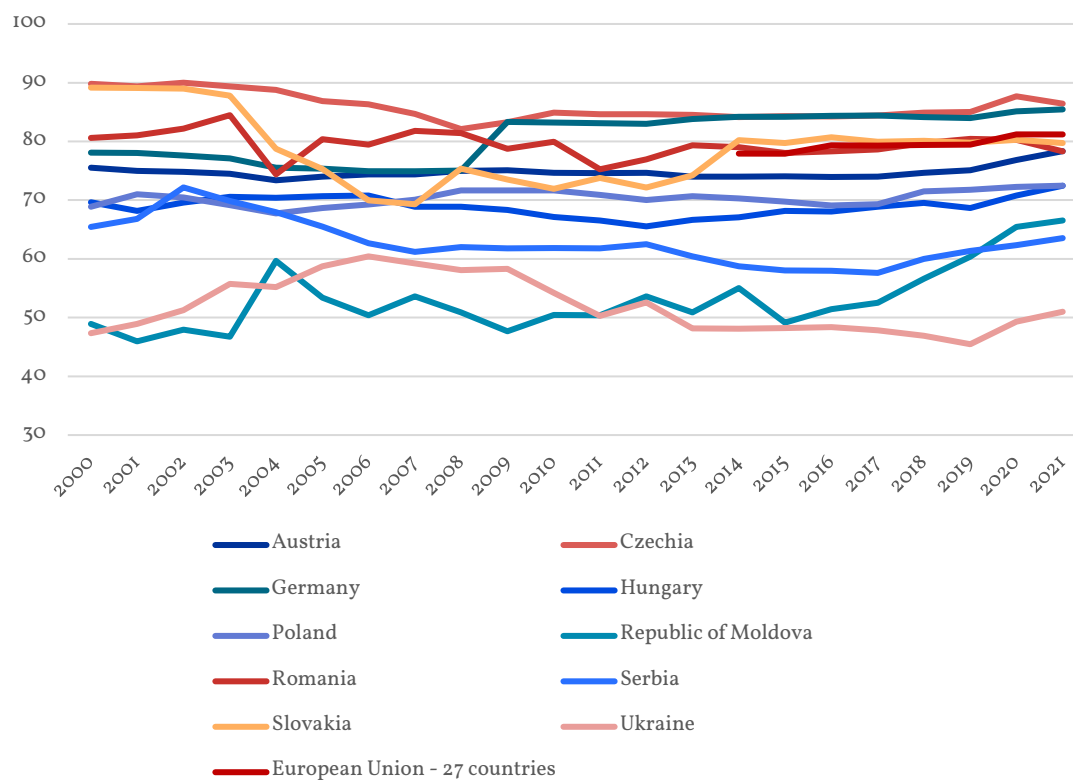
The fact that the level of public expenditure on health in part of the Carpathian countries is insufficient to meet the health needs of the population is illustrated, inter alia, by data on the share of public spending in total current health expenditure (Chart 2.18). On average, in 2021 this share exceeds 81% in the EU-27

¹¹ According to the WHO, in 2020 and 2021 global government spending on health (and its share – with a simultaneous decrease in the out-of-pocket expenditures) increased in response to the COVID-19 pandemic (WHO, 2023).

countries (Czech Republic - 86%), while in Ukraine (the lowest figure), Serbia, the Republic of Moldova, Poland and Hungary it ranges between 51 and 72%.

Chart 2.18

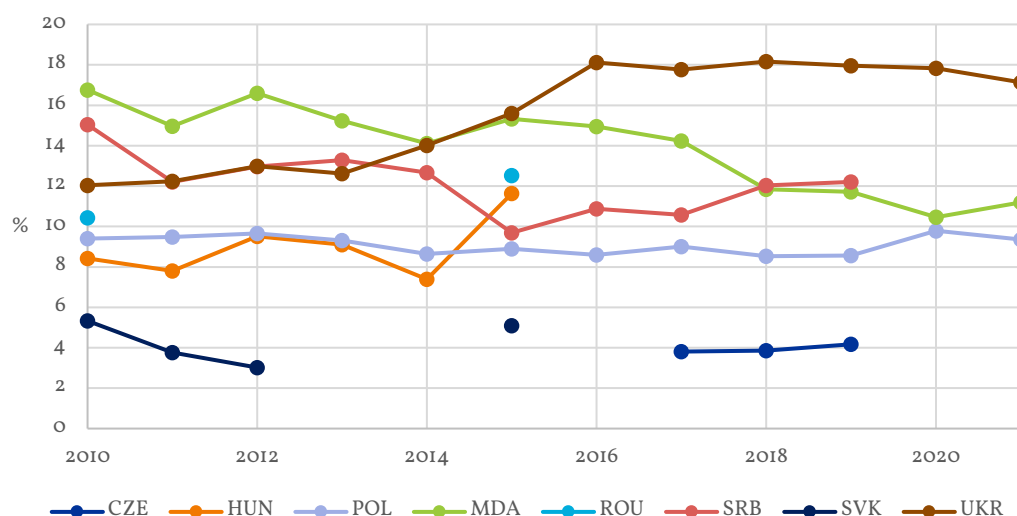
Government schemes and compulsory contributory health care financing schemes as % of current health expenditure, 2000-2021



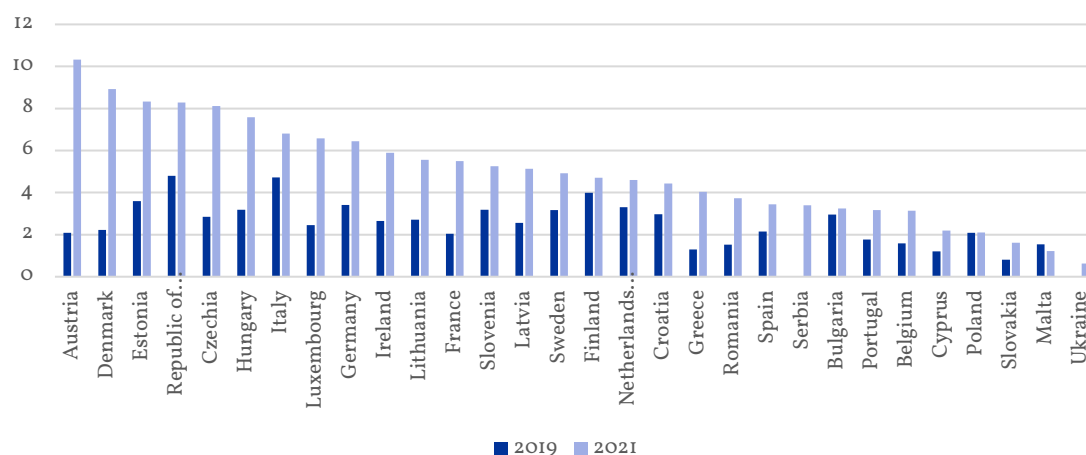
Source: Own elaboration based on WHO (country data) and Eurostat (EU-27 average).

Out-of-pocket health spending can impose a significant burden on household expenditure - one of the indicators used to measure this is the incidence of catastrophic spending (**Chart 2.19**). As the WHO data show, the largest share of households with catastrophic health expenditure comes from the poorest consumption quintile, and the problem is most severe in Ukraine.

One of the health care functions is preventive care - its share in current health care expenditure is differentiated in the Carpathian countries, higher in the Republic of Moldova, Czech Republic and Hungary, lower in Ukraine, Serbia, Slovakia, Poland and Romania. Data for the most recent years should be treated with caution - the graph shows differences in expenditure before (2019) and after the COVID-19 pandemic (2021).

Chart 2.19**The share of all households with catastrophic health spending, 2010-2021**

Source: Own elaboration based on WHO data (not all the countries present the data for every year)

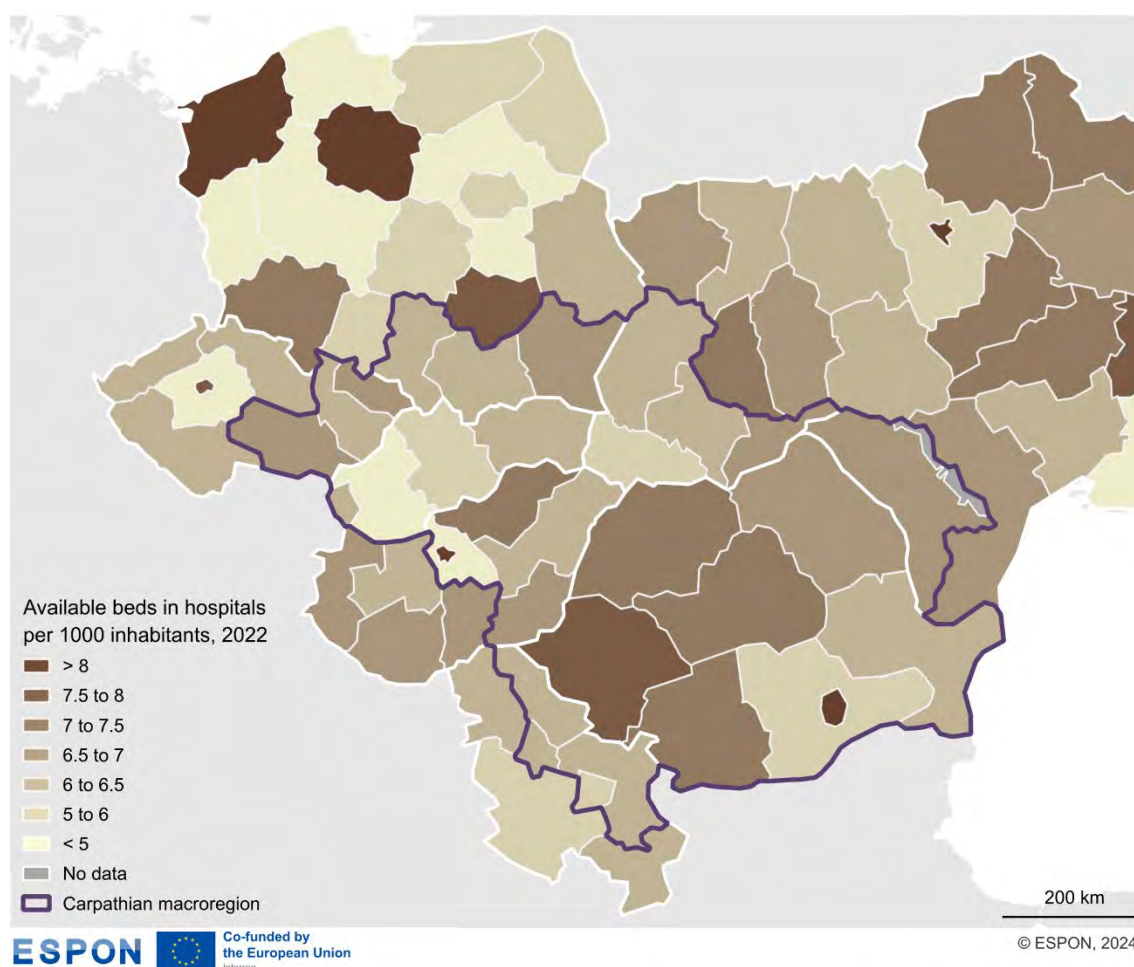
Chart 2.20**Preventive care expenditure as % of current health expenditure (CHE), 2019 and 2021**

* for Ukraine and the Netherlands data for 2020

Source: Own elaboration based on WHO data

In contrast to the significant global increase in per capita expenditure on prevention beginning in 2020 (mainly due to COVID-19 prevention and detection measures), Poland recorded a decrease in this expenditure category (WHO 2022).

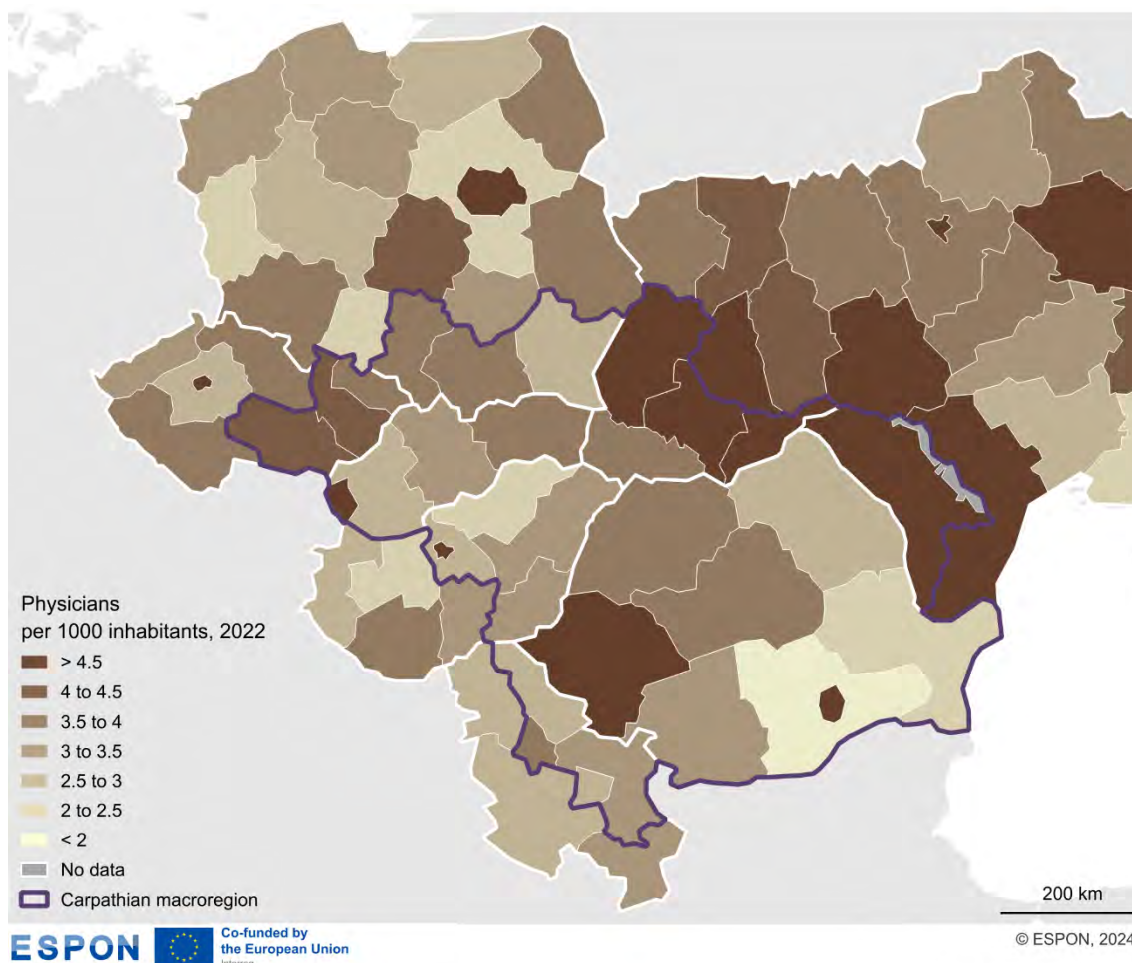
The facilities and medical staff indicators measure the availability of health services. In terms of the availability of hospital beds, the Carpathian macroregion is better equipped than Western and Northern European countries. The average number of hospital beds per 1000 inhabitants in 2022 for the EU-27 area is approaching 5.2, while it ranges from 5.7 in Slovakia to almost 7.3 in Romania.

Map 2.57**Beds in hospitals per 1000 inhabitants, 2022**

Territorial level: NUTS2
 Source: ESPON KARPAT, 2024
 Origin of data: EUROSTAT, UA, MD Statistical Offices
 © EuroGeographics for administrative boundaries

Source: Own elaboration based on Eurostat, National Bureau of Statistics for MD and Ministry of Health for UA.

At the regional level, the situation is more differentiated (**Map. 2.57**). One of the visible patterns is a higher accumulation of hospital beds in the capital regions (except for Poland) with a simultaneous lower level in some neighbouring regions, as it happens in the case of Budapest and Pest (the highest and the lowest number of hospital beds per 1000 inhabitants in Hungary). Compared to 2010, the number of available beds per 1000 inhabitants is decreasing in the Czech, Hungarian (except for Dél-Alföld), Polish, Slovakian, and Ukrainian Carpathian NUTS 2 units and increasing in the Romanian and Serbian (apart from the City of Belgrade) ones. In this context, it should be noted that over the comparable period, avoidable hospital admission rates fell significantly in Poland and Slovakia (OECD 2023), which constitutes an improvement in the quality and organization of health care, as some chronic diseases should be treated mainly in primary care. The number of beds also declined as a result of greater use of daycare and shorter hospital stays.

Map 2.58**Physicians per 1000 inhabitants, 2022**

Territorial level: NUTS2
 Source: ESPON KARPAT, 2024
 Origin of data: EUROSTAT, UA, MD Statistical Offices
 © EuroGeographics for administrative boundaries

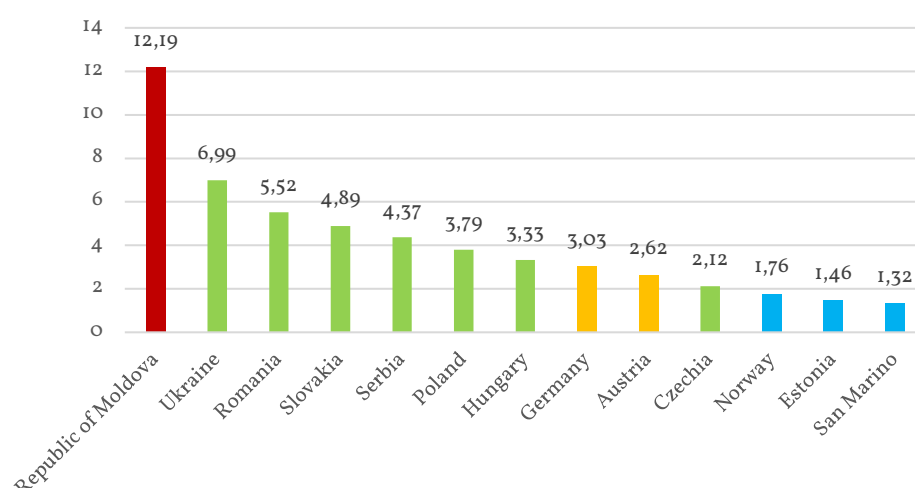
Source: Source: Own elaboration based on Eurostat, National Bureau of Statistics (MD) and Ministry of Health (UA).

In the case of the availability of doctors, the relation to the results for most EU countries is the opposite of that for the availability of hospital beds: with the exception of the Czech Republic and the Republic of Moldova, the number of doctors per 1000 inhabitants in the Carpathian countries in 2022 is lower than the EU average, with the lowest value recorded in Serbia. At the NUTS2 level, capital regions with specialized centres of supra-local importance have the highest number of doctors per 1000 inhabitants (**Map 2.58**). The situation in the Carpathian regions is comparable to the rest of the national territory and, in the case of Ukraine (except Zakarpatska), better. The value of the indicator at NUTS2 level in the Carpathian areas has increased over the last decade (except for City of Belgrade and Bratislavský kraj - in the last data series; no comparable data are available for Ukraine). It can therefore be assumed that there has been an improvement in this respect. Apart from the doctors, the shortages in other medical personnel are noted - the number of nurses per 1000 inhabitants in most Carpathian countries being lower than the European Union average.

Data for OECD countries on the percentage of the population satisfied with the availability of quality health care (OECD average in 2022 - 66.8%) show lower values for Hungary (44%), Poland (51%) and the Slovakia (54%) than for Czechia (77%), with the same pattern for the percentage of the population eligible for core services.

Health outcomes can be measured by indicators of the health status of the population and causes of death. In the case of infant mortality, the Carpathian countries (except for the Czech Republic) observe higher rates than the EU countries, the highest in the capital regions (according to Eurostat data Causes of death - infant mortality rate by NUTS 2 region of occurrence, 3-year average, for 2021). The figure in the Republic of Moldova is the worst in Europe, almost 10 times higher than the lowest value recorded in European countries in 2022 (the graph shows the Carpathian countries, selected neighbouring countries, and countries with the lowest value of the indicator in Europe) (**Chart 2.21**).

Chart 2.21
Infant mortality rate (per 1000 live births), 2022



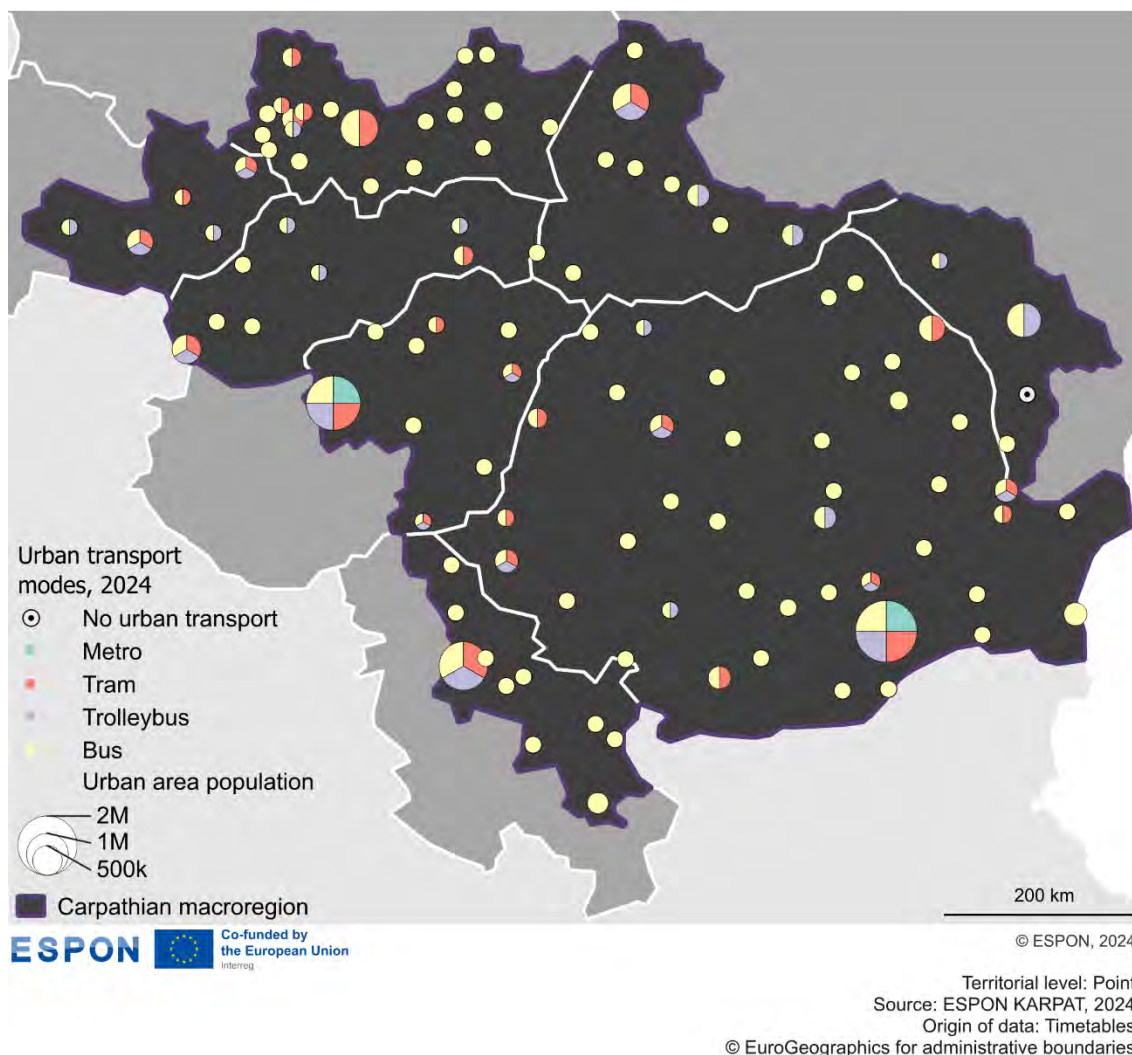
Source: Own elaboration based on WHO data.

2.2.7 Mobility

Understanding the availability of urban and long-distance transportation networks and assessing spatiotemporal access to essential services is crucial for fostering regional development. Improving access to services and transportation infrastructure supports economic development, promotes social inclusion, and fosters the European Union's broader goals of economic and social cohesion between regions. The Carpathian macroregion is characterized by a high variability of access levels, with primarily mountainous areas constituting inner peripheries. Urban areas generally have good levels of access to both essential services and public transportation, with bus and rail systems playing an important role in both local and long-distance travel.

Public transport systems in cities depend primarily on the size of the individual centre (**Map 2.59**). In large cities, including capital cities, the transport offer and network of lines is very extensive. In Budapest and Bucharest, residents have metro, trams, trolleybuses and buses at their disposal. Also in regional and sub-regional centres, a tram or trolleybus network is much more common than in Western European cities. Only the smallest centres are served exclusively by bus transport. Here, public transport is often combined with regional transport.

In addition to the availability of different modes of transport, public transport systems are characterised by great variation in quality. In the eastern part of the macroregion, despite progressive investments, public transport often faces financial problems. Local budgets are limited which results in a large backlog of maintenance of infrastructure - especially trolleybuses and trams. Rolling stock investments are also very limited. An additional problem for public transport in cities with lower budgets and less EU support is the lack of intermodal integration, outdated information ticketing systems and low frequencies that limit competitiveness with cars.

Map 2.59**Urban transport modes, 2024**

Intercity transport in the Carpathians is characterised by great diversity, depending on the country and region (**Map. 2.60**). Despite the dynamic development of the road network and motorisation rates, rail and bus transport still play an important role in ensuring the mobility of the region's inhabitants.

Intercity and international public transport is highly variable in the Carpathian macroregion. Due to infrastructure constraints, the quality and frequency of connections reflects the parameters of the network and decreases with population density. Nevertheless, the role of rail remains high in long-distance travel. This is due to the fact that in the past, when road infrastructure was not sufficiently developed, rail was the primary means of long-distance transport and many regions remain so today.

Practically all large and medium-sized centres have access to international connections. In the smallest cities, this type of offer is limited, but gradual progress can be seen in this respect, linked among other things to the growing role of tourism.

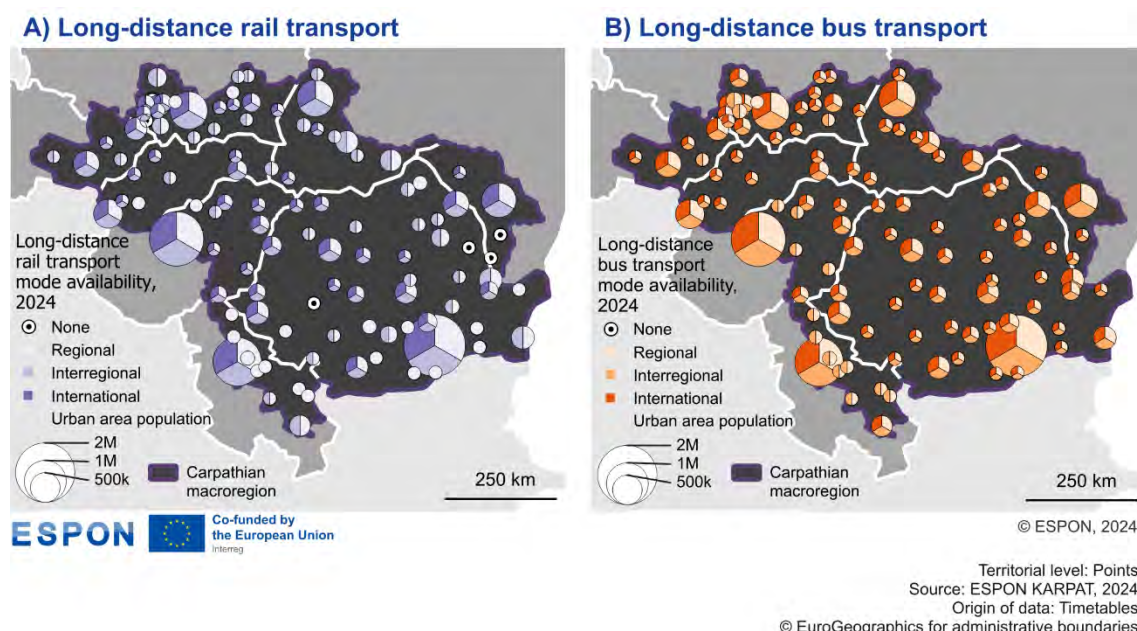
The availability of international transport in cities in the Carpathian macroregion, both in the eastern and western parts, varies and depends on several factors, such as transport infrastructure, geographical location, international cooperation and infrastructure investment.

In Poland, in the south of the country, in cities such as Krakow, Rzeszow and Przemyśl, the availability of international rail connections is very high. Przemyśl is an important point on the route to Ukraine and further east. Krakow is linked to the main rail corridors both north-south and east-west. A similar situation

characterises the bus connections, linking cities in the Carpathian Mountains with neighbouring countries. Krakow, Rzeszów or Przemyśl have direct bus connections with cities such as Lviv, Budapest, Prague, Vienna or Kosice. There are also regular services offered by low-cost lines such as FlixBus . .

Map 2.60

Long-distance ground transport availability in main cities, 2024

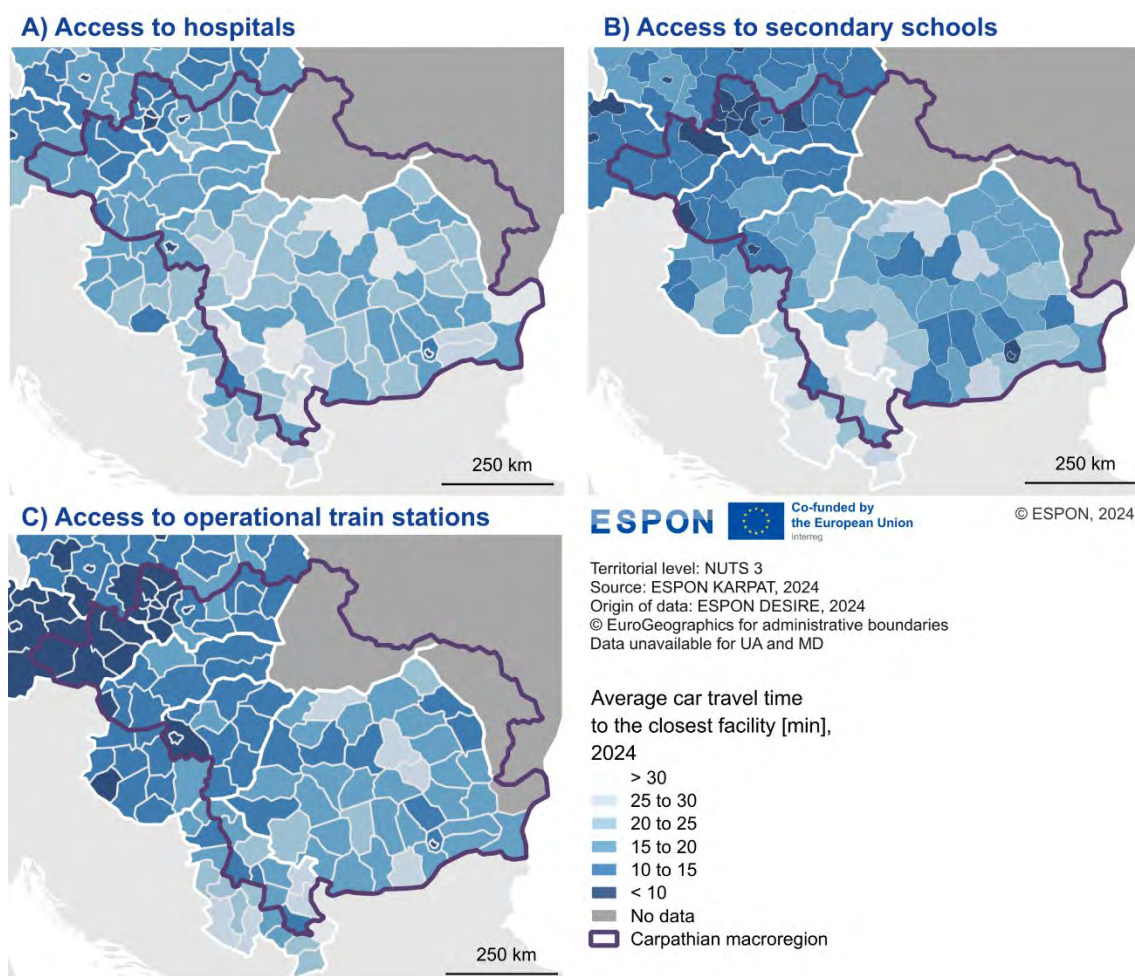


Slovakia also has a well-developed rail network. Connections between Bratislava and Prague, Budapest and Krakow are regular, and the rail network provides easy access to neighbouring countries such as Hungary, Poland, the Czech Republic and Ukraine. Bratislava is a key transport hub, with good connections to Western and Eastern Europe. Numerous international buses run from Bratislava to major cities in these countries. Mountainous regions, such as the Tatra Mountains, also have smaller connections to surrounding countries.

Ukraine, especially Lviv and Ivano-Frankivsk, which are close to the Polish border, have convenient rail connections to Poland and other Eastern European countries. From Lviv, it is easy to travel to Poland, Slovakia, Romania and Hungary. Smaller cities in the Ukrainian Carpathians, such as Uzhhorod, also have limited but regular international connections. Especially western areas and larger centres such as Lviv also have a well-developed network of international bus connections. Lviv is a transport hub for travel to Poland, Slovakia, Hungary and Romania.

In Romania, selected cities in the Carpathian Mountains have rail connections to Hungary, Ukraine and Slovakia. However, these connections are less intensive than those to larger centres such as Bucharest and Timisoara. The situation is similar for bus transport.

Spatiotemporal access to essential services, such as hospitals or schools, is an important factor of population well-being and economic development. The level of access is determined by the transport infrastructure and the existence of nearby facilities. Providing good levels of access is thus particularly challenging in rural, sparsely populated, and mountainous areas that constitute a sizable part of the Carpathian macroregion. Low levels of access constitute a risk for regional development due to their direct and indirect association with lower quality of life, higher costs of transport, poorer economic performance, lower tax revenues, and out-migration. These associations are part of feedback loops that stimulate further marginalization and the loss of population in peripheral areas.

Map 2.61**Access to facilities and remoteness levels, 2024**

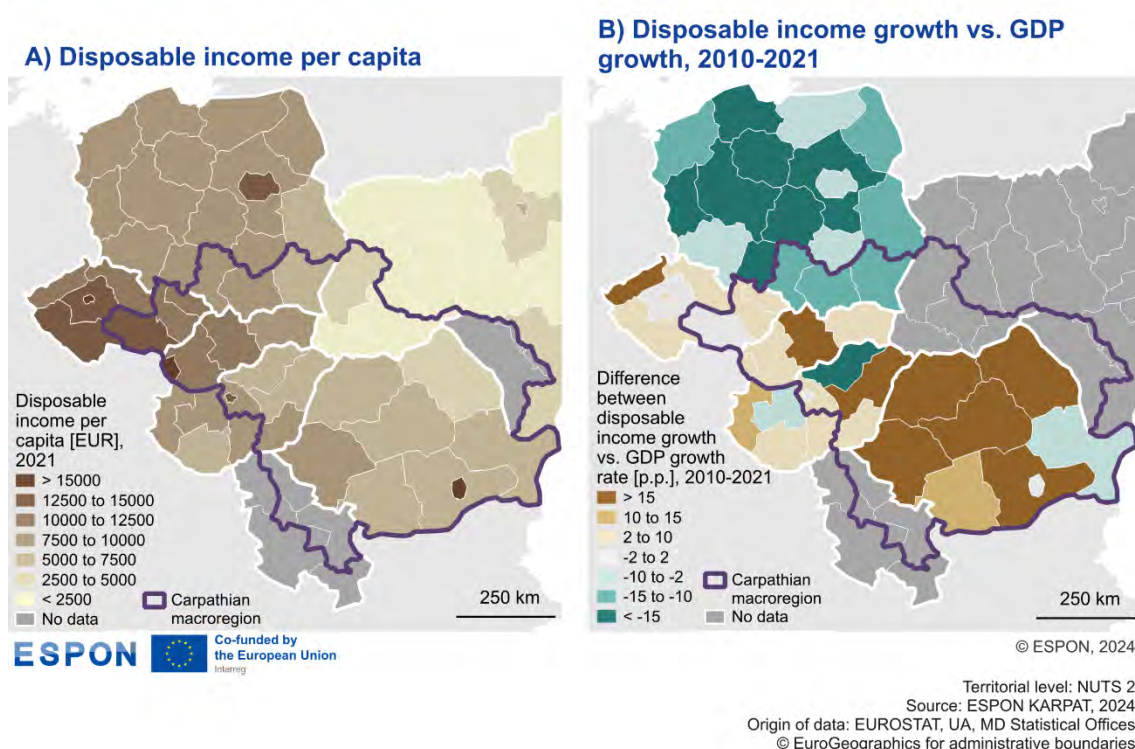
Here, we evaluate spatiotemporal accessibility of three selected service types: hospitals, secondary schools, and train stations. Accessibility is measured as car travel time the distance from regular cells of 2.5 x 2.5 km to the closest facility in each category, using a road data set derived from OpenStreetMap. The measures are derived from grid-level data from the ESPON DESIRE project (ESPON DESIRE, 2024). Here, we present the average travel times to the closest facility of each category aggregated statistics at the NUTS3 level. This analysis presents only an exemplary selection of service types and accessibility measures. A broader set of service types, grid-level measures, and other accessibility indicators can be found in the recently published ESPON DESIRE report. The analyses in the ESPON DESIRE project did not cover the Republic of Moldova and Ukraine. and disaggregated data on remoteness levels defined as areas located 30 and 60 minutes by car to the nearest facility in each category.

The lowest accessibility levels are observed in parts of Romania - particularly the mountainous areas, such as Caraș-Severin, Harghita, Bistrița-Năsăud, or Maramureș, as well as Tulcea located in the Danube Delta – and parts of Serbia, including Borska, Zaječarska and Braničevska oblast. Additionally, other Romanian parts of Southern and Eastern Carpathians are marked with high levels of remoteness even if it does not translate into low average levels of access in their respective NUTS3 regions. The impact of the Carpathian mountains on service access is less pronounced in Poland and Slovakia, although some mountainous areas also have relatively long travel times to facilities and constitute inner peripheries (ESPON DESIRE, 2024). The highest levels of accessibility are observed in the highly urbanized and densely populated areas of Bucharest in Romania, Belgrade in Serbia, Budapest in Hungary, Bratislava in Slovakia, Olomoucky and Moravian-Silesian regions in Czechia, and the Upper Silesia and Cracow in Poland. Compared to other countries and regions, the Czech Republic and the Upper Silesian region in Poland have the highest level of access to operational train stations.

2.2.8 Wealth and social capital

The wealth level of residents in the Carpathian regions can be measured using disposable household income, which accounts for taxation and social security contributions. The spatial distribution of these incomes per capita is partially linked to the overall wealth level, measured by the value of goods and services produced per capita. When converted to EUR, the Carpathian macroregion shows notable positive outliers, including the Czech regions and western Slovakian regions, as well as the Bucharest and Budapest capital regions (**Map 2.62a**). A relatively high level of wealth was also observed in the Polish Śląskie and Małopolskie voivodeships, Timișoara region in Romania and Szeged region in Hungary. In contrast, incomes were significantly lower in Eastern Hungary and other Romania regions, especially the North-Eastern region. The poorest regions, however, were in EU candidate countries, particularly Ukrainian regions excluding the Lviv Oblast.

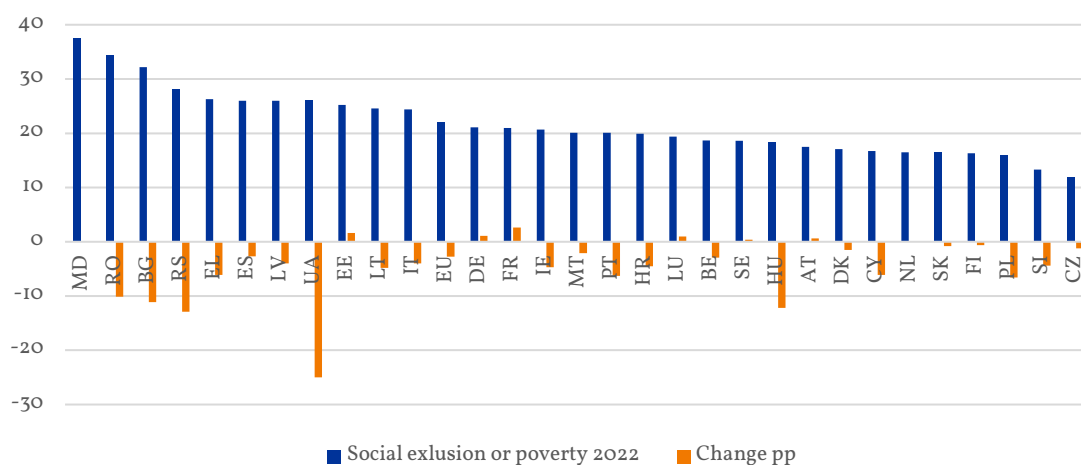
Map 2.62
Disposable income per capita, 2010-2021



Over the past decade, despite a significant increase in the wealth of residents in the Carpathian regions, the growth rate of disposable incomes has lagged behind the dynamics of GDP per capita in some regions. This may indicate a declining role of "labour" in GDP creation in favour of "capital," suggesting increased investment and advancing automation of production processes. This trend was particularly evident in the Polish regions, as well as in northern Hungary and Constanta region in Romania (**Map 2.62b**). In other regions of Romania (except Bucharest), as well as selected regions in Hungary and Slovakia, this disparity was the opposite and disposable incomes growth over GDP growth exceeded 15%. Personal income growth outpaced GDP growth also in other regions of Slovakia, Hungary and Czechia, but the differences between income and GDP growth dynamics did not exceed 10 percentage points.

Chart 2.22

Share of population at-risk of poverty or social exclusion 2022 (%) and 2015-2022 change (pp.)



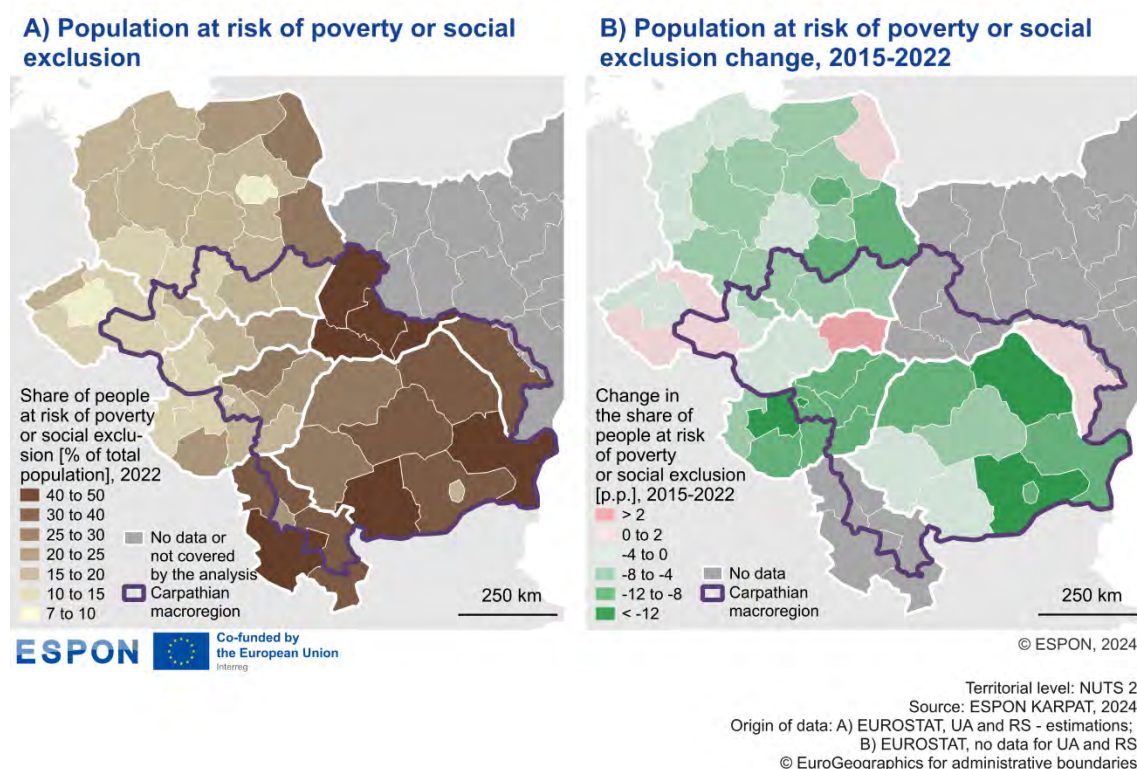
Source: Own elaboration based on Eurostat data.

While disposable income is an important measure of societal wealth, it does not account for income distribution within the population. Indicators such as the risk of poverty (incomes below 60% of the median) and social exclusion, which consider access to basic goods, services, and the labour market, provide a more comprehensive view of income distribution. In the European Union, approximately one in five residents falls into one of these categories (**Chart 2.22**). In the Carpathian macroregion, and particularly in EU candidate countries, the situation was significantly worse, with social issues affecting one in four residents, and in the Republic of Moldova, estimates suggest as much as 40%. This figure is comparable to neighbouring Romania, where 35% of the population faced similar challenges. In contrast, the Visegrad countries, especially the Czech Republic, but also Poland, showed significantly better conditions, with every 10th resident in the Czech Republic and every 6th in Poland at risk of poverty or social exclusion.

In recent years, there has been a significant improvement in the Carpathian countries, particularly in Ukraine (in the pre-war period), as well as in Hungary, Serbia, and Romania, and to a lesser extent in Poland. Meanwhile, the situation regarding social issues has remained relatively stable in Slovakia and the Republic of Moldova.

Overall, the scale of socio-economic deprivation in the Carpathian macroregion remained very high, particularly in certain regions, where it affected up to half of all residents (**Map 2.63**). This was especially true for Romanian regions, particularly those in the southern and eastern parts of the country (excluding Bucharest), as well as regions in EU candidate countries. More than a quarter of the population faced poverty or social exclusion in other Romanian regions, as well as in eastern Hungary and Slovakia.

By contrast, Czech regions, western Slovakia, and the Śląskie voivodeship in Poland were less exposed to socio-economic deprivation, though around 15% of residents in these areas were still affected. At the same time, many regions, particularly in Hungary and some parts of Romania, experienced a notable improvement, with the proportion of residents at risk of deprivation dropping by more than 10 percentage points between 2015 and 2022.

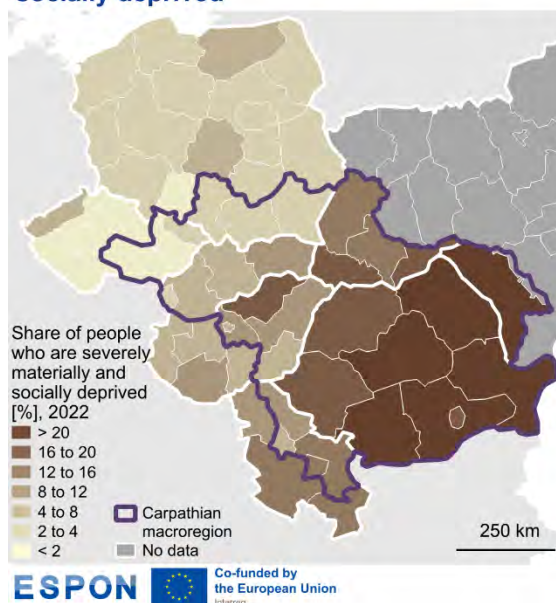
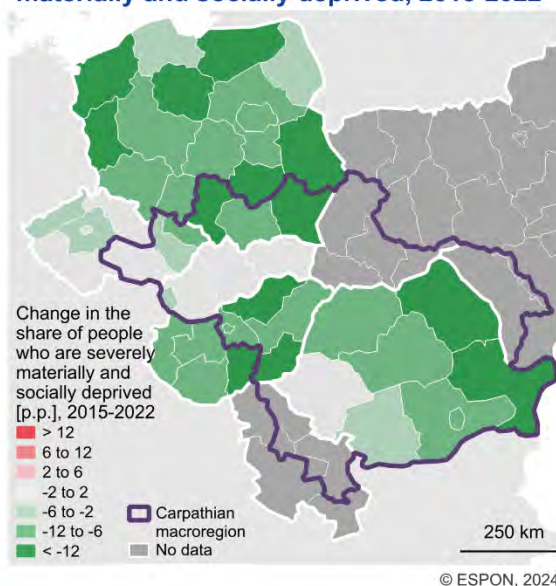
Map 2.63**Population of risk of poverty or social exclusion, 2015-2022**

Significant progress was also recorded in the Polish part of the macroregion, especially in the Podkarpackie voivodeship. However, in other regions—particularly those where the situation was already relatively favourable—the scale of improvement was more modest. Eastern Slovakia stood out negatively in this context, as it experienced a concentration of social problems, exacerbating the situation further.

The indicator reflecting individuals most severely affected by poverty and deprivation was strongly correlated with the broader risk of socio-economic deprivation, although its values were significantly lower (**Map 2.64a**). The worst conditions were observed in Romanian regions, where, in most cases, one in four residents was severely affected by this issue. Outside Romania, the situation was most critical in northern Hungary, with similarly unfavourable conditions in eastern Slovakia and other Hungarian regions within the macroregion, excluding Budapest.

In contrast, the issues were considerably less pronounced in Czech regions and the Małopolskie voivodeship in Poland. During the analysed period, significant improvement was observed, particularly in Polish, Romanian, and Hungarian regions. This progress can be attributed partly to favourable economic conditions and partly to the implementation of social programs targeted at this group of residents (**Map 2.64b**).

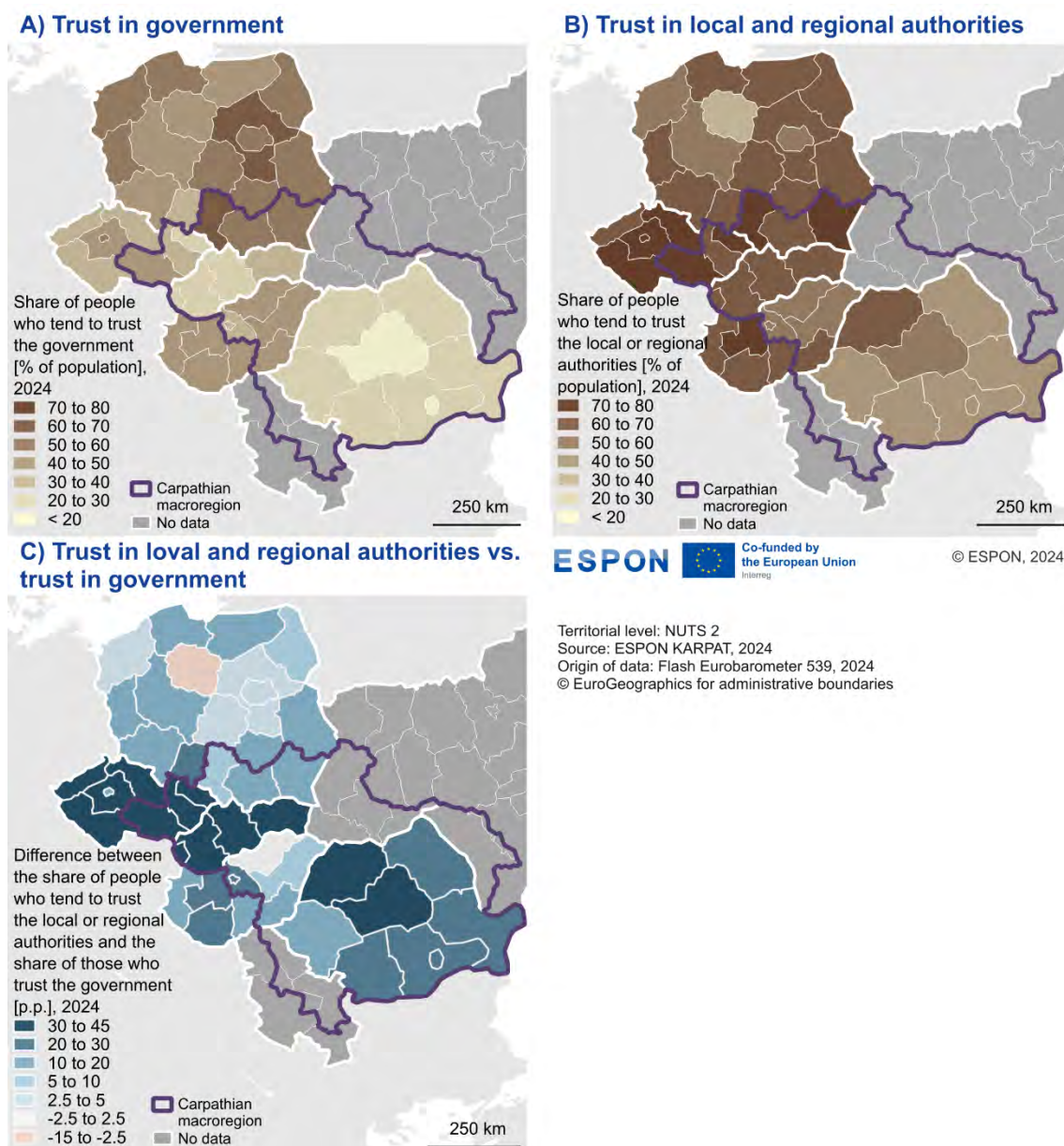
Social trust is another important factor reflecting not only important aspects of social capital, but also intuitional capacity for effective policy implementation and cross-sectoral cooperation. Generally the Carpathian macroregion can be characterised by high social trust towards local and regional authorities with disparities along the West-East axis ranging from 70-40% contrasted by alarmingly low trust towards the governments, especially in Romania and Slovakia.

Map 2.64**Population severely materially and socially deprived, 2015-2022****A) Population severely materially and socially deprived****B) Change in population severely materially and socially deprived, 2015-2022**

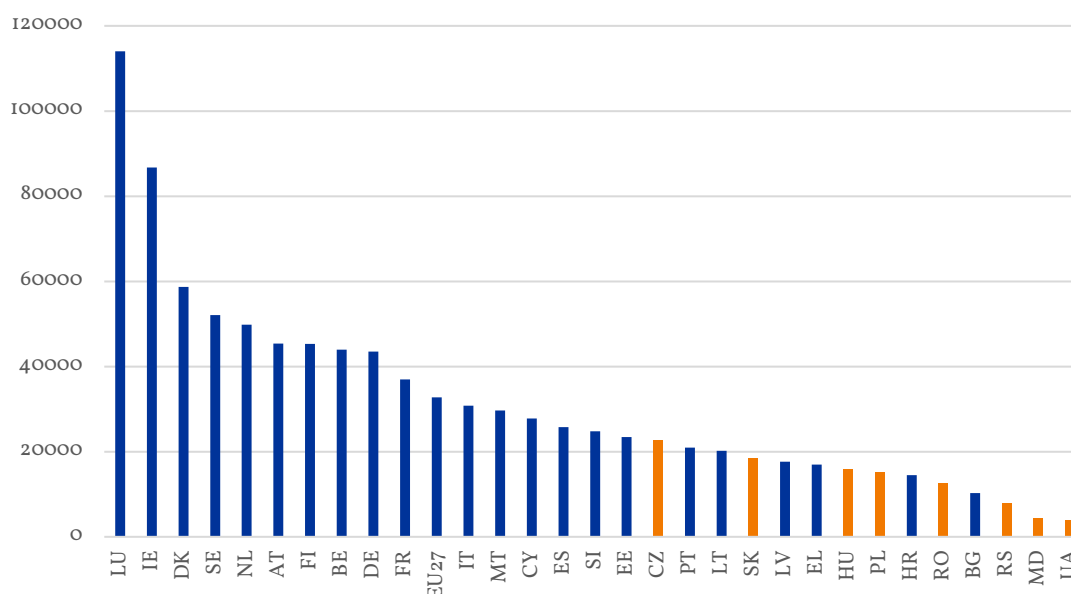
Territorial level: NUTS 2
 Source: ESPON KARPAT, 2024
 Origin of data: A) EUROSTAT; UA, RS - estimations; B) EUROSTAT
 © EuroGeographics for administrative boundaries

The trust towards local and regional authorities in the macroregion is dominantly higher in comparison to trust towards national governments (**Map 2.65**). It is especially the case of the Czech regions, Slovakian regions of Východné, Stredné, Západné and capital region as well as Romanian Nord-Vest and Centru, where trust towards local and regional authorities averages 60% whereas the one towards the government scores below 30%. The most “trusting” regions are Podkarpackie, Małopolskie and Silesia in Poland and overall lowest levels of trust in public authorities can be noted in South-Eastern Romania with the capital region scoring the lowest. Similarly low trust towards regional authorities scoring below 50% for both national and regional level is noted in the Hungarian regions of Észak-Magyarország and Észak-Alföld.

Comparison of these maps indicates firstly that, trust in local and regional authorities tends to be higher than trust in central governments across most of the region, particularly in Poland, Czechia, and Slovakia, where the difference often exceeds 20 pp. Secondly, the disparity in trust levels is geographically uneven, with western Poland and central Czechia showing the strongest preference for local authorities, while parts of Romania and Hungary exhibit more balanced trust or even slightly higher trust in central governments. Thirdly, the maps reveal a broader trend of regional variation in governance trust, suggesting that localized governance structures are perceived as more reliable or responsive in many areas, likely reflecting historical, cultural, or institutional differences across these countries. Finally, observed differences in the territorial distribution of trust constitute an implication for approaches based on the principle of subsidiarity in future public interventions. On the other hand, they indicate the need to strengthen public trust in government institutions in the entire Carpathian macroregion.

Map 2.65**Trust to government and local and regional authorities, 2024****2.3 Economy, science and investments****2.3.1 Economic development and structure**

The Carpathian countries showed significant differences in economic development as measured by GDP per capita. The primary dimension of these disparities was the west-east axis, followed by the north-south axis (**Chart 2.23**). It is important to note that, based on this indicator, the most developed country in the macroregion, the Czech Republic, also markedly deviated from the EU average in terms of GDP per capita in EUR, reaching about 70% of the average. In contrast, the GDP per capita of Ukraine and the Republic of Moldova, at the exchange rate, reached only 10-15% of the EU average, while in the case of Serbia, it was 25%. These values, taking into account purchasing power parity, are obviously higher, but the comparison using the exchange rate quite accurately reflects the competitiveness of individual economies and their positions in the global division of labour.

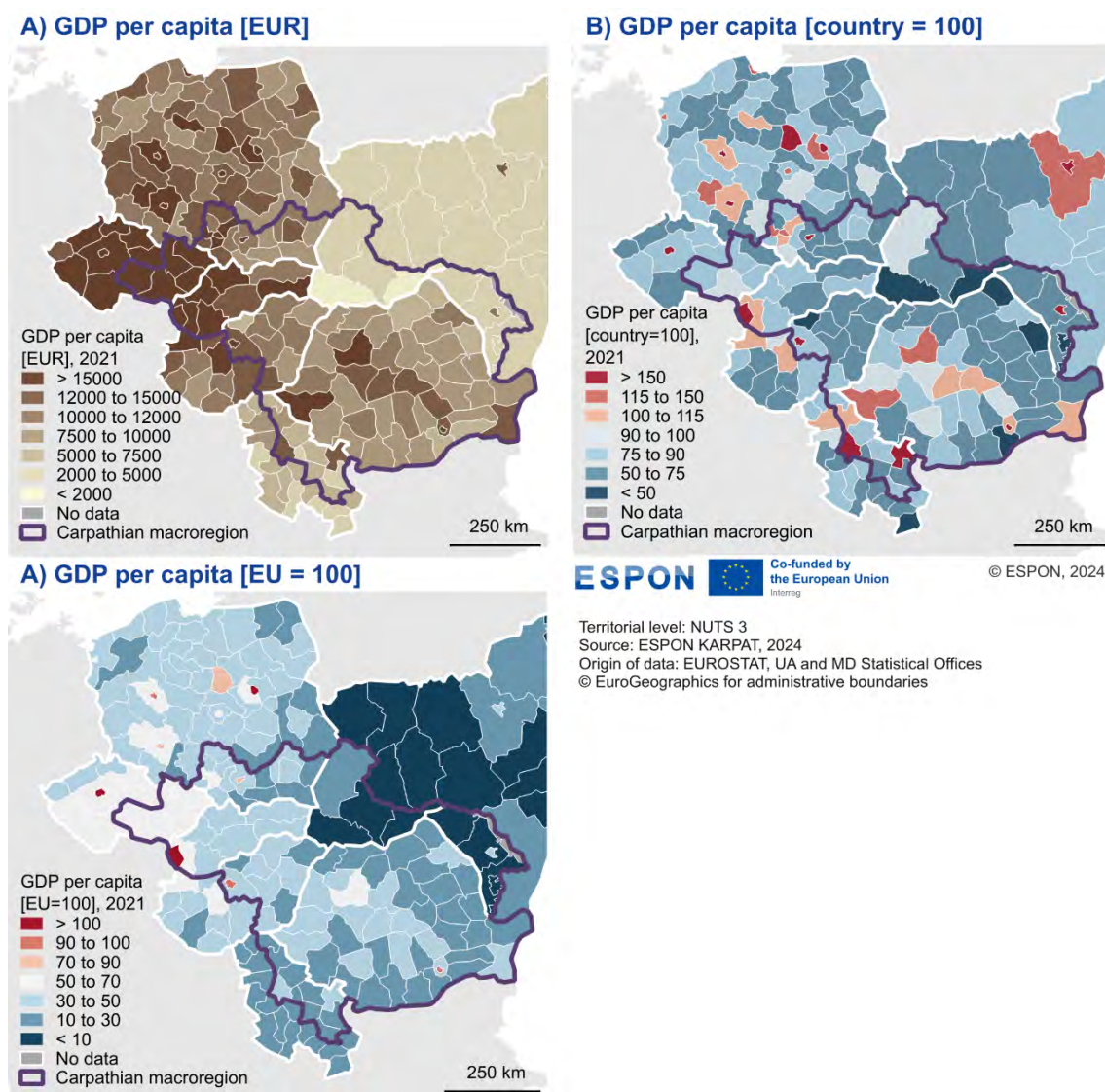
Chart 2.23**GDP per capita in EUR in the Carpathian countries and other EU countries, 2021**

Source: own elaboration based on Eurostat

This was reflected in the regional disparities within the Carpathian macroregion, where the most developed areas were the Czech regions and the regions in the western part of Slovakia (**Map 2.66a**). On the other hand, the regions with the lowest GDP per capita were the Ukrainian regions (especially Zakarpattia and Chernivtsi) and the Republic of Moldova regions, followed by Serbian regions—except for the metropolitan area of Belgrade and the Borski subregion (thanks to precious metal extraction). Another clear dimension of disparity was the metropolis vs. non-metropolitan areas, where the highest GDP per capita levels were found in major cities (capitals cities and other like Kraków, Katowice, Cluj, Timișoara, and to a lesser extent, Košice, Rzeszów, Constanța, and Brașov). This was particularly evident in countries with a polycentric settlement network, such as Poland and Romania. At the other extreme were primarily peripheral regions, including mountainous areas like the Polish sub-mountain regions, the Prešov Region in Slovakia, and parts of Romanian regions. The last dimension of disparity visible on the map was associated with the main transport corridors, a characteristic particularly of Romania, exemplified by the Cluj-Bucharest transport axis.

The clear advantage of capital regions in terms of GDP per capita was a characteristic of all countries, resulting in significantly lower GDP per capita in most other regions compared to the national average. This was especially evident in non-EU countries (**Map 2.66b**). The low development level of the macroregion was particularly noticeable when compared to the European average—the development level of some regions measured in EUR at the exchange rate was less than 10% of the EU average, and for the vast majority of regions, it did not exceed 50% (**Map. 2.66c**). Only a few regions of large cities surpassed the 70% of the EU average, and only the Bratislava region exceeded this average.

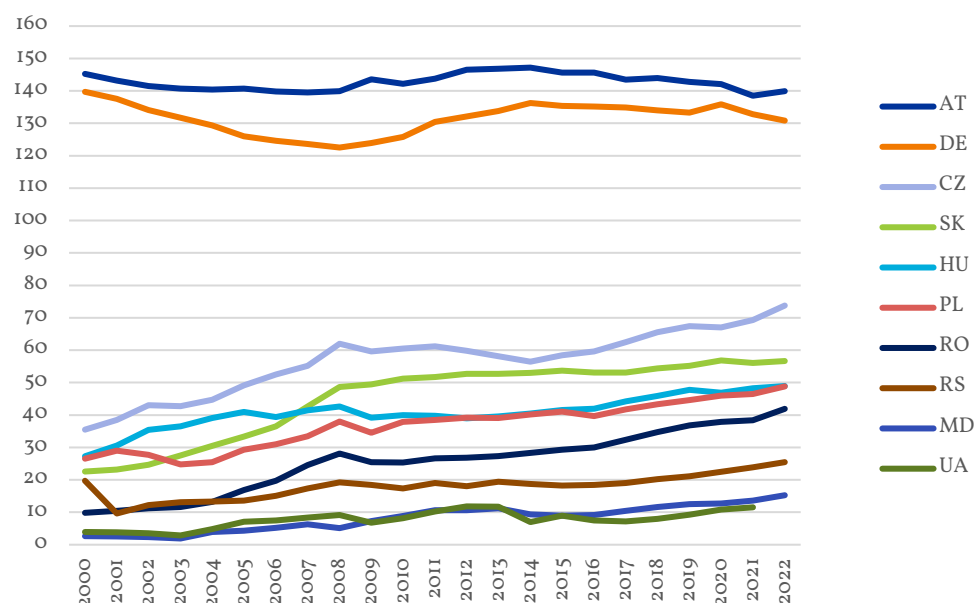
Map 2.66
GDP per capita, 2021



Nevertheless, due to the rapid economic development of most Carpathian countries over the past 20 years (especially EU member states), there has been a clear convergence of their wealth towards the EU average (**Chart 2.24**). This convergence occurred particularly quickly before the economic crisis in 2008, but since 2018, the growth momentum has been noticeably increasing again, especially in the cases of the Czech Republic and Romania, and to a lesser extent in Slovakia and Ukraine. As a result, the gap with neighbouring economies of Germany and Austria is gradually decreasing—particularly since these countries have shown a slight downward trend in GDP per capita relative to the EU average since 2014.

Chart 2.24

Dynamics of GDP per capita in EUR of the Carpathian countries and selected neighbouring countries relative to the EU average (EU=100), 2000-2022

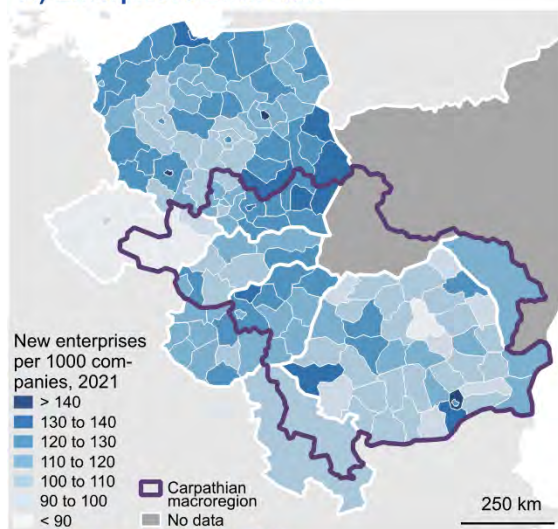


Source: Own elaboration based on Eurostat.

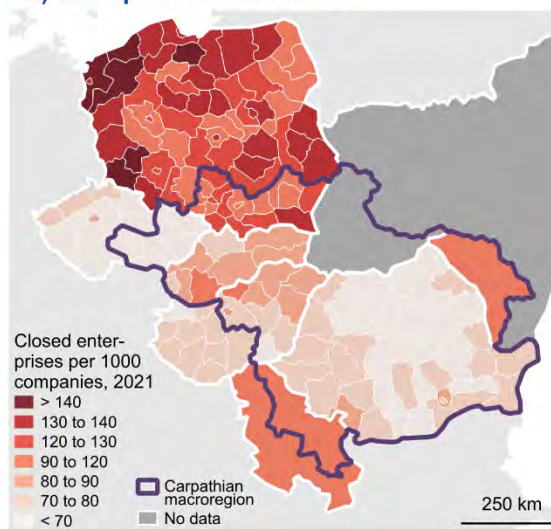
Map 2.67

Business demography, 2021

A) Enterprises Birth Rate



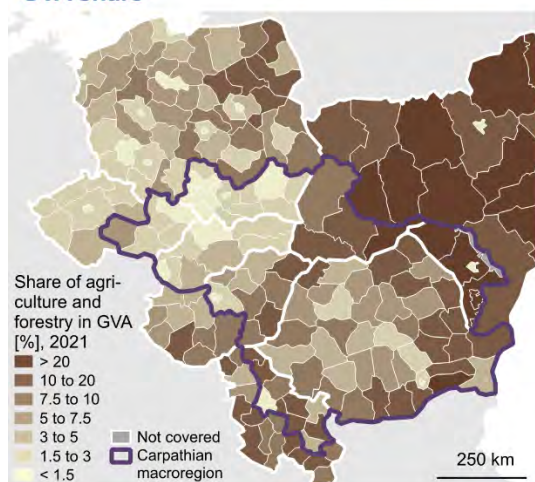
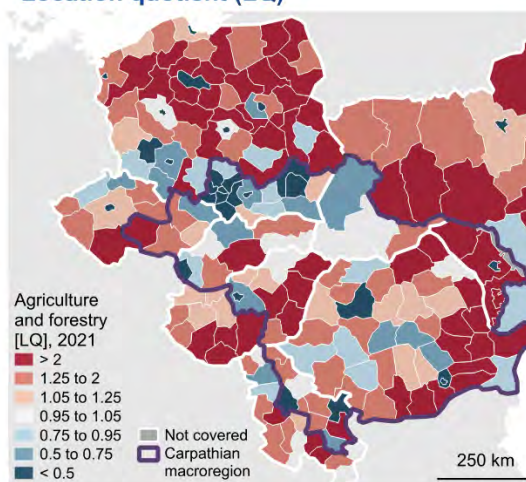
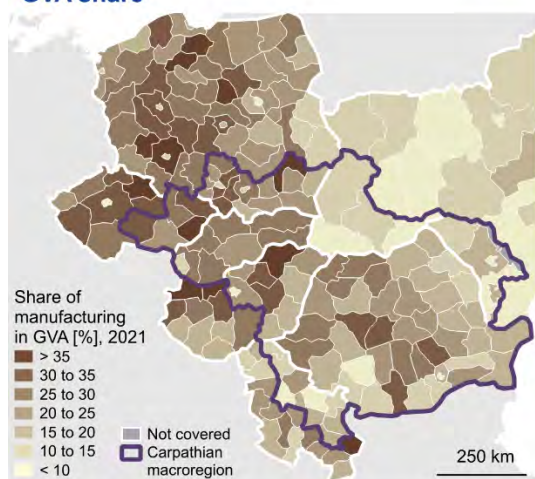
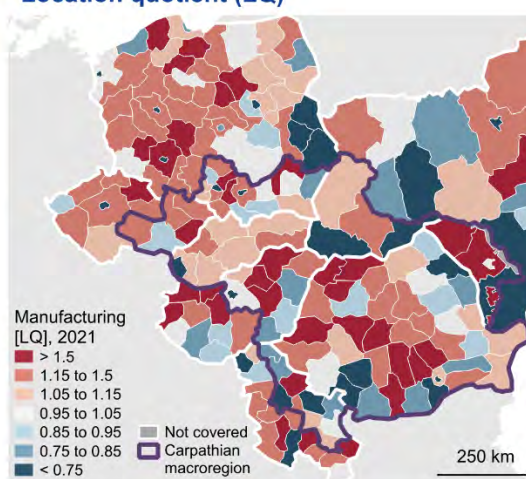
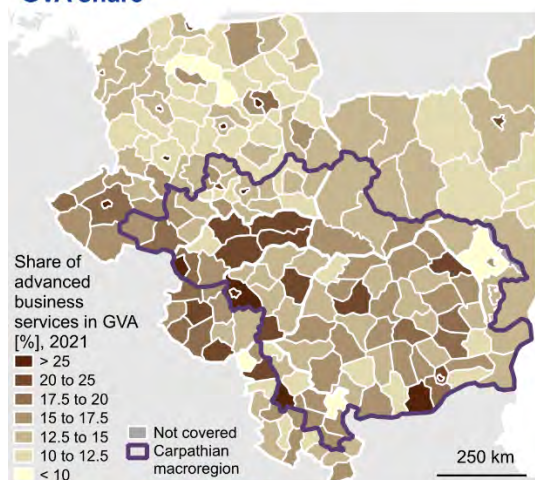
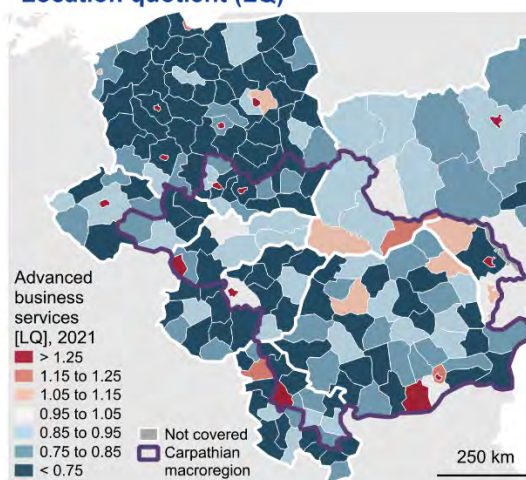
B) Enterprises Death Rate



ESPON Co-funded by the European Union

© ESPON, 2024

Territorial level: NUTS 3, NUTS 0 for RS, MD, UA
Source: ESPON KARPAT, 2024
Origin of data: EUROSTAT; PL, UA, MD, RS statistical offices
© EuroGeographics for administrative boundaries

Map 2.68**Economic structure of regions, 2021****A) Agriculture and forestry****GVA share****Location quotient (LQ)****B) Manufacturing****GVA share****Location quotient (LQ)****C) Advanced business service****GVA share****Location quotient (LQ)**

The growth dynamics of regions (change of GDP per capita in EUR) in the past decade were fastest in Romanian regions, which, with few exceptions, saw an increase in income levels by 70% (**Map 2.67a**). Similar growth dynamics were also observed in some Serbian regions, including Borski (due to the discovery and exploitation of copper and gold ores), as well as in the Lviv Oblast and the Miskolc region in Hungary. Relatively weaker growth dynamics were recorded in the most developed parts of the macroregion, such as the western part of Slovakia, Silesia in the Czech Republic and Poland, and the Zakarpattia Oblast in Ukraine.

Comparing this growth to the respective national averages reveals a wide variation in the situation of regions within the Carpathian macroregion (**Map 2.67b**). On one hand, in every country, there were Carpathian regions that developed significantly faster than the average, but on the other hand, some of them experienced strong relative regression. This may indicate the significant role of specific development factors related, for example, to the situation of certain industries, individual very large production plants, and the implementation of new investments.

One of the reasons for the varied development levels was the distinct differences in the economic structure of the regions within the Carpathian macroregion. For instance, Carpathian regions in Poland and Slovakia were notable for their low share of agriculture in the creation of gross value added, whereas Ukrainian regions were significantly dependent on this sector (**Map 2.68a**). Simultaneously, the degree of agricultural specialization (LQ) in these regions was low in both cases. A high share of agriculture in gross value added also characterized the Republic of Moldova regions, southern Hungarian regions, as well as the submontane areas of Wallachia and Moldavia in Romania.

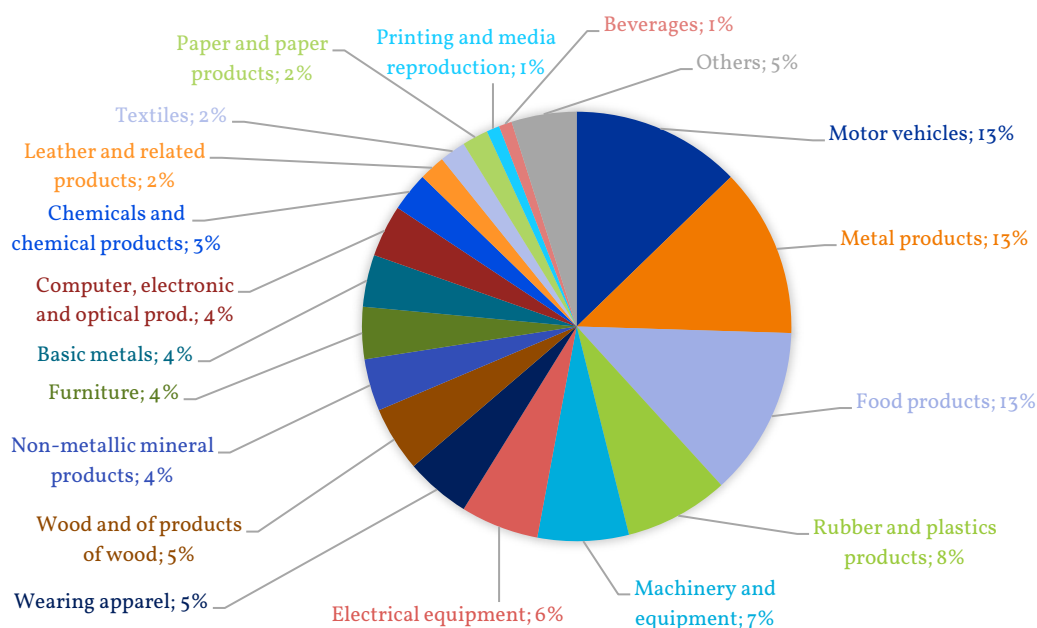
The significance of industrial processing in the economies of Carpathian regions was also highly varied regionally (**Map 2.68b**). This variation was evident even within individual countries, resulting, among other factors, from the presence of large industrial centres located in submontane areas, such as Silesia and the Central Industrial District in Poland, Silesia and Moravia in the Czech Republic, northern Hungary, selected parts of Transylvania, as well as Banat and Maramureş in Romania, and the northern Republic of Moldova.

Meanwhile, advanced business services played an important role in the economic structure of regions in central and eastern Slovakia, beyond the main urban centres of the macroregion (**Map 2.68c**), although their level of specialization still significantly lagged behind that of the Bratislava metropolitan area. This confirmed the general rule that major urban centres served as hubs providing these services to the surrounding agricultural and transit regions.

A more detailed analysis of manufacturing activities allows for identifying the key industrial sectors and regional specialisation in this regard.

The total number of employed persons in six Carpathian countries (excluding Serbia and the Republic of Moldova, for which detailed data on the industrial sector structure were not available) in the manufacturing sector amounted to approximately 7.7 million in 2020, of which about 3.5 million were in regions belonging to the Carpathian macroregion. In terms of employment, the most significant industrial sectors, collectively accounting for around 40% of all workers, were the production of vehicles, metal products, and food products. The position of the first two sectors was further strengthened by a marked increase in employment between 2010 and 2020.

Among the sectors with a share in total employment exceeding 5%, the rapidly growing production of rubber and plastic products, as well as electrical equipment, stood out. The machinery industry also developed, while the wood industry remained stagnant, and the clothing industry experienced a significant decline. Among industries with a smaller share in total employment, the paper, pharmaceutical, and furniture industries saw employment growth between 2010 and 2020. In other, relatively less significant sectors, employment remained relatively stable, except for the leather industry, which recorded a significant decline in the number of workers.

Figure 2.1**Structure of manufacturing employment in the Carpathian countries, 2020**

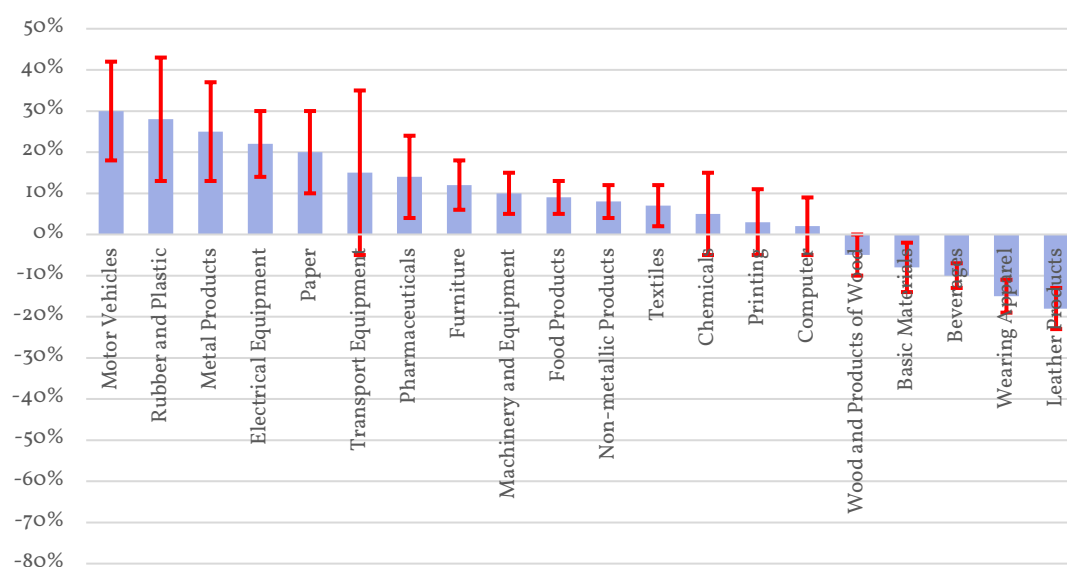
* except Serbia and the Republic of Moldova

Source: own elaboration based on Eurostat and UA statistical office.

In summary, the largest increases in employment were recorded in both medium-high technology industries, such as vehicle and electrical equipment production, and medium-low technology industries, such as the production of rubber and plastic products and metal goods. This trend may indicate the modernization of the macroregion's industrial structure. Following these sectors in terms of employment growth were paper and cardboard manufacturing (low technology) and the production of other transport equipment, some of which was linked to high-tech industries, such as the aerospace sector. Industries that maintained their share in the employment structure included those based on local resources, such as the agri-food and wood industries. On the other hand, industries related to clothing and leather product manufacturing experienced a decline. In the case of the former, this was due to the relocation of production to countries with lower labour costs, particularly in Asia. In the latter case, the decline may have been related to the trend of replacing natural materials with synthetic alternatives.

Figure 2.2

Change of employment in manufacturing branches in Carpathian countries* (%), 2010-2020**

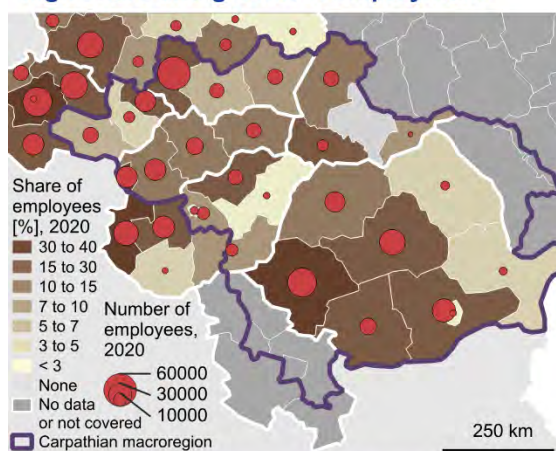
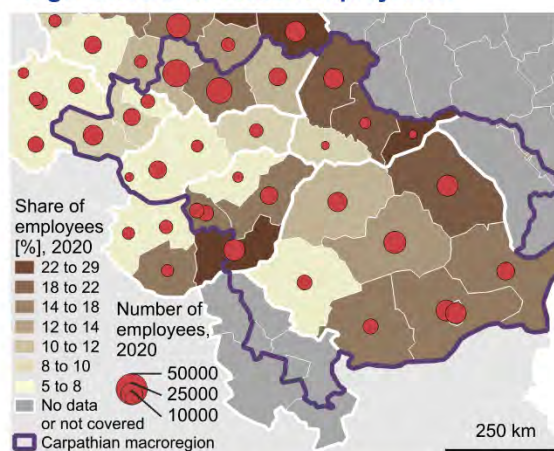
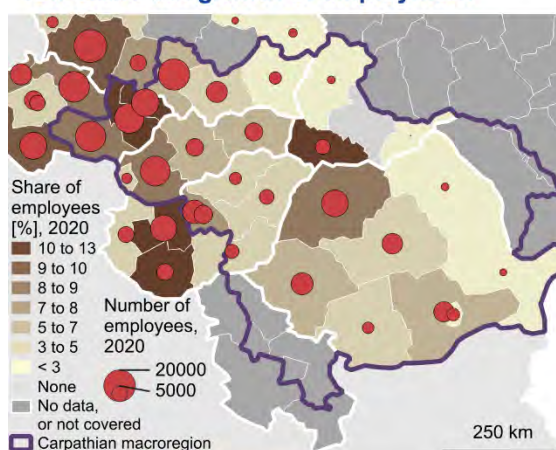
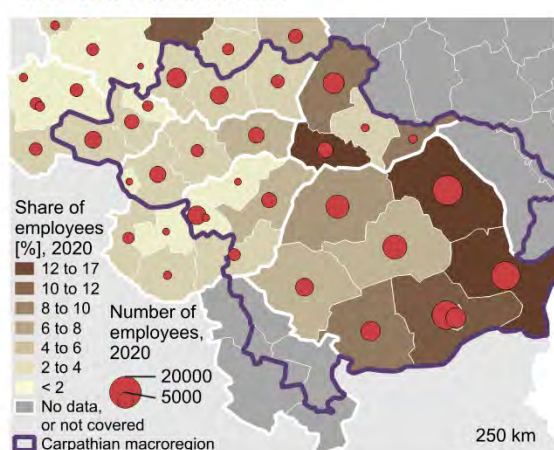


* except Serbia and the Republic of Moldova

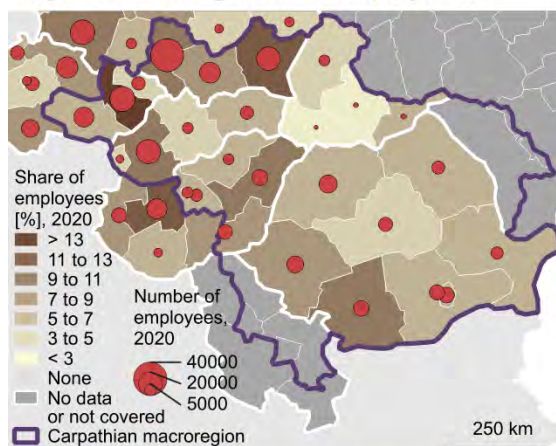
** standard deviation of change in macroregion at country level in red

Source: own elaboration based on Eurostat and UA statistical office.

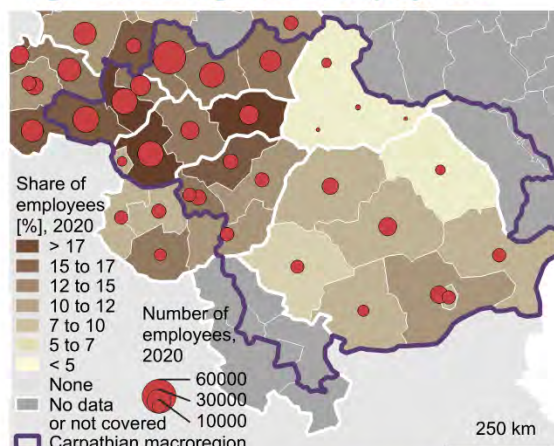
The largest and fastest-growing industrial sector in the macroregion was motor vehicle manufacturing. Its share of industrial employment in most Carpathian regions exceeded 10%, and in some areas, such as Vest in Romania or the Bratislava region, it even surpassed 30%. However, it was relatively less developed in eastern Romania, the Hungarian region of Észak-Alföld, and the Olomouc region in the Czech Republic. A closely related and equally fast-growing sector was rubber and plastic product manufacturing (including the production of car tires). The most specialized regions in this industry were Olomouc in the Czech Republic and Podkarpacie in the Polish part of the macroregion, while the least developed were the Ivano-Frankivsk and Zakarpattia regions in Ukraine. The metal industry, another related sector, played a more significant role in the economy of regions located in the western part of the macroregion, while it was less developed in eastern Romania, particularly in the Carpathian regions of Ukraine. These Ukrainian regions, however, specialized in paper and paper product manufacturing, as well as the wood industry. Packaging production was also well-developed in the urban region of Budapest, while the wood industry was concentrated in northern and eastern Romania, as well as central and eastern Slovakia. The food and agricultural industry was particularly prominent in Hungarian and Romanian regions, as well as in Ukrainian regions with high agricultural production. Clusters in electrical equipment manufacturing were also evident, particularly in Czech regions, northwestern Romania, and Ukraine's Zakarpattia region. Finally, the clothing industry, which was highly dependent on labour costs, was mainly located in the least affluent regions of the eastern part of the macroregion, particularly in eastern Romania and Ukraine.

Map 2.69**Employment in selected industry branches, 2020****A) Motor vehicles production:
high share and growth in employment****B) Food products production:
high share and stable employment****C) Electrical equipment production:
low share but growth of employment****D) Wearing apparel production:
low share and decline**

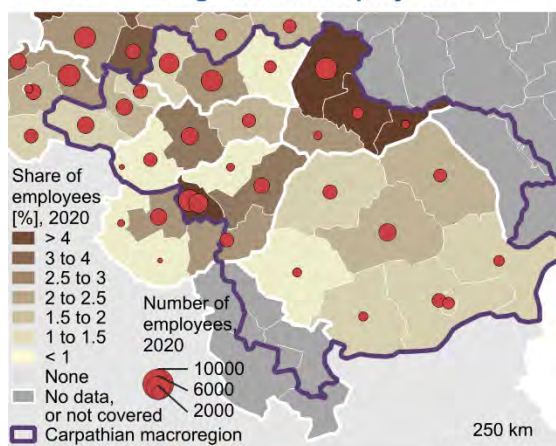
E) Rubber and plastic production: high share and growth in employment



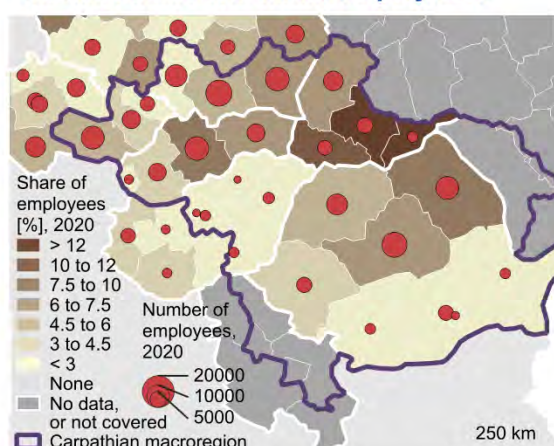
F) Metal products production: high share and growth in employment



G) Paper and paper products production: low share but growth of employment



H) Wood and wood products production: medium share and stable employment

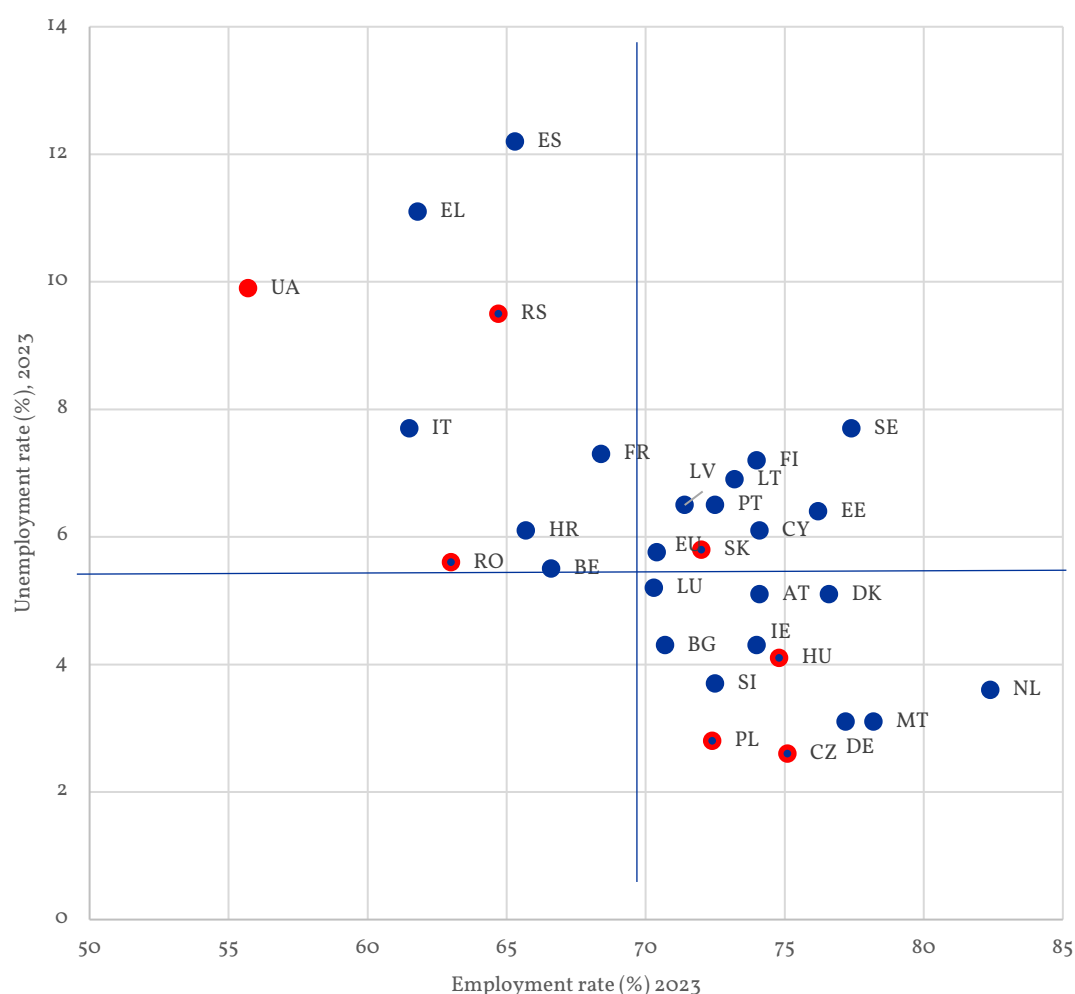


2.3.2 Labour market

The Carpathian countries differed significantly in terms of employment rates and unemployment rates, as measured by the Labour Force Survey (**Chart 2.25**). This was particularly evident when compared to the EU average, highlighting two distinct groups. On one hand, the Visegrad Group countries (except Slovakia) had a relatively favourable labour market situation, illustrated by high employment rates and low unemployment rates. On the other hand, countries outside the EU had much worse labour market conditions, with indicators similar to those of Southern European countries like Greece, Italy, and Spain. The Republic of Moldova, in particular, had a notably low employment rate, although its unemployment rate was relatively low. Similarly, in Romania, despite a relatively low employment rate, the unemployment rate was close to the EU average.

Chart 2.25

Employment and unemployment rates in the Carpathian countries compared to the EU countries, 2023*

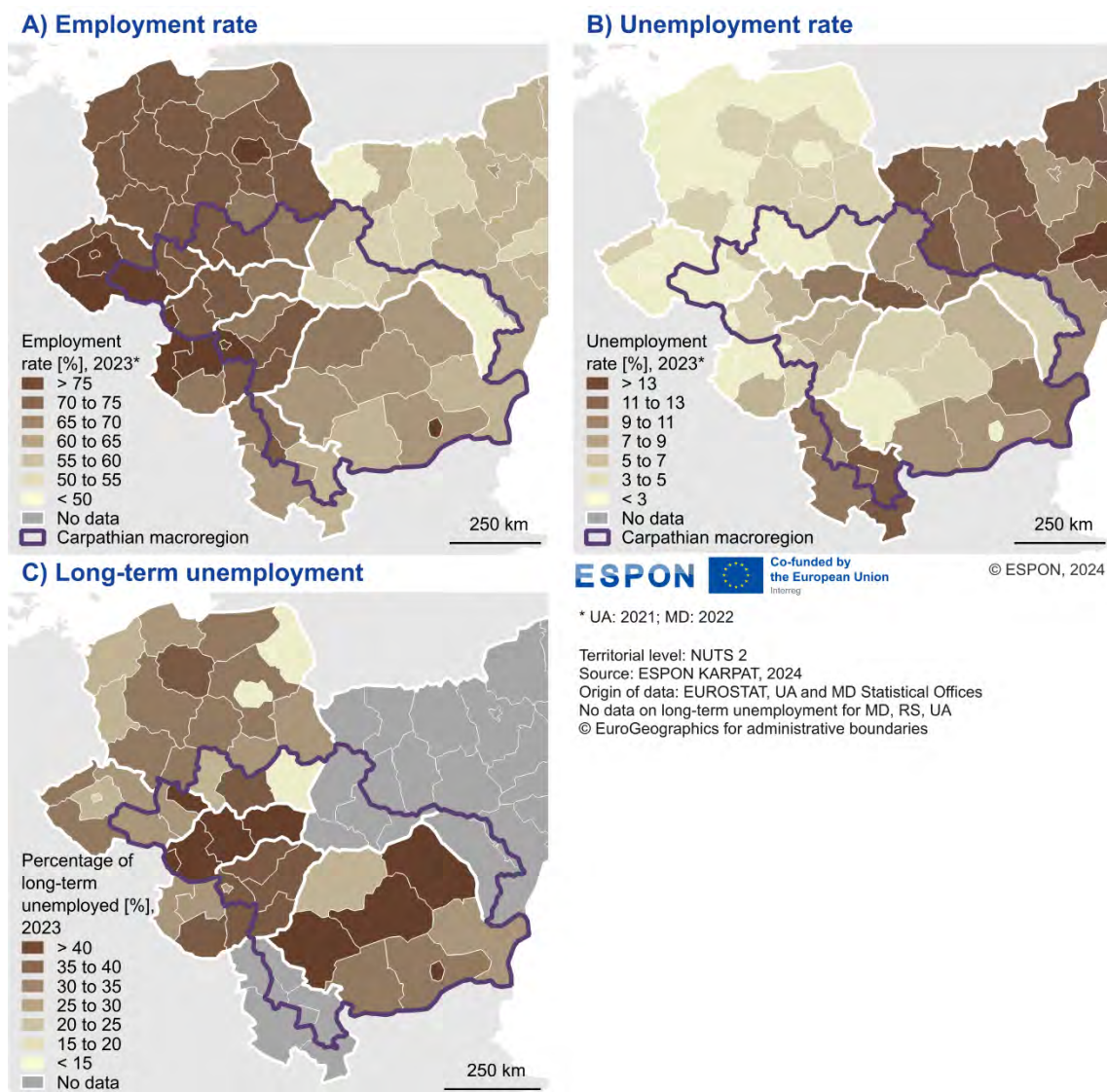


* for Ukraine data from 2021

Source: Own elaboration.

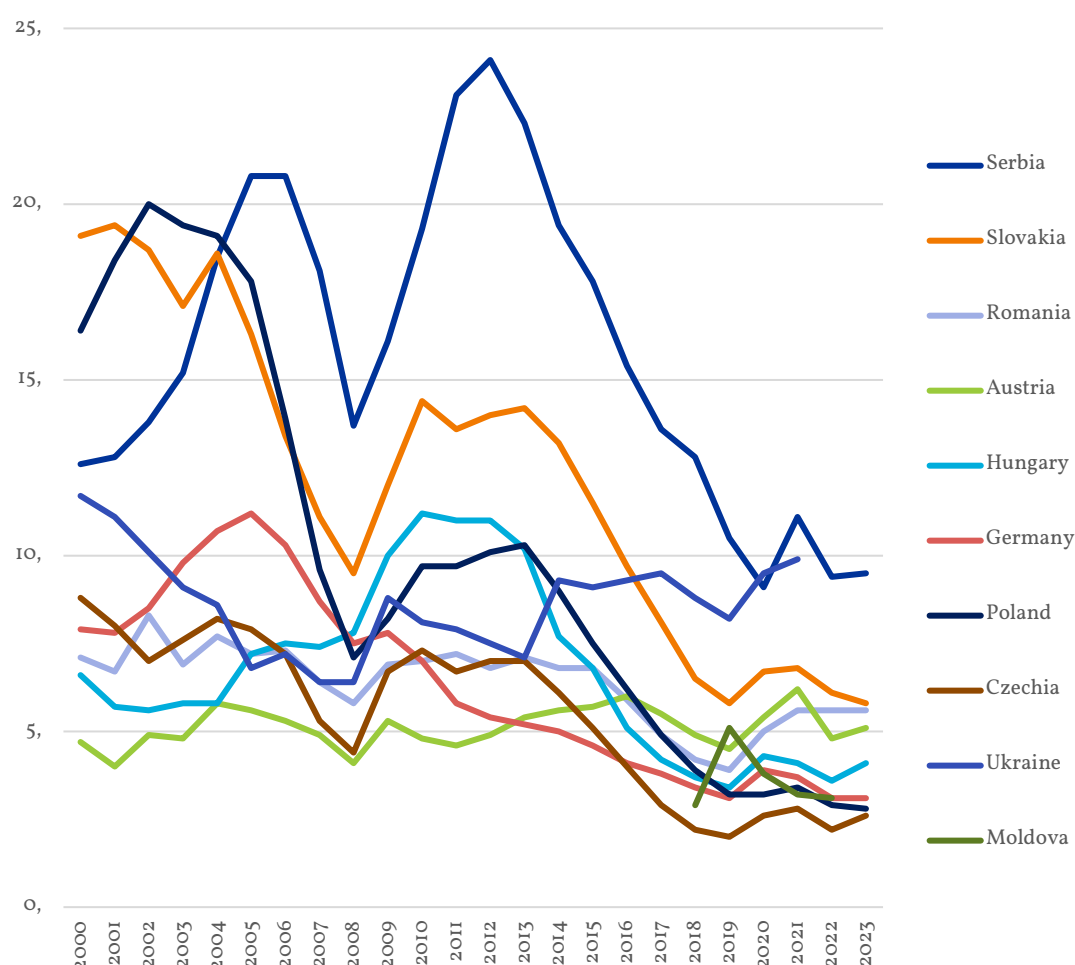
The situation of regions within the Carpathian macroregion did not significantly differ from the national averages in terms of employment rates (**Map 2.70a**). However, in terms of unemployment rates, some regions stood out with notably worse conditions, such as the Zakarpattia Oblast in Ukraine, and regions in southern Serbia and eastern Slovakia (**Map 2.70b**). Conversely, some Carpathian regions in Poland, the Czech Republic, and Romania had some of the lowest unemployment rates in their respective countries.

A clear issue was that some Carpathian regions struggled with the structural problem of long-term unemployment (**Map 2.70c**). This primarily affected Slovak regions, the Moravian-Silesian region in the Czech Republic, and some Romanian regions, with a lesser extent affecting also Hungarian regions.

Map 2.70**Labour market situation, 2023**

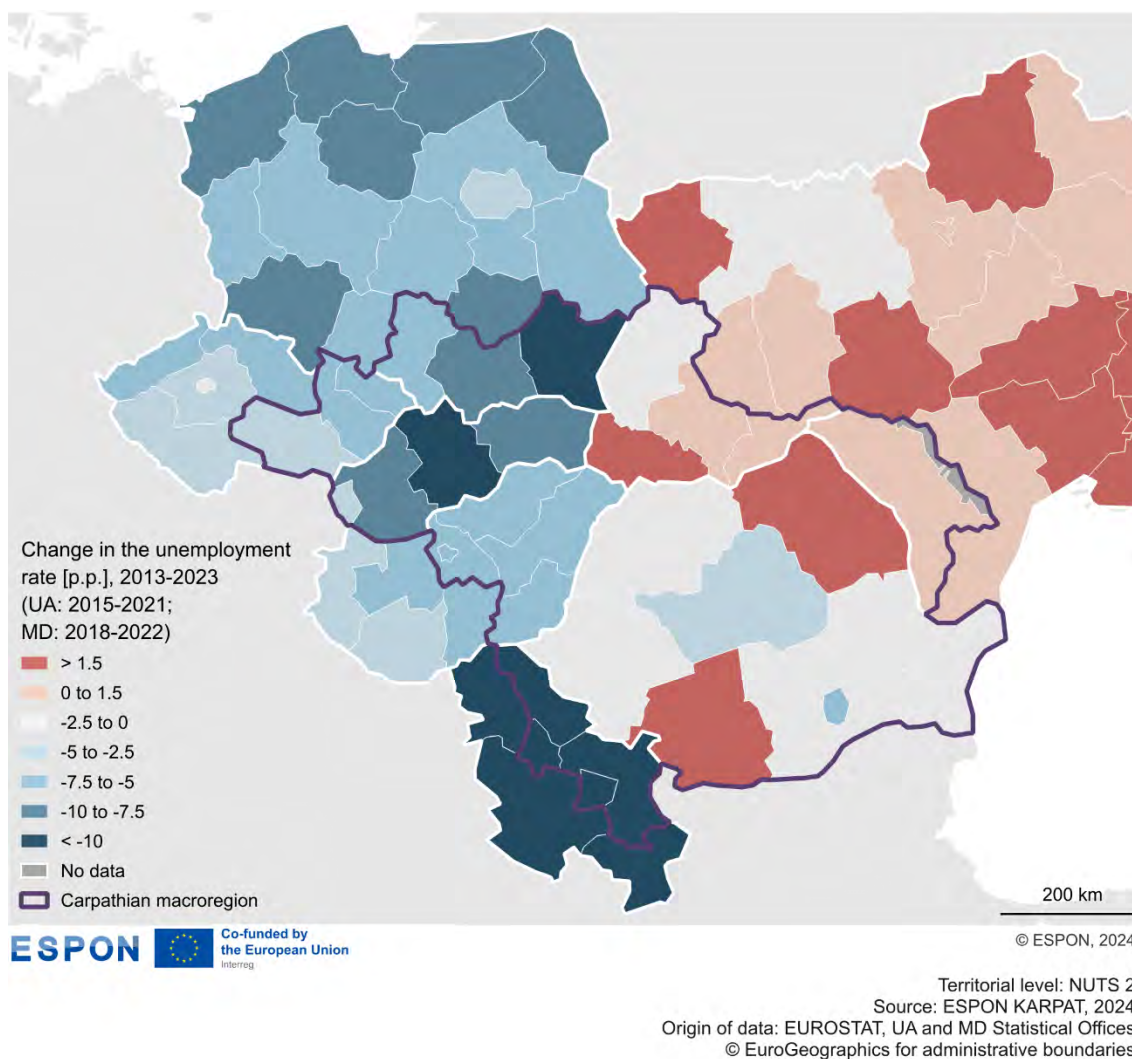
The labour market situation in the Carpathian countries changed in response to significant political-economic events and external shocks (**Chart 2.26**). The accession of some macroregion countries to the EU between 2004 and 2006, along with the period of economic prosperity before 2008, led to a substantial reduction in unemployment rates. However, during the post-crisis period, unemployment rates rose again but did not reach their previous record levels.

Starting from 2013, there was a period of declining unemployment rates in all countries (except Ukraine and with stable conditions in the Republic of Moldova), which was only slightly hindered during the pandemic period. Unemployment rates also decreased in Germany, with Austria maintaining a relatively stable situation characterized by low frictional unemployment, so temporary unemployment that occurs when people are between jobs or entering the workforce.

Chart 2.26**Unemployment rate in the Carpathian countries and in Austria and Germany, 2000-2023**

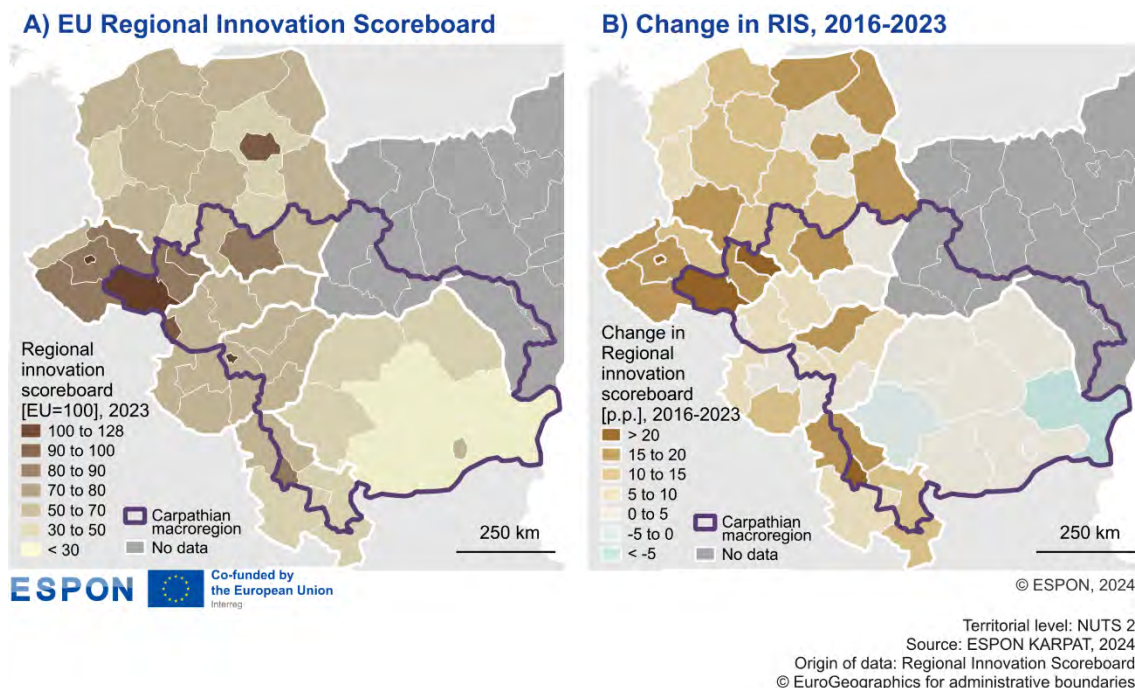
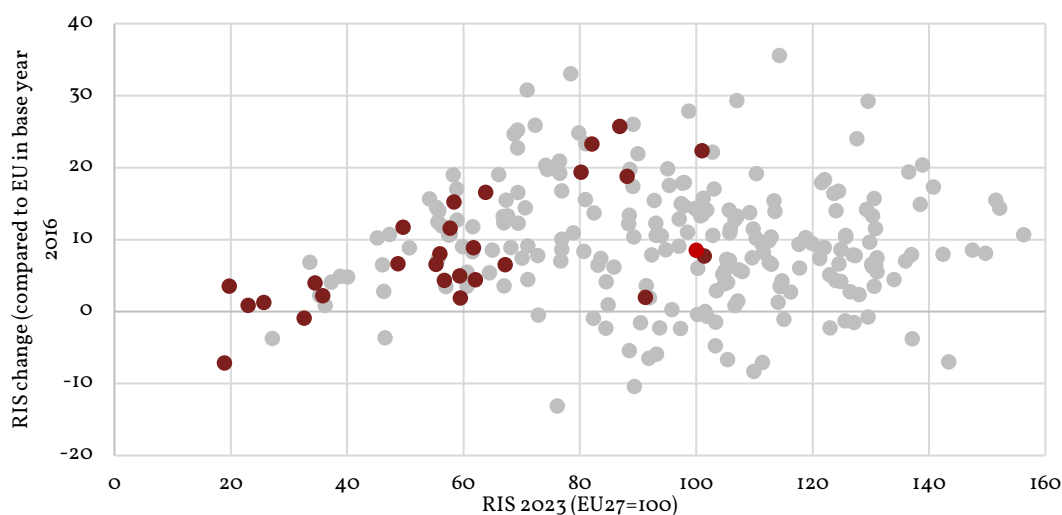
Source: Own elaboration based on Eurostat.

On a regional basis after 2013, there was a particularly pronounced decline in the unemployment rate in the Carpathian regions of Serbia, Poland (including Podkarpacie) and Slovakia (central part of the country) (**Map 2.68**). A more moderate decline, but from a lower level, was also recorded in the Hungarian and Czech regions. In Romania, the situation varied regionally. On the one hand, the unemployment rate fell in Bucharest and the central region, while the situation was relatively stable in the rest of the country, with two regions (NE and SW) experiencing a worsening of the labour market situation. Also, Ukraine and the Republic of Moldova recorded increases, which, especially in the first case, could be derived from the Russian annexation of Crimea and parts of Donbass in 2014, which worsened the investment climate in the former USSR countries. In the Ukrainian part of the macro-region, the largest increase in the unemployment rate took place in the Transcarpathian region, but in turn the Lviv and Chernivtsi regions did not suffer significantly in terms of the labour market situation.

Map 2.71**Change in the unemployment rate, 2013-2023****2.3.3 Science and innovativeness****The overall innovativeness performance of Carpathian regions**

The overall innovativeness position of the Carpathian macroregion can be evaluated using the Regional Innovation Scoreboard (RIS) - a comprehensive analytical tool developed by the European Commission, drawing on data from sources such as Eurostat and the Community Innovation Survey. The indicators used in the RIS are grouped into four key categories: human resources, framework conditions conducive to innovation, innovative activities of enterprises, and the broader impact of innovation. The regions are grouped into 4 broad and 12 detailed categories based on their position relative to the EU27 index.

The overall performance of Carpathian regions is relatively weak, with no region achieving the status of European Innovation Leader. A closer look into the situation in the Carpathian region reveals that the value of the indicator spans from ca. 19 in Sud-Vest Oltenia and Sud-Est to ca. 101 in Budapest and Brno region. This variation is confirmed by the RIS classification. Budapest and Brno region are classified in the second tier as Strong Innovators. Five regions distinguished by the presence of significant urban centres—Bratislava, Střední Morava, Moravskoslezsko, Belgrade, and Kraków—are ranked as Moderate Innovators. Notably, three-quarters of the regions fall into the weakest category, Emerging Innovators, with the Romanian regions exhibiting the lowest performance overall, except for the relatively strong position of Bucharest (**Map 2.72a**).

Map 2.72**Regional innovation scoreboard, 2016-2023****Chart 2.27****The RIS results (EU=100), 2023 vs. change 2016-2023 (pp.)***

* Carpathian macroregion NUTS 2 regions included in the RIS 2023 are marked dark red.

Source: own elaboration based on European Innovation Scoreboard results: https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/regional-innovation-scoreboard_en

As regards changes in performance during the years 2016–2023, Carpathian regions perform poorly compared to the European average. The range of change spans from -7.2 percentage points in the Romanian Sud-Vest Oltenia region to +25 percentage points in Moravskoslezsko in Czechia. While there is a general tendency for better-performing regions to exhibit faster dynamics of change (**Map 2.72**), the relationship between performance and change does not reveal a clear or consistent pattern, either within the Carpathian macroregion or across Europe.

In the Carpathian macroregion, stronger-performing regions sometimes show higher dynamics, but this is not uniformly observed, reflecting structural barriers and the diverse innovation capacities of these regions (**Chart 2.27**). Three top performing Carpathian regions are Brno, Budapest and Bratislava. The Brno region is characterised by above-average innovation performance and high dynamics, demonstrating both its established position and capacity for further improvement. Budapest aligns closely with the EU average in both performance and change, indicating relative stability but limited dynamism. Bratislava, although achieving performance close to the EU average, is hindered by low dynamics, suggesting stagnation in its innovation trajectory.

The remaining Carpathian regions can be grouped into three categories based on their relative performance and dynamics. The first group encompassing Belgrade, Kraków (Małopolskie), Olomouc (Střední Morava), and Ostrava (Moravskoslezsko), is characterised by performance slightly below the EU average but above-average dynamics of change. These regions demonstrate the potential for growth and improvement, as their innovation ecosystems show promising levels of adaptability and progress. The second group includes the remaining Serbian, Hungarian, Slovakian, and Polish regions, which exhibit weak performance and dynamics fluctuating around ± 6 –8 percentage points below the EU average. This group reflects a slower pace of change and persistent barriers to achieving significant innovation gains. The third group, comprising Romanian regions, represents the weakest performers in Europe, combining very low innovation performance with minimal or negative dynamics, ranging from -7.2 to 4.0 . These regions face substantial structural challenges that severely limit their capacity for innovation-led development.

One of the key indicators of innovation performance is the share of innovation-active enterprises. This indicator, calculated on the basis of the Community Innovation Survey (CIS) using a harmonised OECD methodology, is available exclusively at the NUTS 0 level. Among the countries forming part of the Carpathian macroregion, Poland (34.6%), Slovakia (35.1%), Hungary (33.1%), and Romania (8.8%) report the lowest shares across the European Union. Their innovation performance falls well below the EU average of 51.4% and diverges significantly from leading countries such as Belgium, Germany, Greece, Finland, and Italy, where the proportion exceeds 60%. The situation in Romania is particularly concerning, not only confirming the overall low level of innovation within the Carpathian macroregion, but also highlighting substantial internal disparities.

In view of the conditionality linking Cohesion Policy innovation funding to the identification of strategic priorities—so-called smart specialisations (S3)—all regions of the Carpathian macroregion that are part of the European Union have defined their own priority areas. Similarly, Ukraine, Serbia, and the Republic of Moldova, although not formally required to do so, conducted analogous exercises. Based on the collected regional strategies, it was possible to delineate ten broad priority areas that synthetically reflect the smart specialisation orientations identified across the macroregion.

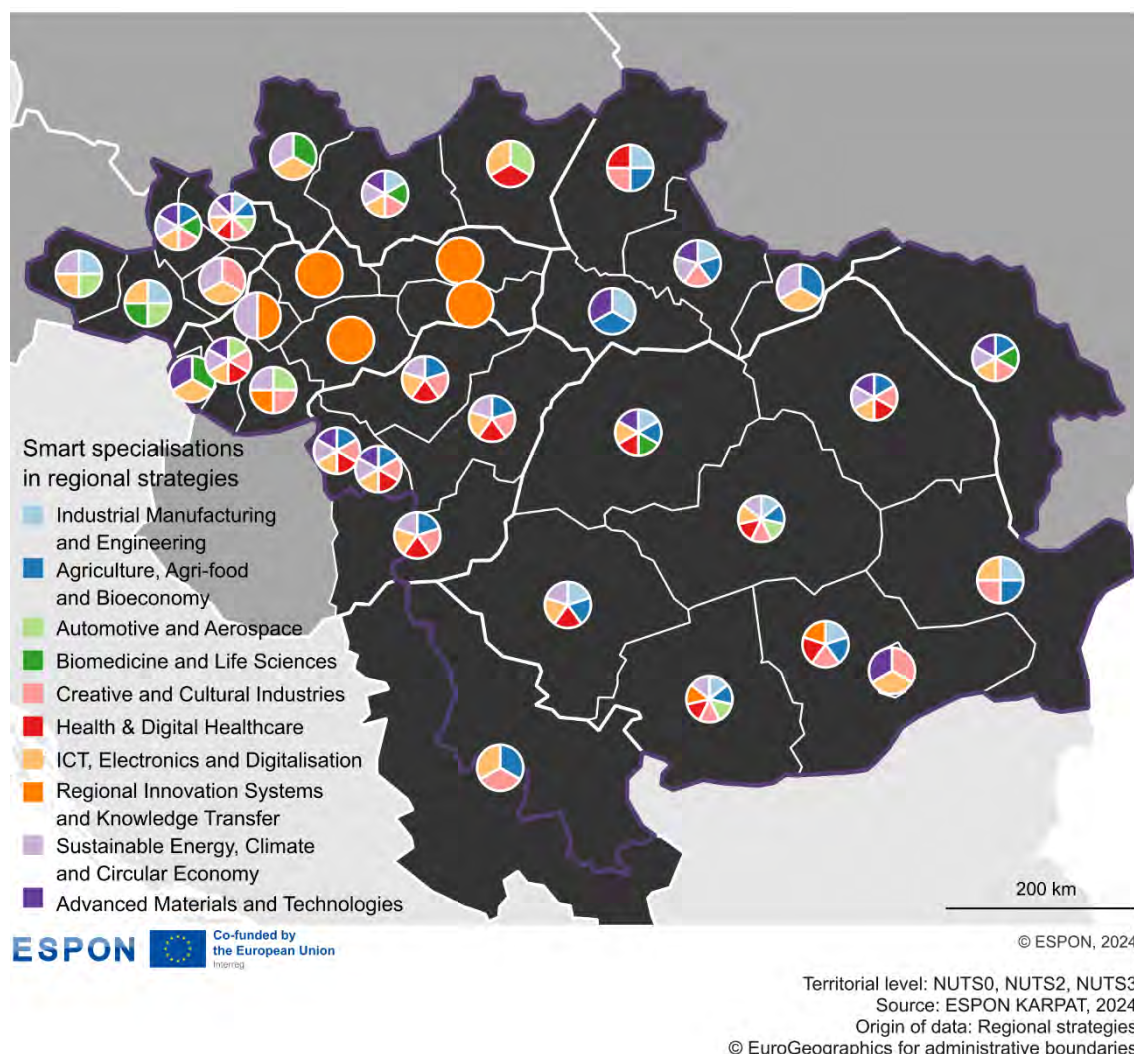
It should be emphasised, however, that the process of defining these areas was grounded in diverse methodologies, and the mode of selecting priorities was not uniform. In some cases, regions formulated their specialisations in highly general terms. As a result, the pattern of regional specialisation priorities presented in Map X should be regarded as indicative only. A rigorous analysis of smart specialisation priorities would require an in-depth examination of their conceptual framing, a review of the underlying documentation, and a qualitative inquiry involving regional stakeholders. Nevertheless, the map supports the formulation of several cautious observations.

Among the ten Smart Specialisation (S3) priorities identified across the Carpathian macroregion, the most frequently selected was ICT, Electronics and Digitalisation (24 regions), followed by Creative and Cultural Industries and Sustainable Energy, Climate and Circular Economy (21 regions each), and Agriculture, Agri-food and Bioeconomy (20 regions). Mid-range frequencies were observed for Health and Digital Healthcare (15), Industrial Manufacturing and Engineering (14), and Advanced Materials and Technologies (13). Less frequently indicated were Automotive and Aerospace and Regional Innovation Systems and Knowledge Transfer (8 each), and Biomedicine and Life Sciences (7) (Map).

The ICT, Electronics and Digitalisation S3 priority covers the development and application of ICTs, electronics, and digital transformation. Included under this heading are priorities such as electronics and advanced manufacturing, software and IT services, electronic measuring and sensing equipment, and systems and components (electronics, optoelectronics, mechatronics, microelectronics, etc.). As the most frequently selected

smart specialisation, this priority is present across the macroregion without forming a spatial cluster, instead displaying a dispersed pattern.

Map 2.73
Smart specialisations, 2022



Source: Own elaboration based on: https://ec.europa.eu/regional_policy/assets/s3-observatory/index_en.html; Ministry of Industry and Trade of the Czech Republic (2021); Banskobystrický samosprávny kraj (2022); BIC Bratislava (2012); Košický samosprávny kraj (n.d.); Government of the Republic of Moldova (2024); Nitriansky samosprávny kraj (2015); Olomouc Region Innovation Council (2022); Ministry of Education, Science and Technological Development of the Republic of Serbia (2020); Trenčianska univerzita Alexandra Dubčeka v Trenčíne (n.d.); Trnavský samosprávny kraj & Mesto Trnava (2018); Določnyj Institute of Regional Research, NAS of Ukraine (2022); VTP Žilina (2015); and European Commission, Smart Specialisation Platform (n.d.).

The Creative and Cultural Industries S3 priority encompasses a broad range of activities related to the creative sectors, design, and tourism. Examples of thematic entries include cultural and creative industries, tourism and cultural identity, clothing industry, innovations in design activities, and creative potential. Regions indicating this specialisation are spatially concentrated along a belt spanning Czechia, Hungary, the Republic of Moldova, Romania, and western Ukraine, which suggests the formation of a south-eastern axis focused on cultural heritage and the potential of the creative sector.

The Sustainable Energy, Climate and Circular Economy S3 priority focuses on green transformation and sustainable development. Thematically, it includes sustainable energy, green economy, circular economy, energy

and renewable resources, technologies for energy production, transmission and storage, hydrogen technologies, and environment and quality of life. Although the pattern of regions selecting this priority overlaps by approximately 50% with the creative axis, it shows greater concentration in central and north-western regions, reflecting historical industrial conditions and heightened needs for ecological transformation.

The Agriculture, Agri-food and Bioeconomy S3 priority addresses agriculture, food processing, and the bioeconomy. It also includes topics related to bioeconomy, agri-smart, forestry, wood processing and furniture industry, and aquaculture and fishing. Regions selecting this priority cover a large area of the macroregion, including its central, southern, and eastern parts.

The Health and Digital Healthcare S3 priority focuses on health and quality of life, e-health, medical tourism, and pharmaceuticals. Regions selecting this priority are concentrated in the central part of the macroregion and in selected northern regions (Podkarpackie, Lvivska, Moravskoslezský).

The Industrial Manufacturing and Engineering S3 priority includes advanced manufacturing technologies, mechanical engineering, construction of production machinery, components and equipment, production of metals, metal products and non-metallic mineral products. This priority is spatially dispersed across the Carpathian macroregion, with regions located in its north-western (Czech Republic, Poland), central-southern (Romania), and eastern parts (Ukraine).

The Advanced Materials and Technologies S3 priority covers innovation in materials science and chemical technologies, and includes advanced materials, smart materials and nanotechnologies, new materials, and chemistry. This priority was selected in regions in Hungary, Czechia, Slovakia, and Poland, as well as in the eastern-central part of the macroregion.

The Automotive and Aerospace S3 priority focuses on thematic entries such as automotive industry and engineering, aeronautical industry, transport systems, and eco-friendly transport. Regions with this priority include Podkarpackie, Centre RO, South-West Oltenia, Vysočina, Jihomoravský, Moravskoslezský, Trnavský, and Nitriansky kraj.

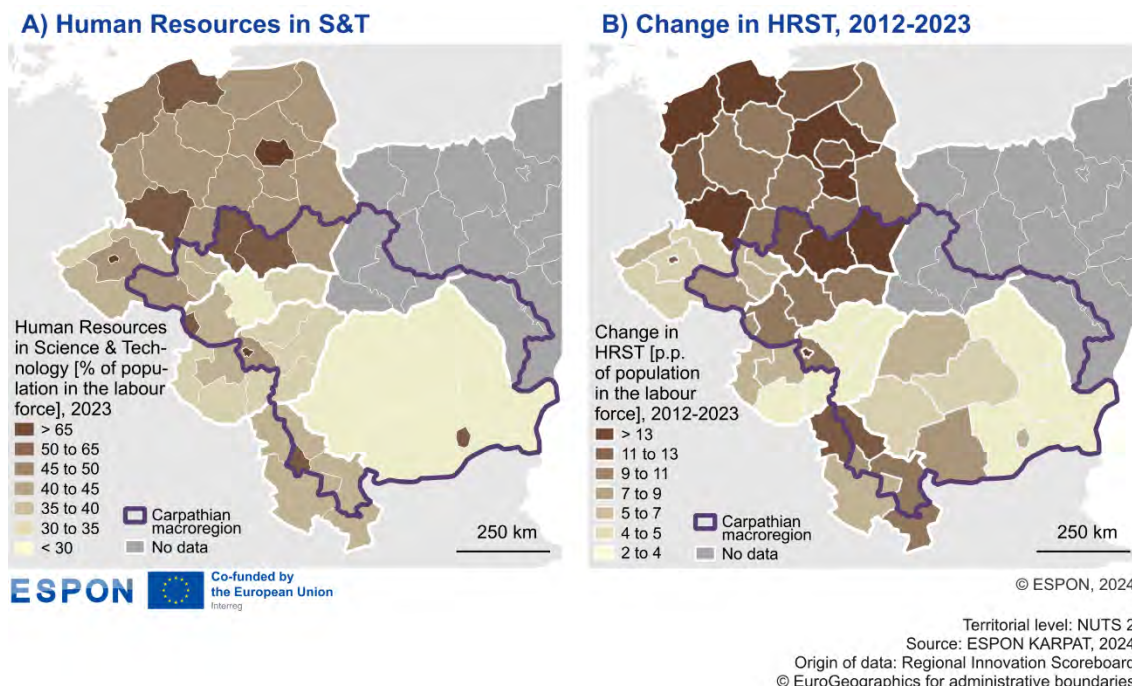
The less specific Regional Innovation Systems and Knowledge Transfer S3 priority refers broadly to the improvement of innovation infrastructure, human capital, and systems for technology transfer. Regions in Slovakia and southern Romania indicate this specialisation, often as a combination of several sub-specialisations falling within this broad area.

The Biomedicine and Life Sciences S3 priority covers research and innovation in life sciences, medicine, and biotechnology. Selected themes include biomedicine, life sciences and wellbeing, biotechnologies, medical and pharmaceutical products, diagnostics, and medicine. This specialisation is associated with strong academic centres in medicine and life science clusters located in Brno, Olomouc, Chişinău, Kraków, Katowice, Cluj-Napoca, and Bratislava.

Human Resources

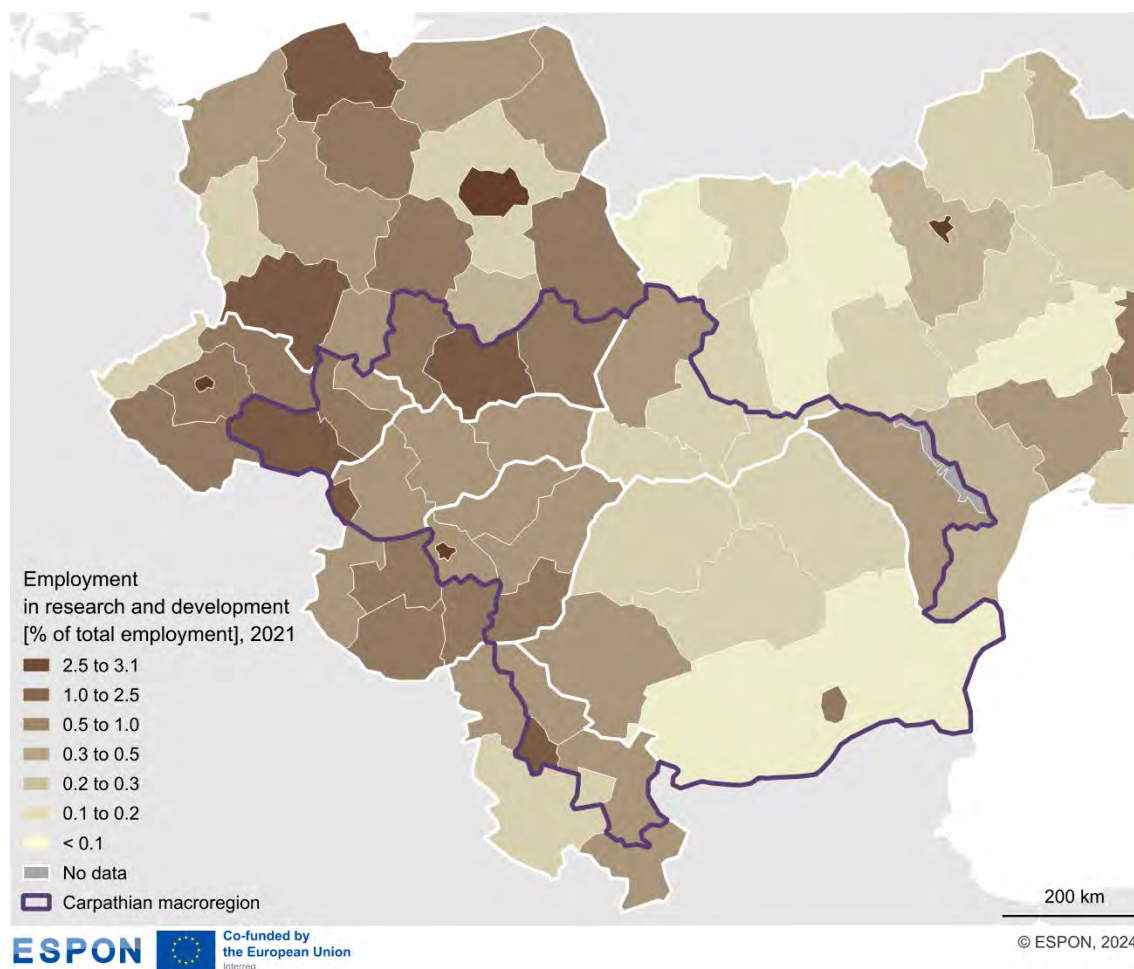
Human capital is a key driver of innovation, technology transfer, and long-term economic growth. The Human Resources in Science and Technology (HRST) distribution in the central and northern Carpathian macroregion reveals substantial concentrations of human capital in urban and industrial centers, with Budapest (68.7%) and Bratislavský kraj (64.9%) as standout hubs (**Map 2.74**).

These regions significantly surpass the surrounding areas, reflecting advanced R&D infrastructure and thriving innovation ecosystems. Poland's Małopolskie (54.1%), Śląskie (50.7%), and Podkarpackie (44.3%) further illustrate northern HRST dominance, supported by industrial zones and academic centres. Belgrade (53.3%) and Bucureşti-Ilfov (52.5%) also highlight the central role of capital cities in fostering technological growth. In contrast, the Republic of Moldova, western Ukraine, eastern Hungary, and eastern and southern Romania represent the weakest areas regarding HRST, with levels ranging from 21% to 33% (**Map 2.74**). The highest increases in HRST have been observed in three Polish voivodeships, with Małopolskie leading, alongside Budapest and northern Serbia (Vojvodina) and Slovakia. This upward trend reflects growing investments in human capital, reinforcing the role of these areas as emerging hubs for innovation. In contrast, eastern Hungary and eastern and central Romania show minimal growth in HRST, reflecting persistent challenges in expanding the science and technology workforce. The region demonstrates a pronounced and persistent polarisation, with capital cities and northern areas serving as primary hubs for HRST, while structural constraints and divergent development pathways are likely to sustain this disparity across the macroregion.

Map 2.74**Human Resources in Science & Technology, 2012-2023**

The distribution of research and development (R&D) employment in the Carpathian macroregion highlights its importance as a key element of human resources in science and technology (HRST), directly contributing to the region's capacity to support innovation and technological advancement. Despite its critical role, R&D employment remains scarce across much of the macroregion, with only a few areas demonstrating higher concentrations of specialised human capital. The highest levels of R&D employment are recorded in Budapest (3.07%), Bratislavský kraj (2.43%), and Małopolskie (1.45%), reflecting the strong concentration of skilled labour in capital cities and northern industrial regions. Other notable clusters, such as Belgrade (1.16%) and Ji-hovýchod in Czechia (1.34%), emphasise the role of regional centres in sustaining scientific and technological talent. In contrast, the Republic of Moldova, western Ukraine, and eastern and southern Romania exhibit the lowest levels of R&D employment (ranging from 0.06% to 0.40%), indicating a limited pool of human resources dedicated to research and development. This shortage highlights significant gaps in the availability of skilled labour, constraining the ability of these regions to expand their scientific workforce (Map 2.71).

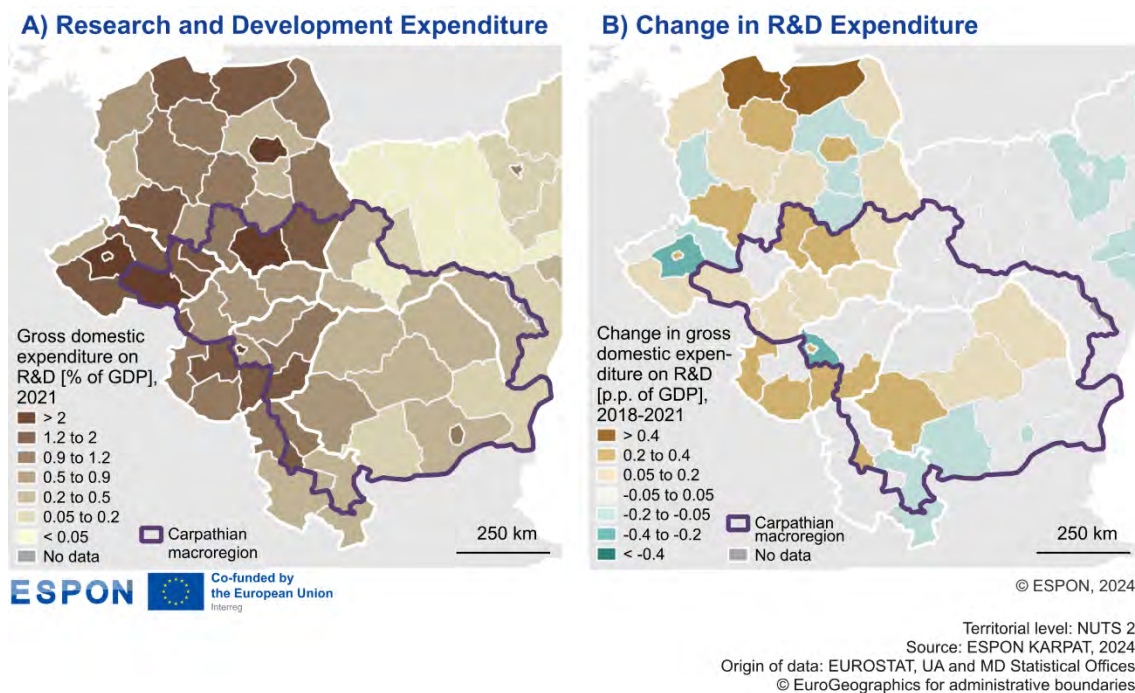
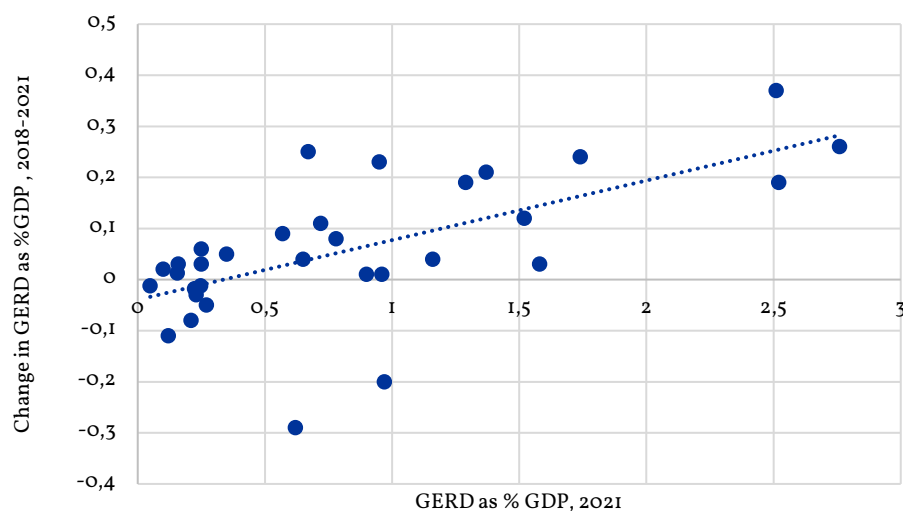
The spatial distribution of R&D employment closely follows the pattern of HRST, clustering in capital regions and northern industrial zones. However, the narrower range of values (0.06% to 3.07%) gives the impression of a more even distribution of human resources across the macroregion, masking disparities at the local level. While capital cities remain dominant in attracting and retaining talent for R&D, peripheral regions, particularly Romania, the Republic of Moldova, and Ukraine, struggle to develop and sustain the human capital necessary to drive innovation (Map 2.75).

Map 2.75**Research and Development Employment, 2021**

Territorial level: NUTS 2
 Source: ESPON KARPAT, 2024
 Origin of data: EUROSTAT, UA and MD Statistical Offices
 © EuroGeographics for administrative boundaries

R&D expenditures

Map 2.76 illustrates the relative levels of gross domestic expenditure on research and development (GERD) in the macroregion. The highest expenditures are concentrated in regions hosting scientific centers and robust innovation ecosystems, typically driven by advanced technological industries and branches of international corporations. In the former, public funding plays a crucial role, while in the latter, financing primarily comes from the private sector. Particularly notable regions include Małopolskie (2.51%) and Podkarpackie (1.29%) in Poland, Jihovýchod (2.52%) and Střední Čechy (1.58%) in the Czech Republic, Budapest (2.76%) and Dél-Alföld (1.37%) (Szeged) in Hungary, as well as Bucharest (0.97%) and Belgrade (1.74%).

Map 2.76**Gross Domestic Expenditure on Research and Development, 2018-2021****Chart 2.28****The GERD as % GDP in 2023 vs. the change in GERD as % GDP in 2018-2021**

Source: Own elaboration based on Eurostat, and National Statistic Offices in UA, SRB, and MD.

Interestingly, areas with high GERD intensity are often surrounded by weaker regions. Examples include Pest, which encircles the dynamically growing Budapest; Západné Slovensko, located west of Bratislava; and Sud-Muntenia, which borders Bucharest. A similar pattern is observed in Southern and Eastern Serbia, which border Belgrade to the north. Additionally, the majority of Romanian regions (excluding the capital region) and Ukrainian oblasts demonstrate the lowest GERD levels within the macroregion, with Ivano-Frankivsk in Ukraine recording the lowest values. These regions exhibit a significantly lower capacity for research and development, underscoring the disparities in innovation potential across the macroregion.

Map 2.76 and **Chart 2.28** reveal a positive correlation between GERD levels in 2021 and their changes between 2018 and 2021. Regions with higher GERD in 2021 often recorded more significant increases in expenditures during the analysed period. However, four notable exceptions emerge. The Pest and Bucureşti-Ilfov regions experienced above-average declines in expenditures. At the same time, Vest and Śląskie showed above-average increases, suggesting that these regions may significantly worsen or improve their position in the macroregion.

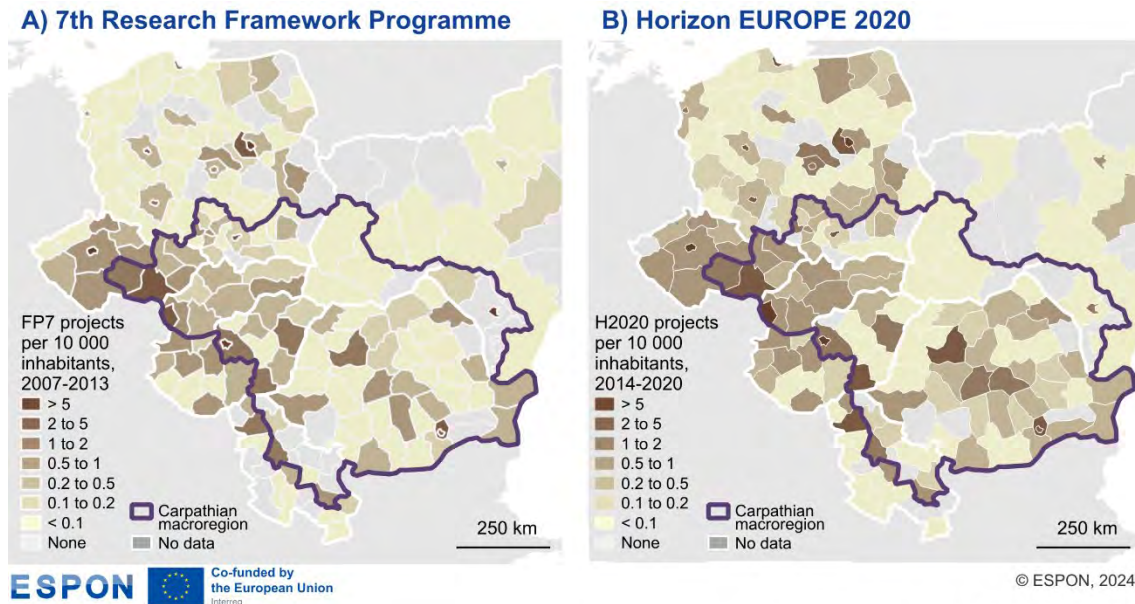
The observed pattern of resource concentration in metropolitan regions, coupled with the marginalisation of peripheral areas, appears to be intensifying, particularly in the cases of Budapest and Belgrade. Conversely, Bucharest may fail to strengthen its position in Romania due to structural factors, potentially yielding prominence to the Voivodina region.

Science

Participation in the EU 7th Framework Programme (FP7) and Horizon 2020 reflects the Carpathian macroregion's capacity to collaborate within international research teams and to attract external funding for scientific and R&D activities within the academic sector. The analysis of participation in the EU programmes must be preceded by the critical observation that the macroregion records some of the lowest levels of participation in the EU-27, both in terms of project involvement and secured funding (see: ESSPIN HORIZON project results¹²). In the 7th Framework Programme (FP7), 4263 participations were recorded, while in Horizon 2020 (H2020), this number increased to 5342, when the number of participations differs from the number of projects, as multiple Carpathian regions could participate in the same project, leading to multiple counts of a single project. It is essential to note that participation alone does not fully capture the quality or impact of this collaboration. A more detailed analysis of the partnerships—such as the leadership roles, the depth of their engagement, and specific contributions to project outcomes—is necessary to evaluate the effectiveness and influence of regional institutions in these international networks.

Map 2.77

European Research Projects, 2007-2020



Territorial level: NUTS 3
Source: ESPON KARPAT, 2024
Origin of data: CORDIS
© EuroGeographics for administrative boundaries

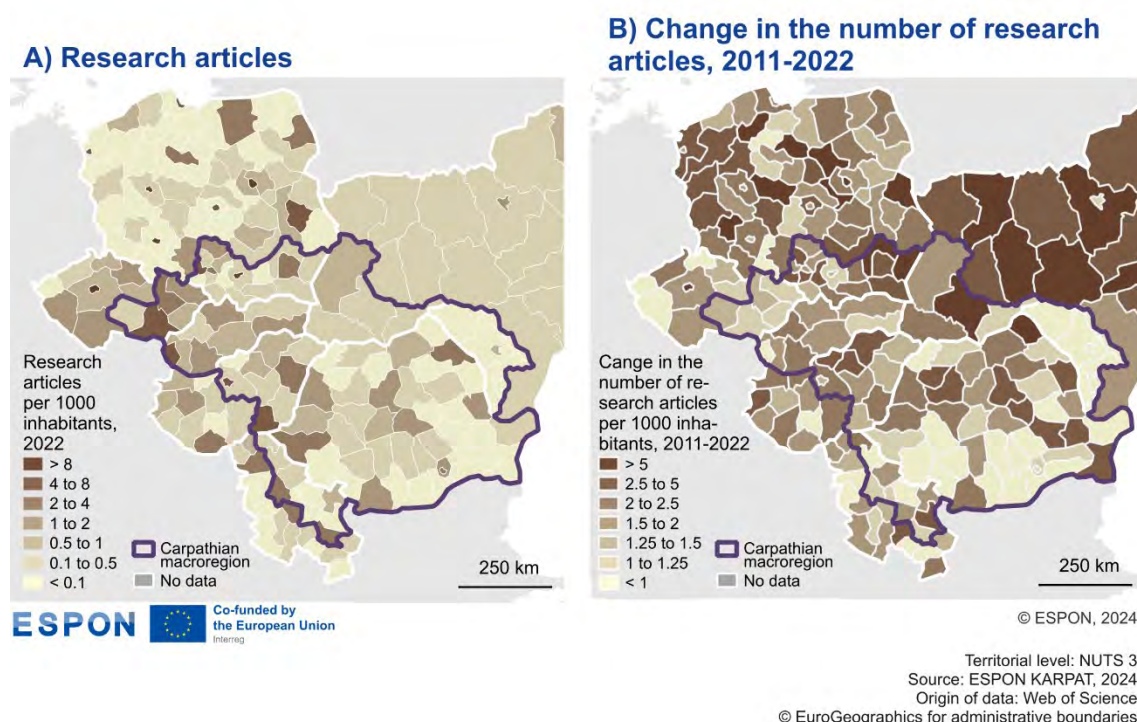
Significant interregional disparities in participation in Horizon 2020 are evident within the Carpathian macroregion. The intensity of participation in FP7, 2007-2013 and Horizon 2020, 2014-2020 measured as the

¹² <https://www.esspinhorizon.eu/>

number of project partners per 10,000 inhabitants, ranges widely from 0 to 7.5 in both periods. In Horizon 2020, the lowest scores were observed predominantly in peripheral areas, mostly mountainous or agricultural, marked by underdeveloped industry and limited research and development potential. These regions are scattered across Poland (Tarnowski, Rybnicki, Nowotarski, Przemyski), Romania (Gorj, Vaslui, Ialomița, Caraș-Severin, Regiunea Sud), Serbia (Pomoravska oblast, Severnbanatska oblast), Hungary (Nógrád), and Ukraine (Chernivetska). By contrast, capital cities such as Bratislava (7.34), Budapest (5.8), Bucharest (4.1), Belgrade, and Chișinău, along with some neighbouring regions (e.g., Pest and Ilfov), demonstrate considerably higher participation levels. Other non-capital cities recognised as significant scientific hubs with well-developed entrepreneurial ecosystems also perform strongly. These include Krakow and Gliwice in Poland, Brno and Jihlava in the Czech Republic, Szeged and Debrecen in Hungary, and Brașov and Sibiu in Romania (**Map 2.77a**).

A comparison of the two maps reveals a positive trend of increasing integration of the Carpathian macroregion into EU-funded scientific projects. During FP7, as many as 80% of regions recorded zero participation, while only 17% achieved scores exceeding one partner per 10,000 inhabitants. This situation improved significantly in Horizon 2020, where the proportion of non-participating regions fell to 63%, and one-fourth of all regions surpassed the 1% participation threshold. Consequently, most regions – mostly those participating to some extent in 7FP – experienced growth in participation levels; however, certain areas saw notable declines. In the case of Chișinău, a sharp decrease of over 6.2 percentage points was observed, causing its ranking to drop from first place in FP7 to 12th in Horizon 2020. Smaller yet still significant declines were noted in Budapest, Ilfov, and Hajdú-Bihar, highlighting challenges in sustaining their earlier performance.

Map 2.78
Research papers, 2011-2022



The scholarly output of the Carpathian macroregion remains marginal in the European context (ESSPIN). Likewise, participation in EU-funded programmes, the macroregion is marked by substantial interregional inequalities in scientific productivity, as measured by publications per capita in 2022 (**Map 2.78**). The disparity between the highest and lowest-performing NUTS3 regions is striking, ranging from 10.2 in Kraków to 0 in regions lacking higher education institutions (HEIs), notably concentrated in the southern and eastern parts of Romania and scattered in Hungary (Nógrád), Serbia (Branicevska oblast), and the Republic of Moldova (Unitatea Teritorială Autonomă Găgăuzia).

The spatial distribution of better- and worse-performing regions reveals an apparent concentration of scientific activity in established academic centres, including capital cities and other non-capital significant regional hubs (**Map 2.78**). Kraków (10.2), Poland's second important scientific centre, is a clear leader. Among the capitals, notable performers include Budapest (4.5), Bratislava (4.5), Bucureşti (3.7), and Belgrade (3.2). Beyond the capitals, several cities stand out as vital non-capital scientific hubs, such as Gliwice (4.9), Szeged (4.1), Brno (4.1), and Katowice (3.5), as well as Olomouc (2.7), Iaşi (2.9), Nis (2.2), Rzeszów (2.2), and Timişoara (2.1).

The spatial patterns of scientific activity have not changed significantly over the past 11 years. The persistence of scientific disparities between regions is a phenomenon of the *longue durée*, shaped by historical inequalities in educational infrastructure, funding allocation, and institutional capacity. Regions that recorded significant growth in scientific output typically had weak initial performance, adhering to the low-base effect. Notable examples include Przemyśl (15.6), Ivano-Frankivsk (6.2), and Tarnobrzewski (9.0). However, several regions with average publication results in 2011 distinguished themselves through notable growth by 2022. Examples include regions hosting Rzeszów (2.2 → 2.6), Craiova (1.3 → 2.1), Nitra (1.1 → 2.3), Oradea (1.1 → 2.0), and Žilina (1.1 → 1.9). This upward trend reflects improving research performance in regions that initially demonstrated modest publication activity, indicating a positive momentum in their scientific output.

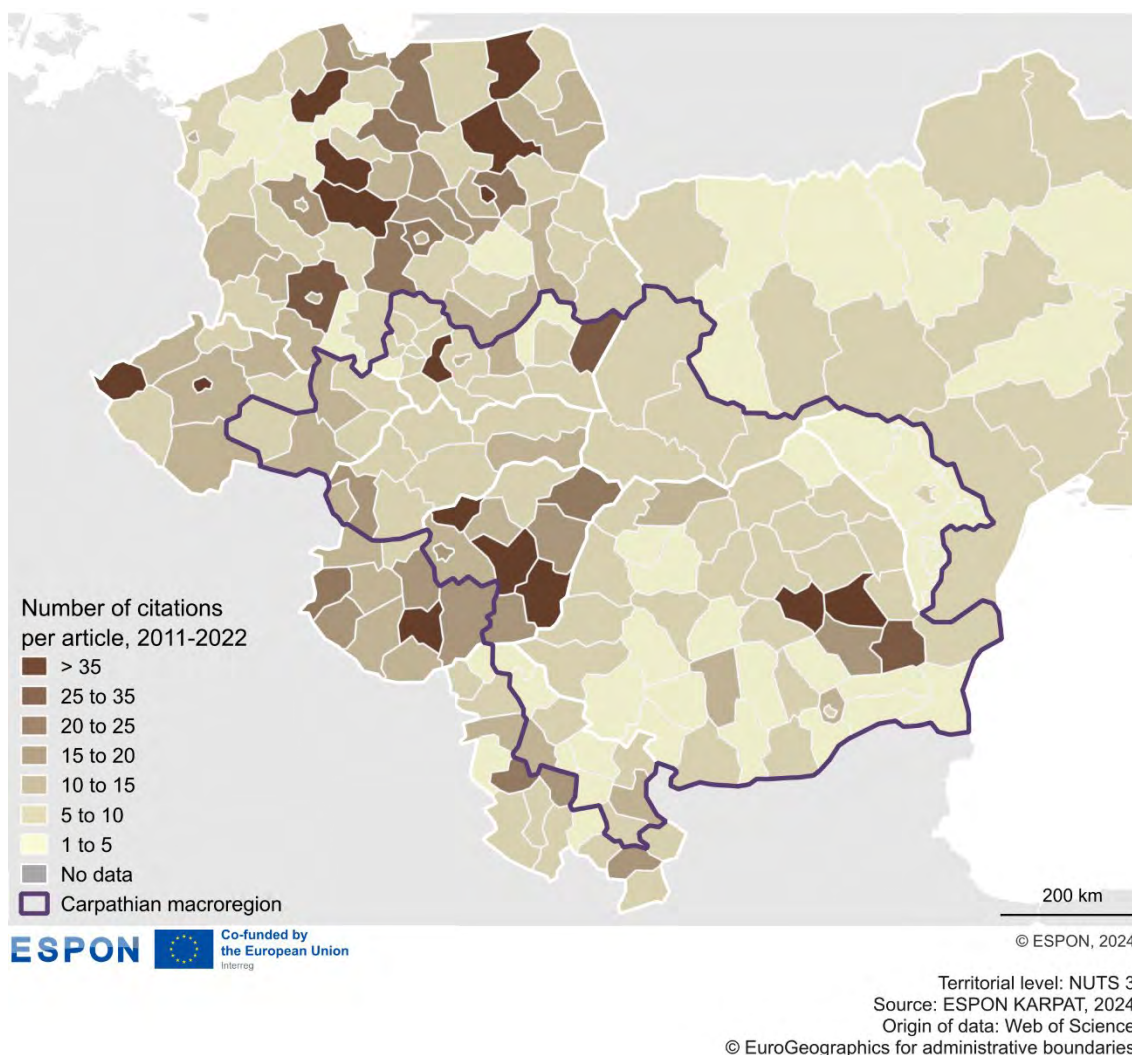
Citations of scientific publications, reflecting how frequently other authors reference a paper, are a valuable measure of the quality and impact of scientific research. However, this indicator must be used cautiously, as factors unrelated to the actual scientific value, such as self-citations, contextual citations, or network effects, may play a role. Moreover, citation patterns are discipline-specific, and due to the predominance of English-language publications in databases like WoS, they often disregard local scientific output (Olechnicka et al., 2019).

The average level of citations in the Carpathian macroregion varies significantly (**Map 2.79**). The highest values are observed in the Romanian region of Vrancea (72.5 citations per article published between 2011 and 2022). Notably, the leading regions in terms of citations often have low scientific output. In contrast, regions with substantial scientific output achieve relatively high, though not the highest, citation rates, with between 10 and 16 citations per article. Examples include Szeged, Budapest, Debrecen, Olomouc, Kraków, Brno, and Bratislava. However, this ranking does not align with the regions with the largest publication output, highlighting a discrepancy between scientific output and impact. At the lower end of the spectrum are the south-western Romanian regions and the Republic of Moldova, where the average number of citations remains below 3.5 per article, with the lowest values recorded in the Romanian Olt and Moldovan Regiunea Centru regions (1.6 citations per article).

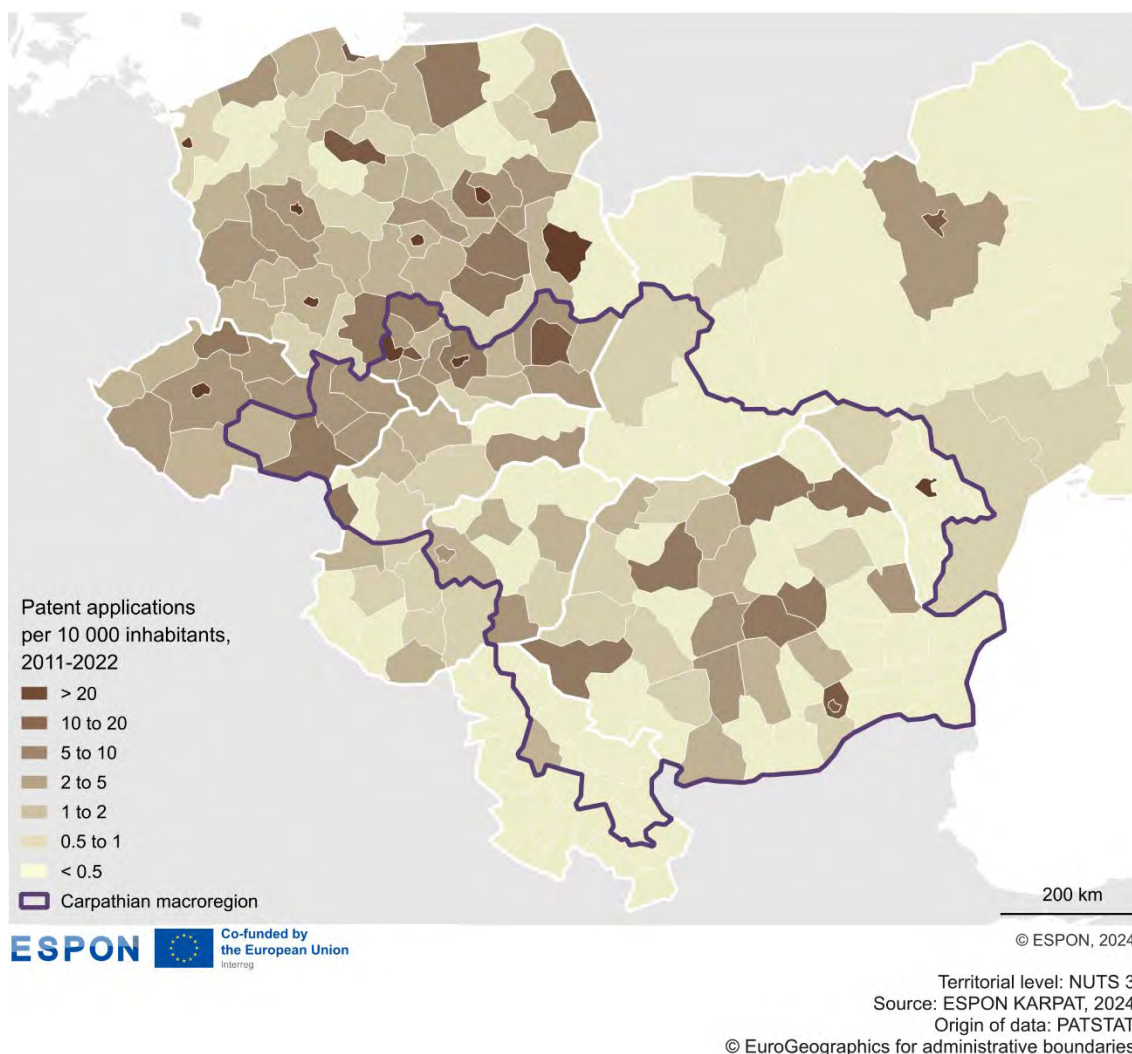
A combination of citations and publication output reveals significant differences between scientific activity and scientific quality. The spatial pattern of publication output is more dispersed and mosaic-like, with more significant regional variation. Strong academic centres, such as capitals and well-established university cities—Budapest, Kraków, Brno—dominate in terms of output. In contrast, the map of average citations demonstrates a more concentrated pattern, with fewer standout regions. The comparison suggests that a high volume of publications does not necessarily translate into high scientific quality or impact.

This phenomenon, well-documented in scientometrics, is closely linked to supra-regional and international scientific collaboration, which is essential for publishing in internationally indexed journals, particularly for small, specialised research centres. One plausible explanation for this trend in the macroregion is the collaboration with prominent foreign research centres, which enhances the visibility of publications despite limited local activity. For example, in Covasna (Romania), the significant Hungarian minority fosters strong ties with research institutions in Budapest, resulting in internationally recognised and highly cited publications. Another explanation is the specific research focus of international relevance conducted in peripheral regions due to the presence of key institutions. A case in point is Oświęcimski, home to the Auschwitz-Birkenau State Museum, which supports research on the Holocaust and World War II history. Similarly, the Vrancea region in Romania is a centre for seismic research, attracting international scientific collaboration in geology and seismology.

Map 2.79
Citation index, 2011-2022



Map 2.80 illustrates the uneven spatial concentration of patent activity across the Carpathian region. The relative patent application is highest in the northern parts of the macroregion (Polish NUTS 3 regions: Gliwice, Kraków, Katowice, Rzeszów), in the capital of the Republic of Moldova, as well as in scattered Romanian regions (Ilfov, Braşov, Covasna, Cluj, Timiş, Iaşi, Suceava), with the Bucharest metropolitan area playing a prominent role. A combination of patent application and academic output reveals significant spatial disparities, indicating that some regions are more specialised in scientific activities, which typically contribute to innovation and development over the long term. In contrast, others focus on research and development activities closer to market-oriented applications of developed solutions. The spatial pattern of patent activity is more spatially concentrated, particularly in Polish and dispersed Romanian regions. In contrast, the publication pattern highlights the dominant role of capital cities and strong academic centres.

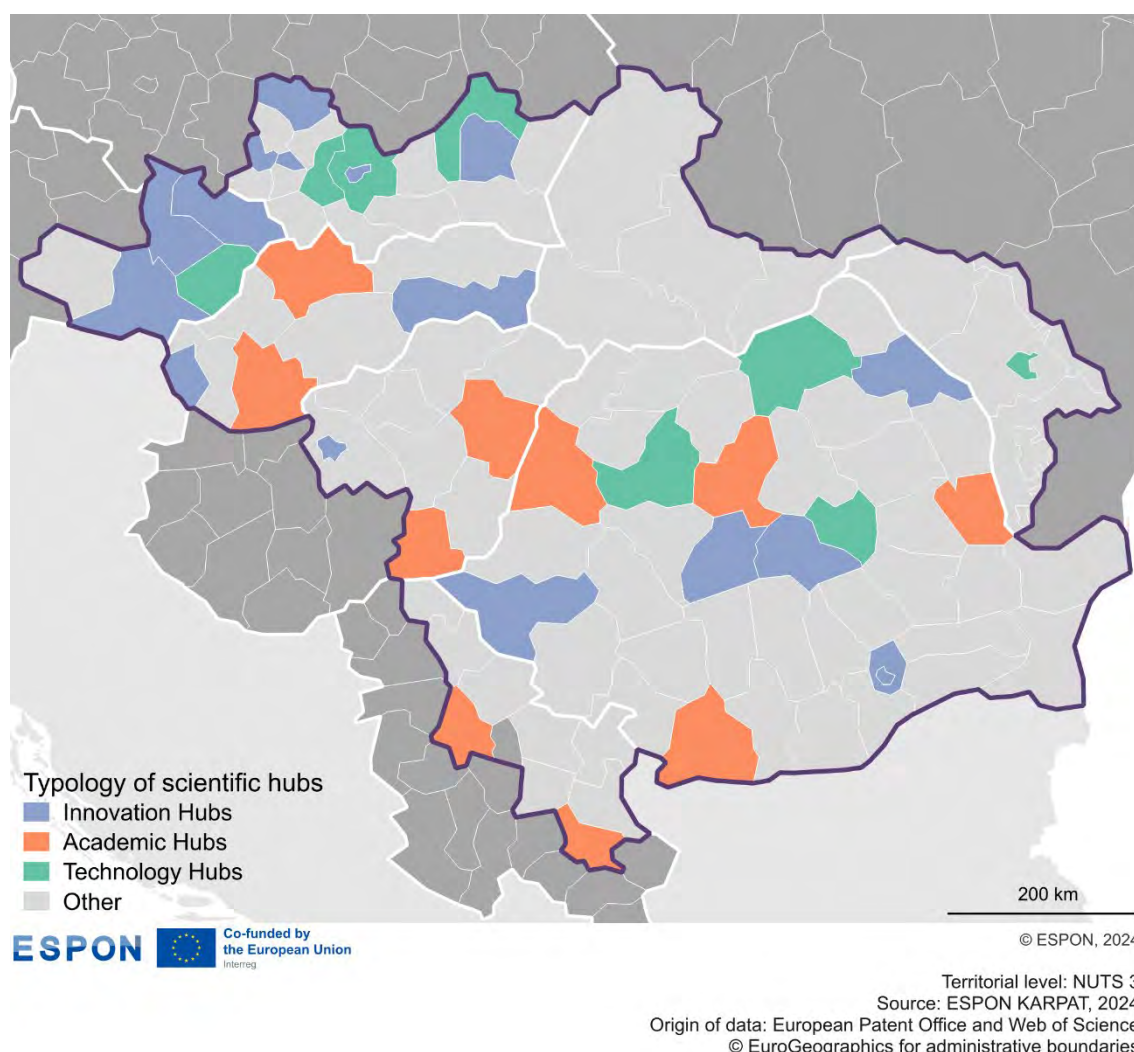
Map 2.80**Patent applications, 2011-2022**

By comparing the number of patents and publications relative to the average values for the Carpathian region and considering the levels of both indicators, four categories of regions were distinguished, each representing different levels of innovation and scientific potential (**Map 2.81**).

The first category Innovation Hubs includes the leaders of science and innovation in the Carpathians, distinguished by both high patent activity and a significant number of scientific publications. These regions include Hungarian (Budapest), Czech (Jihomoravský kraj, Olomoucký kraj, Moravskoslezský kraj), Polish (Miasto Kraków, Częstochowski, Gliwicki, Katowicki, Rzeszowski), Romanian (Braşov, Sibiu, Iaşi, Bucureşti, Ilfov, Timiş) and Slovak regions (Bratislavský kraj, Košický kraj). An excellent example is the Gliwicki region, which achieved the highest deviation in patents at +1207.7% above the average and outstanding publication results at +468.3% above the average.

The second category Technology Hubs consists of regions oriented toward practical innovation, presenting high patent activity and relatively low scientific output. These regions include Czech (Zlínský kraj), Polish (Krakowski, Oświęcimski, Tarnobrzieski), Romanian (Cluj, Covasna, Suceava) and Moldovan (Municipiul Chişinău). An exemplary case is Chişinău in the Republic of Moldova, where the number of patents exceeded the average by +438.3%, while the publication indicator remained 32.1% below the average. The spatial distribution of these regions is more dispersed, covering industrial and economically specific areas such as Moldova and certain Romanian regions.

Map 2.81
Typology of scientific hubs, 2022



The third category Academic Hubs includes academic regions characterised by strong publication indicators and low patent activity. These regions include Hungarian (Hajdú-Bihar, Csongrád-Csanád), Romanian (Bihor, Mureș, Galați, Dolj), Slovak (Nitriansky kraj, Žilinský kraj) and Serbian regions (City of Belgrade, Nišavska oblast). An example is Nitriansky Kraj in Slovakia, where the publication indicator was 26.1% above the average, while the number of patents remained 56.5% below the average. These regions are mainly located in the southern Carpathians, in smaller academic centers or on the outskirts of metropolitan areas, suggesting a greater focus on basic research rather than commercialisation activities.

The largest group, Others, comprises 67 regions with lower results in both patent activity and scientific publications, indicating limited potential in both aspects, science and innovation. These regions are widely dispersed across the Carpathians, with a particular concentration in economically less developed eastern and southern areas.

The study of technological and scientific specialisation in the Carpathian macroregion integrates patent and scientific publication analysis, capturing both technological innovation and scientific development.

Regional patents-based and publication-based specialisations

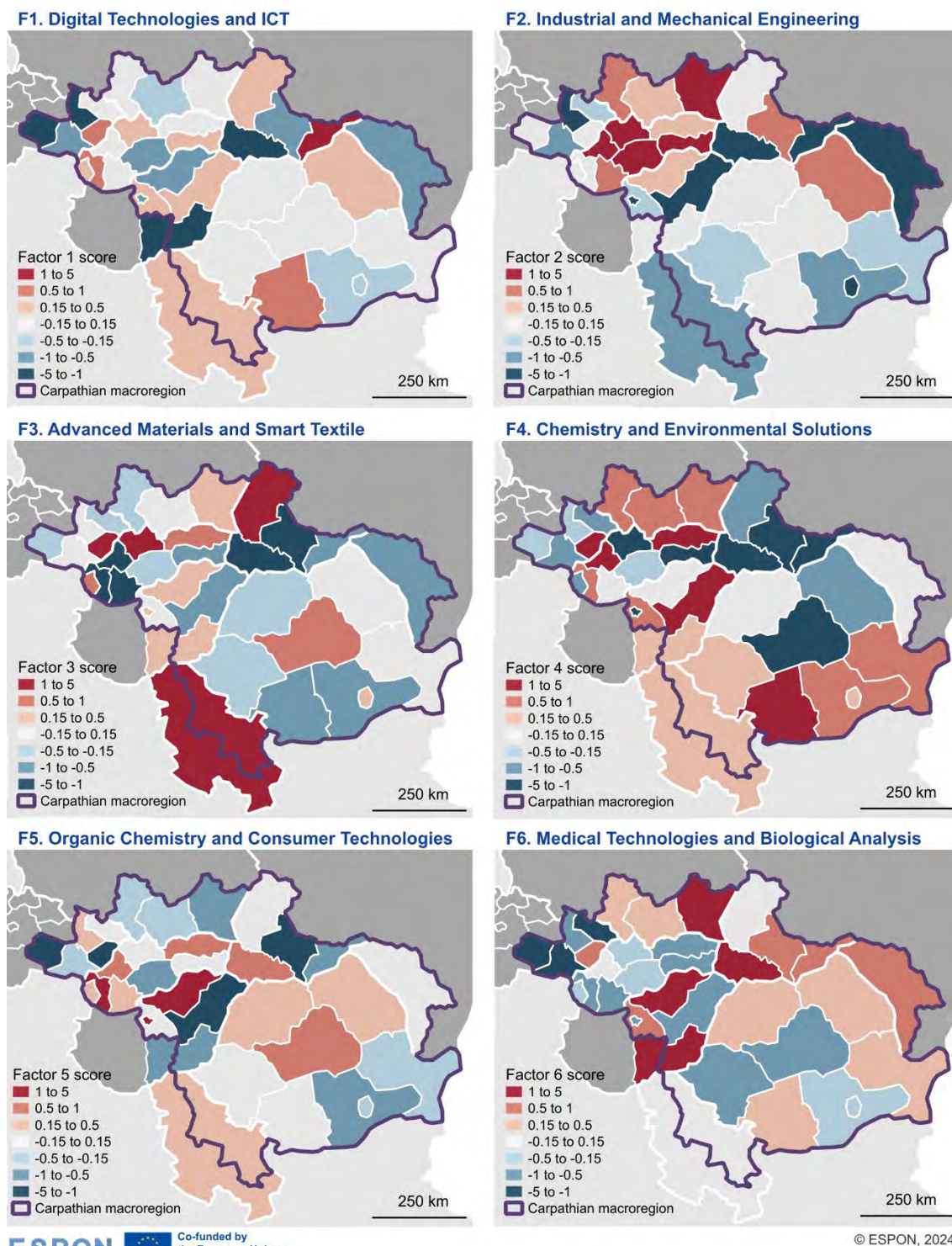
Patent data from the European Patent Office (EPO) for 2011–2021, covering 35 technological groups, and scientific publications from 2011–2022 indexed in Web of Science (WoS) were analysed using Location Quotient

(LQ) to compare macroregional sector shares. LQ analysis of 273 scientific fields and technological groups identified key areas of specialisation. Factor analysis of LQ applied to patent and publication data highlighted the region's primary technological and scientific strengths.

LQ indicators were calculated at administrative levels aligned with Smart Specialisation Strategies (S3): country level for the Republic of Moldova and Serbia, NUTS 2 for Hungary, Poland, and Romania, and NUTS 3 for the Czech Republic and Slovakia. Cartographic visualisations reveal spatial patterns of specialisation across the region.

The factor analysis of Location Quotient (LQ) indicators identified six technological groups that explain the specialisation of the Carpathian macroregion. The explained variance shares for Factors 1–6 are 12%, 11%, 9%, 9%, 8%, and 9%, c.a. 60%, indicating a fragmented and multidimensional technological structure where no single area demonstrates dominance.

- Factor 1: Digital Technologies and ICT Innovation represents a specialisation in advanced ICT technologies, including communication processes, computer technologies, and semiconductors. While these technologies indicate the potential for applications in electronics, energy systems, and automation, their relatively low absolute patent counts (e.g., 299 for semiconductors and 675 for computer technologies) highlight the region's limited scale of ICT innovation.
- Factor 2: Industrial and Mechanical Engineering emphasises mechanical and industrial technologies, such as machine handling, thermal processes, and mechanical tools. These sectors demonstrate a higher absolute number of patents (e.g., 1,272 for mechanical tools and 751 for machine handling), suggesting they form the foundation of traditional industrial strengths. However, this activity primarily reflects incremental innovations rather than cutting-edge advancements.
- Factor 3: Advanced Materials and Smart Textiles includes polymer chemistry, textile technologies, and digital communication. Despite notable LQ values, the absolute patent numbers are modest (e.g., 772 for polymer chemistry and 335 for textile machines). This factor indicates a niche specialisation with potential in high-value applications, such as intelligent textiles and biodegradable materials, but with limited broader impact.
- Factor 4: Sustainable Chemistry and Environmental Solutions focuses on chemical and environmental technologies, including chemical engineering and basic materials chemistry. These sectors display relatively higher patent activity (e.g., 1,315 for chemical engineering and 1,305 for basic materials chemistry), reflecting established specialisation. However, innovation remains rooted in traditional processes, with little evidence of breakthroughs in green and sustainable technologies.
- Factor 5: Organic Chemistry and Consumer Technologies identifies links between fine organic chemistry and consumer goods. While fine organic chemistry exhibits significant patent volume (1,103 patents), technologies related to consumer goods are less prominent (272 patents). This suggests that although the sector has established areas of specialisation, it lacks the scale and transformative potential to drive broader innovation.
- Factor 6: Medical Technologies and Biological Analysis highlight specialisation in medical technologies and biological material analysis, with the highest absolute patent count (1,445 patents for medical technologies). This indicates a relative strength in technologies critical to global health sectors. However, specialisation remains localised and has yet to translate into broader regional leadership or spillover effects into other sectors.

Map 2.82**Specialisation of regions based on patents – factor analysis, 2022**

Territorial level: NUTS 2, NUTS 3 (CZ, SK), NUTS 0 (MD, RS)
 Source: ESPON KARPAT, 2024
 Origin of data: European Patent Office
 © EuroGeographics for administrative boundaries

The regions with the highest concentration of specialisation across various sectors reveal distinct geographic patterns. In Digital Technologies and ICT (Factor 1), the leading regions include Chernivets'ka Oblast, Košice, South Moravian Region, and Sud-Vest Oltenia in Romania. Specialisation in Industrial and Mechanical Engineering (Factor 2) is prominent in the northern Carpathian areas of Poland and Slovakia, as well as in Ivano-

Frankivsk and Nord-Est Romania. A narrow corridor from north of Bratislava through Czech and Slovak regions to Lviv and Lvivska Oblast, along with Serbia and Sud-Vest Oltenia, stands out in Advanced Materials and Smart Textiles (Factor 3). The highest specialisation in Chemistry and Environmental Solutions (Factor 4) is observed in Polish and Slovak regions, the South Moravian Region in Czechia, Pest and Central Hungary, and southern Romania. In Organic Chemistry and Consumer Technologies (Factor 5), Budapest and Central Hungary, along with Nitra, Trenčín, and Košice in Slovakia, central Romania, and Zakarpatska Oblast, lead the way. For Medical Technologies and Biological Analysis (Factor 6), notable specialisation is evident in Central Hungary, Southern Great Plain, and Central Transdanubia, as well as in Podkarpackie, Zakarpatska Oblast, Chernivets'ka Oblast, Ivano-Frankivsk Oblast, and Moldova (**Map 2.82**).

The factor analysis of Location Quotient (LQ) indicators for articles published between 2011 and 2022 in Web of Science (WoS) identified ten factors that characterise the scientific specialisation of the Carpathian macroregion. These factors account for 15%, 14%, 12%, 11%, 10%, 9%, 8%, 7%, 7%, and 7% of the variance, reflecting a diverse and multifaceted research landscape without a single dominant thematic area. Disciplines with fewer than 500 articles were excluded to ensure the representation of significant research fields, allowing for a clearer assessment of the region's core scientific directions..

- Factor 1: Biomedical Sciences, Clinical Medicine, and Molecular Research (eigenvalue 29.92) encompasses disciplines such as immunology, cell biology, oncology, cardiology, and biophysics, highlighting the dominance of biomedical and clinical research. The inclusion of both basic and applied sciences underscores significant advancements in biochemistry, pharmacology, and medical diagnostics, emphasising research on molecular mechanisms of diseases and innovative therapies.
- Factor 2: Environmental and Agricultural Sciences with Ecological Research (eigenvalue 31.29) covers fields such as environmental sciences, ecology, soil science, plant biology, zoology, and biodiversity conservation. The prominence of these disciplines reflects a focus on ecosystems, biological diversity, and agricultural research. This factor also spans meteorology, agriculture, and water sciences, demonstrating a comprehensive approach to natural resource management and environmental processes.
- Factor 3: Engineering, Computer Science, and Transport Technologies (eigenvalue 18.36) includes civil engineering, construction technologies, mechanics, robotics, and interdisciplinary computer science, including artificial intelligence. This factor highlights strong specialisation in infrastructure technologies and automation. The inclusion of transport, telecommunications, and geological engineering emphasises the interdisciplinary nature of this factor, bridging industrial technology with logistics and digital engineering.
- Factor 4: Legal Medicine, Clinical Psychology, and Multidisciplinary Chemistry (eigenvalue 18.68) encompasses forensic medicine, clinical psychology, chemical engineering, and interdisciplinary chemistry, focusing on forensic science, mental health, and chemical research. The addition of linguistics and literary theory introduces cultural and social dimensions, highlighting a multidisciplinary approach that integrates health sciences with the humanities.
- Factor 5: Social Psychology, Public Health, and Humanities (eigenvalue 15.75) incorporates social psychology, public health, ethics, philosophy, and science education, reflecting research centered on social behavior and population health. The inclusion of religion, arts, and communication reinforces the interdisciplinary nature of this factor, underscoring its relevance to studies of social relations, culture, and public health.
- Factor 6: Neurology, Orthopedics, and Clinical Imaging (eigenvalue 17.32) focuses on orthopaedics, neurology, surgery, anesthesiology, and medical imaging, reflecting specialisation in the diagnostics and treatment of neurological and musculoskeletal conditions. The presence of health and sports tourism links this factor to rehabilitation and sports medicine, further emphasising its interdisciplinary scope.
- Factor 7: Health Policy, Biomedical Materials, and Analytical Chemistry (eigenvalue 11.99) includes health policy, healthcare services, biomedical materials, ceramics, and analytical chemistry, reflecting specialisation in healthcare systems and the development of advanced materials for medical and technological applications.

- Factor 8: Forestry, Political Science, and Physical Geography (eigenvalue 11.52) spans forestry, wood and paper sciences, political science, law, and physical geography. This factor highlights a focus on natural resource management, political processes, and spatial analysis.
- Factor 9: Polymer Science, Biomaterials, and Laboratory Technology (eigenvalue 11.94) emphasise polymer science, biomaterials, and laboratory technology, reflecting specialisation in materials research with applications in medicine, engineering, and industry.
- Factor 10: Archaeology, Life Sciences, and Multidisciplinary Humanities (eigenvalue 10.59) includes archaeology, biology, toxicology, and multidisciplinary humanities, underscoring research in cultural heritage, life sciences, and health.

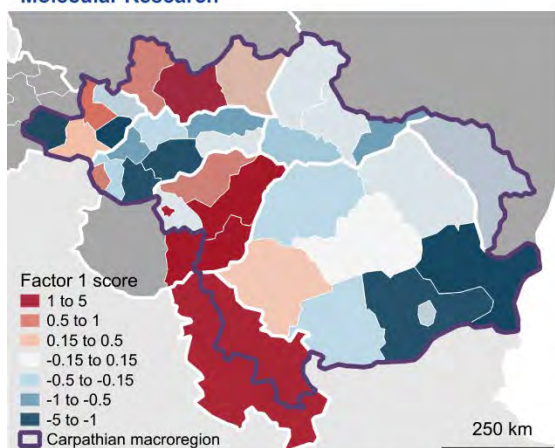
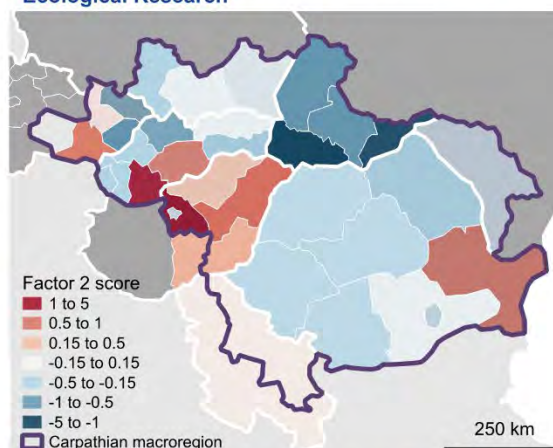
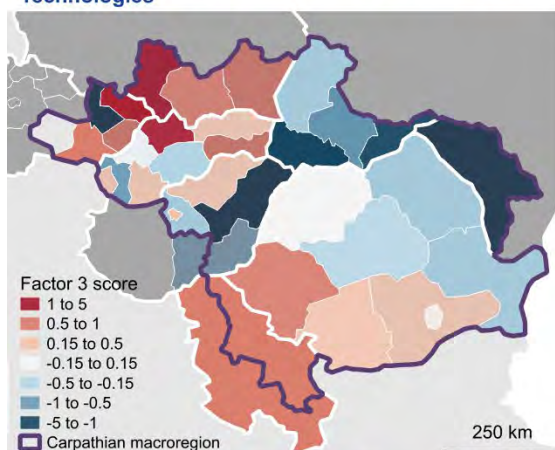
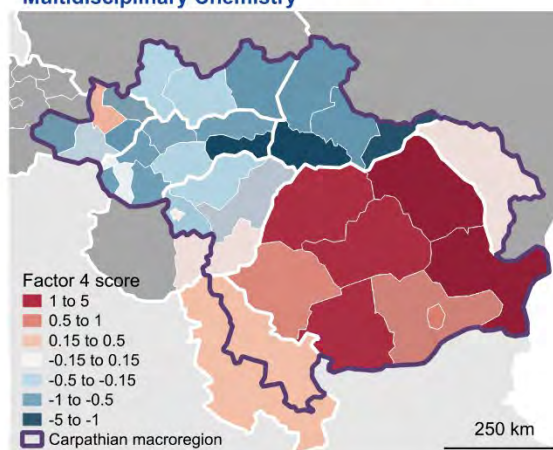
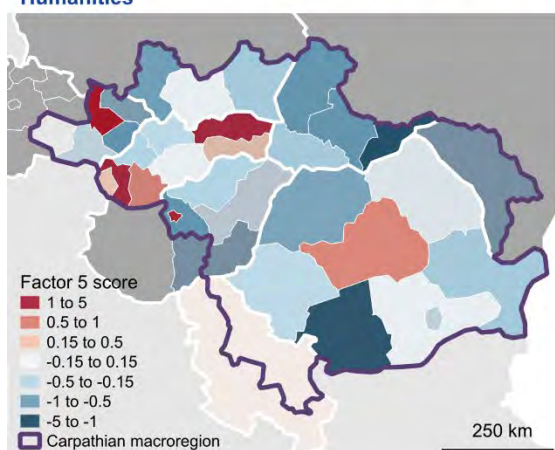
In summary, factors with the highest eigenvalues – particularly Biomedical Sciences, Clinical Medicine, and Molecular Research (Factor 1) and Environmental and Agricultural Sciences with Ecological Research (Factor 2) – account for the largest share of data variability, emphasising the critical role of biomedicine and environmental sciences in Carpathian macroregion research over the past decade. These two factors explain over 20% of the total variance, confirming that biomedical sciences and environmental sciences represent the two dominant yet contrasting trajectories of regional specialisation.

The regions demonstrating the highest concentration of specialisation in Biomedical Sciences, Clinical Medicine, and Molecular Research (Factor 1) include Budapest, Małopolska, and Serbia. The strongest hubs for this specialisation are located in the northern part of the Carpathian macroregion and the southwestern regions encompassing Serbia and Hungary. In Environmental and Agricultural Sciences with Ecological Research (Factor 2), the leading regions are those in Hungary (excluding Budapest), neighbouring Slovakia, and the Eastern Carpathians in Romania. Engineering, Computer Science, and Transport Technologies (Factor 3) are predominantly represented in the northern and southwestern parts of the macroregion. Legal Medicine, Clinical Psychology, and Multidisciplinary Chemistry (Factor 4) distinguish Romania, with Serbia also demonstrating a notable, albeit smaller, presence in this domain. Regions specialising in Social Psychology, Public Health, and Applied Humanities (Factor 5) include Olomoucký kraj, Budapest, and Slovakia's Trnavský and Košický kraj. Neurology, Orthopedics, and Clinical Imaging (Factor 6) characterise Jihomoravský kraj, Olomoucký kraj, the Hungarian Plain, and Moldova. In Health Policy, Biomedical Materials, and Analytical Chemistry (Factor 7), select Slovakia and northeastern Romania regions stand out.

Forestry, Geography, and Political Science (Factor 8) are prominent in a belt of Czech regions, two Slovak regions (Bratislava and Žilinský kraj), Nord-Vest in Romania, and Zakarpattia Oblast. Polymer Science, Biomaterials, and Laboratory Technology (Factor 9) define the western and southeastern parts of the macroregion. Meanwhile, Archaeology, Life Sciences, and Multidisciplinary Humanities (Factor 10) are dominant in regions stretching from the southwest to the northeast of the macroregion.

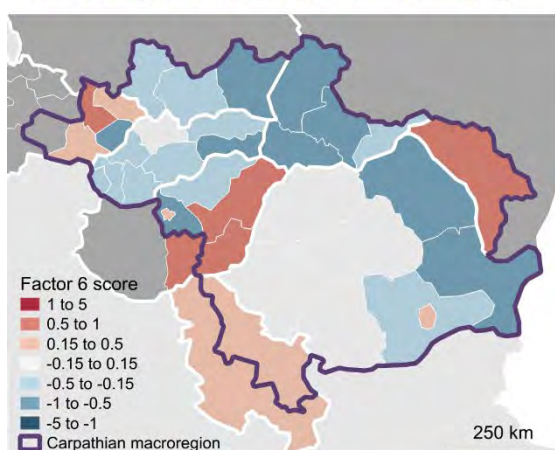
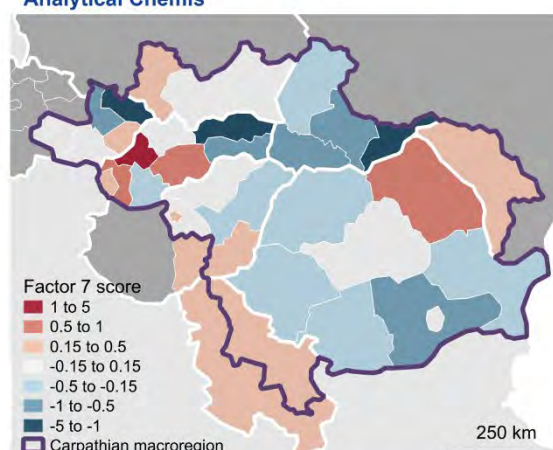
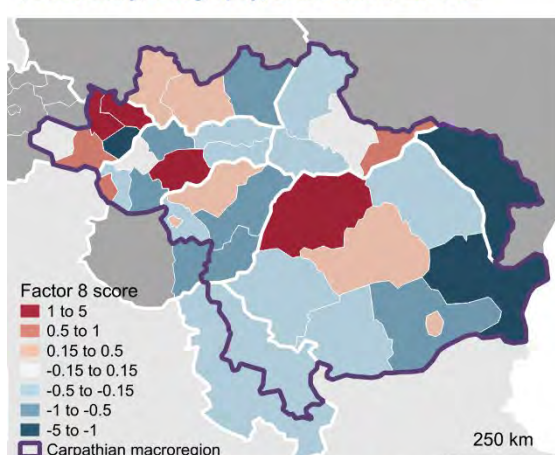
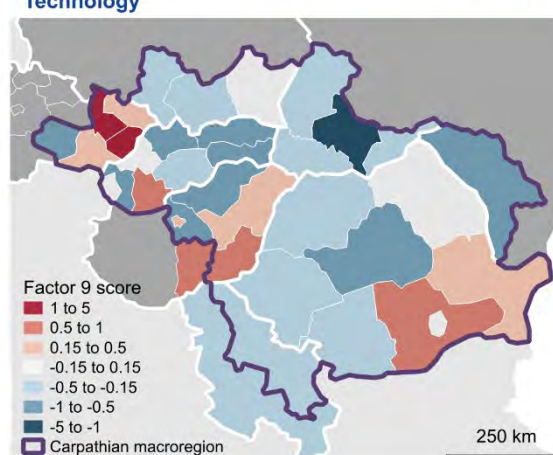
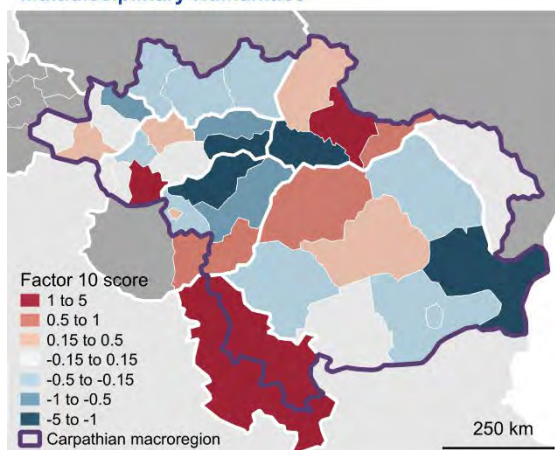
The distribution of scientific specialisations across the Carpathian macroregion shows significant variation. However, the analysis of positive and negative eigenvalues does not reveal a clear spatial division separating regions by distinct development trajectories. Instead, these values suggest complementary specialisation patterns that often coexist within the same areas. High eigenvalues for biomedical and technological sciences (e.g., Factor 1 – Biomedical Sciences, Clinical Medicine, and Molecular Research, Factor 5 – Social Psychology, Public Health, and Humanities, and Factor 6 – Neurology, Orthopedics, and Clinical Imaging) are concentrated in large, urbanised centers with advanced academic infrastructure, such as Budapest, Prague, Bratislava, and Małopolska. These areas demonstrate strong ties between medical science development and the presence of academic institutions, research centers, and medical infrastructure, fostering intensive research and publication activity.

In contrast, ecology, humanities, and social sciences (e.g., Factor 2 – Environmental and Agricultural Sciences with Ecological Research, Factor 3 – Engineering, Computer Science, and Transport Technologies, Factor 4 – Legal Medicine, Clinical Psychology, and Multidisciplinary Chemistry, Factor 8 – Forestry, Political Science, and Physical Geography, and Factor 10 – Archaeology, Life Sciences, and Multidisciplinary Humanities) are more prevalent in less urbanised, mountainous, and natural areas like Northern Hungary, the Eastern Carpathians in Romania, Zakarpattia, and Košice. These regions focus on environmental protection, cultural heritage, and construction engineering. Despite the theoretical distinction between positive and negative values, the data reveals that these two specialisation types frequently overlap within many regions. The Carpathian macroregion's scientific profile is marked by a balance between biomedical innovation, environmental sciences, and engineering advancements, reflecting the region's diverse economic and natural landscape.

Map 2.83**Specialisation of regions based on scientific publications – factor analysis, 2022****F1. Biomedical Sciences, Clinical Medicine, and Molecular Research****F2. Environmental and Agricultural Sciences with Ecological Research****F3. Engineering, Computer Science, and Transport Technologies****F4. Legal Medicine, Clinical Psychology, and Multidisciplinary Chemistry****F5. Social Psychology, Public Health, and Applied Humanities****ESPON**Co-funded by
the European Union
Interreg

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Territorial level: NUTS 2, NUTS 3 (CZ, SK), NUTS 0 (MD, RS)
 Source: ESPON KARPAT, 2024
 Origin of data: Web of Science
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F6. Neurology, Orthopedics, and Clinical Imaging**F7. Health Policy, Biomedical Materials, and Analytical Chemis****F8. Forestry, Geography, and Political Science****F9. Polymer Science, Biomaterials, and Laboratory Technology****F10. Archaeology, Life Sciences, and Multidisciplinary Humanities****ESPON**Co-funded by
the European Union
Interreg

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The combination of health-focused research, environmental sustainability, and technological progress suggests a synergistic development pathway that leverages regional strengths in medicine, ecology, and applied sciences.

The analysis of patents and publications in the Carpathian macroregion reveals a diverse and fragmented scientific and technological specialisation landscape with no dominant field. Biomedicine emerges as a notable sector, with Biomedical Sciences, Clinical Medicine, and Molecular Research prominent in publications and Medical Technologies and Biological Analysis reflected in patents. This highlights the region's strength in health-related research and medical technologies.

The results suggest potential interdisciplinarity, with overlapping fields across natural, social, and technological sciences. However, this coexistence, observed in factor analysis, points to parallel development rather than fully integrated progress, indicating that scientific and technological advances unfold at varying scales and paces without a clear thematic leader.

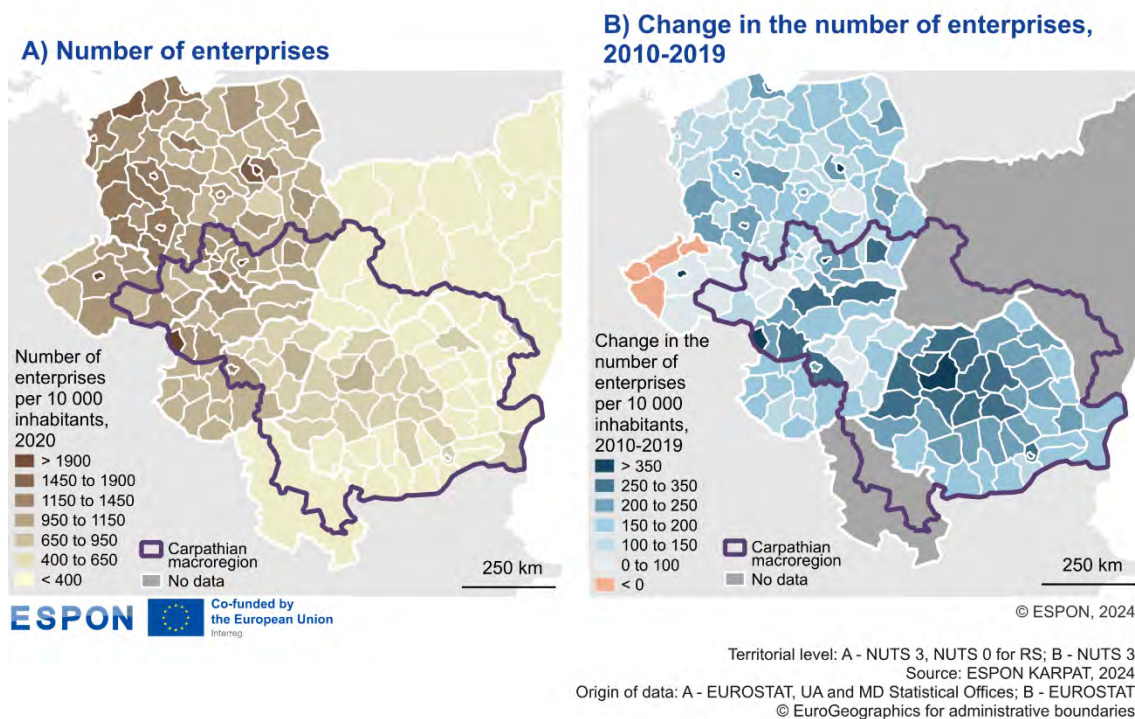
A key distinction emerges between patents and publications: patents emphasise industrial strengths in Industrial and Mechanical Engineering and Advanced Materials and Smart Textiles, reflecting the region's industrial roots, while publications prioritise environmental and agricultural sciences, driven by the Carpathians' ecological and agricultural importance.

Despite the strong academic focus on environmental research, patent activity in ecology and agriculture remains low, suggesting limited technological innovation. This contrast indicates that while biodiversity protection and ecosystem research are well-represented in publications, they have yet to translate into patents or industrial applications.

2.3.4 Entrepreneurship

Entrepreneurship is important for understanding the region's economic dynamics, as it reflects local innovation (especially if it is led by market opportunity), employment trends, and economic resilience. While entrepreneurship can be a result of the market-oriented pursuit, whereby individuals establish businesses in response to existing or anticipated market needs, it can also be driven by necessity, as challenging labour market conditions leave individuals with no other viable employment options. Furthermore, it is important to bear in mind that not all registered businesses are actively operating; many enterprises in the Carpathian macroregion remain formally registered but inactive (Dvoulety, 2024), which can distort economic analyses and lead to overestimations of entrepreneurial activity.

Map 2.84
Entrepreneurship, 2020



The distribution of enterprises per 10,000 residents across the region demonstrates significant disparities, laying bare the economic dynamics at play in Central and Eastern Europe. Those discrepancies reflect the natural advantage of metropolitan areas, where access to resources, infrastructure, and vibrant markets fosters higher concentrations of entrepreneurial activity. Hence, Bratislava and Krakow occupy the top positions

in the ranking with almost 2000 enterprises per 10,000 inhabitants. Budapest, the capital of Hungary, occupies the third position with 1,325 enterprises per 10,000 residents, thereby underscoring its status as the country's principal centre of economic activity.

Overall, the selected Polish, Czech and Slovak regions performed well, with numerous urban and industrial areas exhibiting elevated concentrations of enterprises per capita, thereby exemplifying high regional economic activity. In Poland, regions such as Katowicki and Bielski also demonstrate a high ranking, each with enterprise densities markedly exceeding 1,000 businesses per 10,000 residents. These areas, historically associated with Poland's coal belt, have successfully diversified their economies in recent years, fostering an environment conducive to business growth as the industrial landscape evolves. Enterprise density in Slovakia and the Czech Republic remains among the highest in the region, with averages considerably above those of many neighbouring countries. Notably, several Czech and Slovak regions, including Jihomoravský kraj and Žilinský kraj, as well as Nitriansky kraj and Zlínský kraj, exhibit particularly strong performances in terms of enterprise density. These regions may benefit from a robust infrastructure and policies that encourage entrepreneurship and endogenous economic growth.

In comparison, Romania and its regions lag significantly, with the exception of its capital, București, which recorded nearly 800 enterprises per 10,000 residents. In stark contrast, the most underserved areas of Romania, such as Giurgiu, Botoșani, and Teleorman, recorded values significantly below 300 enterprises per 10,000 residents, making them the least entrepreneurial within the EU. These regions, situated in the southern and north-eastern parts of the country, are confronted with a potential series of systemic challenges, including a paucity of investment, an absence of adequate infrastructure and a geographical peripherality that impedes the development of a thriving business ecosystem.

The situation in non-EU countries is even more pronounced. Enterprise density in Ukraine is notably low, with Zakarpatska and Chernivets'ka exhibiting the figures oscillating around 50 enterprises per 10,000 residents. By the same token, Moldova's Regiunea Sud recorded similar values, also below 60. These regions of Ukraine and the Republic of Moldova, alongside other regions, such as Ukraine's Ivano-Frankivska and Moldova's Regiunea Nord, which fared slightly better, have endured years of economic instability, inadequate access to markets, and persistent geopolitical challenges. Meanwhile, Serbia boasts 294 enterprises per 10,000 residents, yet those are figures available at NUTS0 level, which does not allow to analyse regional disparities in the country.

The number of enterprises per 10,000 residents increased in all Carpathian macroregion NUTS3 regions between 2010 and 2020, indicating a rise in entrepreneurial activity across the area. The most precipitous increases were observed in the metropolitan areas of Bratislavský kraj, City of Kraków and Cluj, where the decade between 2010 and 2020 witnessed a spike of over 350 companies per ten thousand inhabitants. These were followed by steep increases in some regions of Romania and Slovakia. In the former case, particularly large increases occurred in the Transylvanian regions and the weakest in the southern and eastern peripheral regions. In the case of Slovakia, the largest increases occurred in the regions bordering Poland, which could potentially indicate the development of cross-border interactions, and in the Nitra region.

Conversely, the lowest rates of increase were observed in regions with saturated enterprise landscapes, such as the Czech Republic's and Silesia in Poland; in these regions, the number of enterprises per 10,000 residents was already approximately 1,000 in 2010. Yet, the growth in the number of enterprises not surpassing 100 entities per 10,000 inhabitants was also seen in some entrepreneurially underdeveloped regions in the eastern part of Hungary (e.g. Jász-Nagykun-Szolnok or Heves).

Structure of enterprise sector

This section analyses the structure of the enterprise sector in the Carpathian macroregion, placing a premium on three selected branches, i.e. industry (NACE sections B-E), tourism (NACE section I), and advanced business services (NACE sections J-N). The comparison highlights regional differences in economic specialisation and the significance of these sectors for local economies.

Advanced services emerge as a sector that prevails over industry and tourism across all countries, particularly in Hungary and Slovakia, where they account for more than a third of entrepreneurial activity overall. Industry also plays a significant role, with countries such as Czechia and Serbia showing a greater business activity in this sector, while Hungary and Romania exhibit a lower such share in industrial entrepreneurs compared to others. Tourism, by contrast, has a relatively smaller share across the board, with Serbia displaying the

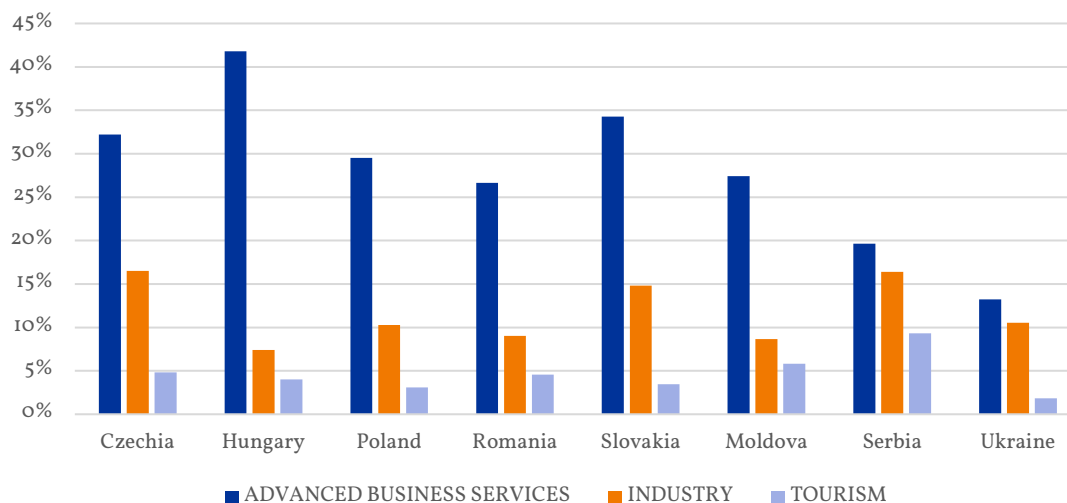
relatively highest values, while countries like Hungary and Czechia are marked by more modest levels of entrepreneurship in tourism in comparison to other sections, and Ukraine recording the lowest values.

Some regions (including Carpathian ones) in Romania, Poland, and Hungary show much higher levels of entrepreneurship in industrial branches compared to their national averages, as evidenced by location quotients (LQ) exceeding 1.5 in Romania's Harghita, Neamţ, and Covasna, Hungary's Jász-Nagykun-Szolnok, and Poland's Częstochowski.

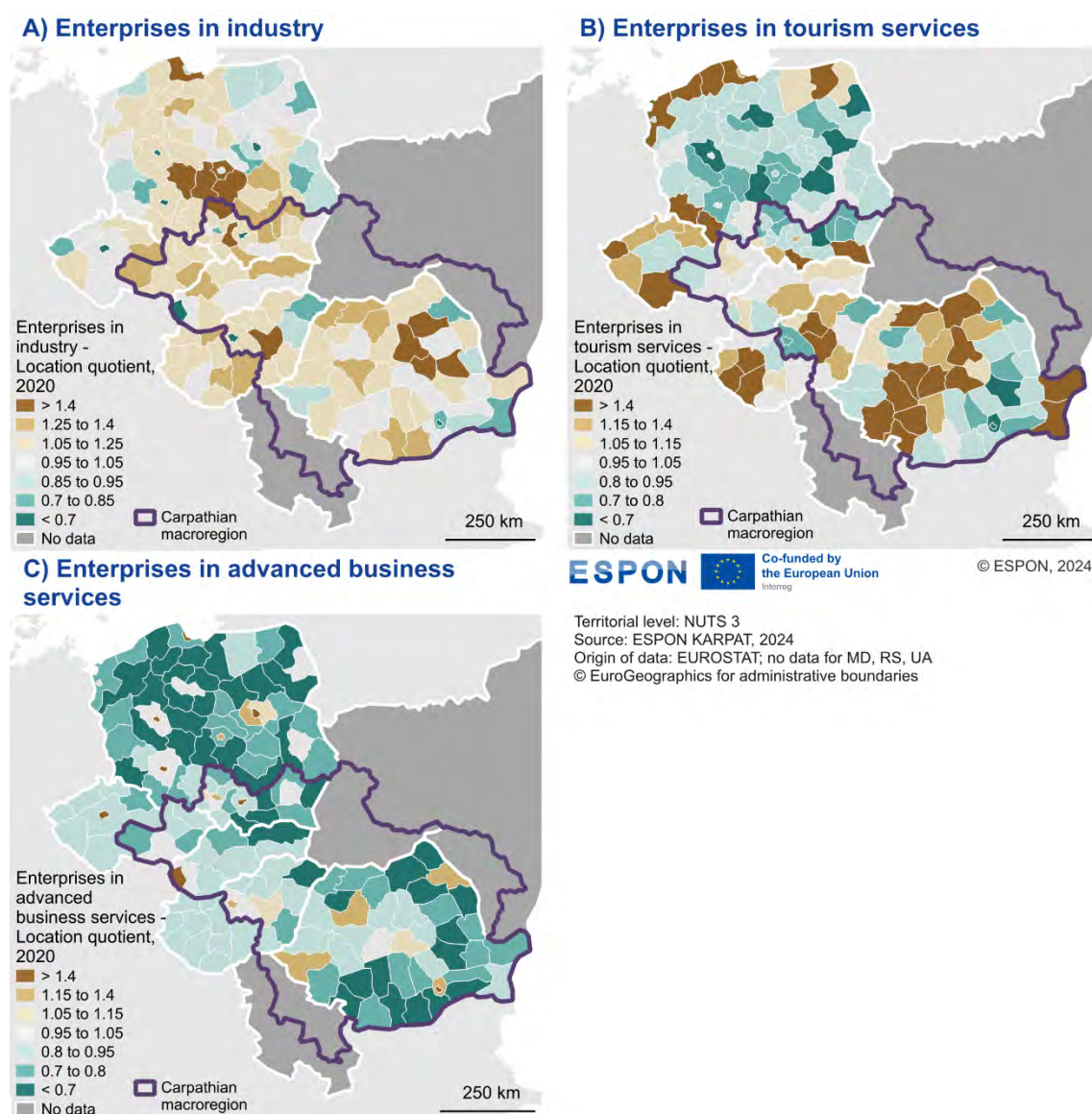
In contrast, the least relatively entrepreneurial activity was observed in major urban centres such as Budapest, Miasto Kraków, Bratislavský kraj, and Bucureşti, all with LQ values below 0.7, reflecting their service-oriented economies. Low LQs were also recorded in Romania's Constanţa, mostly comprising a sea resort, and Poland's Katowice region has shifted away from its coal-based industrial legacy, as demonstrated by a significant decrease in employment in mining activities. In Hungary, the lowest level of entrepreneurship in industry was observed in the Szabolcs-Szatmár-Bereg region bordering Ukraine. Interestingly, in Romania the pattern is in keeping with the geographical distribution of the country's industrial zones. At the same time, Hungary and Slovakia are characterised by well-developed entrepreneurship in industry, also in larger metropolitan macroregions of their national capitals.

The share of tourism services in the economy, as reflected in the location quotient (LQ), varies significantly across regions in the Carpathian macroregion, with certain areas standing out due to their strong tourism orientation. The highest LQ, exceeding 4, was recorded in Poland's Nowotarski region, home to Zakopane, the country's most recognisable mountain resort, highlighting the importance of tourism-related activities in this area. In Romania, the sea resort regions of Tulcea and Constanţa showed LQs nearing 2, thus further emphasising the importance of hospitality services in these coastal areas. Overall, some regions in Romania (including border regions of Suceava and Caras-Severin as well as some mountain regions in Eastern and Southern Carpathians) and in Eastern Hungary (Heves and Jász-Nagykun-Szolnok) tend to exhibit higher LQs in tourism services, followed closely by some Polish mountain regions, such as Krośnieński and Bielski.

Chart 2.29
Share of enterprises in selected branches, 2021



Source: Own elaboration based on Eurostat.

Map 2.85**Entrepreneurship specialisation in selected branches, 2020**

* location quotient at country level for share of enterprises in a) industry (NACE, Section B-E), b) tourism services (NACE, Section I) c) advanced business services (NACE, Section J-N)

On the other hand, the lowest LQs, around 0.5, were observed in București and slightly higher in the surrounding region of Ilfov, reflecting the relatively limited role of entrepreneurship in tourism services in the capital and its immediate vicinity. Similarly low LQs, approximately 0.7, were noted in southern Polish regions such as Tarnowski and Rzeszowski, suggesting a relatively low specialisation in the tourism sector by local entrepreneurs.

The share of advanced services in the economy, as indicated by location quotient (LQ), demonstrates a strong concentration in metropolitan and urban areas across the Carpathian macroregion. The highest LQs, exceeding 1.5, were recorded in major urban hubs such as București, Bratislava, and Krakow, underscoring the prominence of advanced business and professional services in these cities. These were followed by Budapest, Romania's second-largest city of Cluj. This phenomenon was also observed in other major cities, such as Iași, Timișoara, and Brașov in Romania; Rzeszów and the Upper Silesian Metropolis in Poland; and to a lesser extent, Košice and Banská Bystrica in Slovakia, as well as Brno and Ostrava in the Czech Republic, which provide this type of service for their respective regional surroundings.

In contrast, the lowest LQs were observed in some peripheral regions, i.e. Poland's Nowotarski and Hungary's Szabolcs-Szatmár-Bereg, respectively, both hovering around 0.5. Similarly, Romanian regions like Vaslui, Teleorman, and Vrancea, which are among the poorest in the country, also recorded LQs of 0.6 or lower, highlighting the limited presence of advanced services in these areas. Overall, Romania had the most regions with low LQs in advanced services, followed by Poland and Slovakia, indicating a significant role of large urban centres that provide advanced business services for their regional surroundings.

Business demographics

This section examines business demography, focusing on enterprise birth and death rates in 2021, a year shaped by the ongoing effects of the COVID-19 pandemic. The pandemic disrupted normal business patterns, therefore it might to an extent influence the comparability of 2021 data with other periods. However, when compared to the earlier period, it is evident that the impact of the pandemic was not significant, as the average birth rate for the period 2016-2019 was approximately 12% for the Carpathian EU member countries (with the exception of the Czech Republic, where it was lower at 9), similarly to the death rate, which was around 9%, and in the Czech Republic approximately 7%.

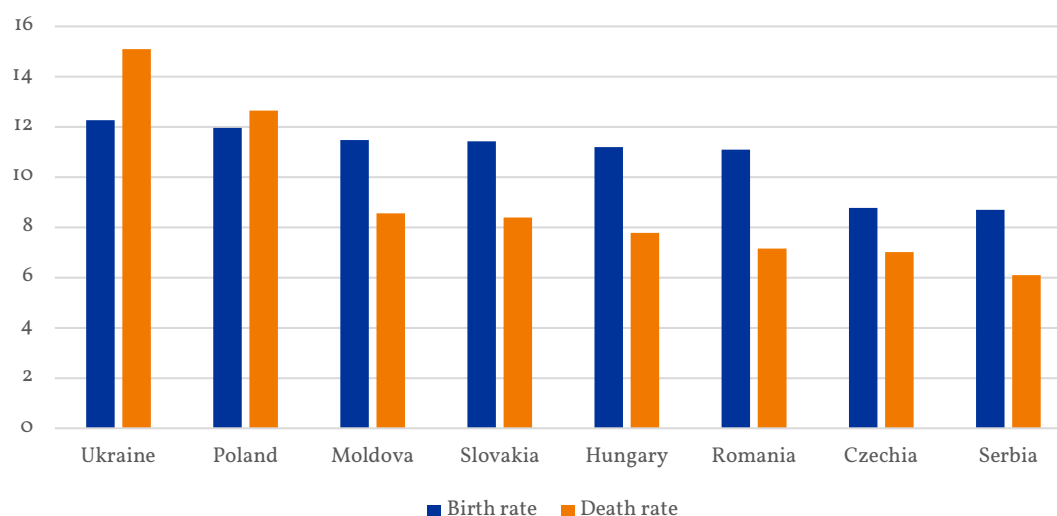
Poland and Hungary exhibit the highest business creation rates in the macroregion in 2021, with figures approaching 12%, indicating dynamic entrepreneurial activity. Romania and Slovakia follow closely, reflecting relatively high rates that remain just below the leading pair. The Republic of Moldova and Serbia demonstrate rates slightly above the EU average of 10.7%, suggesting moderate levels of new business formation. In contrast, Czechia and Ukraine report notably lower rates, approximately 2 percentage points below the EU benchmark, highlighting comparatively subdued entrepreneurial activity in these countries. In the former case, this may be attributed to a long-term equilibrium relationship between business churn, company survival rates, and real GDP per capita (Andrei et al., 2021), while in the latter case it may be derived from various bureaucratic barriers.

Ukraine and Poland exhibit enterprise closure rates significantly above the EU average, highlighting contrasting entrepreneurial dynamics in the two countries. In Poland, the high closure rate is offset by an equally high birth rate, indicating a dynamic entrepreneurial ecosystem where the natural growth rate of enterprises is near zero. In Ukraine, however, the combination of a high closure rate and a low birth rate points to unfavourable conditions for entrepreneurship and a struggling business environment. The Republic of Moldova, Slovakia, and Hungary recorded closure rates near the EU average, suggesting relative stability in these countries. At the lower end of the spectrum, Romania and Czechia reported low closure rates, potentially reflecting greater business resilience, while Serbia recorded the lowest rates, more than 2 percentage points below the EU average, potentially suggesting an unusually stable entrepreneurial climate.

The highest enterprise birth rates in the Carpathian macroregion were observed in Poland, Hungary, and Romania, with specific regions standing out for their high values. The importance of the proximity of major urban centres is evident, influencing the development of entrepreneurship in the metropolitan regions of Bucureşti in Romania and Poland's Rzeszowski and Kraków. In Poland, the growth in the number of new companies has also been fostered by the border location with Ukraine. In contrast, the lowest rates were observed in the Czech Republic and some regions of Romania, including the border ones, thus producing a conclusion that a location close to the frontier might bring about different outcomes.

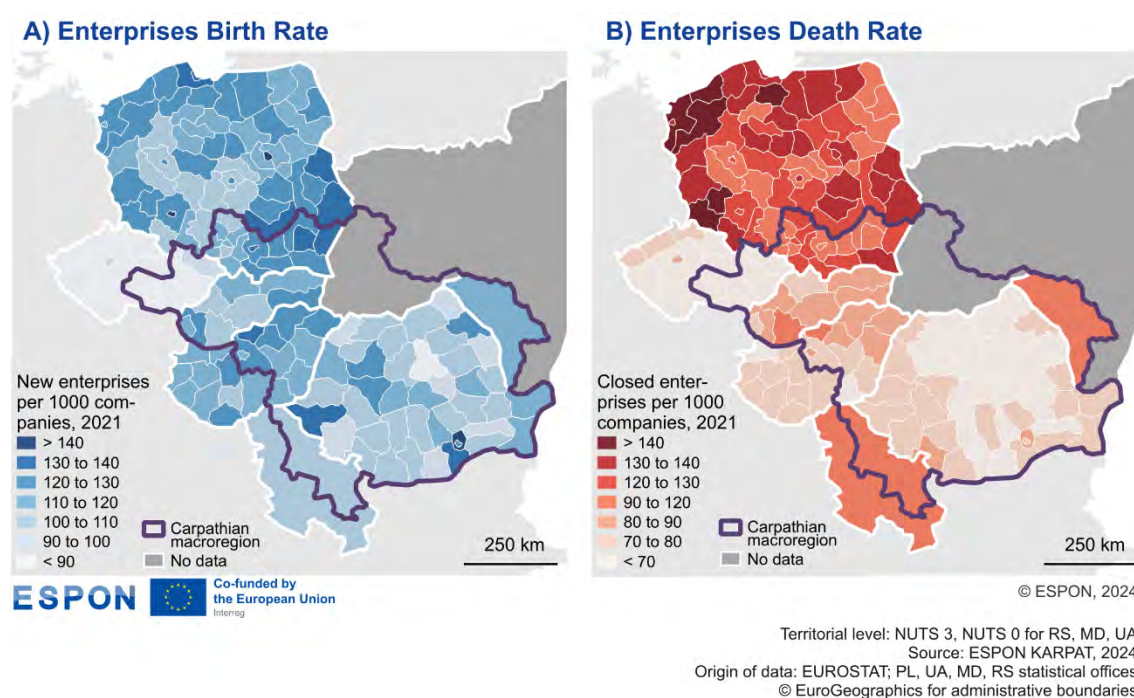
The highest enterprise closure rates were observed in Poland, with values reaching up to 130 closures per 1,000 companies in regions such as Krośnieński at the border with Slovakia. These figures, juxtaposed with their exceptionally high birth rates, suggest a volatile business environment characterized by significant turnover and limited long-term stability for enterprises. Overall, Poland consistently recorded the highest death rates, reinforcing this pattern of entrepreneurial dynamism coupled with instability. Following these were Slovak regions such as Prešovský kraj and Nitriansky kraj, the former of which lies at the border with Poland and the latter at the border with Hungary, as well as the Hungarian region of Nógrád, located at the border with Slovakia. In stark contrast, the lowest closure rates, oscillating around 50 closures per 1,000 companies, were found in Romania and the Czech Republic.

Chart 2.30
Birth rate and death rate of enterprises, 2021



Source: Own elaboration based on Eurostat.

Map 2.86
Business demography, 2021



2.3.5 Investments and business environment

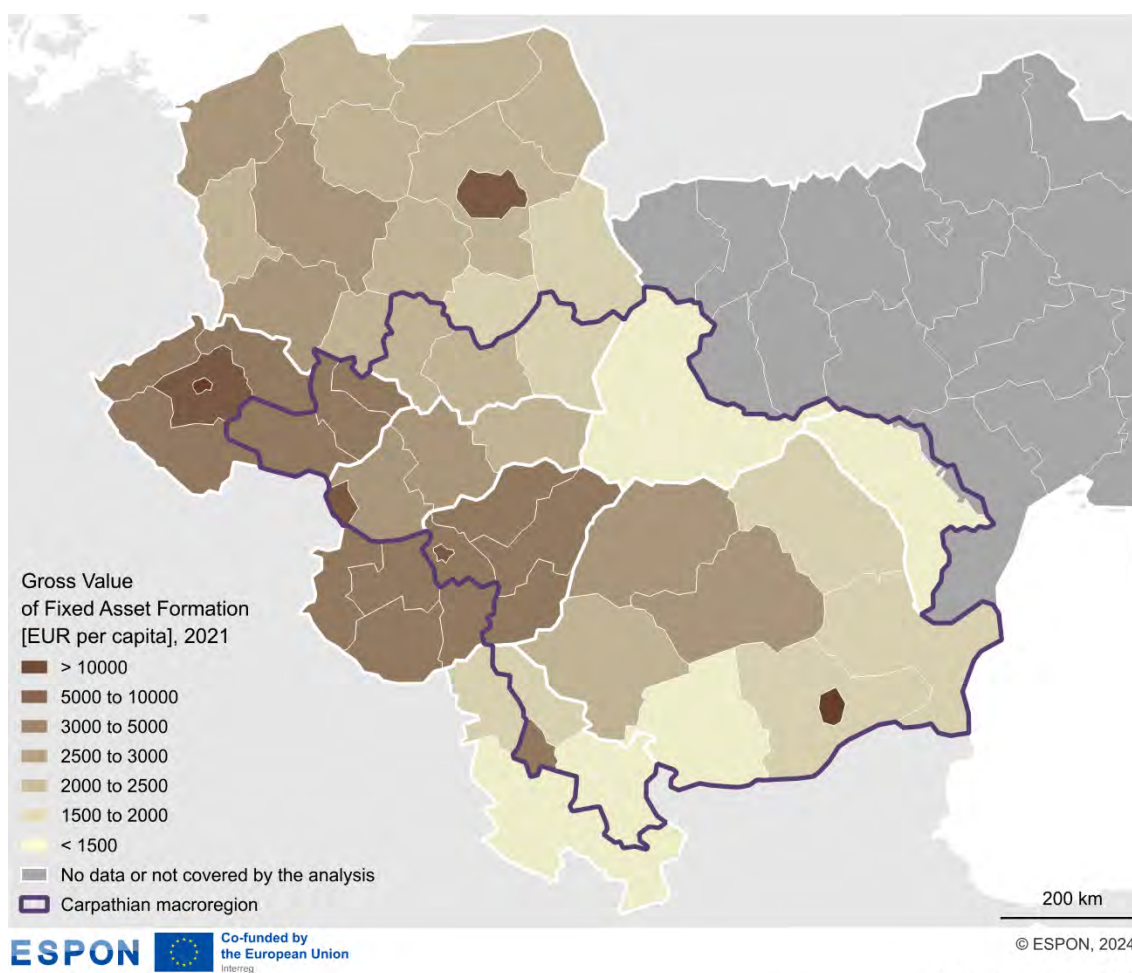
Investment and business incentive issues play a crucial role in shaping the economic development and wealth levels of regions, making them an essential element of analysis for the Carpathian macroregion. The per capita value of fixed assets (are long-term tangible or intangible assets used in business operations, not intended for resale like buildings, machinery, vehicles) and the structure of sectoral investments enable an assessment

of the economic advancement level and its capacity to absorb new investments, directly impacting the quality of life for residents and economic growth prospects. Increased investment levels, particularly in the form of foreign direct investment and special economic zones, support job creation, infrastructure modernisation, and the introduction of innovative solutions, which in turn enhance the region's attractiveness to further investors. Concurrently, business incentive policies and institutional support are important as they help to equalize development disparities, especially in peripheral areas, stimulating growth and counteracting stagnation.

The value of fixed assets formation is one of the key indicators of economic development. This aspect is typically strongly linked — especially in international comparisons using fixed asset valuations in EUR — with the overall level of regional affluence measured by GDP per capita. Based on this indicator, regions in the Carpathian macroregion differ significantly in their investment levels, with Czech and Hungarian regions standing out positively, while Ukrainian, Moldovan, and selected Romanian and Serbian regions lag behind in investment (**Map 2.87**). In Poland, Slovakia, and Romania, a west-east disparity in fixed asset values is evident.

Map 2.87

Gross Value of Fixed Assets Formation, 2021



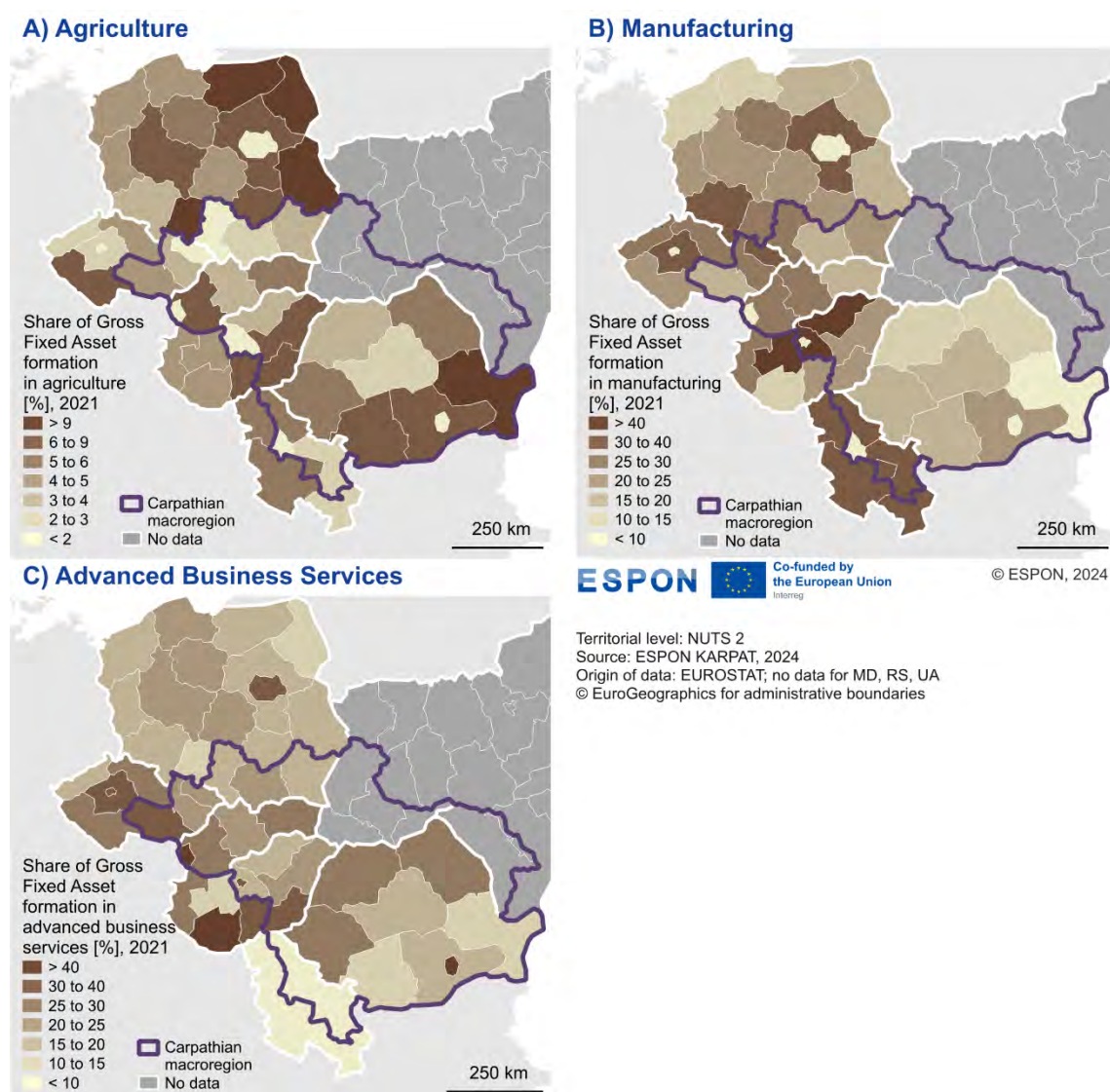
Territorial level: NUTS 2
Source: ESPON KARPAT, 2024
Origin of data: EUROSTAT, UA and MD Statistical Offices
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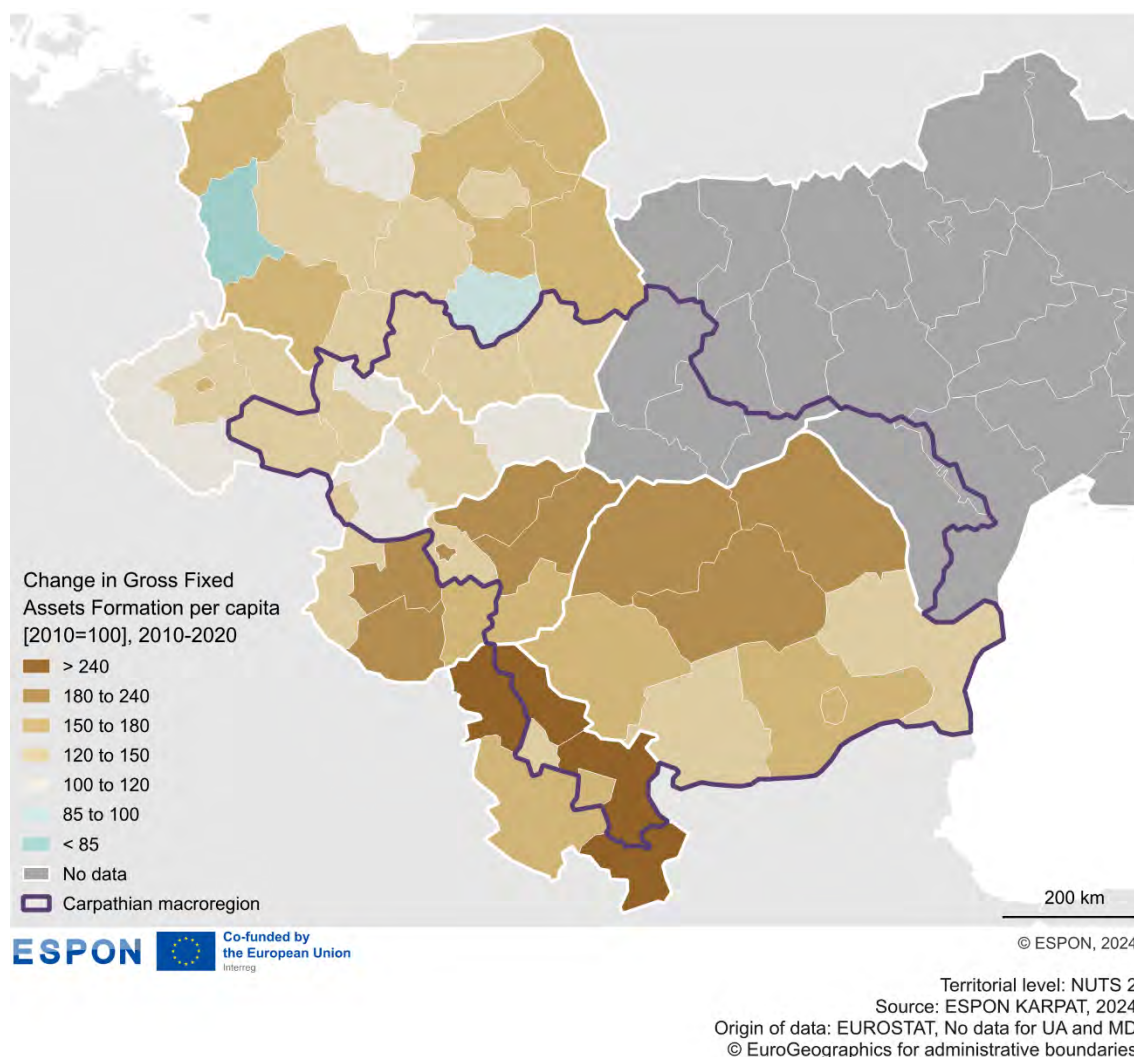
The structure of fixed assets formation can also indicate the importance of various sectors in a region's economy (**Map 2.87**). For instance, the significance of agriculture, as derived from this analysis, was relatively high in select Romanian regions, particularly in Wallachia, as well as in parts of Hungary and Slovakia, which may

indicate the high intensity of agricultural production. Conversely, in Polish regions within the macroregion, agriculture's share in the fixed asset formation was low, linked to the fragmentation of farms, which, unlike in other CEE countries, did not experience widespread agricultural collectivization after World War II. A similar situation occurred in parts of Transylvania and the mountainous regions of Serbia, where agricultural fragmentation was also relatively high. In terms of industrialization, regions in the northwest of the macroregion, particularly northern Hungary, stood out. Meanwhile, the strictly urban regions of Bratislava, Budapest, and Bucharest were intensively invested in advanced business services. This resulted in a high share of this sector in the fixed asset formation and simultaneous low shares of agriculture and industry. Besides these cities, the significant share of advanced business services also applied to regions hosting the largest urban centres of the macroregion, visible in Romania, Slovakia, and, to a lesser extent, Poland.

Map 2.88

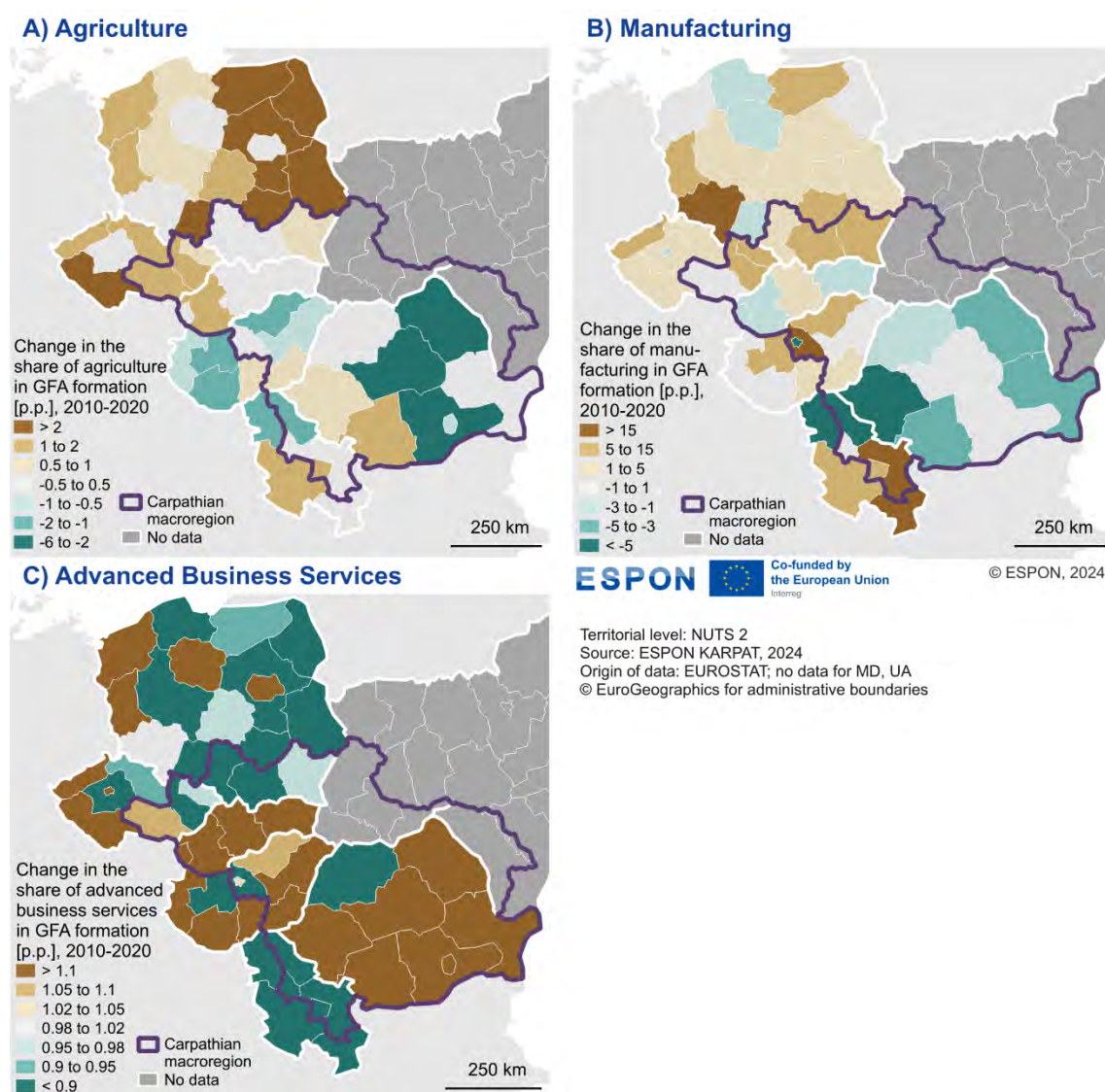
Structure of Gross Fixed Assets Formation, 2021



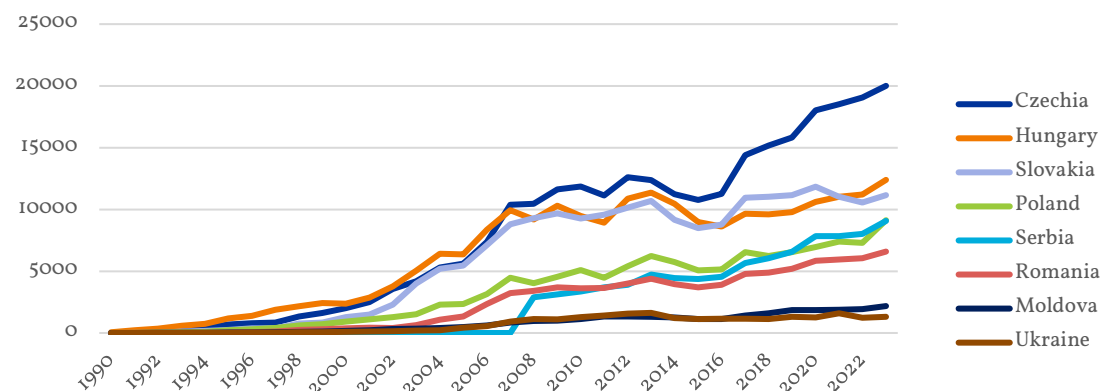
Map 2.89**Change in Gross Fixed Assets Formation per capita, 2010–2020**

Over the last decade, growth in the gross value of fixed assets per capita was particularly evident in Serbia, as well as in Romania — especially in its northern regions — and in eastern Hungary (**Map 2.89**). Conversely, a relative decline was observed in Polish, Slovak, and Czech regions, which may indicate that under the conditions of rapid economic growth experienced by these countries, there has been an increase in the efficiency of using existing fixed assets. In Poland and the Czech Republic, this was accompanied by a relative increase in the importance of fixed assets in the production sector, while in Slovakia, Romania, and Hungary, the importance of advanced business services grew (**Map 2.90**).

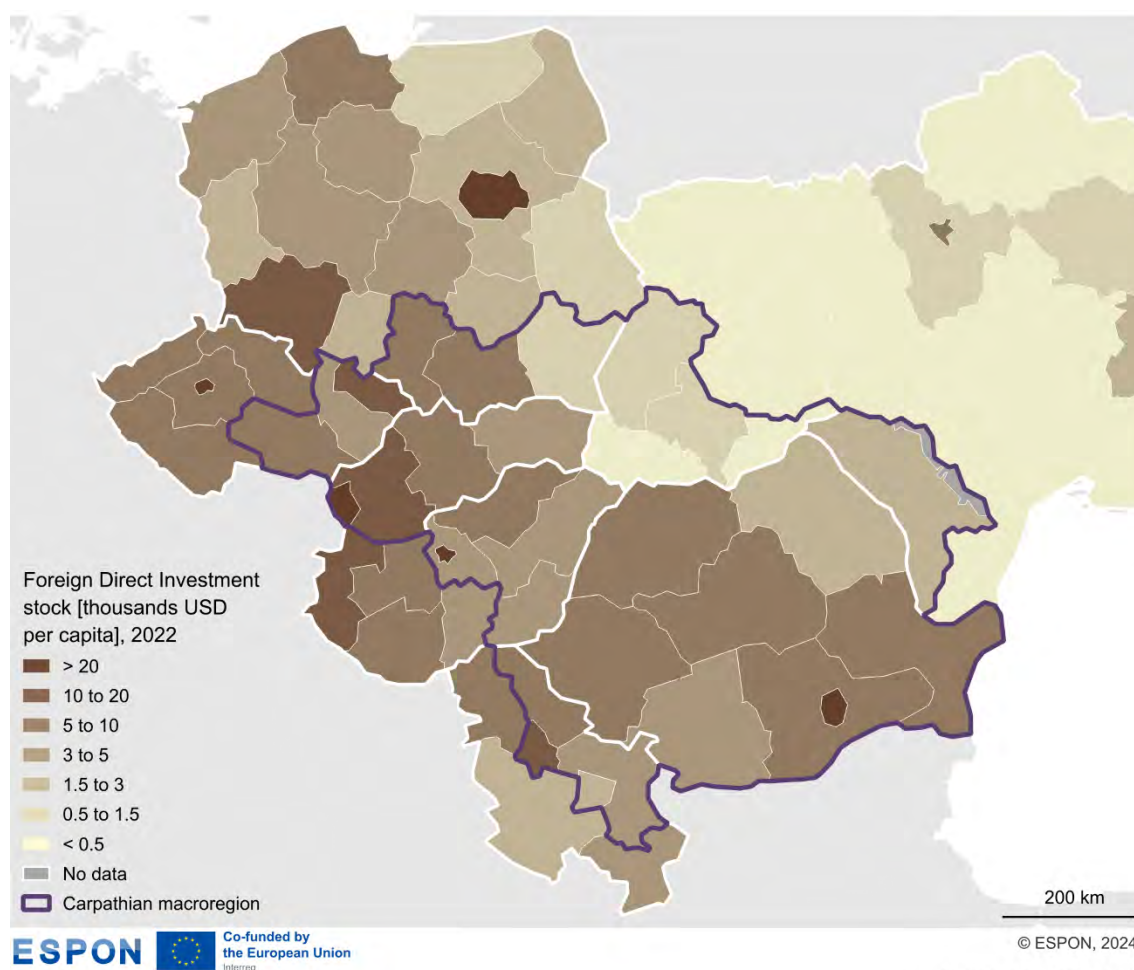
Changes in the gross value of fixed assets are largely driven by new investments. In particular, during the early stages of economic transformation, under conditions of limited domestic capital, foreign direct investment (FDI) played a crucial role. However, as economies grew, the role of FDI gradually diminished, and individual countries increasingly became exporters of investments to other countries. According to UNCTAD data on investment inflows per capita since 1990, the Czech Republic ranks first among Carpathian countries (**Chart 2.31**).

Map 2.90**Change in the Structure of Gross Fixed Assets Formation, 2010–2020**

This country, especially after 2016, significantly outpaced Hungary and Slovakia, which before 2008 had experienced FDI growth rates similar to the Czech Republic. The global financial crisis, however, led to a pronounced stagnation in new investment inflows to these countries in the post-crisis period. Notably, these three countries attracted foreign investor interest even before joining the EU. For Poland and Romania, the increase in foreign investment inflows was more strongly associated with their accession to the EU, which similarly led to a marked rise in FDI after 2015. Serbia has also become a notable destination for foreign investments in recent years — despite being unable to fully benefit from the EU single market — which, given its smaller population, has brought its investment levels close to those of Poland and Romania. In contrast, Ukraine and the Republic of Moldova have shown limited attractiveness to foreign investors, further impacted by Russian aggression against Ukraine beginning in 2014, a situation that has deteriorated further with the full-scale war initiated by Russia in 2022.

Chart 2.31**Foreign Direct Investment Inward Stock per capita (USD), 1990-2023**

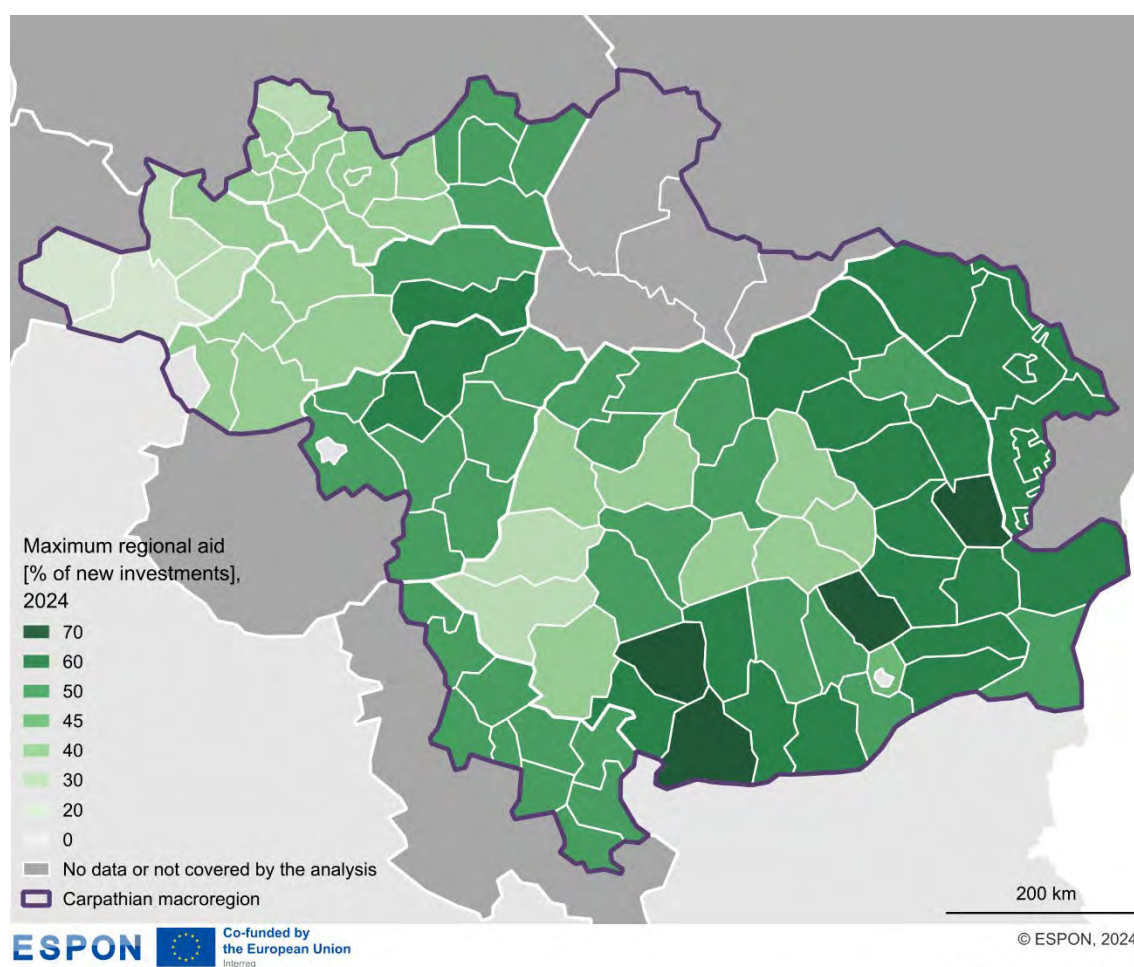
Source: Own elaboration based on UNCTAD,

Map 2.91**Foreign Direct Investment per Capita, 1990–2022**

Territorial level: NUTS 2
 Source: ESPON KARPAT, 2024
 Origin of data: UNCTAD, ESPON
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The spatial distribution of foreign investment in the Carpathian macroregion shows the highest concentration of foreign capital in major urban centres, namely Bratislava, Budapest, and Bucharest. It is worth noting that the role of capital regions may be somewhat overestimated, as foreign investors tend to register companies in these cities while conducting activities, such as production, in other regions of the country. Based on the spatial arrangement of foreign investments, it appears that transport accessibility to western supply and market destinations has played a significant role. Consequently, in most countries, more peripheral regions have recorded lower foreign capital inflows, as observed in eastern parts of Poland, Slovakia, and Hungary, as well as southern Serbia. High fixed asset values and skilled labour resources have also contributed to the investment attractiveness of certain industrial regions, as exemplified by Silesia in Poland and the Czech Republic, as well as northern Hungary. Conversely, foreign investors have shown the least interest in Ukrainian regions, partly due to the ongoing Russian aggression in Ukraine since 2014.

Map 2.92
Regional aid ceiling, 2024



Territorial level: NUTS 3
Source: ESPON KARPAT, 2024
Origin of data: European Commission
© EuroGeographics for administrative boundaries

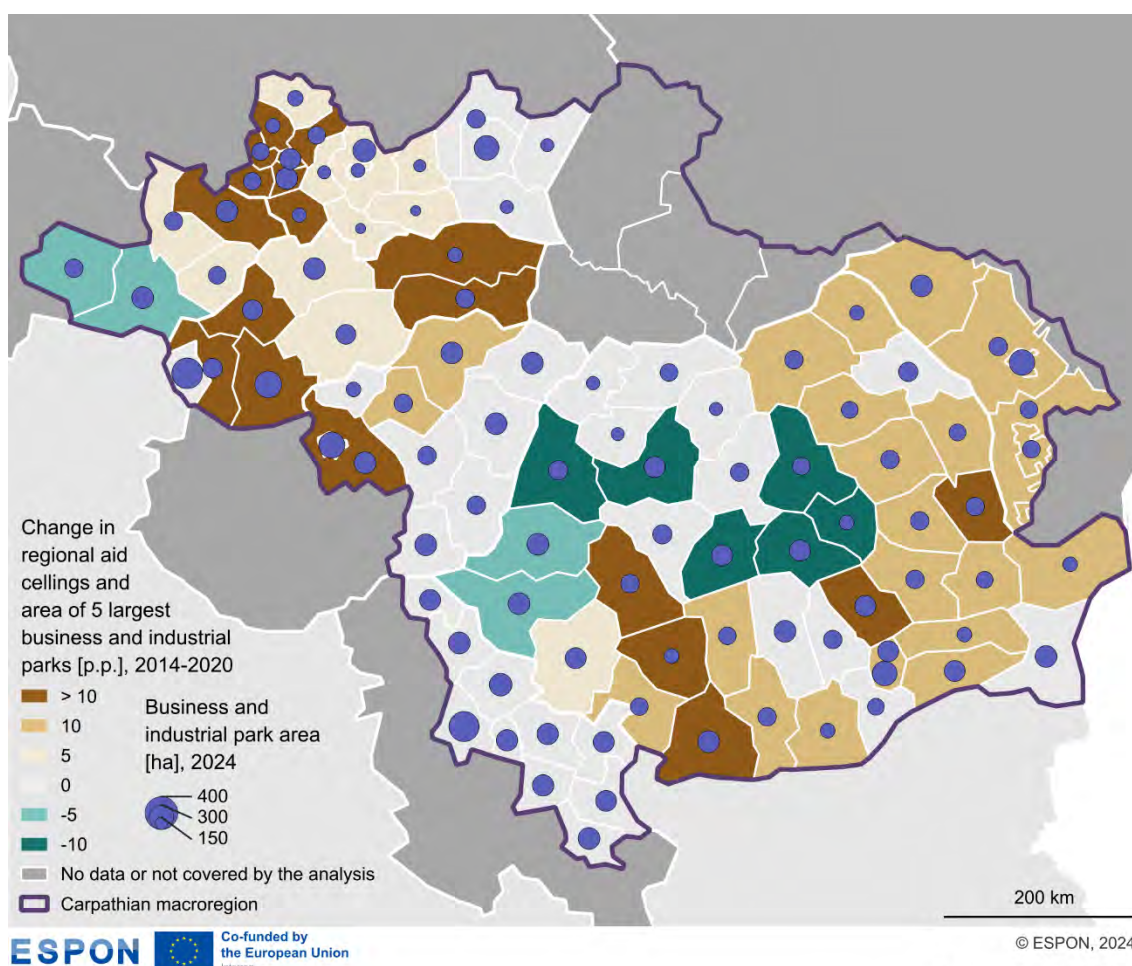
Investment incentive systems and an increasingly effective institutional environment have facilitated new foreign investments in Carpathian countries. Various incentives, including the establishment of special economic zones, have been implemented in the macroregion since the 1990s. The accession of some Carpathian countries to the EU in 2004 and 2006 led to the evolution of support systems for new investments, which have since adopted a more systemic character, no longer tied to specific investment locations. On the other hand, the maximum level of public aid (regional aid ceiling) permitted by the European Union, including various

investor preferences, has been linked to regional characteristics, particularly the region's level of affluence (**Map. 2.92**).

In general less affluent territorial units of the Carpathian macroregion on average see higher-percentage public aid in order to stimulate economic growth and development. A 70% of public regional aid can be granted in four Romanian regions, i.e. Galați, Prahova, Dolj and Gorj. Other EU regions eligible for allocating more than 50% aid are mostly located in Romania, e.g. Bacău, Botoșani and Neamț, to name but a few, as well as two regions in Hungary, i.e. Borsod-Abaúj-Zemplén and Heves, and one in Slovakia, Košický kraj. Outside of the EU, across all regions of the Republic of Moldova, maximum regional aid stands at 60%, marking a hike from 50% in 2018, and 50% throughout Serbian regions, including the City of Belgrade. In most Slovak, Czech and Polish regions the maximum regional aid oscillates between 20% and 40%, while in Hungary this value tends to reach 50%. More central and the wealthiest regions of the Carpathian macroregion, i.e. Budapest, București and Bratislavský kraj are not eligible for any regional aid, while the fourth richest region, Miasto Kraków, is allowed aid of 40%.

Map 2.93

Change in regional aid ceilings and area of 5 largest business parks, 2011-2023



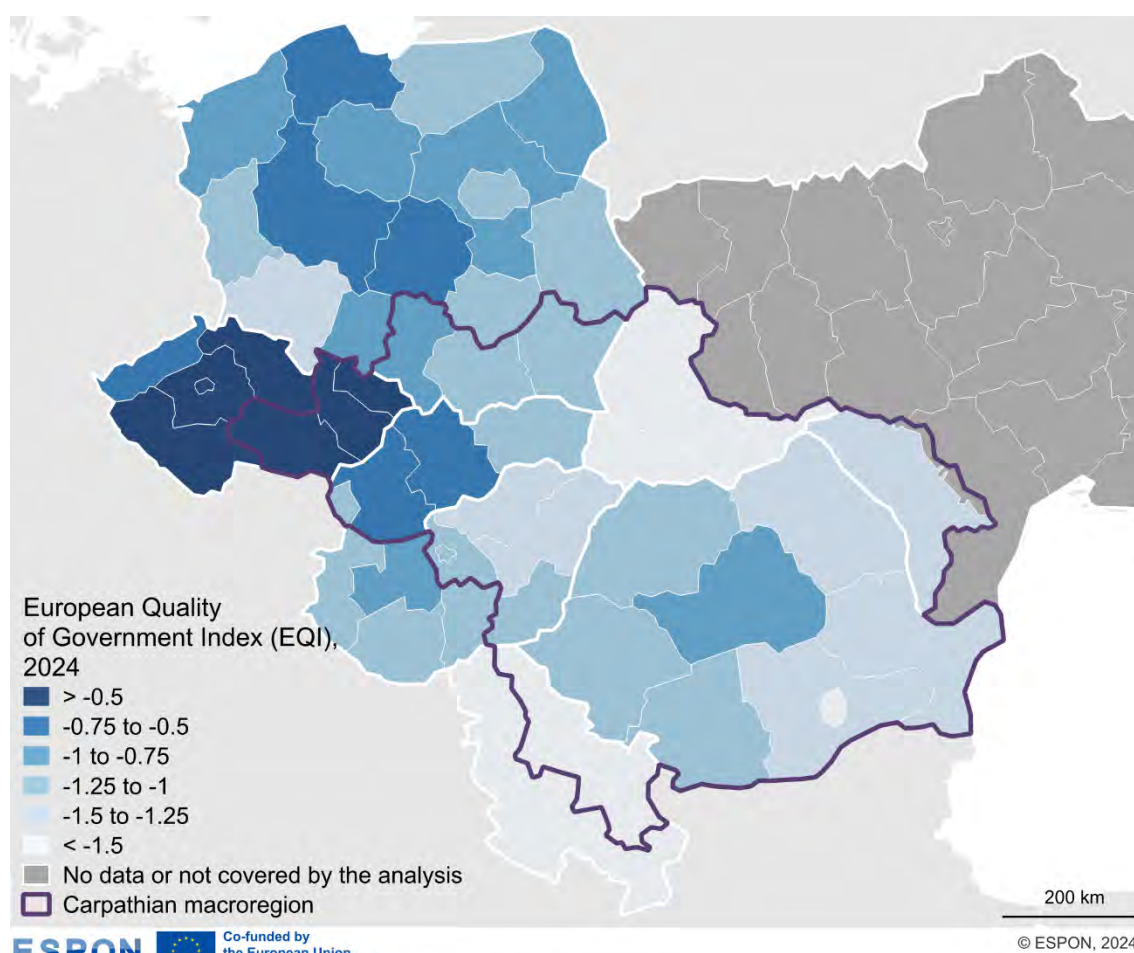
Territorial level: NUTS 3
Source: ESPON KARPAT, 2024
Origin of data: European Commission,
National and regional websites on business parks
© EuroGeographics for administrative boundaries

In addition to direct support for businesses through location incentives or assistance in developing existing economic projects, local and regional authorities have aimed to attract and retain investors by establishing adequate technical infrastructure. One of the most popular approaches has been the creation of business and industrial parks, some of which operate as previously mentioned special economic zones.

Based on a desktop review of business parks across all analysed regions, the combined area of the five largest business parks has been identified as a key indicator of their significance. Considering that the number and role of parks vary in each analysed regional unit, the area of these parks is considered more appropriate than the number of employees, as the latter is more prone to data gaps and inaccuracies. The research did not reveal significant differences between various regions, with the smallest areas recorded in Poland's southern regions of Nowotarski, Nowosądecki, and Tarnowski, and the largest in major metropolitan areas such as Bratislava, Belgrade, Budapest, and Chişinău. It has also been noted that cross-border regions tend to have a smaller combined area of their five largest business parks, consistent with the challenges faced by barrier-facing regions, which are typically underserved and less innovation-oriented. In summary, the availability of investment land does not significantly differentiate Carpathian regions in terms of external capital inflow attractiveness. Nonetheless, in certain locations, particularly mountainous areas, the lack of attractive development sites may pose a barrier to economic growth.

Map 2.94

European Quality of Government Index, 2024



* based on citizens' perception of health, education and policing

Territorial level: NUTS 2
 Source: ESPON KARPAT, 2024
 Origin of data: EUROSTAT; Estimations for UA, RS and MD;
 estimations for RS and UA based on Corruption Index at country level
 © EuroGeographics for administrative boundaries

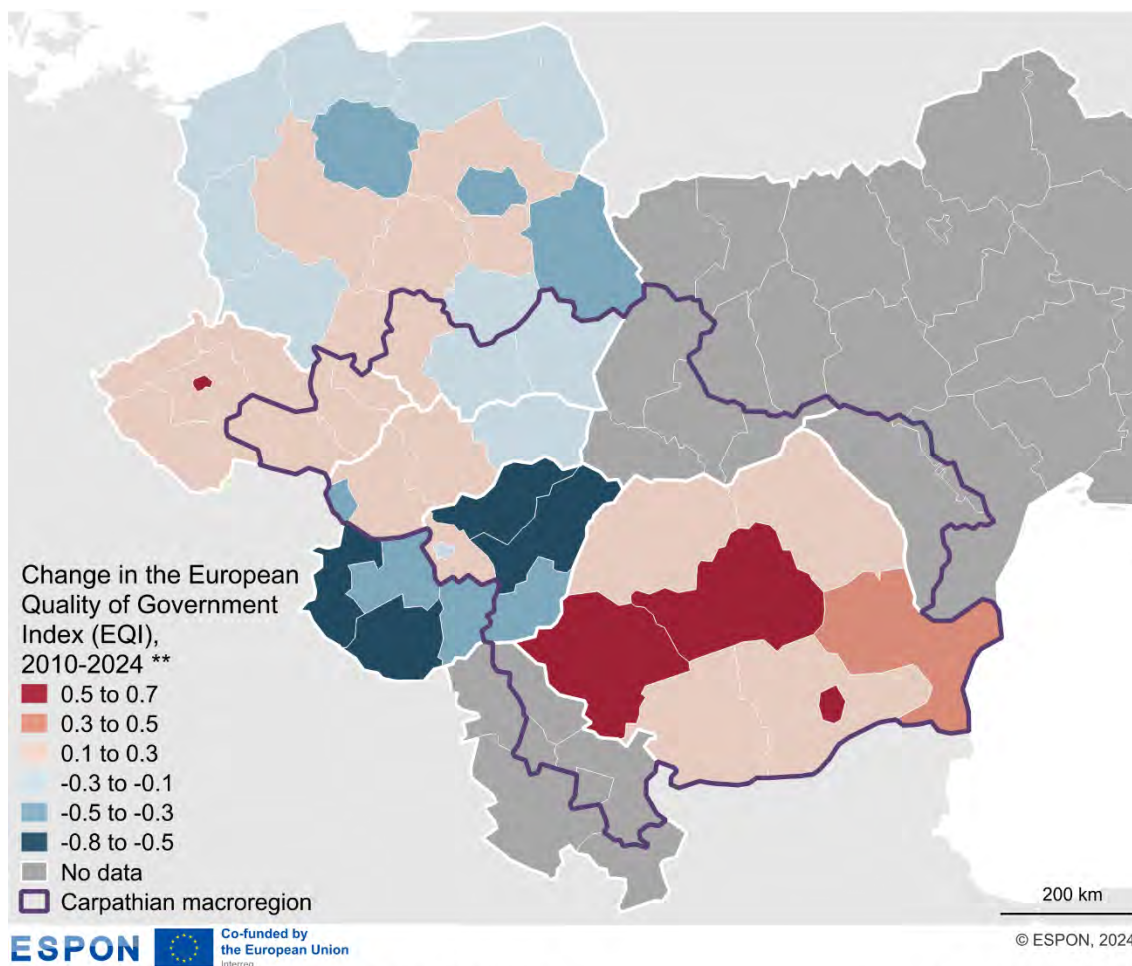
A significant "soft" factor from an investment attractiveness perspective is the institutional environment, a key element of an investment-friendly climate. One synthetic indicator illustrating this aspect is the European Government Quality Index (EQI), which includes perceptions and experiences of residents regarding corruption, quality, and equality of access to selected public services, such as healthcare, education, and policing. The EQI values, relative to the EU average, indicate that, in almost all Carpathian regions, the quality

of the institutional environment was relatively low. The best situations were observed in the Czech regions and western Slovakia, excluding Bratislava. In Poland, the Silesian voivodeship stood out positively compared to other regions, as did the Centru region in Romania and the surroundings of Budapest in Hungary. Conversely, estimates based on national corruption indices indicated the worst situations in Serbian and Ukrainian regions. the Republic of Moldova and eastern Romanian regions also recorded low values.

Over the past decade, parts of the Carpathian regions have improved in terms of governance quality. This improvement was most evident in Romanian regions, especially in Bucharest, as well as in central and western Romania. This likely had a positive effect on the country's economic growth dynamics, although it may also reflect an overall increase in affluence. Some improvement was also seen in the Czech Republic, as well as in the Silesian voivodeship and central Slovakia. However, the most significant decline, relative to the European average, was noted in Hungarian regions, with some decline also observed in southeastern Poland and eastern Slovakia.

Map 2.95

Change of European Quality of Government Index, 2000-2024



* based on citizens' perception of health, education and policing
 ** comparison between periods 2000-2013 and 2021-2024

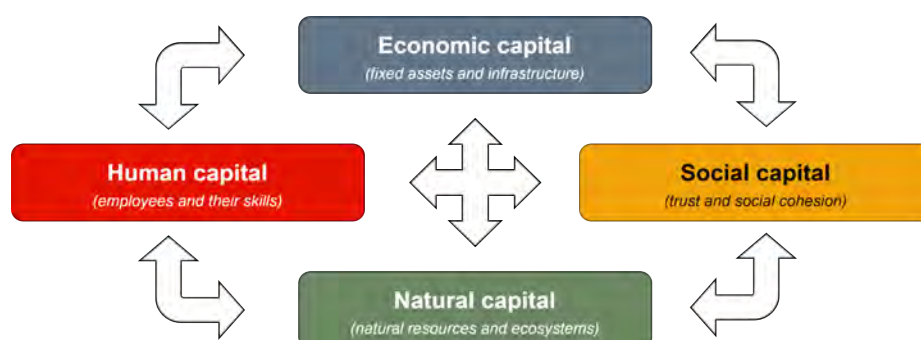
Territorial level: NUTS 2
 Source: ESPON KARPAT, 2024
 Origin of data: EUROSTAT; No data for MD, UA and RS
 © EuroGeographics for administrative boundaries

3 Typology of Regions and Interactions Between Territorial Capitals

The development conditions of the Carpathian macroregion require a comprehensive synthesis that will allow the identification of various types of regions. For each of these, appropriate recommendations can then be proposed. To achieve this, the 4 Capitals Model (**Dahlstrom, Ekins, 2005**) was employed. This model extends the earlier concept of the three pillars of development—natural, manufactured, and human (**World Bank, 1995**)—by further distinguishing social capital within the human dimension. Consequently, these capitals can be defined as follows (**cf. Brink et al., 2006**):

- natural (or environmental) capital covering all forms of ecosystems and natural resources that provide services for social welfare,
- economic (or manufactured) capital, broadly synonymous with economic infrastructure and assets,
- human capital, relating to the stock of human productivity potential of individual people based on their health, motivation, talents and skills,
- social capital, relating to the stocks of social trust, norms and formal and informal networks that people can draw upon to access resources, solve common problems and create social cohesion.

Figure 3.1
Four capitals model

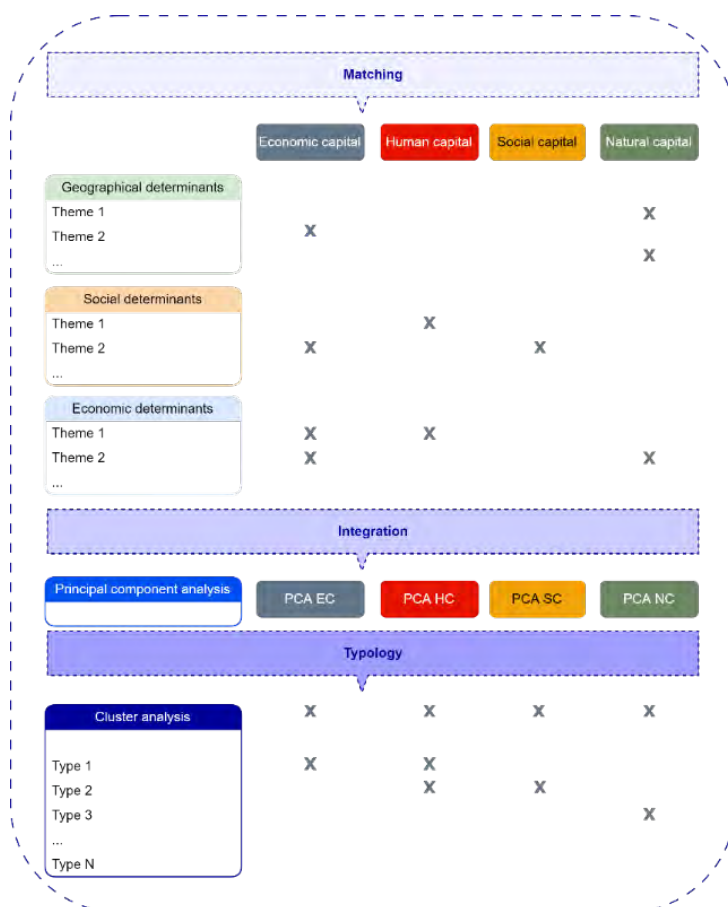


Source: Own elaboration based on Brink et al. 2006.

Adopting such an approach signifies that, in order to ensure sustainable development that meets societal needs, it is vital to ensure that the stock of particular capitals remains intact or increases over time.

To illustrate each of the territorial capitals, a range of indicators was utilized and synthesized using the principal component analysis method. This approach allowed for the identification of two dimensions of differentiation for each capital. Based on these dimensions, various types of regions were distinguished (four for each case), for which thematic recommendations were formulated. Subsequently, these sub-dimensions of differentiation (a total of eight) were synthesized again to derive the most significant general dimensions of regional differentiation. Using cluster analysis, this process enabled the development of a general typology of areas within the Carpathian macroregion. The adopted research procedure is illustrated in **Figure 3.2**.

Figure 3.2
Method of data synthesis



Source: own elaboration (EUROREG)

A key element of the synthetic approach was also the assessment of interactions between the various territorial capitals. In addition to the quantitative analyses described above, this assessment incorporated the opinions of Carpathian stakeholders gathered through on-line survey and expressed during participatory workshops.

3.1 Main Dimensions of Territorial Capitals Regional Differentiations and Thematic Typologies

Each of the four capitals of the Carpathian macroregion was operationalized using selected indicators developed specifically for assessing the region's development conditions. For each capital, two key dimensions of differentiation were identified, which were then used to develop a series of regional typologies.

3.1.1 Economic capital

The main dimensions of the spatial diversity of economic capital in the Carpathian macroregion relate, on the one hand, to the degree of capital accumulation mainly in the form of fixed assets used in economic activities or transport infrastructure that facilitates the production and exchange of goods and services, referred to as "capital accumulation." On the other hand, they concern specific relationships between the production and consumption sectors within economic processes, referred to as "production vs. consumption" (Table 3.1). These two dimensions explained approximately 70% of total regional differentiation in terms of economic capital.

The "accumulation" aspect of economic capital in the Carpathian macroregion is associated relatively equally with a high level of economic development (GDP per capita) and the accumulated fixed assets in business activities, supported by foreign investments inflow and well-developed public transport infrastructure (road and rail). This dimension also reflects, to a lesser extent, the effects of agglomeration (the population share of the largest city) and research and development potential (R&D expenditure relative to GDP). High values of accumulated economic capital were observed primarily in large cities and in the western part of the macroregion, which generally exhibited more favourable conditions for economic development, supported by well-developed transport infrastructure. The importance of the latter for higher levels of accumulated capital was evident in Romania, as seen in regions located along major transport corridors (existing and planned A1 and A3 motorways) connecting Bucharest to the Romanian-Hungarian border. Conversely, capital accumulation is significantly lower in the EU candidate countries, as well as in some peripheral regions of Poland, Slovakia, Romania, and, to a lesser extent, Hungary.

Table 3.1

Main dimension of economic capital spatial diversity based on principal component analysis*

Indicators	Economic capital – components (Varimax Rotation)	
	1st "Capital accumulation"	2nd "Production vs. Consumption"
Share of the largest FUA in total population	0.58	0.20
Density motorways and expressways per 100 sq km	0.85	0.07
Density road infrastructure per 100 sq km	0.90	0.08
Density railway infrastructure per 100 sq km	0.83	0.16
Freight transport loadings per capita	0.21	0.78
Dwelling stock per 1000 residents	0.24	-0.74
GDP per capita [EUR]	0.87	0.16
R&D Expenditures as % GDP	0.58	0.57
Gross fixed assets per capita [EUR]	0.85	-0.10
FDI stock per capita [USD]	0.85	-0.27
Variance explained	5.22	1.67
Share	0.52	0.17

* The higher the value, the stronger the correlation between the indicator and the principal component, which serves as the composite indicator

Source: own elaboration

The second weaker dimension of economic capital spatial diversity in the Carpathian macroregion has been defined as the **"primacy of production over consumption"**. The production in this case is associated with the transport of manufactured goods using road networks per capita, indicating the "export potential" of a given area and indirectly reflecting its transport accessibility. In these areas, the number of housing units per 1,000 residents was often lower than the average, suggesting a dominance of the production aspect (represented by goods transport) over the consumption aspect (housing availability). However, some regions, such as Bratislava and Budapest, diverged from this dichotomy, as their strong production potential was accompanied by a relatively good housing situation in terms of availability. Overall, high values for this principal component characterized the northwestern part of the Carpathian macroregion, which is more accessible to the main markets for manufactured goods in Western Europe. In contrast, lower values were found in the southern and southeastern parts of the macroregion, where the housing situation, expressed by the number of dwellings per resident, was comparatively better.

Combining these two dimensions of economic capital into a typology highlights regions for which targeted recommendations can be formulated in line with their specific characteristics (**Map. 3.1**):

- (Red) Regions with a higher level of economic development and substantial fixed assets but a potential dominance of the production over the consumption. Here, public authorities may benefit from

focusing more on the consumer dimension, such as through social programs, including for instance municipal housing initiatives. This recommendation applies particularly to the industrialised western part of the Carpathian macroregion, namely the Czech Republic, western regions of Poland, Slovakia, and Hungary as well as Belgrade region in Serbia.

Map 3.1

Economic Capital – Dimensions of Diversity and Types of Regions

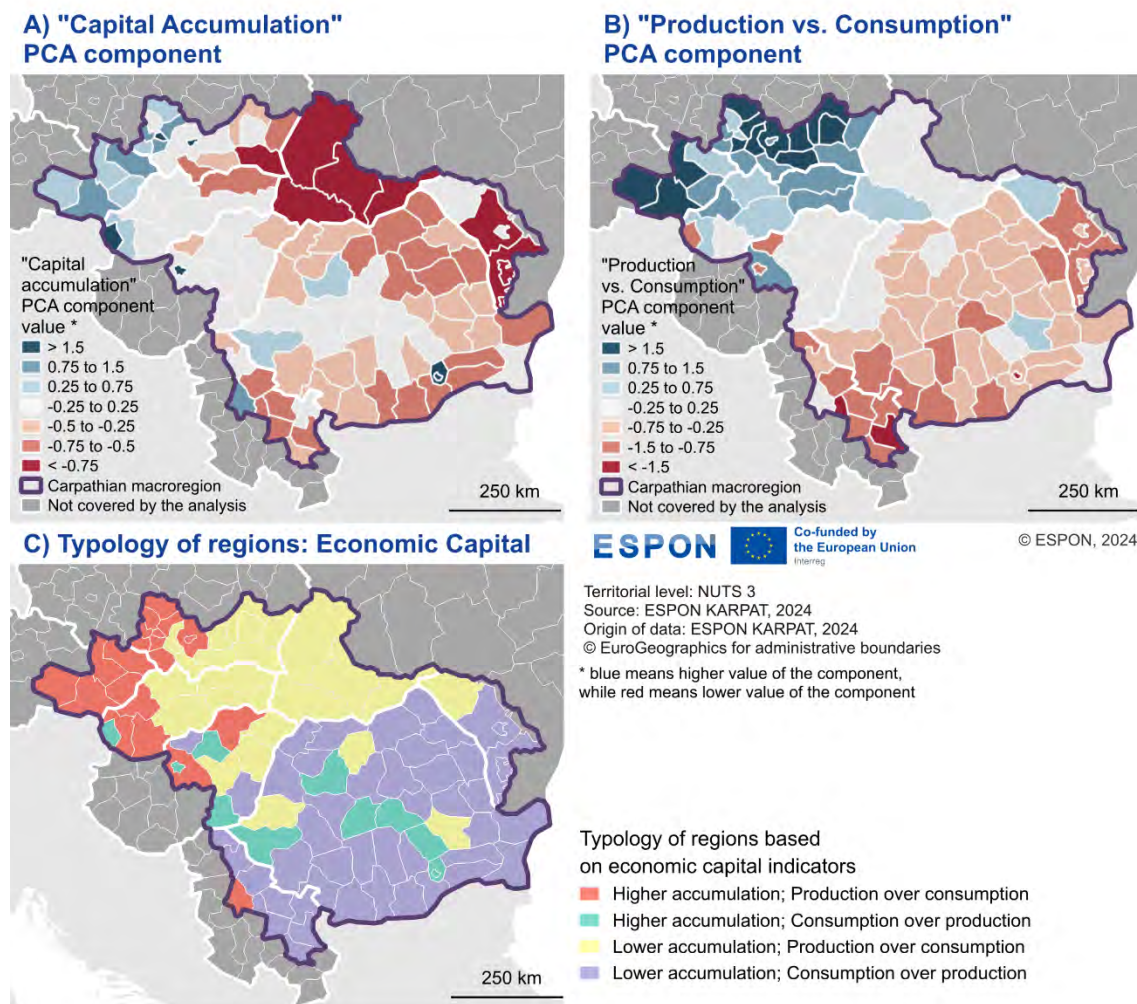


Table 3.2

Recommendations for the regions - economic capital

	„Capital accumulation” – higher	„Capital accumulation” - lower
„Production over consumption”	Opportunity to Strengthen the Consumer Dimension	Smart Specialisations
„Consumption over production”	Incentives for investors	Development of basic infrastructure and improvement of business climate

Source: own elaboration (EUROREG)

- (Violet) Regions with lower economic development levels, where the consumer sector takes precedence over production activities. Development in these areas may require investments in technical and transport infrastructure, along with the creation of a favourable business environment to attract new investments and to support the creation of new local businesses. This is particularly relevant for Moldovan and Serbian regions, as well as most Romanian regions.
- (Green) Regions with higher economic development and a predominance of the consumer sector over production. These areas have strong economic growth potential, and it is important to establish conditions that make optimal use of existing fixed assets, supported by well-aligned incentive systems for investors. This approach would leverage their favourable transport accessibility and high potential agglomeration effects. It applies to selected metropolitan regions, especially in Romania like Bucharest, Cluj-Napoca, Brasov, Timisoara but also some Hungarian regions of Seged and Helyes.
- (Yellow) Regions with low economic development but existing potential for production development. In these areas, efforts should focus on developing higher-value-added economic activities, supported by strategically chosen smart specializations. The strengthening of these specialisations will be possible, especially under conditions of the development of regional production systems and the creation of conditions for the inflow of external investments. This recommendation particularly concerns eastern regions of Poland and Slovakia, as well as certain areas in Hungary, Ukraine, and Romania.

It is important to note that these general recommendations are not limited to specific types of regions and may also be implemented in other regions, provided they are adapted appropriately (Table 3.2).

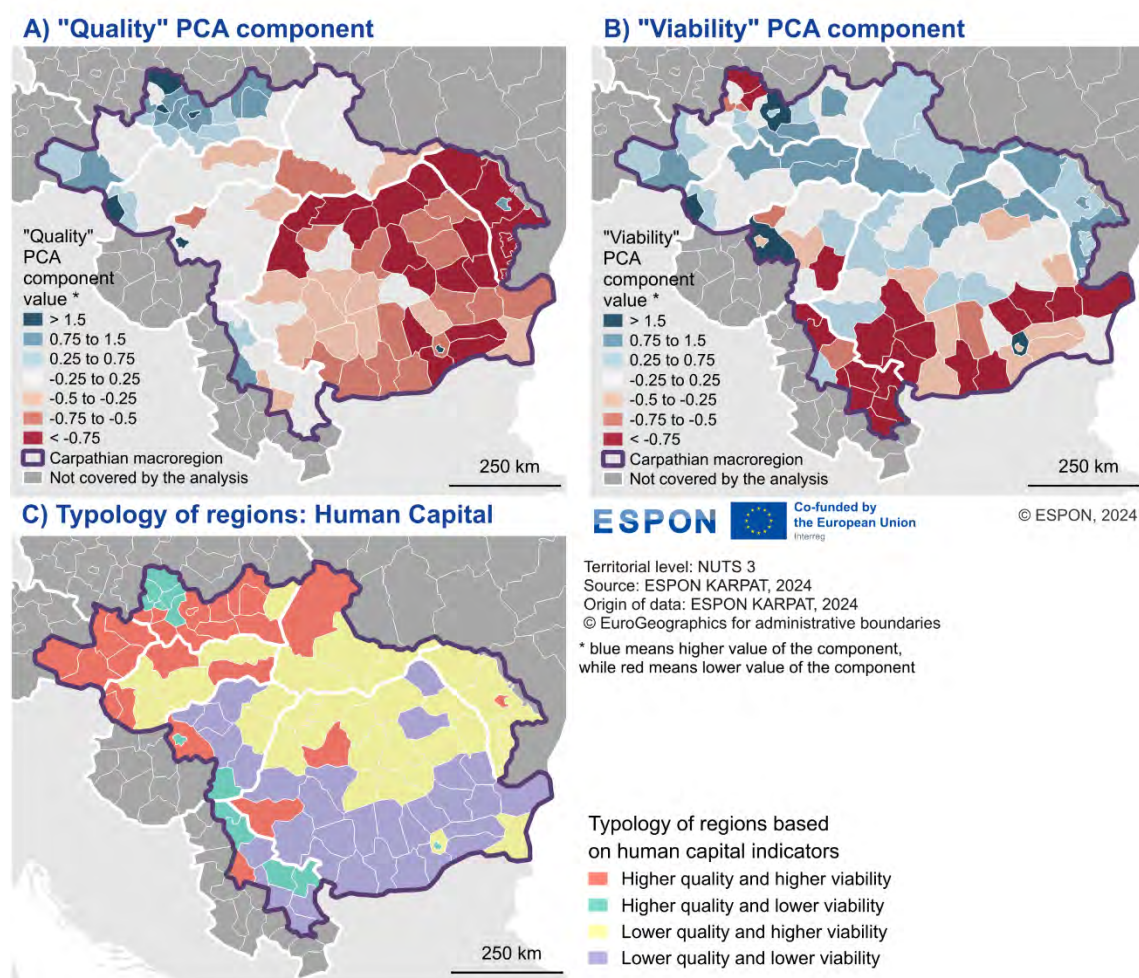
3.1.2 Human capital

The main dimensions of human capital spatial differentiation concern, on one hand, the “quality” of human capital resources, and on the other, the “viability” of this capital especially important in the context of population ageing processes (Table 3.3).

Table 3.3
Main dimension of human capital spatial diversity based on principal component analysis

Indicators	Human capital – components (Varimax Rotation)	
	1st "Quality"	2nd "Viability"
Population change	0.27	0.84
Median age of population	0.04	-0.83
Natural increase	0.23	0.85
Migration balance	0.12	0.64
Share of population with higher education	0.97	0.15
Share of human resources in science and technology in the labour force	0.97	0.12
R&D employment as % total	0.89	0.20
Variance explained	2.81	2.61
Share	0.40	0.37

Source: own elaboration

Map 3.2**Human Capital – Dimensions of Diversity and Types of Regions****Table 3.4****Recommendations for the regions - human capital**

	„Quality” - higher	„Quality” – lower
„Viability” – higher	Challenges related to spatial planning	Improving the accessibility and quality of public education
„Viability” – lower	Improve quality of life, especially in housing	Halting the loss of human capital (including incentives for return migration). Significant strengthening the education system

Source: own elaboration (EUROREG)

The first dimension of regional variations in human capital in the Carpathian macroregion relates to its **“quality”**. This dimension indicates a high proportion of individuals with higher education within the population, a large number of workers capable of participating in the development and implementation of innovations, as well as a significant share of people actively engaged in research and development activities. High values for this component of human capital are especially noticeable in metropolitan areas, a pattern observed across all studied countries. Conversely, peripheral areas, particularly rural regions, exhibit a distinctly lower quality of human capital, partly due to out-migration processes that usually leads to brain drain. In the spatial dimension of human capital quality within the Carpathian macroregion, the northwest-southeast axis is notable. A pronounced deficiency of human capital is evident in the northern, eastern, and southern areas of Romania and in the Republic of Moldova, excluding Chişinău.

The second regional dimension of human capital variation is its **“viability”**. High viability is associated with a lower median age in the population, often accompanied by a relatively high natural population increase and population growth in the region, sometimes supported also by positive migration balances. Notably, Carpathian areas in Poland and Slovakia, as well as some Ukrainian, Moldovan, and specific Romanian regions (mainly in the northern and western parts of the country), stand out in this respect. High values are also observed in areas surrounding large cities due to suburbanization. By contrast, the southern part of the macroregion and the northern part of the Silesian Voivodeship in Poland exhibit the lowest values.

Combining these two dimensions into a typology of regions highlights areas where (**Map. 3.2**):

- (Red) Relatively high-quality human capital is paired with a high viability of the regional population. Population growth and potential wealth increase in these areas could generate pressure to develop new land, requiring appropriate spatial planning to prevent uncontrolled sprawl. This should include, among other measures, transit-oriented development. Additionally, special attention should be given to protecting valuable natural and landscape areas and their buffer zones from construction, particularly for secondary homes. This situation primarily concerns large cities and their surroundings, as well as regions in the northern part of the macroregion, which also generally feature high population densities.
- (Yellow) Relatively low-quality human capital is paired with high regional population viability. This situation indicates a need to improve the accessibility and quality of education systems. The resulting enhancement in human capital quality could unlock endogenous development potential and mitigate negative impacts from outmigration. This applies mainly to northern Romania, Ukraine, the Republic of Moldova, and selected Slovak regions.
- (Green) Relatively high-quality human capital is paired with low regional population viability. This may suggest a need to improve quality of life, including housing programs, to increase the migration appeal of these regions. This situation mainly affects certain subregions in the Silesian Voivodeship in Poland, some Serbian regions, and the Szeged region in Hungary.
- (Violet) Low-quality human capital is combined with relatively low regional population viability. In these regions, efforts should focus on halting the loss of human capital and encouraging the return of those who have left. Strengthening regional education systems adapted to labour market needs should also be a key priority. This applies particularly to parts of eastern Hungary, as well as southern Romania and Serbia.

It is important to note that these recommendations are not limited to specific types of regions and may also be implemented in other regions, provided they are adapted appropriately (**Table 3.4**).

3.1.3 Social capital

The main dimensions of social capital variation in Carpathian macroregion relate, on one hand, to **“social cohesion”**, and on the other, to the **“potential for social interactions”**, influenced by population density and existing settlement and administrative structures (**Tab. 3.5**).

Table 3.5**Main dimension of social capital based on principal component analysis**

Indicators	Social capital – components (Varimax Rotation)	
	1st "Social cohesion"	2nd "Potential for social interactions"
Cities (>10,000) share in population	-0.10	0.77
Population density	0.09	0.77
Social exclusion	-0.95	-0.08
Severe material deprivation	-0.92	-0.16
Unemployment rate	-0.83	0.11
Enterprises per 1000 residents	0.69	0.45
European Quality of Government Index	0.87	-0.35
Variance explained	3.70	1.56
Share	0.53	0.22

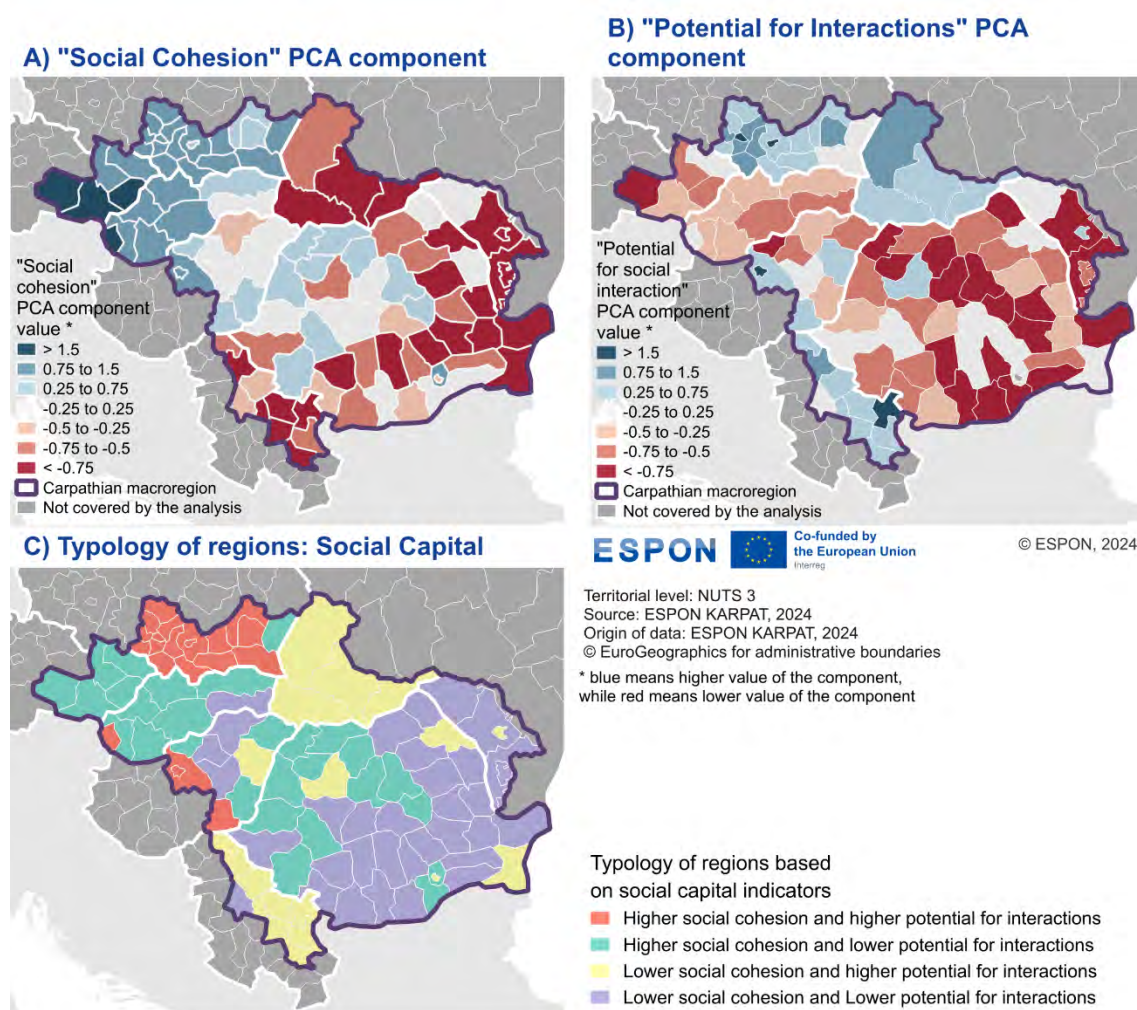
Source: own elaboration

The first dimension of social capital variation is associated with **“social cohesion”**, reflected in a low percentage of people at risk of poverty or social exclusion. This typically aligns with low unemployment rates, a strong entrepreneurial environment, and a high quality of governance. Favourable conditions in this respect are especially evident in the northwestern part of the macroregion, parts of metropolitan areas, and some regions in southern Hungary and Transylvania in Romania. Conversely, regions in EU candidate countries, parts of southern and eastern Romania, northern Hungary, and the Košice region in Slovakia represent the less cohesive end of this spectrum.

The second dimension of social capital variation relates to the **“potential for social interactions”**, which is supported by higher population density and, specifically, the existence of larger population centres. This factor is partly influenced by differences in administrative structures across countries, favouring regions with relatively large municipalities resulting from administrative reforms. This is especially true for Poland, but also applies to Ukraine, Serbia, selected regions of Hungary, and to a lesser extent, Romania.

Combining these two dimensions yields the following typology of regions (**Map. 3.3**):

- (Red) Socially cohesive regions with high potential for social interactions. In these regions, efforts can focus on identifying micro-areas at risk of socioeconomic deprivation and addressing local issues. This need arises from the increased likelihood of such areas developing in larger population centres due to polarization and segregation processes. This typology most significantly applies to subregions in Poland, but also includes the Bratislava, Budapest and Szeged regions.
- (Yellow) Regions with lower social cohesion but high potential for social interactions. Here, the focus can be on strengthening and enhancing the efficiency of local institutions to increase social trust and build civil society. This could enhance the capacity for social initiatives targeted at marginalized groups and foster conditions for local entrepreneurship development. This category primarily includes regions in candidate countries Ukraine and Serbia and Chisinau in the Republic of Moldova, but also some regions in Romania and Hungary.
- (Green) Regions with high social cohesion but low potential for social interactions. For these regions, it may be beneficial to consider administrative reforms to improve public service delivery, including efforts to prevent transport exclusion. This typology is most relevant for regions in the Czech Republic, Slovakia, and northern Romania.
- (Violet) Regions marked by a concentration of social issues and relatively low potential for social interactions. In these regions, efforts should focus on improving access to public services and implementing social programs to break the cycle of poverty. This applies most significantly to regions in Moldova, as well as southern and eastern Romania and eastern Hungary.

Map 3.3**Social Capital – Dimensions of Diversity and Types of Regions****Table 3.6****Recommendations for the regions - social capital**

	„Social cohesion” – higher	„Social cohesion” – lower
„Potential for social interactions” – higher	Addressing issues of localized socio-economic deprivation concentration	Supporting social cohesion through strengthening institutions and fostering entrepreneurship
„Potential for social interactions” – lower	Administrative reforms to improve public service delivery	Improving access to public services and implementing social programs

Source: own elaboration (EUROREG)

It is important to note that these recommendations are not limited to specific types of regions and may also be implemented in other regions, provided they are adapted appropriately (Table 3.6).

3.1.4 Natural capital

The main dimensions of natural capital variation in Carpathian macroregion pertain, on one hand, to **“natural environment assets”** and, on the other, to selected aspects of **“environmental pollution”** related to particulate emissions and natural resource exploitation. However, CO₂ emissions linked to climate targets were not found to correlate with this second dimension, nor was high livestock density (Table 3.7).

Table 3.7
Main dimension of natural capital based on principal component analysis

Indicators	Natural capital – components (Varimax Rotation)	
	1st “Natural environment assets”	2nd “Environmental pollution”
Share of NATURA 2000	0.77	-0.31
Share of protected areas	0.81	-0.15
PM 2.5 index	-0.03	0.80
Mining and quarrying - area %	0.13	0.68
Forest cover %	0.82	0.18
Arable areas %	-0.69	-0.40
Cattle stock density	0.10	-0.07
CO ₂ emissions	0.18	-0.45
Variance explained	2.45	1.62
Share	0.31	0.20

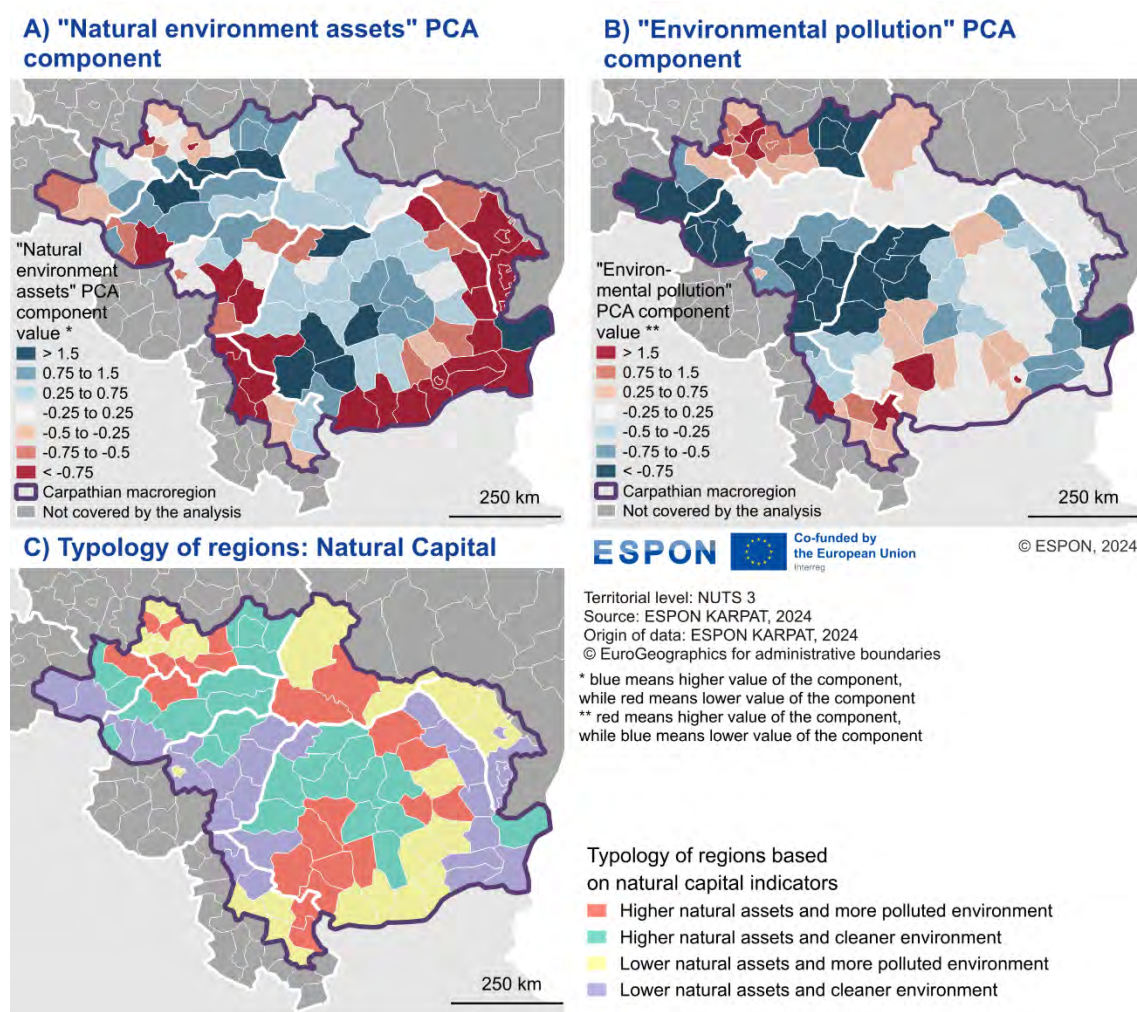
Source: own elaboration

The first dimension of natural capital variation in the Carpathian macroregion, **“natural environment assets”**, is closely related to forest cover, which generally coincides with a high percentage of protected areas under national and European conservation frameworks (such as the Natura 2000 network). This is also typically associated with a relatively low share of arable land. The spatial distribution of this factor aligns clearly with the Carpathian mountain range, while outside this range, high values are characteristic of the Danube Delta in Romania.

In terms of selected elements of **“environmental pollution”** (pollutant emissions and resource extraction), southeastern Hungary, northwestern Romania, northern Serbia, and parts of western Slovakia, the Czech Republic, and the Podkarpackie Voivodeship in Poland stand out positively. These areas experience low PM_{2.5} emissions, partly due to favourable topography that prevents the formation of persistent smog, a particular challenge in valleys and foothill basins. Additionally, these regions are largely agricultural, with minimal mineral extraction activity, which is more common in mountainous or highland areas and often underpins resource-intensive industries.

Combining these two dimensions allows for the following typology of regions (Map. 3.4):

- (Green) Areas with high natural assets and low levels of environmental pollution. These regions are particularly well-suited for the development of sustainable tourism. They include significant portions of the Western and Eastern Carpathians, the Romanian-Hungarian border area, and the Danube Delta in Romania.
- (Violet) Areas with low pollution but relatively limited natural assets. These regions are especially well-suited for the development of sustainable agriculture and renewable energy production. This category primarily includes the Pannonian Basin in Hungary, the Danube Valley in Serbia, and the Prut Valley in the Romanian part of Moldova.

Map 3.4**Natural Capital – Dimensions of Diversity and Types of Regions****Table 3.8****Recommendations for the regions - natural capital**

	„Natural environment assets” – higher	„Natural environment assets”
„Environment pollution” – lower	Development of sustainable tourism	Development of sustainable agriculture and renewable energy production
„Environment pollution” – higher	Mitigating the negative effects of environmental pollution. Increasing the use of renewable energy sources	Significant energy transformation and enhanced protection of valuable natural assets

Source: own elaboration (EUROREG)

- (Red) Areas with high environmental value but facing specific environmental challenges. In these regions, special focus should be placed on mitigating the adverse effects of low-stack emissions, especially during the colder months, as this can hinder tourism development. Additionally, efforts

should be made to reduce the negative impacts of natural resource extraction and transition toward renewable energy sources. This category includes various regions in the western, eastern, and southern Carpathians.

- (Yellow) Areas with relatively low natural assets and at risk of environmental pollution. In these regions, comprehensive energy transformation is essential, along with efforts to designate and strengthen protection for areas of ecological importance. This applies to parts of Polish, Ukrainian, Moldovan regions, Wallachia in Romania, and the southern section of the Carpathian macroregion in Serbia.

It is important to note that these recommendations are not limited to specific types of regions and may also be implemented in other regions, provided they are adapted appropriately (**Table 3.8**). The general recommendation for all types of regions focuses on educational activities aimed at increasing knowledge, awareness, and understanding of environmental issues among residents.

3.2 Typology of Regions and Interactions Between Territorial Capitals

3.2.1 Main dimension of territorial differentiation and cross-thematic typologies of regions

The most significant dimensions of regional disparities in the Carpathian macroregion—taking into account the above-mentioned variations in each of the four territorial capitals—are linked to economic, social, and environmental aspects (**Table 3.9**).

The **economic** aspect pertains to the high accumulation of fixed assets, which enhances the productivity of the regional economy. This is further supported by the high quality of human capital and the potential for social interactions arising from high population density and significant urbanization levels. Spatially, this factor highlights disparities along the axis of metropolitan areas versus peripheral, including mountainous regions, as well as between the north-western and south-eastern parts of the macroregion (**Map 3.5**).

Table 3.9
Main Components of Spatial Diversity

Dimensions	Components (Varimax rotation)		
	"Economic"	"Social"	"Environmental"
EC1 – "Accumulation of capital"	0.87	0.20	-0.19
EC2 – "Production vs. Consumption"	0.14	0.62	0.52
HC1 – "Quality" of human capital	0.91	0.14	0.14
HC2 – "Viability" of human capital	-0.03	0.77	-0.08
SC1 – "Social Cohesion"	0.18	0.80	0.27
SC2 – "Potential for social interactions"	0.91	-0.10	-0.07
NC1 – "Natural environment assets"	-0.14	0.10	0.79
NC2 – "Environmental pollution"	-0.49	0.46	-0.41
Variance explained	2.7	1.9	1.2
Share	0.34	0.24	0.15

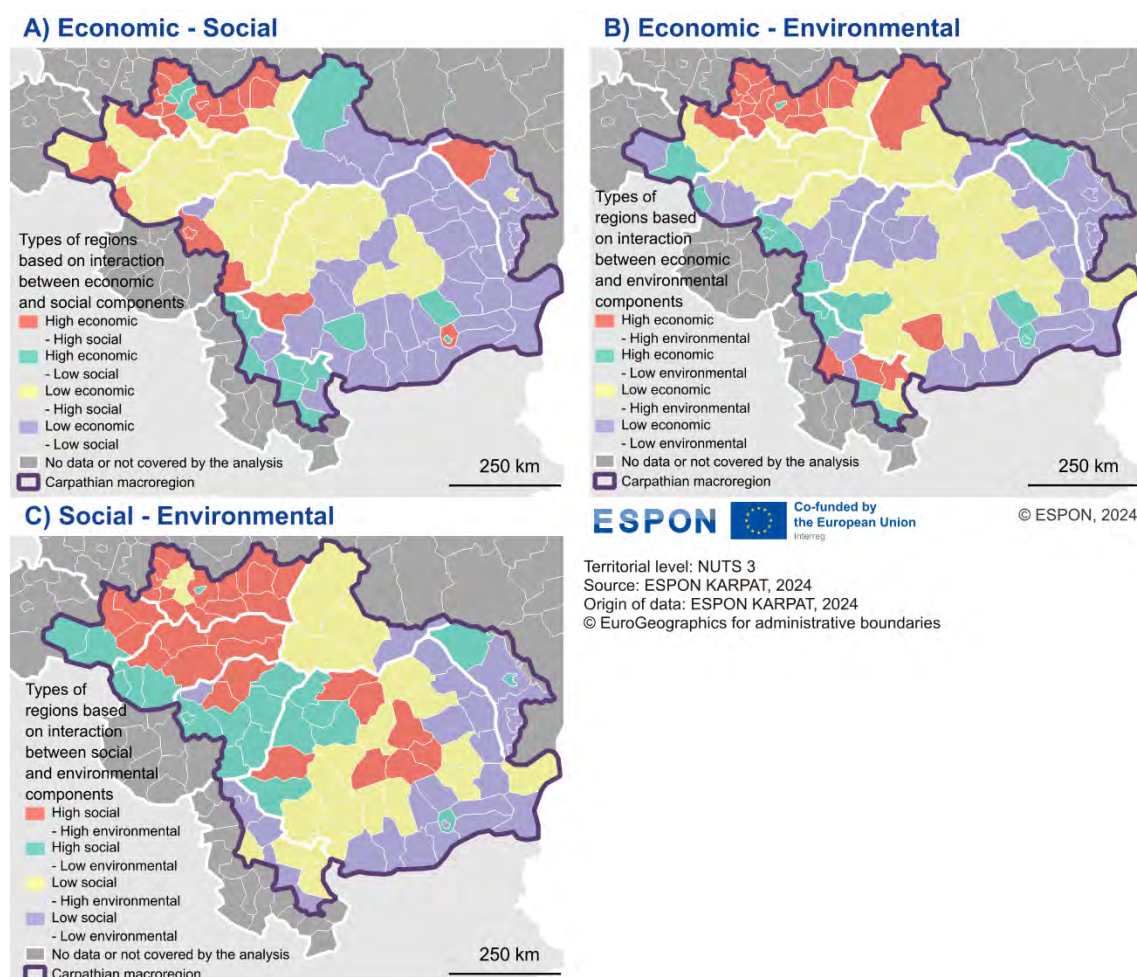
Source: own elaboration (EUROREG)

The **social** aspect relates to social cohesion and the vitality of the regional population, with a notable emphasis on the consumptive dimension over the productive one in economic development processes. Spatially, the pattern of disparities is similar to that of the economic aspect but shows a stronger alignment with the NW-SE axis compared to the metropolitan versus non-metropolitan areas axis.

The **environmental** aspect is primarily associated with the high natural values that constitute a key component of this dimension of disparities. Spatially, this dimension of regional variation is most strongly reflected in the Carpathian mountain chain and, beyond it, the Danube Delta.

Map 3.5

Typology of regions based on interactions between main components of diversity



Combining the three dimensions in pairs allows for the creation of the following regional typologies in the Carpathian macroregion (**Map 3.5**):

- **Economic-Social Typology:** This typology identifies regions with particularly favourable conditions for economic activity development, accompanied by high quality of life and social cohesion (red). It also highlights areas where these conditions are relatively poor, with weaker economic outcomes coinciding with various social challenges (blue). Some regions show good economic results despite significant social issues (green), while others display strong social cohesion but weaker economic performance (yellow).
- **Economic-Environmental Typology:** This categorization highlights regions where high levels of economic development coincide with substantial natural values (red), as well as areas where both economic outcomes and natural values are relatively low (blue). Additionally, the macroregion includes regions with strong economic performance but limited natural values (green) and areas—primarily mountainous regions—with significant natural assets but relatively weak economic development (yellow).
- **Social-Environmental Typology:** This typology identifies regions combining strong social and environmental potential (red), as well as those with deficits in both dimensions (blue). Some regions

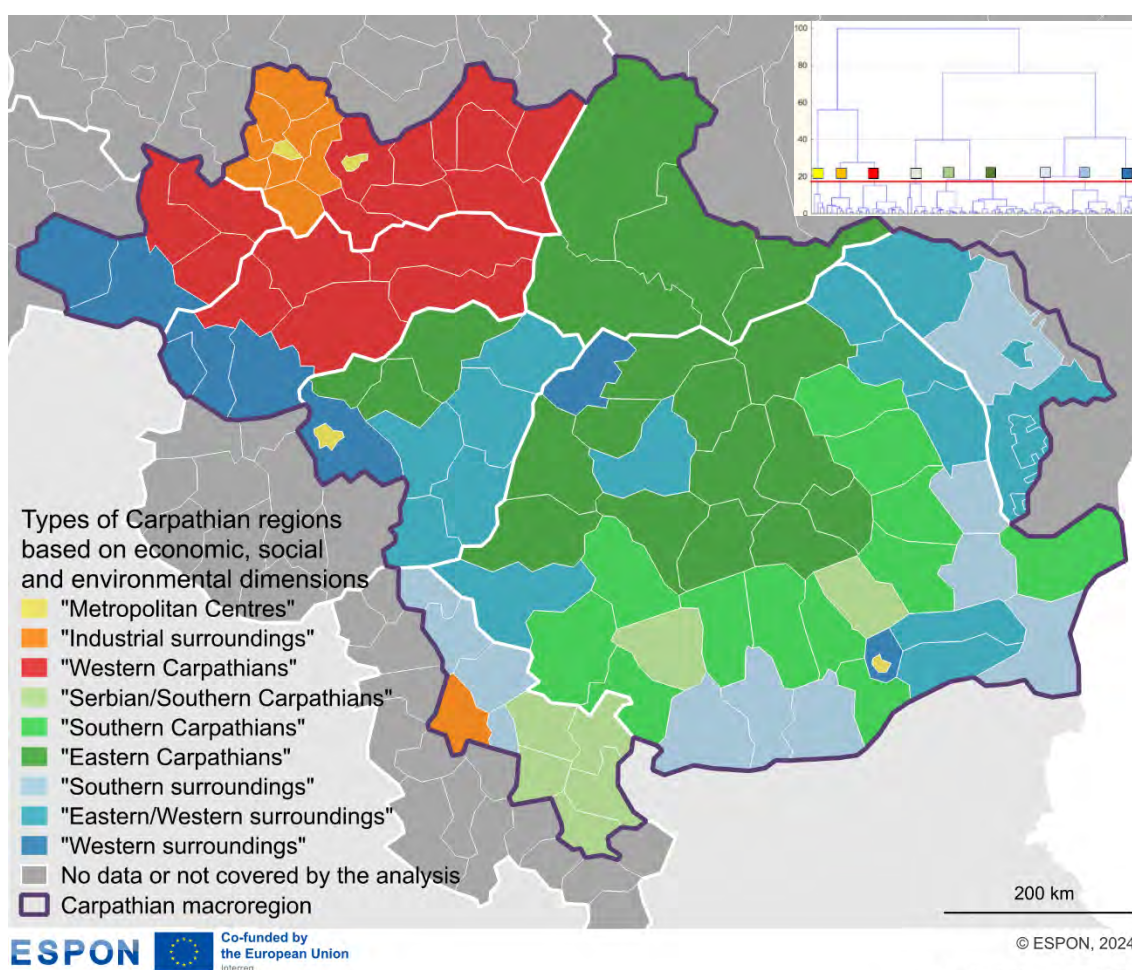
demonstrate high social potential but lack natural assets (green), while others are rich in natural capital but have lower levels of social capital (yellow).

The combination of the three key dimensions of disparities in the Carpathian macroregion enables the creation of a typology that reflects economic, social, and environmental issues.

The map illustrating this typology reveals the existence of relatively spatially cohesive areas, largely shaped by environmental factors (**Map 3.6**). These include: The “Western Carpathians” in the north, excluding northern Hungary (red); The “Eastern and Southern Carpathians”, along with the Transylvanian Plateau (excluding the Cluj region) and the Danube Delta in the east and south (green); Predominantly lowland areas situated on the western, eastern, and southern peripheries of the macroregion (blue). This typology also highlights metropolitan centres, particularly those where major cities are designated as standalone NUTS3 units (yellow), as well as highly industrialized regions such as the Silesian Voivodeship in Poland and the Belgrade region (orange).

Map 3.6

Typology of Carpathian regions based on economic, social and environmental dimensions



Territorial level: NUTS 3
Source: ESPON KARPAT, 2024
Origin of data: ESPON KARPAT, 2024
© EuroGeographics for administrative boundaries

The most distinctive type is represented by these metropolitan regions, where the economic component shows particularly high values, but environmental qualities are significantly limited, largely due to the high degree of urbanization and small land area. This sets them apart from “industrial surroundings” regions, which, due to their larger area, benefit from diverse environmental assets, including zones that act as protective buffers against industrial pollution. Regions classified as “Western Carpathians” stand out not only for

their high environmental value but also for substantial social resources. This sharply differentiates them from the Southern and Eastern Carpathians, where social capital is considerably weaker, particularly in the "Serbian" and "Southern" Carpathians. These regions also perform less favourably—except for the "Serbian/Southern Carpathians"—in terms of economic capital. A common characteristic of the Carpathian "surroundings" regions is their comparatively lower environmental assets in comparison to Carpathian Mountains. However, the "Western surroundings" show a significantly better economic situation compared to the "Eastern/Western" and "Southern surroundings"..

Table 3.10
Characteristic of different types of regions

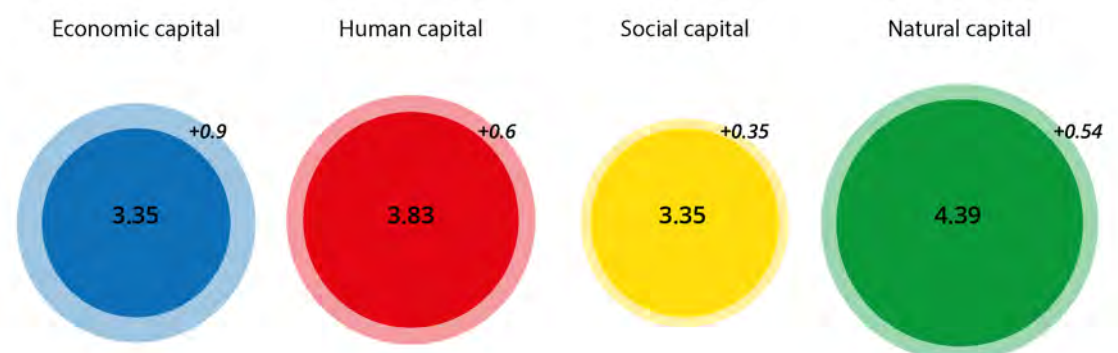
Tye of regions	"Economic"	"Social"	"Environmental"
„Metropolitan Centres"	3.78	-0.08	-0.94
„Industrial surroundings"	1.13	0.12	1.06
„Western Carpathians"	-0.05	0.99	1.03
„Serbian/Southern Carpathians"	0.32	-2.17	0.51
„Southern Carpathians"	-0.58	-0.79	0.38
„Eastern Carpathians"	-0.55	0.06	0.26
„Southern surroundings"	-0.27	-0.80	-1.05
„Eastern/Western surroundings"	-0.44	0.16	-1.07
„Western surroundings"	0.10	1.64	-0.82

Source: own elaboration (EUROREG)

3.2.2 Assessment of interactions between different types of capitals in Carpathian macroregion

To assess the interactions between territorial capitals in the Carpathian macroregion, opinions from regional and local stakeholders were gathered. A survey was conducted with 370 participants from eight countries within the macroregion. Respondents were first asked to evaluate the status and changes in economic, human, social, and natural capital in their respective regions.

Figure 3.3
Assessment of the state of capitals and their changes in recent years by respondents



Source: own elaboration based on survey results.

They were then invited to assess the relationships between these capitals across the entire Carpathian macroregion, as well as the synergies and conflicts observed in different types of functional areas. The

relationships and interactions between the capitals were further discussed during a stakeholders workshop, which included approximately 50 participants.

According to the respondents, the regions comprising the Carpathian macroregion possess the greatest resources in terms of natural capital, followed by human capital (**Fig. 3.2**). This aligns fully with the diagnosis of the development conditions of the macroregion for natural capital. However, while the quantitative analysis of human capital resources identified numerous deficiencies, these were not perceived as critical by the respondents. Conversely, the respondents gave lower ratings to the resources of economic and social capital, which largely corresponded with the findings of the conducted diagnosis. In terms of the dynamics of territorial capital resources over the past decade, respondents noted improvements, particularly in economic capital, and to a lesser extent in human and natural capital. Opinions on the improvement of social capital, however, were more diverse, suggesting that no significant change has occurred in this area in the last decade.

The assessment of the state and changes in various types of capital varied across countries (**Fig. 3.2**). Positive changes in the state of economic capital were most evident in Romania, Poland, and Serbia, aligning with the high GDP growth rates observed in these countries in recent years. Conversely, the growth dynamics of economic capital were rated poorly in Slovakia, the Czech Republic, and Hungary. The state of human capital received high ratings in the Czech Republic and Poland but was assessed poorly in Ukraine and Slovakia. Positive changes in human capital were noted, as with economic capital, in Romania and Poland. However, Hungary, Ukraine, and Slovakia received negative assessments regarding the growth dynamics of human capital, potentially exacerbating disparities within the macroregion.

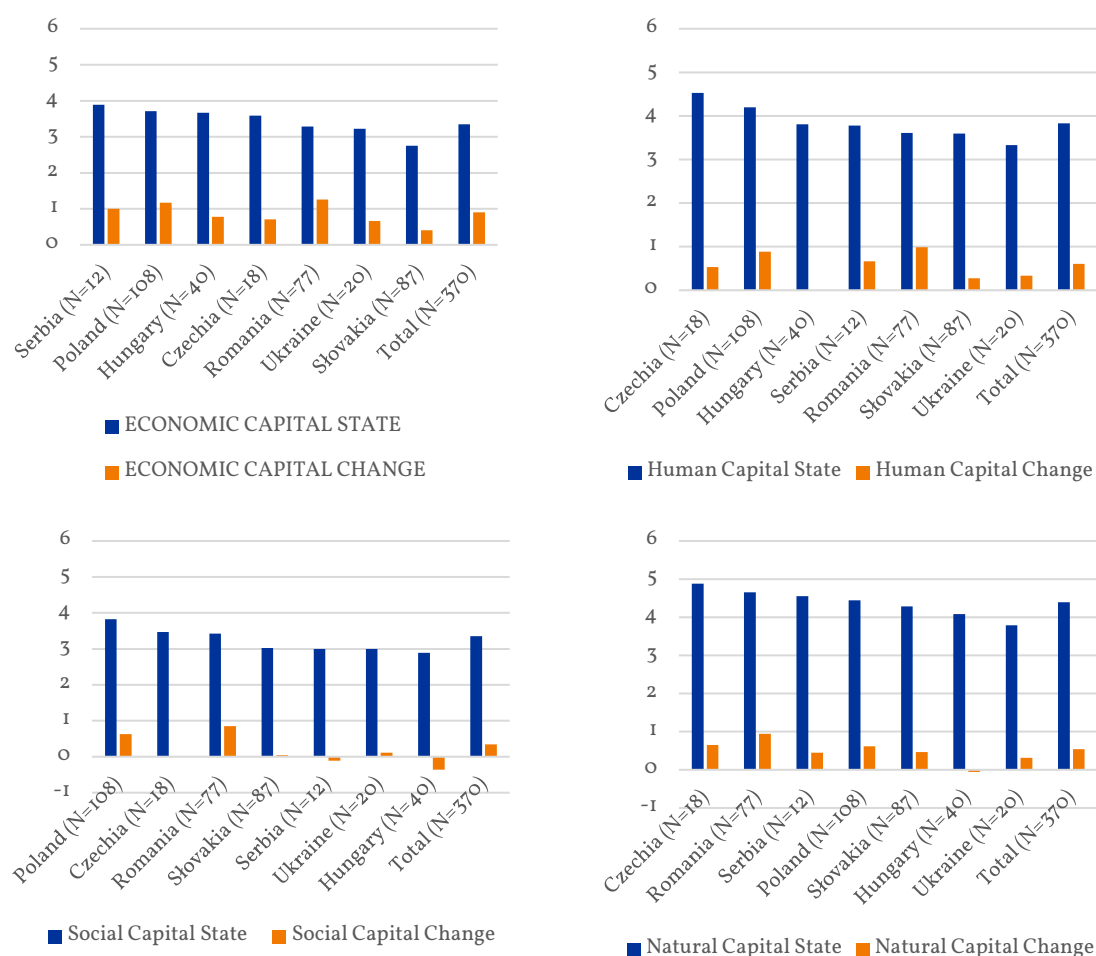
The state of social capital was rated particularly high in Poland and to a lesser extent in the Czech Republic and Romania. Positive changes in social capital were observed only in Romania and Poland. In Hungary, a deterioration in the state of social capital was reported, while in other countries, no significant changes were perceived. This highlights the need for targeted actions to strengthen social capital across the region. The state of natural capital was generally well-regarded, with positive changes noted in all countries except Hungary. Romania stood out with particularly favourable assessments in this category. In summary, while there are positive trends in economic and human capital in some countries (notably Romania and Poland), challenges persist in social and human capital dynamics in other parts of the macroregion. The overall improvement in natural capital, except in Hungary, offers a foundation for sustainable development, though disparities between countries underline the need for coordinated regional strategies.

The relationships between various types of capitals, as assessed by respondents, reveal both signs of synergy and areas of conflict (**Chart 3.1**). Notable synergies were identified, particularly between economic and human capital. However, workshop discussions highlighted issues such as weak linkages between the R&D sector and production activities, as well as the misalignment of academic programs with the needs of the regional economy. Another type of synergy involved the positive interaction between human and social capital. This included the impact of appropriate training for professionals on the quality of administration, as well as the potential to leverage the region's cultural resources for the development of human capital. The influence of natural capital on other types of capitals was assessed as weaker. It was largely characterized by the exploitation of natural resources, with less emphasis on the positive changes that socio-economic development could bring to the environment. Workshop participants raised concerns about industrial pollution, threats from intensive agricultural production, and the negative impacts of excessive tourism and transport infrastructure development in environmentally valuable areas. On the other hand, participants pointed to opportunities for developing ecotourism and sustainable tourism, highlighting the region's potential to balance environmental preservation with economic and social benefits.

The primary manifestation of conflicts pertains to the relationship between economic and natural capital, highlighted by approximately half of the respondents. This primarily concerned issues related to uncontrolled suburbanization, mineral resources exploitation, the construction of new roads through environmentally valuable areas, excessive tourism, and unsustainable timber harvesting. Conflicts among the remaining capitals were assessed as significantly weaker, but 25%-30% of respondents recognized their presence. Conflicts between human and social capital and natural capital were observed only sporadically.

Chart 3.1

Assessment of the state and changes in capitals in their regions by respondents from individual countries *



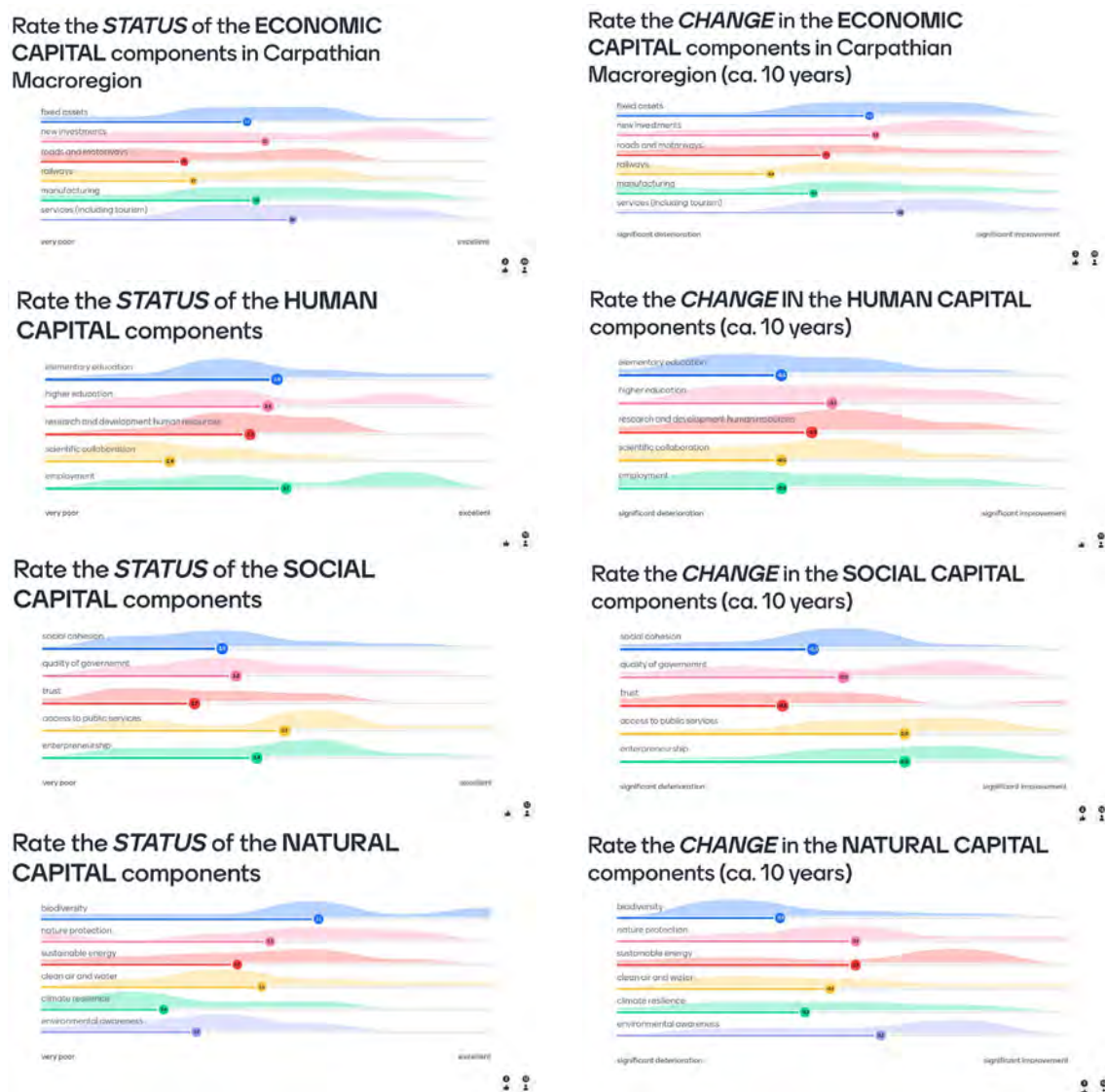
*status of capital (6 – excellent, 5 – very good, 4 – good, 3 – sufficient, 2 – poor, 1 – insufficient); change of capital (2 – significant improvement, 1 – some improvement, 0 – no change, 1 – deterioration, 2 – significant deterioration)

Source: own elaboration based on survey results.

Survey respondents were also asked to evaluate the occurrence of synergies and conflicts across various functional areas (**Fig. 3.4**). These areas were categorized based on two criteria: (1) Structure of the Settlement Network (large cities and their functional areas, small and medium-sized towns, and rural areas) (2) Specific characteristics derived from location or specific resources or legal status (border areas, mountainous regions, and protected areas).

According to respondents, synergies were most evident in the metropolitan areas of large cities, followed by the functional areas of small and medium-sized towns. Synergies in metropolitan areas were particularly noticeable in Poland, Serbia, and Hungary, while they were weakest in Ukraine. In Ukraine, greater synergies were observed in the functional areas of small and medium-sized towns, a trend also noted in the Czech Republic and Poland, though less so in Slovakia. In Slovakia, positive interactions between capitals in rural areas were rated particularly poorly, a finding echoed in Serbia and Hungary. Synergies between capitals were most frequently reported in border areas in Ukraine and Serbia, while Hungary showed the least recognition of such synergies. Similar patterns were observed in mountainous areas, where synergies were least frequently identified in Hungary. In protected areas, synergies between capitals were primarily reported in the Czech Republic and Slovakia, with significantly fewer observations in Romania and Hungary.

Figure 3.4
Assessment of the Components of Territorial Capitals by Workshop Participants



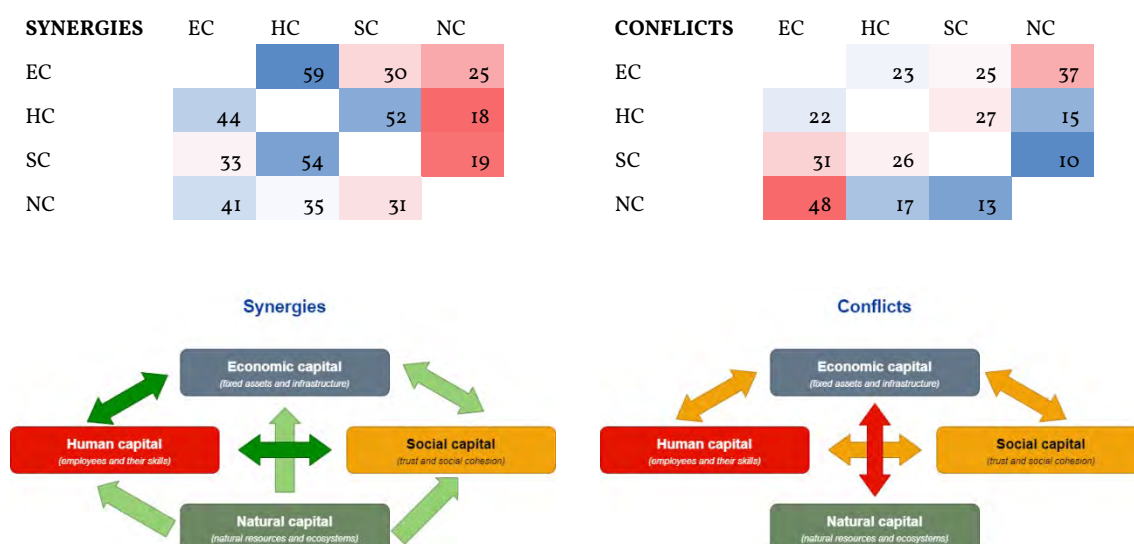
Source: own elaboration based on Workshop results

The relationships between various types of capitals, as assessed by respondents, reveal both signs of synergy and areas of conflict (**Fig. 3.5**). Notable synergies were identified, particularly between economic and human capital. However, workshop discussions highlighted issues such as weak linkages between the R&D sector and production activities, as well as the misalignment of academic programs with the needs of the regional economy (Annex 3). Another type of synergy involved the positive interaction between human and social capital. This included the impact of appropriate training for professionals on the quality of administration, as well as the potential to leverage the region's cultural resources for the development of human capital. The influence of natural capital on other types of capitals was assessed as weaker. It was largely characterized by the exploitation of natural resources, with less emphasis on the positive changes that socio-economic development could bring to the environment. Workshop participants raised concerns about industrial pollution, threats from intensive agricultural production, and the negative impacts of excessive tourism and transport infrastructure development in environmentally valuable areas. On the other hand, participants pointed to opportunities for developing ecotourism and sustainable tourism, highlighting the region's potential to balance environmental preservation with economic and social benefits.

The primary manifestation of conflicts pertains to the relationship between economic and natural capital, highlighted by approximately half of the respondents. Conflicts among the remaining capitals were assessed as significantly weaker, but 25%-30% of respondents recognised their presence. Conflicts between human and social capital and natural capital were observed only sporadically.

Figure 3.5

Assessment of Relationships Between Territorial Capitals *



* percentage of respondents that indicated specific synergy/conflict

Source: own elaboration based on survey results.

Survey respondents were also asked to evaluate the occurrence of synergies and conflicts across various functional areas (**Fig. 3.5**). These areas were categorized based on two criteria: (1) Structure of the Settlement Network (large cities and their functional areas, small and medium-sized towns, and rural areas) (2) Specific characteristics derived from location or specific resources or legal status (border areas, mountainous regions, and protected areas).

According to respondents, synergies were most evident in the metropolitan areas of large cities, followed by the functional areas of small and medium-sized towns. Synergies in metropolitan areas were particularly noticeable in Poland, Serbia, and Hungary, while they were weakest in Ukraine. In Ukraine, greater synergies were observed in the functional areas of small and medium-sized towns, a trend also noted in the Czech Republic and Poland, though less so in Slovakia. In Slovakia, positive interactions between capitals in rural areas were rated particularly poorly, a finding echoed in Serbia and Hungary. Synergies between capitals were most frequently reported in border areas in Ukraine and Serbia, while Hungary showed the least recognition of such synergies. Similar patterns were observed in mountainous areas, where synergies were least frequently identified in Hungary. In protected areas, synergies between capitals were primarily reported in the Czech Republic and Slovakia, with significantly fewer observations in Romania and Hungary.

The perception of conflicts between territorial capitals varied significantly across countries. Conflicts in metropolitan areas and functional areas of small and medium sized cities were most frequently reported by respondents from Hungary, though similar observations, to a lesser extent, were made in Poland, Romania, and the Czech Republic. Negative interactions between territorial capitals in rural areas were also noted in all these countries, particularly in Hungary. Such conflicts were less commonly reported in EU candidate countries and Slovakia. Conflicts between territorial capitals in border areas were primarily observed in the Czech Republic and Hungary. In mountainous regions, conflicts were most often reported in Romania, while in other countries, such conflicts were relatively rare. Protected areas were seen as arenas of conflict between capitals, particularly in Hungary, Romania, and Serbia, with some reports also from Poland, though to a lesser extent.

Figure 3.6**Synergies and Conflicts Between Territorial Capitals in Functional Areas by Country***

	Metropolitan areas	Small and medium cities	Rural areas	Border areas	Mountain areas	Protected areas
SYNERGIES						
Czechia (N=18)	1,9	1,9	1,8	1,3	1,3	1,8
Poland (N=108)	2,2	1,8	1,5	1,5	1,5	1,5
Romania (N=77)	2	1,7	1,4	1,3	1,5	1,3
Serbia (N=12)	2,1	1,6	0,9	1,6	1,3	1,5
Slovakia (N=87)	1,8	1,4	0,9	1,3	1,4	1,6
Ukraine (N=20)	1,6	1,8	1,4	1,7	1,4	1,5
Hungary (N=40)	2,1	1,7	1,1	1,1	1	1,3
TOTAL (N=370)	2	1,6	1,3	1,4	1,4	1,5
CONFLICTS						
Czechia (N=18)	1,4	1,4	1,6	1,8	1,2	1,1
Poland (N=108)	1,5	1,5	1,5	1,1	1,2	1,4
Romania (N=77)	1,6	1,7	1,5	1,1	1,5	1,5
Serbia (N=12)	0,9	1,4	1,3	1	1,1	1,4
Slovakia (N=87)	1,4	1,2	1,3	1,3	1,1	1,3
Ukraine (N=20)	1,1	1,1	0,9	0,9	1,2	1,2
Hungary (N=40)	2	1,6	1,9	1,5	1,3	1,7
TOTAL (N=370)	1,5	1,5	1,5	1,2	1,3	1,4

* Average based on ratings (0-3): 0 – no synergy/conflict. 1 – weakly visible. 2 – moderately visible. 3 – highly visible

Source: own elaboration based on survey results.

4 Administrative structure and multi-level governance

4.1 Domestic level

The administrative structure of the Carpathian countries differs significantly. The main feature of the multi-level governance framework defines all of the studied countries as a unitary parliamentary democracy with a three-tier or a two-tier system of subnational government. The three-tier system consisting of regions, counties, and municipalities exists in Poland and Ukraine. The two-tier system composed of regions (or districts) and municipalities as the main governing bodies is found in Czechia, Slovakia, Hungary, Romania, Serbia and the Republic of Moldova. It is worth noting that some of the two-tier countries (Czechia, Slovakia) have a quasi-intermediate level of governance which operates basically for statistical purposes.

The position of subnational governments (SNG) in the Carpathian countries vary considerably mainly due to the troubled history and political shifts which resulted in transition from the communist centralized states toward democracies with territorial self-government units. Following OECD data, SNG consists of 3 levels: local, intermediate and upper-intermediate. A local level refers to municipalities, an intermediate level refers to counties (e.g. raion in Ukraine, powiat in Poland), an upper intermediate level refers to regions. As shown in **Figure 4.1**, there is a substantial range of competences which have been attributed to different levels of governance in the Carpathian countries. However, their power and financial autonomy vary significantly responsibilities in most sectors important for macroregional development including transport, environmental protection, housing, planning, education, health, social welfare, culture and sport.

Figure 4.1

Competencies at different levels of governance in the Carpathian countries, 2024

Sectors and sub-sectors	Levels of governance	CZ	SK	PL	HU	RO	RS	MD	UA
Transport and economic affairs	Local								
	Intermediate								
	Upper intermediate								
Environment protection	Local								
	Intermediate								
	Upper intermediate								
Housing	Local								
	Intermediate								
	Upper intermediate								
Planning and Community amenities	Local								
	Intermediate								
	Upper intermediate								
Health	Local								
	Intermediate								
	Upper intermediate								
Culture and recreation	Local								
	Intermediate								
	Upper intermediate								
Education	Local								
	Intermediate								
	Upper intermediate								
Social welfare	Local								
	Intermediate								
	Upper intermediate								

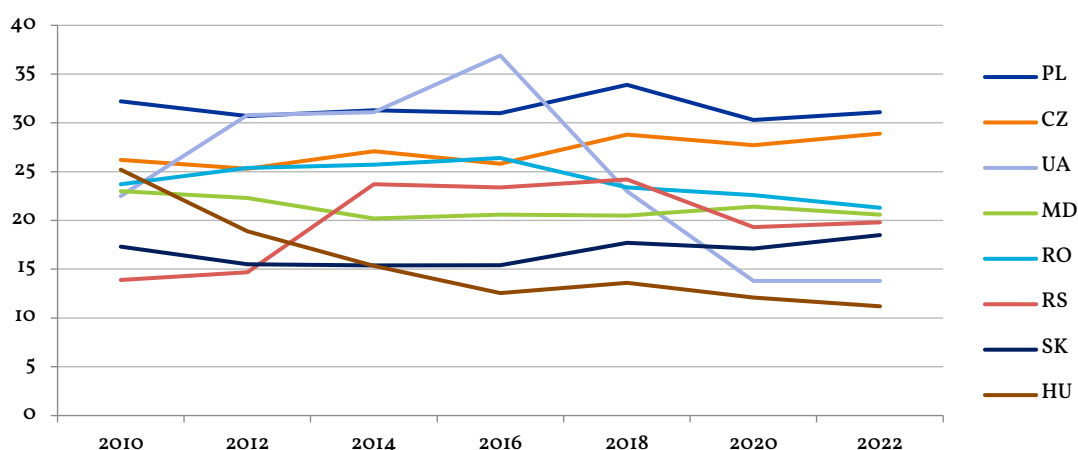
Source: Elaborated based on OECD/UCLG data (2022)

Only in the Republic of Moldova the competences in health and education sectors are exclusively allocated to the central government. In turn, in Serbia the planning policy has been transferred from the central to the regional level of governance. Unlike most of the Carpathian countries, Poland and Ukraine have the intermediate level of governance owning autonomous and delegated responsibilities shared with the regional authorities. Across a range of competences, only housing and planning has been excluded from the intermediate level in Poland and Ukraine and become a domain of municipalities. The upper intermediate level of governance which is performed by regions or districts not only facilitates the cooperation with central governments but also provides key supralocal services. As given in **Figure 4.1** Hungary is the only Carpathian country where the duties of supralocal authorities in all sectors, apart from planning, have been recentralized. As the ESPON COMPASS project showed, spatial planning and the land development control system is not functioning there strongly (ESPON, 2018, p. 65).

The power attributed to different levels of governance is reflected in a degree of decentralization, which can be measured as a share of local government expenditure in the total public expenditure. **Chart 4.1** provides a picture of the above rate in the Carpathian countries for the period 2010–2022. It shows that in 2022 the highest share of local expenditure in general government spending was recorded in Poland (31.1%) and Czechia (28.9%), while the lowest in Hungary (11.2%), and Ukraine (13.8%).

Chart 4.1

Dynamics of sub-national government expenditure as a % of general government expenditure, 2010–2022



Source: elaborated based on OECD/UCLG and IMF data (2022).

*subnational level (regional, intermediate or local)

The dynamics of expenditures also indicates that in the given period the largest decrease of SNG spending was noticed in Hungary and Ukraine. Whereas in Hungary the fall of local expenditures from 25.2% in 2010 to 11.2% in 2022 was stimulated by recentralization tendencies, in Ukraine the drop from 22.5% to 13.8% was caused by political turmoil initiated by Russian aggression in 2014 and then the conflict escalation in 2022. During the same period, only in 3 out of the 8 Carpathian countries the SNG spending increased (Czechia, Slovakia, Serbia).

In summary, the average of subnational government (SNG) expenditures in the Carpathian countries amounted to 20.6% of public spending in 2022 and was far below the OECD average (36.6%) and the EU27 average (34.3%). Only in Poland and Czechia the ratios are above the OECD average for unitary countries (27.5%). This implies that in these two countries local authorities have the strongest position among the analyzed states.

In Poland and Czechia the primary spending sectors of local government is education which in 2020 accounted for 25.1% and 30.6% of total SNG expenditure respectively. This reflects not only the competencies of local bodies in maintaining educational facilities, but also their responsibilities for teacher salaries. Education

has also been a primary spending sector of SNG in Slovakia (40.2%) and the Republic of Moldova (55.3%). Another important sectors of SNG activity in Poland, Czechia, Slovakia, and the Republic of Moldova are healthcare and transport. In turn, healthcare measured by expenditure has become a primary subnational competence in Romania (22.8%), which is followed by transport and economic affairs (19.6%). In Romania the competences in health care have been developed to SNG authorities since a decentralisation of this field in 2010. Although the overall level of SNG expenditure decreased in Romania by 5 % in recent years (SNG are no longer responsible for teacher salaries), their spending in other areas including culture, environment protection and community amenities remain stable.

The share of municipalities expenditure has increased in Serbia, reflecting an extension of their competences. However, still staff salaries remain the key item in the budgets, accounting 38.7% of the total SNG spending in 2020. The opposite trend of governing represents Hungary, where upper local authorities (counties) have lost competencies in education, healthcare, environment protection, culture, social welfare, and transport. As a result, the shares of SNG expenditure in the given sectors have sharply fallen. In Hungary only municipalities have sustained some responsibilities in general public services (26.1% of SNG expenditure), and transport (20.3%) as key areas of their activity.

A sharp decline of SNG competences have also been observed in Ukraine. Since the start of Russia's invasion against Ukraine in 2022 the transfer of responsibilities has become very complicated and full of tensions. Currently, the distribution of duties across different levels of government is unclear. Although local administration has been empowered in certain areas (e.g. planning, development, healthcare) most competencies are shared with the central government. Subnational governments have little power over expenditure priorities and are mostly responsible for the payment of employees in the education, social protection and healthcare sector. Over 43% of SNG spending is allocated on payroll in these areas.

Generally, although diverse administrative reforms have been implemented in the Carpathian countries over the last few decades, the position and competences of actors at different levels of governance remain labile.

4.2 Cross-border level

The cross-border cooperation in the Carpathian area is mainly developed within EGTCs registered with the Committee of Regions (CoR), the Euroregions and INTERREG programs. They all together create a very diverse network of partners which are complemented with a series of bilateral and multilateral cooperation formats.

4.2.1 Euroregions

Euroregions are a form of cross-border cooperation which associates local governments of neighbouring countries at different administrative levels. The governance structure of Euroregions is based on political agreement among bordering entities and usually consists of the council, secretariat, and working committees led by different members. In most cases this is a flexible form of cooperation without a legal personality. The scale of territorial cooperation of Euroregions in the Carpathian macroregion is very diverse. By 2023 a total number of 19 Euroregions were established in the Carpathian area (**Table 4.1, Map 4.1**).

Table 4.1
Euroregions, 2024

Euroregion	Member states	EGTC status	Year of establishment
Carpathian Euroregion	PL, SK, UA, HU, RO	NO	1993
Tatry	PL, SK	EGTC	1994
Danube-Kris-Mures-Tisa	RO, HU, RS	NO	1997
Pomoravi-Zahorie-Weinwiertel	CZ, SK, AT	NO	1997
Śląsk Cieszyński	PL, CZ	NO	1998
Carpathian Euroregion	PL, SK, UA, HU, RO	NO	1993
Tatry	PL, SK	EGTC	1994
Danube-Kris-Mures-Tisa	RO, HU, RS	NO	1997

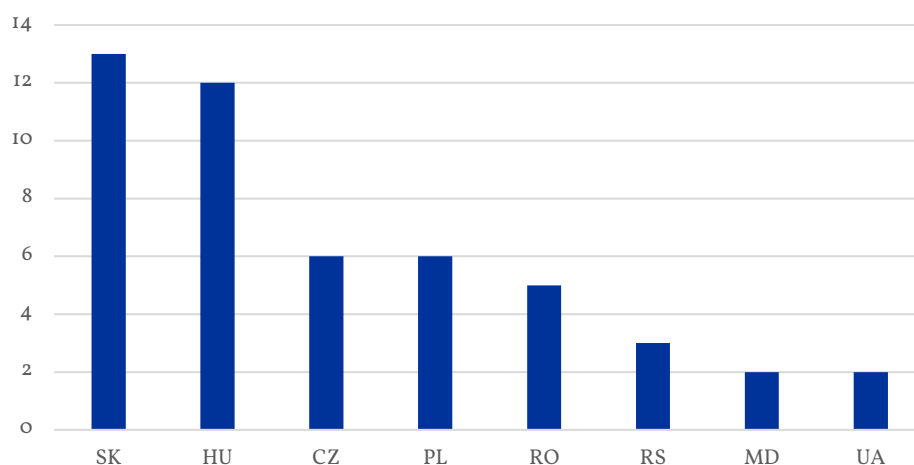
Euroregion	Member states	EGTC status	Year of establishment
Pomoravi-Zahorie-Weinviertel	CZ, SK, AT	NO	1997
Śląsk Cieszyński	PL, CZ	NO	1998
Silesia	PL, CZ	NO	1998
Upper Prut	RO, MD, UA	NO	1998
Vag-Danube-Ipel	SK, HU	NO	1999
Ipel-Ipoly	HU, SK	NO	1999
Beskidy	PL, CZ, SK	NO	2000
Bílé Karpaty	CZ, SK	NO	2000
Neogradieci	SK, HU	NO	2000
Biharia	RO, HU, RS	NO	2002
Siret-Prut-Nistru	RO, MD	NO	2002
Kocice-Miscolc	SK, HU	NO	2003
Ister-Granum	SK, HU	EGTC	2003
Zemplen	SK, HU	NO	2004
Sojo-Rima	SK, HU	NO	2007
Banat Triplex Confinium	HU, RO, (RS)	EGTC	2009

Source: own elaboration

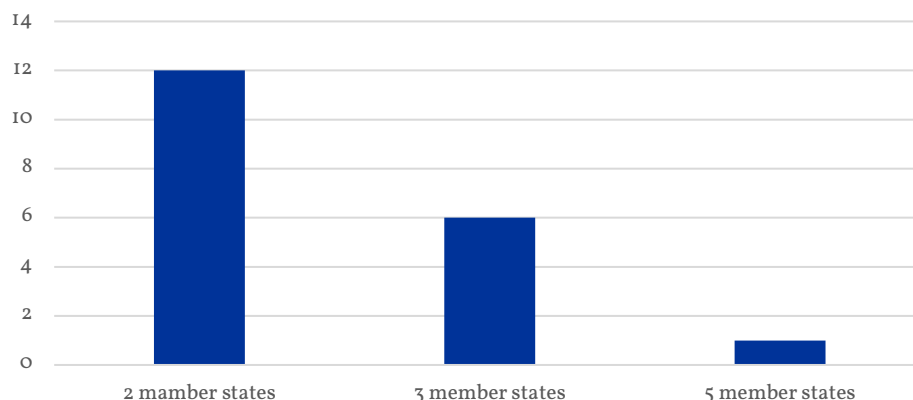
The largest concentration of Euroregions is in Slovakia (12) where they cover the entire border of the country and in Hungary (11). Poland is a member of 6, while Czechia, and Romania participate in 5 Euroregions located in the Carpathian macroregion. Serbia, Ukraine and the Republic of Moldova as the non-EU states have a much lower degree of participation (**Chart 4.2**).

Chart 4.2

Number of Euroregions, 2024



Source: own elaboration

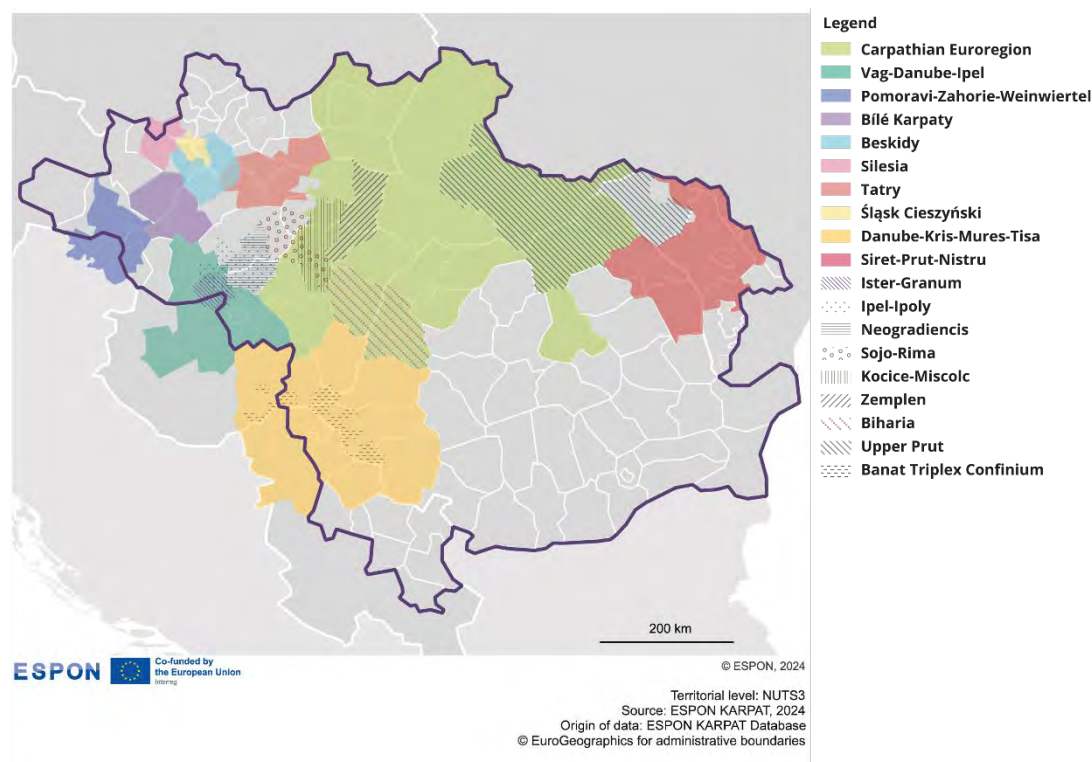
Chart 4.3**Number of member states in individual Euroregions, 2024**

Source: own elaboration

The majority of Euroregions located in the Carpathian area have a bilateral cross-border form of cooperation (**Chart 4.3**). Out of 19 Euroregions 12 (63%) cover territories from two member states and 6 (31%) Euroregions integrate 3 member states. The Carpathian Euroregion is the only one, which is the largest and the longest operating structure located across the borders of 5 countries including Poland, Slovakia, Hungary, Romania and Ukraine. Although the Carpathian Euroregion has developed professional cross-border governing bodies across local, supra-local and sub-states levels, the spatial stretching between 19 regional units in 5 countries reaching over 500 km distances causes many challenges in multilateral contacts, e.g. language barriers, divergent legal systems, political and economic disparities (Lytvyn and Tyushka, 2020). Nonetheless, the Euroregion is a platform for a few active structures such as SMEK - Network of Cities of the Carpathian Euroregion, the Carpathian Regional Development Agency, and the Carpathian Forum of NGOs.

The concentration of Euroregions in the Western Carpathians and the relative absence of Euroregions in the southeastern part of the macroregion can be explained through a combination of historical, political and geographical factors. The Western Carpathians, which are situated primarily between the Czech Republic, Slovakia, Poland and Hungary, have been historically part of more interconnected political entities (e.g. the Austro-Hungarian Empire). The countries in the southeastern part of the Carpathians (especially Ukraine, Serbia, and the Republic of Moldova) have been more focused on consolidating national identity and securing borders after the collapse of the Soviet Union. The map (**Map 4.1**) also shows that the Western Carpathians are more geographically conducive to cross-border cooperation due to the way the mountains and valleys intersect between Poland, the Czech Republic, Slovakia, and Hungary. In contrast, the southeastern part of the macroregion (including parts of Romania, Ukraine, and the Republic of Moldova) features more isolated mountain ranges and less developed infrastructure for cross-border cooperation.

Map 4.1
Euroregions, 2024

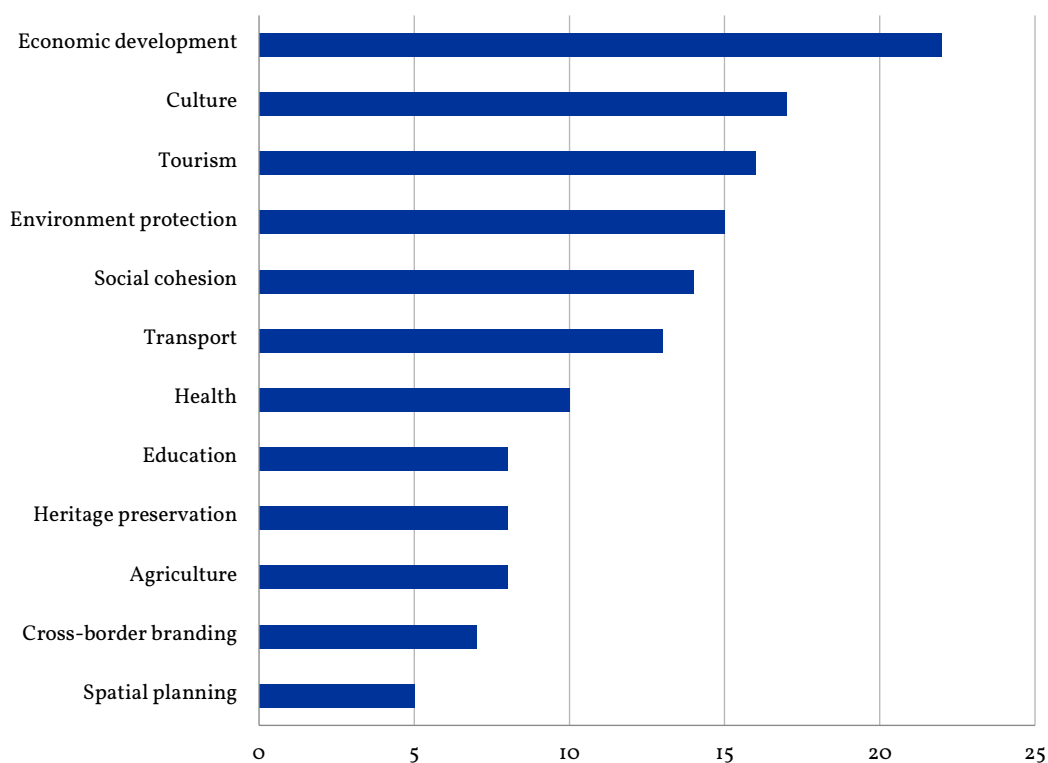


4.2.2 European Grouping of Territorial Cooperation

The European Grouping of Territorial Cooperation (EGTC), created in 2006 by a regulation of the European Parliament, is one of the main legal instruments of cooperation that confers legal personality and autonomous structure of established cross-border organization. The governing structure of EGTCs is rather clear. In most cases it includes statutory bodies (general assembly and director) and supervisory boards. The primary advantage of EGTC is the ability to sign legal contracts and apply for EU and external funding. Given such possibilities, one of the main goals of EGTCs created in the Carpathian area is to reduce economic and geographic marginalization by developing infrastructural, cultural, economic, and environment initiatives. This scope of goals largely correlates with the main areas of cooperation declared by the majority of EGTC located in the Carpathian macroregion (**Chart 4.4**).

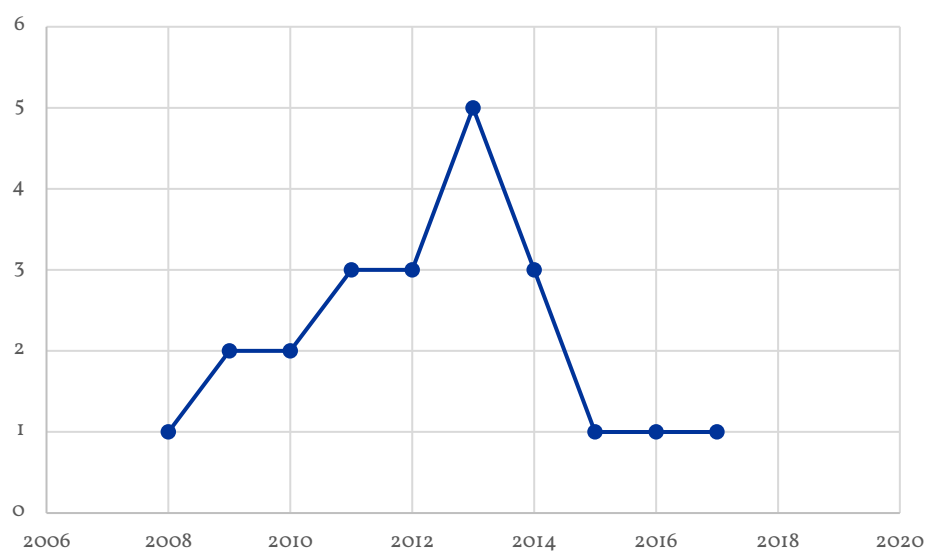
The territorial spread of EGTC in the Carpathian countries is largely associated with the cultural and historical background of cooperating municipalities (**Map 4.2**). However, the financial support provided by the European institutions is a very important trigger of EGTC proliferation. By 2023 in the Carpathian macroregion 22 EGTCs have existed. The dynamic of EGTC formation (**Chart 4.5**) shows that this process started in 2008, when the first EGTC (Ister-Granum) was established by converting the Euroregion into an EGTC formula.

Chart 4.4
Thematic areas of EGTC cooperation, 2024

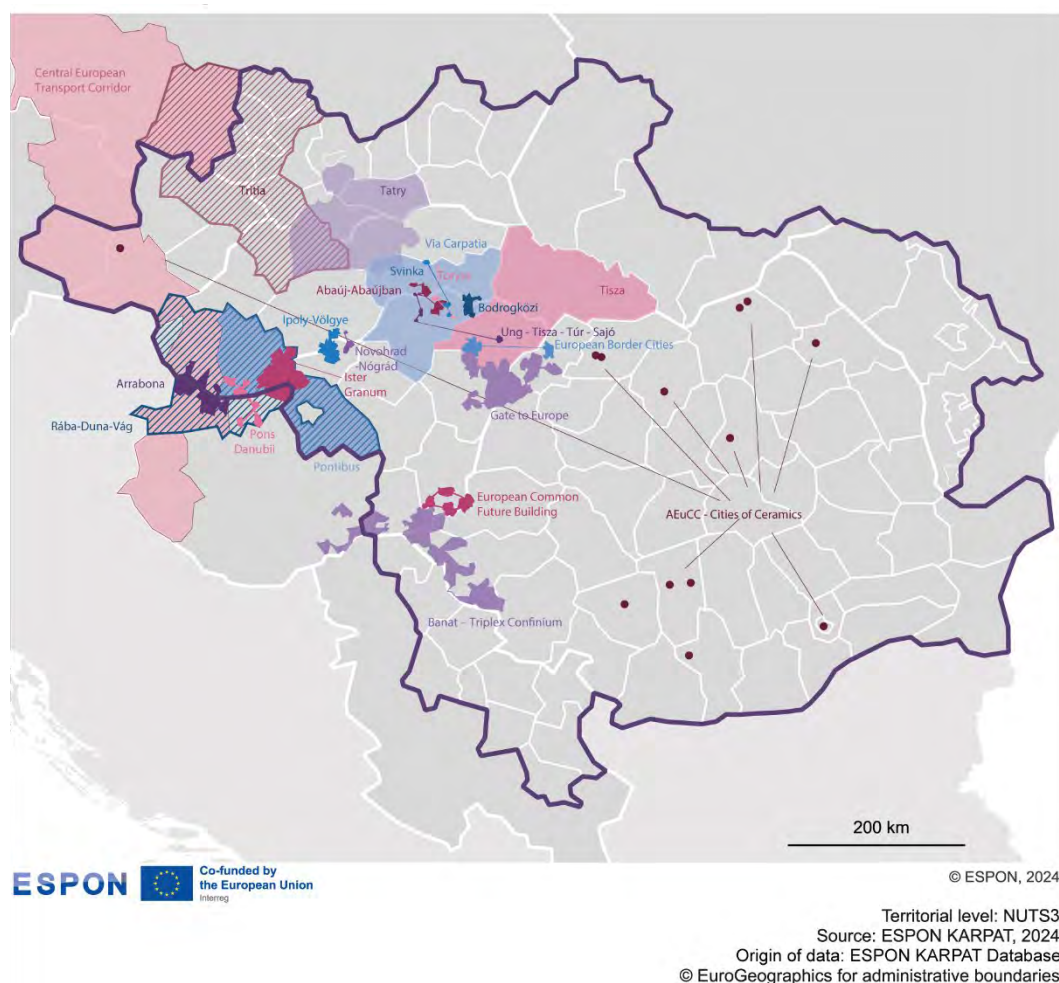


Source: own elaboration

Chart 4.5
Dynamic of EGTC formation, 2006-2018



Source: own elaboration

Map 4.2**European Groupings of Territorial Cooperation (EGTC), 2024**

Source: own elaboration based on <https://egtcmmonitor.cesci-net.eu/en/>

The largest increase of EGTC occurred in 2013 when another 22% of them were established. This growth was mainly stimulated by the upcoming 2014-2020 programming period, which provided new funding opportunities through the EU instruments. The majority of EGTC (75%) is located in Hungary, where most of them are situated on the border with Slovakia. Hungarian border also concentrates one of the largest and the smallest EGTC collaborating at meso and micro level respectively. While the largest EGTC Rába-Duna-Vág covers 25407 km², the smallest one Torysa is operating on an area of only 60 km². Overall, out of 22 EGTC located in the Carpathian macroregion, 6 have an area over 10,000 km², 9 EGTC between 500-10,000 km², 5 EGTC between 100-500 km², and 2 the smallest EGTC operate on the area below 100 km².

Notably, Hungarian-Slovak EGTC are among the most active organizations. On both sides of the border they bring together hundreds of municipalities working together in the field of economic development, environmental protection, transport, heritage preservation, culture and tourism based on the promotion of local products. Cross-border branding is particularly focused on wine and cheese production. Nevertheless, some EGTC experience challenges, including financial difficulties, deepened by language barriers. As a result, a few of them, although legally exist, have not been active for years.

4.2.3 Interreg CBC Programs

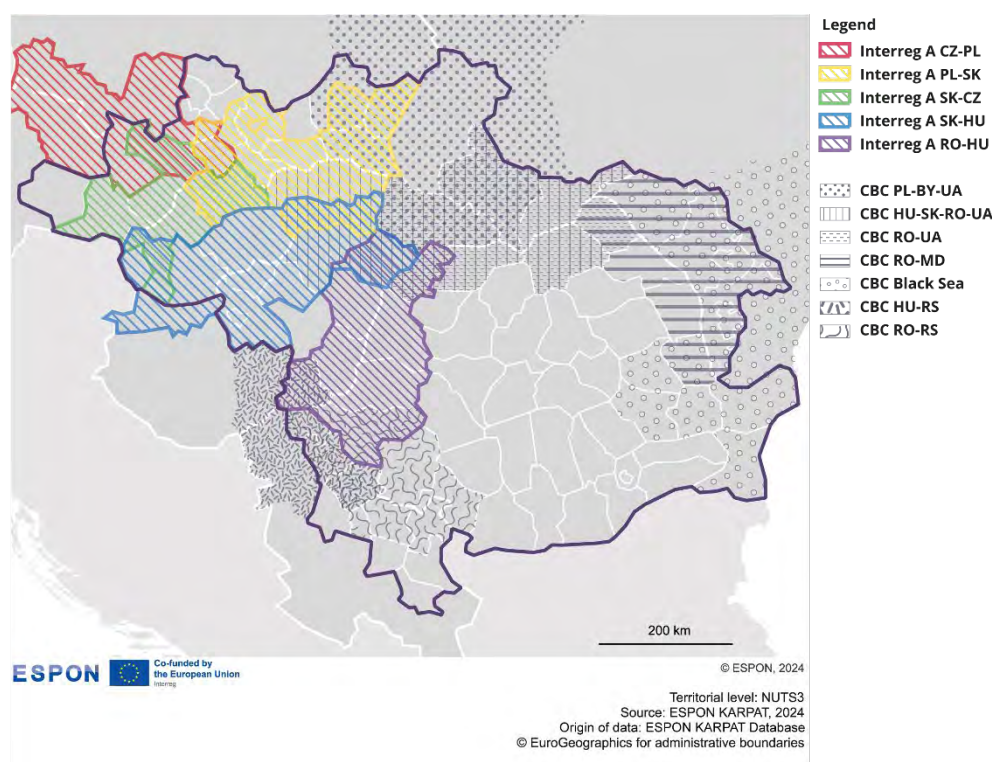
Important triggers of cross-border consolidation in the Carpathian macroregion are Interreg programmes. They offer a range of frameworks in multilevel-governance bringing together actors from public, private and

NGO sectors. In total, there were 12 such programmes available to beneficiaries, including 5 funded by Cohesion Policy funds and 7 co-financed by Pre-Accession or Neighbourhood Policy funds in the period 2014-2020.

Multiple Interreg CBC programmes cover the same geographical areas, leading to overlapping zones where stakeholders can benefit from various funding opportunities for cross-border initiatives (**Map 4.3**). This multi-program environment allows stakeholders to address regional needs and provide opportunities for synergies between programs. For instance, regions might align their projects to maximize the impact of investments in infrastructure, environmental protection, or cultural exchange. Despite the benefits, such overlaps may also pose challenges. Coordination is essential to prevent duplication of efforts, ensure efficient resource allocation, and harmonize project goals. Effective governance mechanisms are critical to navigating these complexities.

On the other hand, this highlights the need in some regions for territorial cooperation programmes that are not limited to cross-border collaboration, as significant areas of Romania, including mountain regions, are not eligible for CBC programmes. Individual regions in Poland, the Czech Republic, Hungary, and Serbia are also unable to benefit from cross-border cooperation funding and participate in joint CBC projects.

Map 4.3
Interreg cooperation structures, 2014-2020



Source: own elaboration based on European Commission

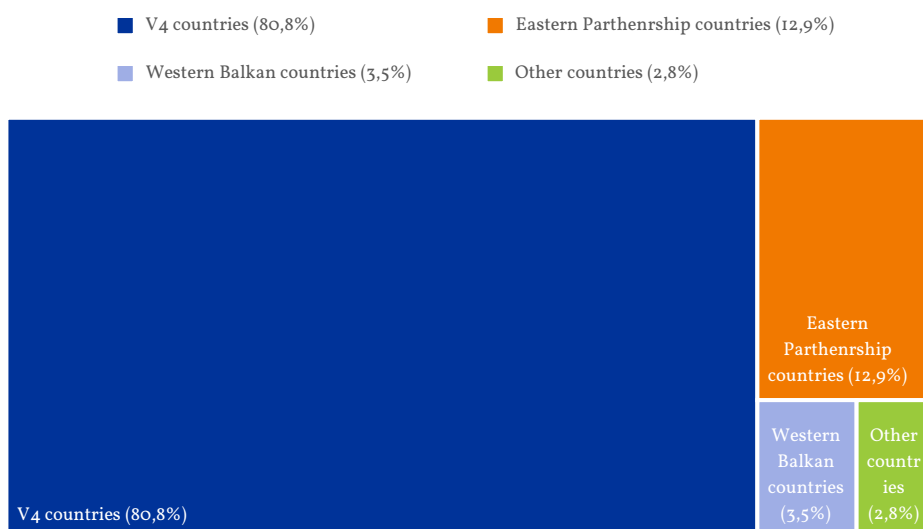
4.3 Transnational level

The first transnational cooperation formats in the Carpathian area date back several years before first CEE countries joined the EU (2004). These initiatives were largely focused on regional development and based on horizontal and vertical linkages among different international stakeholders.

4.3.1 Visegrad Fund

A primary example of such cooperation is the International Visegrad Fund (IVF) established in 2000 by Czechia, Slovakia, Hungary, and Poland (V4 countries). The supreme body of the Fund is the Conference of Ministers of Foreign Affairs of the V4 countries, which accepts the Fund's budget and determines the rules of cooperation.

Figure 4.2
Distribution of funds by the International Visegrad Fund by countries, 2000-2020

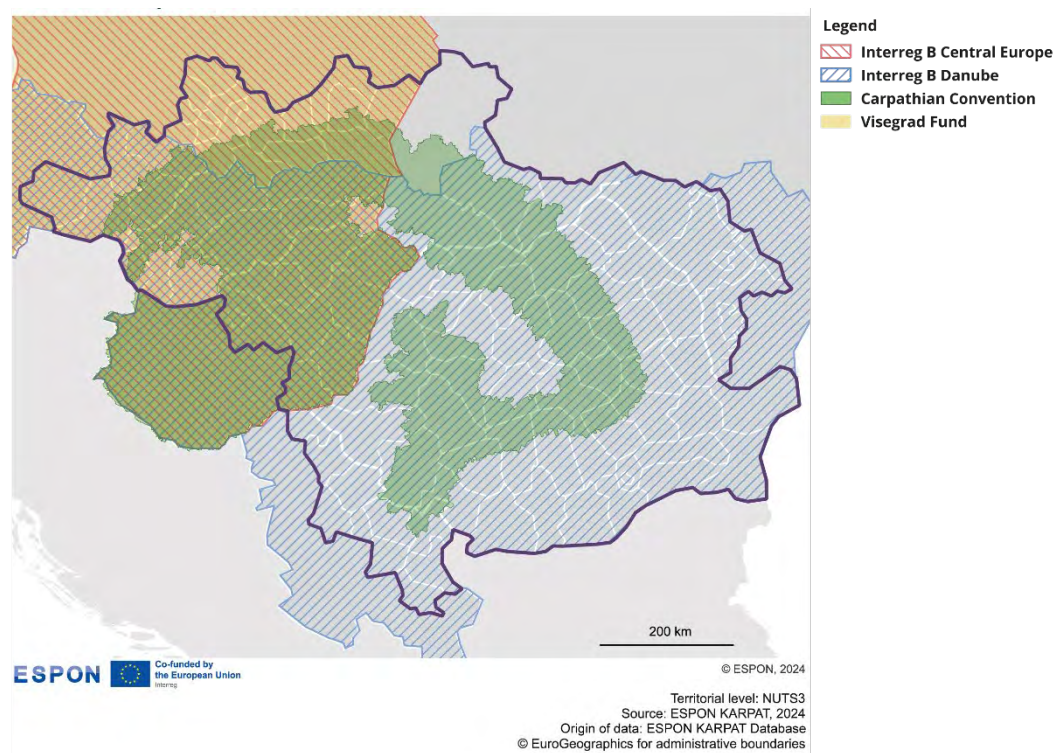


Source: elaborated based on the IVF and the Polish Economic Institute data (2021)

Since 2000 the Fund has supported over 6,000 projects with a total budget of 120 million EUR distributed among various public and nongovernmental actors, including over 600 cities from V4 and other neighbouring countries working together in various transnational initiatives. The available data given by the IVF and the Polish Economic Institute (Amroziak et al., 2021) does not differentiate beneficiaries of the Fund from the Carpathian area. However it shows that in the period 2000-2020 the funds were distributed as follows: 80.8% to V4 countries, 12.9 % to Eastern Partnership countries (including the Republic of Moldova and Ukraine), 3.5% to Western Balkan countries (including Serbia), and 2.8% to other countries (**Figure 4.2**). The main spectrum of beneficiary activities extends from small cross-border ventures to multilateral and international projects in the area of culture, education, environment, tourism, innovation, and social development.

Another crucial instrument for transnational cooperation in the Carpathian macroregion are Interreg programs transnational strand B, which allows large entities without joint borders to work together and develop networks of cooperation. In the macroregion, there is no program that encompasses all areas. On the one hand, regions located in the northwest can benefit from Interreg Central Europe, which in the case of the macroregion overlaps with the availability of the Visegrad Fund. On the other hand, regions located in the southeast can benefit from Interreg Danube, which, however, excludes Polish partners and those located in the Ukrainian Lviv region. As a result, this weakens the potential for cooperation, especially in relation to the specificity of mountain areas.

Map 4.4
Transnational programs and initiatives, 2014-2020



Source: own elaboration base on European Commission

4.3.2 Carpathian Convention

Transnational cooperation in the Carpathian area has been also developed under the Carpathian Convention, which is a multilateral environmental agreement signed in 2003 and ratified in 2006 by seven countries of the Carpathian Mountains, i.e. Czechia, Slovakia, Poland, Hungary, Romania, Serbia, Ukraine. The Convention provides a legal and governance framework to protect the region's natural heritage and promote sustainable development. It is the second sub-regional treaty for a mountain region globally, following the Alpine Convention, and serves as the only mechanism covering the entire Carpathian region. The Convention acts as an open platform for stakeholder engagement, fostering cooperation across sectors, and supporting the development of strategies and projects aimed at environmental conservation and sustainable regional development. The main decision-making body of the Convention is the Conference of the Parties (COP), which is represented by ministries of environment or agriculture of the member states. The collaboration between the Parties (COP) is supported by several Working Groups which drive various activities in the areas of sustainable development, biodiversity, infrastructure, transport, agriculture, tourism, cultural heritage, climate change and forest management. The Convention has brought 182 partners (8%) working together in different projects in the Carpathian area. So far the parties (COP) have adopted 5 Protocols under which several networks of cooperation have been established, e.g. The Carpathian Network of Protected Areas (CNPA), the network of experts in the field of education for sustainable development (CASALEN), Carpathian Network of NGOs (CERI), Science for the Carpathians (S4C) (Vetier, 2016).

Despite its ambitious framework, the Carpathian Convention is perceived by some as overly formal and less active in its practical implementation. Critics highlight its limited visibility and lack of dynamic communication, such as regular updates or impactful stakeholder engagement. Governance appears minimal, often reduced to bureaucratic processes and sporadic meetings, with insufficient grassroots initiatives to drive actionable change. Interviewees note the reliance on voluntary strategies and plans, which lack robust structures and dedicated personnel to sustain momentum. By others the Convention is seen as a cornerstone initiative, uniquely positioned to address the Carpathian region's environmental and socio-economic challenges.

Its legal framework and mandate for sustainable development underscore its relevance. Efforts like the Carpathian Platform for Sustainable Tourism illustrate its potential to engage with broader stakeholders and foster cross-border collaboration. Advocates suggest that activating this potential requires a shift towards grassroots, bottom-up approaches, complemented by stronger institutional backing and systematic engagement with local and regional communities.

4.3.3 Carpathian Interregional Group at The Committee of Regions

The Carpathian Interregional Group was established in February 2016 as a working body within the European Committee of the Regions (CoR). Its primary mission is to advocate for the development of a Macro-regional Strategy for the Carpathian Region and promote collaboration between local and regional authorities to enhance integration and sustainable development across the Carpathian arc. The group is chaired by Władysław Ortyl (PL/ECR) and involves both EU and non-EU states, specifically Serbia and Ukraine, emphasizing inclusivity in its strategic framework.

The Carpathian Interregional Group focuses on promoting a Macro-regional Strategy for the Carpathian Region, advocating for its adoption at the European Council level. It aims to enhance integration by building partnerships among local and regional authorities, fostering cross-border cooperation, and aligning efforts with the Danube Strategy for complementary actions. Central to its mission is the inclusion of non-EU states, such as Serbia and Ukraine, ensuring their development and security objectives are part of the strategy. The group also prioritizes sustainable development, cultural preservation, and environmental protection while creating platforms for dialogue, shared best practices, and informal yet targeted collaboration among stakeholders.

The group has emerged as a crucial platform for dialogue, fostering collaboration among European local authorities and promoting regional identity. Its efforts have created synergies with existing strategies, such as the Danube Strategy, amplifying its impact. The group's lobbying activities, driven by leaders like Władysław Ortyl, have garnered attention at both EU and local levels, while its informal networks encourage participation from diverse stakeholders, including NGOs, businesses, and scientific communities. By emphasizing shared heritage and sustainable development, the group has successfully highlighted the Carpathian region's importance on the European stage.

The group faces significant challenges, including uneven commitment among member states, with proactive efforts from Poland contrasted by weaker engagement from countries like Romania. Fragmented interests and limited unity have diminished the group's credibility, complicating external partnerships. Moreover, the absence of structured governance, such as regular meetings or a formalized framework, has hindered coordination. Balancing informal collaboration with the need for cohesive governance remains a challenge, as does persuading less engaged states to actively participate and integrate their objectives within the group's broader vision.

Proponents argue that the Carpathian strategy could enhance coordination and foster synergies, particularly through sectoral networks and thematic working groups modelled on successful practices from other regions. Local partnerships and lobbying are seen as crucial to achieving this vision. Advocates also suggest prioritising practical, incremental approaches rather than solely relying on top-down frameworks. Efforts should focus on integrating existing resources, enhancing local capacities, and fostering international cooperation. Grassroots participation and regional consensus will be essential for ensuring the strategy's relevance and sustainability.

A common challenge is the lack of unanimous support among Carpathian region countries, with Romania, for example, showing less enthusiasm than Poland. This divergence undermines the collective voice of stakeholders, weakening external perceptions of the region's commitment and unity. Furthermore, scepticism persists about the practical benefits of such strategies, with critics pointing to limited funding, coordination challenges, and the potential for strategies to become symbolic rather than impactful. The Alps' macro-regional strategy, for example, despite its prestige, often fails to facilitate practical cooperation or alleviate financial constraints. Critics underscore the need for the Carpathian region to avoid creating a "strategy for strategy's sake" and to instead focus on sustainable, grassroots-driven structures and solutions that genuinely address regional needs.

5 Transnational Territorial Cooperation

This chapter presents two key aspects of cross-border cooperation in the Carpathian macroregion: on the one hand, the grassroots collaboration between twinning cities, and on the other, international initiatives, including the Interreg program, which leverage external funding and primarily take the form of projects. Partnerships between cities and regions serve as an essential foundation for strengthening interpersonal ties and facilitating the exchange of experiences. Meanwhile, multilateral projects implemented under international programs provide regional and local stakeholders with the opportunity to adopt a comprehensive approach to regional development. Both aspects demonstrate how diverse forms of cooperation can contribute to social cohesion and sustainable development in the Carpathian macroregion. However, it is important to note that cross-border collaboration often faces significant barriers, including administrative complexities, cultural differences, and varying levels of economic development, which require continuous efforts to overcome. Addressing these barriers presents an opportunity to create more inclusive and efficient frameworks for territorial cooperation, particularly in areas such as governance, environmental protection, and economic integration. To maximize these benefits, it is recommended that various levels of territorial cooperation—local, regional, and international—prioritize coordination, capacity-building, and the establishment of long-term strategies that align with shared objectives.

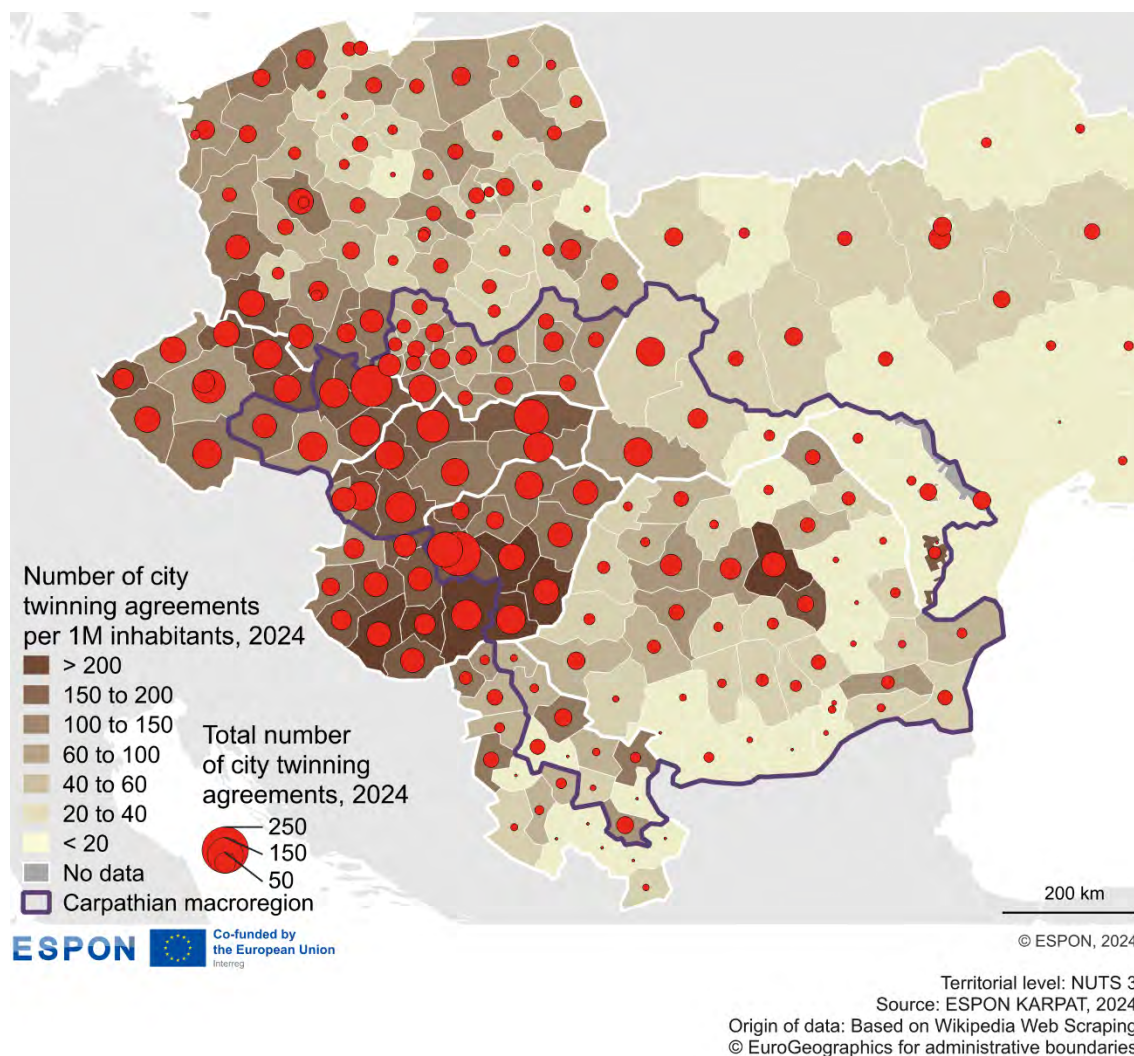
5.1 City twinning agreements

Territorial cooperation between local and regional authorities in different countries can take many forms. The oldest modern form of territorial cooperation at the subnational level is considered to be city twinning arrangements, known as twinning cities in Europe. The origins of this cooperation in Europe date back, according to some sources, to the 19th century and, according to others, to the 1920s (**Furmankiewicz 2005**). However, it was only after the Second World War that these initiatives became widespread, linked to post-war reconstruction and the beginning of the European integration process.

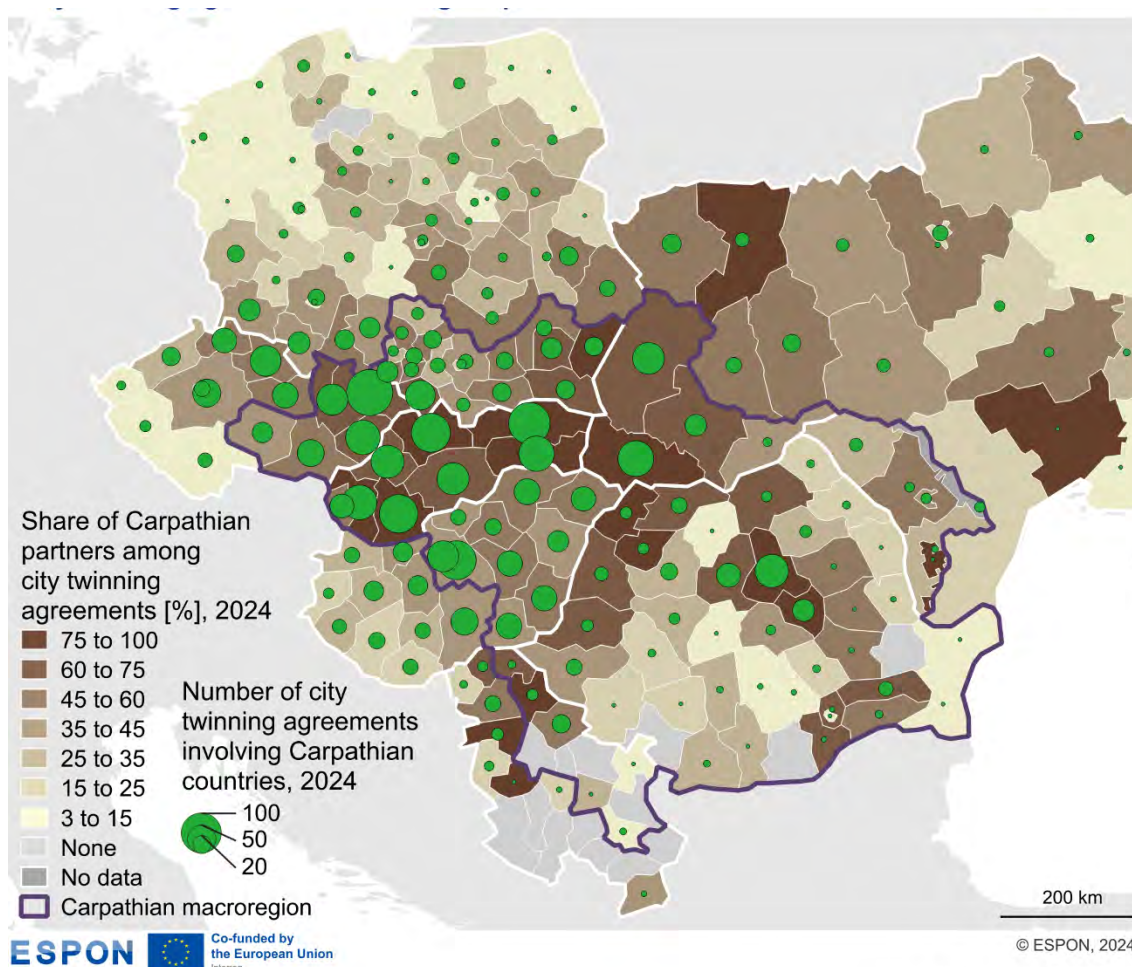
Twinning agreements between cities are generally bottom-up initiatives, often resulting from personal contacts of local government leaders (e.g. **Furmankiewicz 2005**). The development of this form of territorial cooperation is also supported by international organisations, including European Union institutions and bodies and other European organisations/associations of local and regional authorities such as The Council of European Municipalities and Regions. As a result, this form of territorial cooperation has become very widespread, with the number of agreements concluded in Europe exceeding several thousand (**Płoszaj 2013, CERM 2007**). At the same time, it should be borne in mind that not all concluded agreements turn into active and/or sustainable cooperation, and according to conservative estimates only 1/3 of the total number of agreements may meet such criteria (**Smętkowski et al. 2022**).

Twinning between towns is strongly developed in the Carpathian macroregion, especially in its western part of the area (**Map 5.1**). In quantitative terms, local governments located in the Czech Republic, Slovakia and Hungary have the highest number of twinning arrangements. To a certain extent, this is due to the fragmented administrative structure of these countries, which are characterised by a very high number of local governments at local level. At the sub-regional level, in relation to the number of inhabitants, cities in the southern part of Hungary have the highest number of such agreements. The Czech Republic and Slovakia also have more than 15 such agreements for every 100,000 inhabitants. Similar values characterise selected regions in Romania and Serbia. It should be noted, however, that the latter two countries are highly regionally differentiated in terms of city twinning. In Romania, twinning is strongest in selected Transylvanian regions, especially NUTS3 Harghita, while in Serbia, NUTS3 Južnobanatski and Borski lead the way in terms of intensity per capita. In the Polish part of the macroregion, there are about 6-10 agreements for every 100 000 inhabitants, while in Ukraine there are about 2-4. This form of cooperation - at city-level - appears to be least prevalent in the Republic of Moldova, in some Romanian regions — particularly those located in the southern and eastern parts of the country — as well as in certain regions of Serbia.

Map 5.1
City twinning agreements in NUTS3 regions, 2024

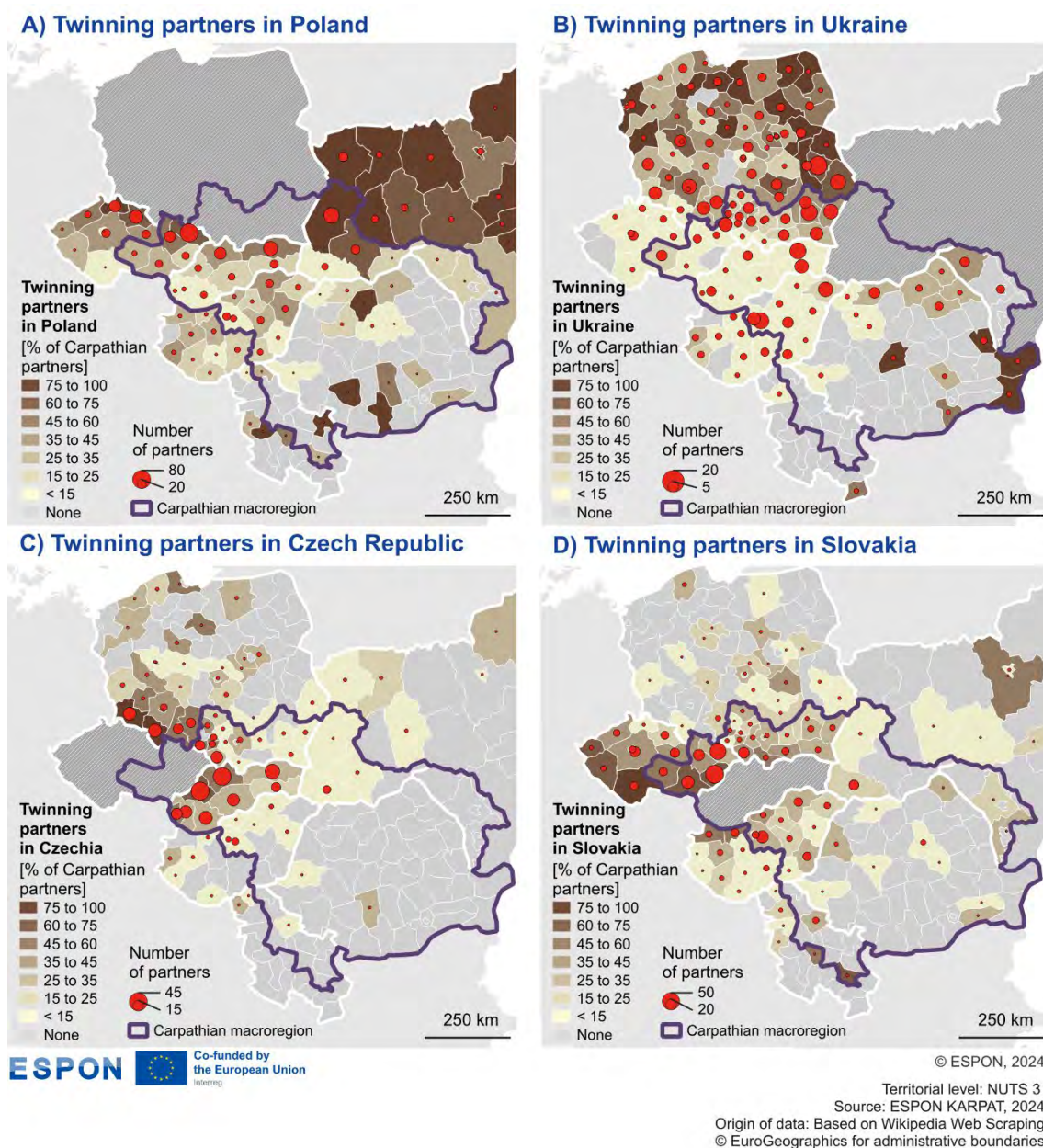


An analysis of the direction of bilateral agreements shows that this form of cooperation is particularly intensive between partners located in neighbouring countries (**Map. 5.2**). As a result, a large number of agreements, and in the case of some regions of the Carpathian macroregion even all the agreements concluded, fall within its framework. This is particularly evident - due to its central location within the macroregion - in Slovakia. Here, for most regions, more than $\frac{3}{4}$ of all city twinning agreements involve partners from the Carpathian countries.

Map 5.2**City twinning agreements involving Carpathian countries, 2024**

Territorial level: NUTS 3
 Source: ESPON KARPAT, 2024
 Origin of data: Based on Wikipedia Web Scraping
 © EuroGeographics for administrative boundaries

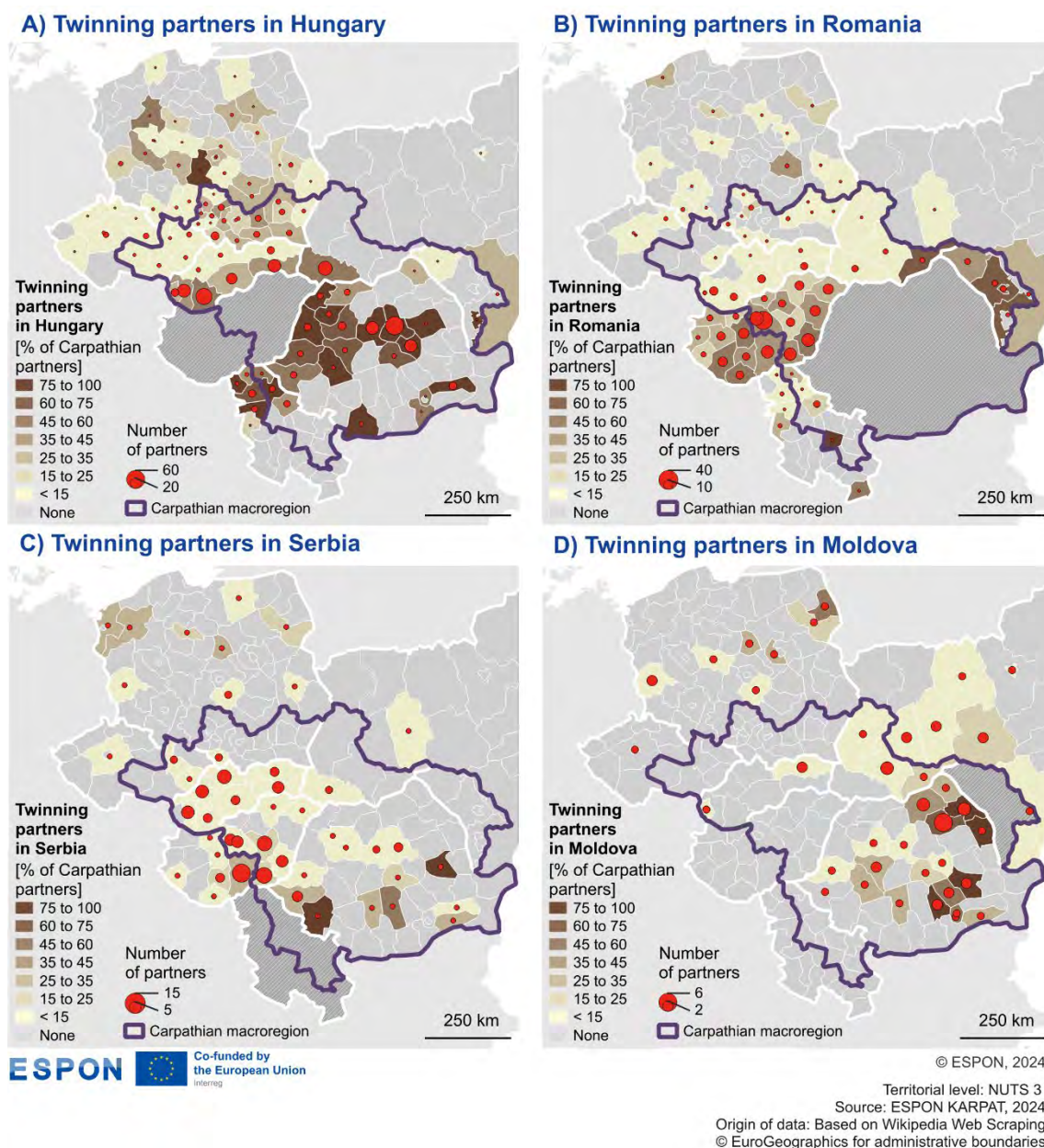
On the other hand, it should be noted that some cities located in the Serbian part of the macroregion were not involved in cooperation within the Carpathian countries (**Map 5.3**). In Hungary, the Carpathian cooperation networks were also strongly developed, especially with cities located in the Slovak, Romanian and Serbian border regions, and among the more distant Polish regions, especially those located in the southern part of the country, as well as selected Romanian regions. In Poland, the Carpathian direction of cooperation concerned especially the Podkarpackie voivodeship, as well as the Bielsko-Biala subregion. Outside of Ukraine, cooperation between twinning cities was also developed with Czech, Slovakian and Hungarian local authorities, but also included selected regions of Romania and Serbia. Similarly, in the case of the Czech Republic, cooperation within the framework of the Carpathian countries was particularly evident in Moravia, and was most pronounced in western Slovakia and south-western Poland. In contrast, the cooperation of Moldovan cities was primarily directed towards Romania and to a lesser extent Ukraine).

Map 5.3**City twinning agreements within each of the Carpathian countries – part 1, 2024**

Particularly high intensification - which is probably a legacy of the co-creation of a common state until 1990 - cooperation concerns the Czech Republic, followed by cooperation with municipalities located in the Hungarian and Polish border regions (**Map. 5.4**). Relatively strongly developed cooperation within the Carpathian countries also concerned cities located in the Ukrainian part of the macroregion. In this case, this was mainly due to very strongly developed Polish-Ukrainian cooperation, but also to cooperation with partners located in the border regions of Romania, the Republic of Moldova and also Hungary. Carpathian cooperation was also important for selected regions in Romania, with Hungary and the Republic of Moldova, as well as the Chernivtsi Oblast in Ukraine, being the main directions of this cooperation. The Carpathian direction of cooperation was also dominant in parts of the Serbian regions, especially those in the northern part of the country which cooperated particularly intensively with neighbouring Hungary and Romania.

Map 5.4

City twinning agreements within each of the Carpathian countries – part 2, 2024



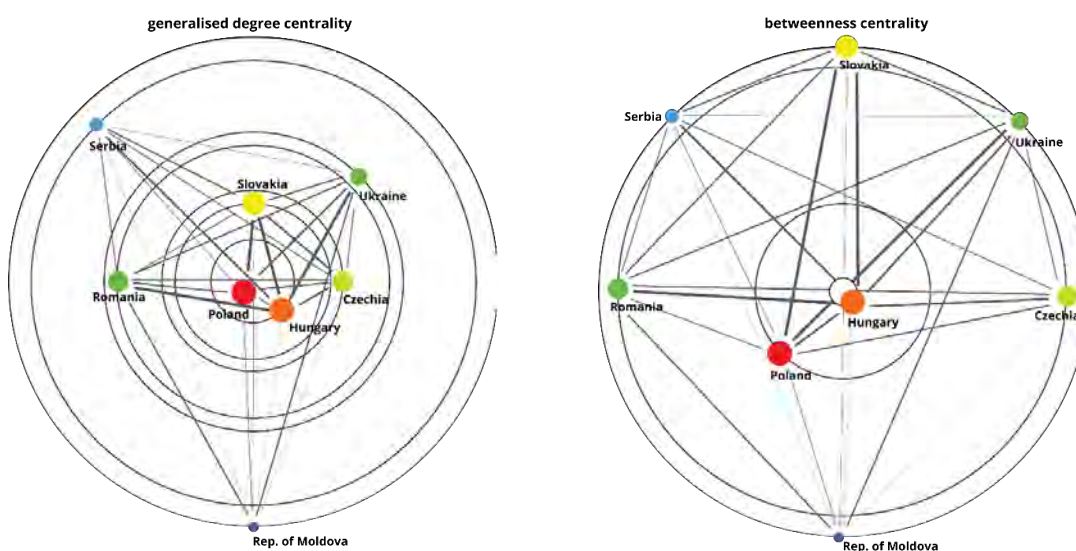
Among the reasons for cooperation within the framework of the Carpathian countries, one can point to factors reported in the literature (e.g. [Smętkowski et al. 2022](#)) related to the absence or low linguistic barriers (including the existence of national minorities), geographical proximity, the role of which is strengthened by the availability of funds within the framework of cross-border cooperation programmes, as well as the broader historical context.

Aggregating the number of twinning agreements concluded at the local level allows for an assessment of each country's overall importance within transboundary cooperation networks in the Carpathian macroregion (**Chart 5.1**). In terms of the degree of development of twinning within the Carpathian macroregion (generalised degree centrality index), Poland played the greatest role, followed by Hungary. The role of the Czech Republic and Slovakia as twinning nodes was also important. Romania and Ukraine, on the other hand, played a less important role in this network, while Serbia and the Republic of Moldova were on the periphery of twinning in the Carpathian macroregion due to a small number of agreements within macroregion. On the other hand, taking into account the role of individual countries in mediating between partners from different countries (index of betweenness centrality), Hungarian partners played the greatest role, followed by Polish

partners in second place. The role of cities located in the other countries for mediating transnational cooperation was much smaller and not significantly differentiated between countries. This indicates that the partnership networks of Polish and Hungarian local governments were the most diverse in terms of the directions of cooperation within the Carpathian macroregion, while bilateral relations with selected countries predominated in the other countries.

Chart 5.1

City twinning networks in the Carpathian countries - network centralities, 2024

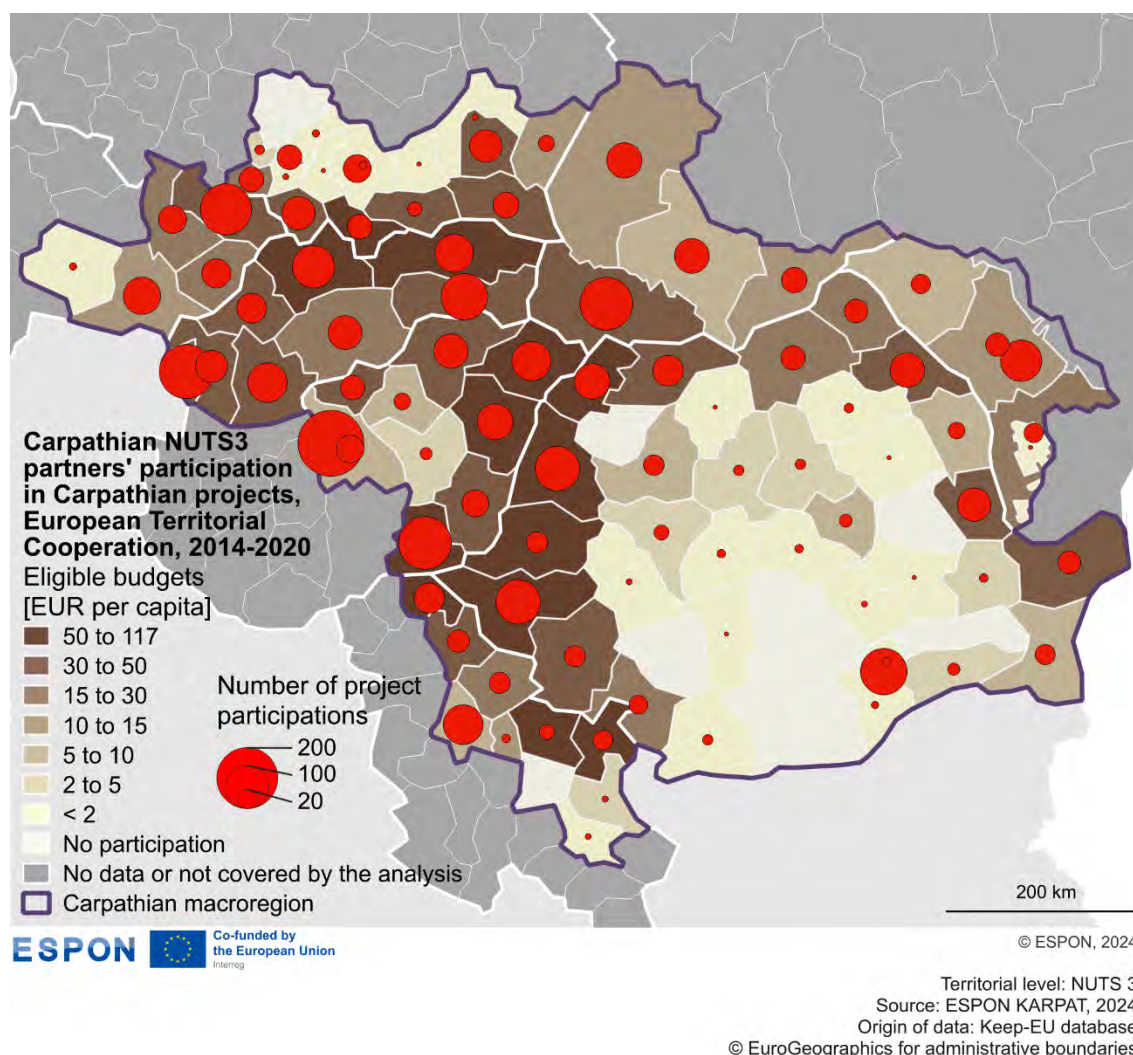


5.2 Transnational initiatives and projects

Transnational initiatives and projects play a pivotal role in fostering regional development and integration within the Carpathian macroregion. This chapter explores a variety of collaborative efforts, with a particular focus on projects implemented under the framework of Interreg programmes, which provide financial and organizational support for cross-border and transnational cooperation. Beyond Interreg, the Carpathian macroregion is also home to other significant initiatives, such as the Carpathian Convention and regional platforms aimed at promoting sustainable development, environmental conservation, and cultural exchange. To provide a comprehensive understanding of these efforts, the chapter includes a network analysis of cooperation within the macroregion, examining the relationships and linkages between various stakeholders, including local authorities, non-governmental organizations, and international institutions.

5.2.1 Interreg programmes

To illustrate the patterns of transnational cooperation in the Carpathian macroregion, the keep.eu data on **European Territorial Cooperation (Interreg)** were used. Keep.eu is an Interact Programme official database covering EU-funded cross-border, transnational and interregional cooperation programmes among the member States, as well as between member States and neighbouring or pre-accession countries. This illustrates cooperation within various Interreg programmes. The **Interreg strand A** covers cross-border cooperation (CBC) – within EU and at its external borders: Interreg IPA (Instrument for Pre-Accession Assistance) CBC with EU candidate countries (Serbia) and Interreg ENI (European Neighbourhood Instrument) CBC with neighbouring countries, in the 2021-2027 period implemented under the name of Interreg NEXT (Ukraine and the Republic of Moldova). The transnational cooperation, covering wider geographic areas, inter alia linked to macroregional Strategies, is carried out within the **Interreg strand B**. For the purposes of interregional cooperation the **Interreg strand C** is established, promoting the exchange of experiences and capacity building between regions.

Map 5.5**Project participations and budgets shares of Interreg Carpathian projects per capita, 2014-2020**

The keep.eu projects database was downloaded on 29 April 2024 for the relevant list of Carpathian territorial units (**Annex 1**). Included were projects whose leader or partner came from the listed entities. The database consisted of separate tables of partners and projects and included those projects in which an organisation from the Carpathian macroregion was involved. The 2014-2020 programming period was selected for further analysis as it formed a closed and comprehensive dataset (provided in a uniform format allowing the analysis of projects' budgets, partners, territorial data at NUTS2 or NUTS3 level, after the necessary gap-filling, and themes), providing an insight into the Carpathian cooperation. For this aim, **a set of 1388 "Carpathian projects" from the 2014-2020 programming period**, was selected from the keep.eu database for the study analysis¹³. There were **6163 partners (project participations) in the Carpathian projects, including 3649**

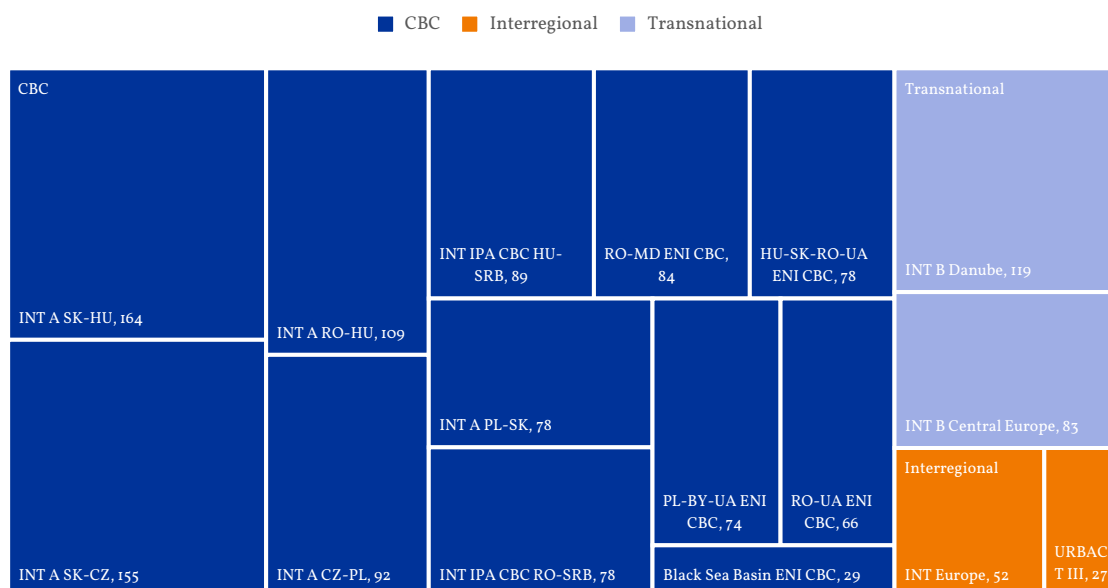
¹³ The methodology of selection was the following: 1) projects in transnational and interregional programmes with **at least two partners** from the Carpathian NUTS3; 2) all downloaded projects in cross-border cooperation (CBC) programmes that involve at least two Carpathian countries, with at least one Carpathian NUTS3 partner reported in the database. It should be noted that for 150 projects only the lead partner was featured in keep.eu, which may affect the results of territorial analyses. The projects for which no more than one partner was recorded in the database, except for one project, were

partners located in Carpathian macroregion. The number of partners is calculated at the project level (not at the level of individual organisations) which means that if an organisation participated in several projects, it is counted several times (in this way, the number of partners is equal to the number of **project participations**).

CBC projects (INTERREG A) were the most common type of project, accounting for around 79 % of Carpathian projects (1069 projects for the amount of 1,02 billion EUR, 69% of total EU funding), followed by transnational projects (INTERREG B) (15% of projects - 209 projects, 25% of total EU funding) and interregional projects (INTERREG C) (83 projects, 6% of projects and total EU funding). The high share of CBC projects in cooperation can be seen on the map (**Map. 5.5**), which shows a higher intensity of collaboration along all national borders (e.g. well visible in Romania). This is related to eligibility criteria that prefers support for beneficiaries located in the direct vicinity to the border (NUTS3 region). For transnational and interregional projects, national capitals stand out in terms of the number of project partners that is visible, especially in the case of Budapest and Bratislava. There were **6163 partners (project participations) in the Carpathian projects, including 3649 partners located in Carpathian macroregion**. The number of partners is calculated at the project level (not at the level of individual organisations) which means that if an organisation participated in several projects, it is counted several times (in this way, the number of partners is equal to the number of **project participations**).

Chart 5.2

Number of Carpathian projects, broken down by Interreg programme, 2014-2020



* Programmes with less than 5 projects were excluded from the chart.

Source: own elaboration based on keep.eu

CBC projects (Interreg A) were the most common type of project, accounting for around 79 % of Carpathian projects (1069 projects for the amount of 1,02 billion EUR, 69% of total EU funding), followed by transnational projects (Interreg B) (15% of projects - 209 projects, 25% of total EU funding) and interregional projects (Interreg C) (83 projects, 6% of projects and total EU funding). The high share of CBC projects in

encountered in the following CBC programmes: Interreg V-A Czech Republic – Poland, Interreg V-A Poland – Slovakia, Interreg V-A Slovakia - Czech Republic, and Interreg V-A Slovakia - Hungary.

cooperation can be seen on the map (**Map. 5.5**), which shows a higher intensity of collaboration along all national borders (e.g. well visible in Romania). This is related to eligibility criteria that prefers support for beneficiaries located in the direct vicinity to the border (NUTS3 region). For transnational and interregional projects, national capitals stand out in terms of the number of project partners that is visible, especially in the case of Budapest and Bratislava.

The share of the project budget, illustrated on the map, is based on the value of the partner's eligible budget; if this value was missing in the database, it was estimated by dividing the project's total budget expenditure by the number of partners in that project¹⁴. The total expenditure of the Carpathian projects (all project partners) amounted to about 1,76 billion EUR (with about 1,47 billion EUR of the EU funding). The share of the Carpathian NUTS3 partners in the eligible budget accounted for around 1,27 billion EUR (87% of this sum coming from CBC projects, 11% from transnational and around 1,6% from interregional projects as they involved more partners from outside the Carpathian macroregion). Throughout the programming period, some regions received support exceeding EUR 30 per capita, particularly along the Romanian-Hungarian and Polish-Slovak borders, as well as in selected areas of the Romanian-Serbian border. Although such calculated support was lower in the case of Ukrainian and Moldovan regions, it is important to note that, given the lack of access to other European funds and the lower level of economic development (and public investment), this funding could have been crucial for the development of cross-border cooperation and regional economies.

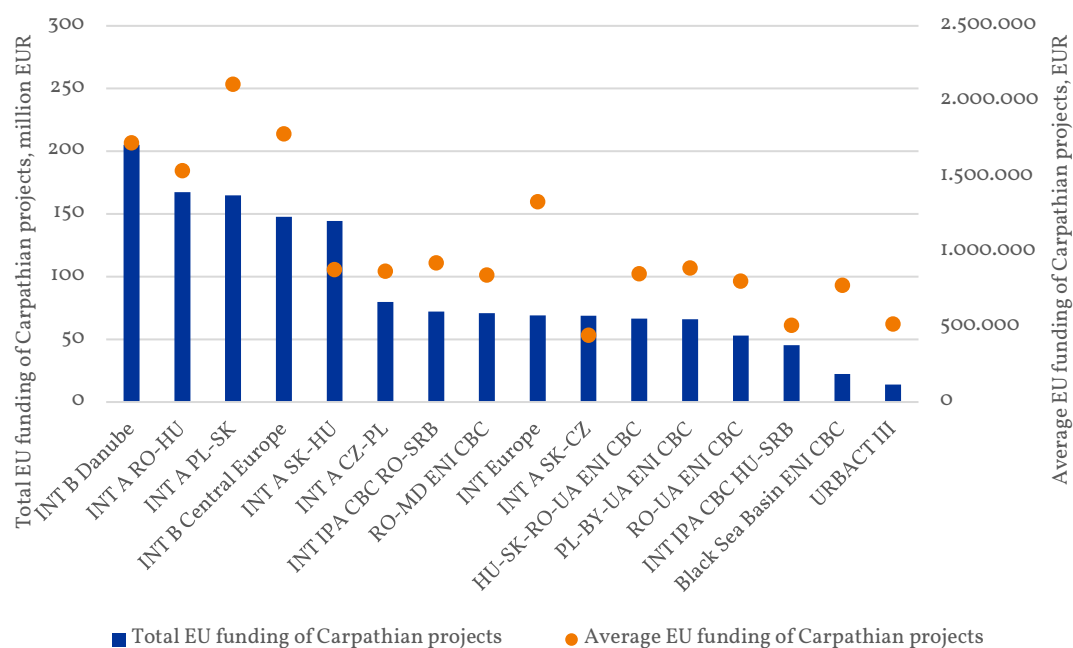
The numbers of Carpathian projects within specific programmes are presented in **Chart 5.2**. The biggest share of projects was implemented in the Interreg A bilateral programmes between Slovakia – Hungary, and Slovakia – Czech Republic. Transnational cooperation was mainly supported by the Interreg B Danube and Central Europe Programmes, each supporting a part of Carpathian countries (the Interreg Danube does not cover Poland while in the case of the Interreg Central Europe, Romania, Ukraine, the Republic of Moldova, and Serbia are not eligible). The interregional cooperation emerged within Interreg Europe, URBACT, and ESPON Programmes into which, however, the non-EU members Carpathian countries were not included in the 2014-2020 programming period.

Regarding **budgets**, the largest amount of EU funding was distributed to Carpathian projects in the Interreg B Danube Programme, followed by the Interreg A Romania – Hungary, Interreg A Poland – Slovakia, and Interreg B Central Europe (**Chart 5.3**). The different order than the one observed in the case of the projects' numbers was due to the projects' average value – the projects implemented in the Interreg A Poland – Slovakia, Interreg B Central Europe, and Interreg B Danube Programmes were, on average, more expensive ones. As far as the Carpathian NUTS3 partners are concerned, the biggest share in the partner's eligible expenditure was attributed to Romanian, Slovakian, and Hungarian entities. However, taking into account an average partner budget share of one Carpathian NUTS3 partner, the Polish organizations are leading, followed by Slovakian and Romanian ones.

Romanian, Hungarian, and Slovakian partners participated in the largest share of projects – it was related to the largest number of programmes in which the Carpathian entities from these countries were eligible (**Chart 5.4**). The three countries mentioned earlier prevailed in the nominal numbers of Carpathian projects and project participations (partners). Poland, the Czech Republic, and Ukraine participated in a twice smaller number of Carpathian projects than the leading countries. Serbia and the Republic of Moldova completed the list – the number of Carpathian projects in the case of the latter amounted to less than one-third of the leading countries' nominal numbers. However, the picture looks different when taking into account the population of the Carpathian entities. If the number of projects is related to the number of inhabitants, Hungary and Slovakia are still in the lead. Meanwhile, Romania drops back, towards the end of the list and Serbia's position grows significantly. It is worth noting that for the Republic of Moldova, the Carpathian projects may be seen as constituting nearly the total of its initiatives within the European Territorial Cooperation. At the same time, other countries participate in various projects or whole ETC programmes that do not have a Carpathian dimension.

¹⁴ If the project's total budget value was missing, the project's EU funding value was used instead. For the projects with only one partner featured in the database – this partner was assigned the entire project budget in case this value was missing.

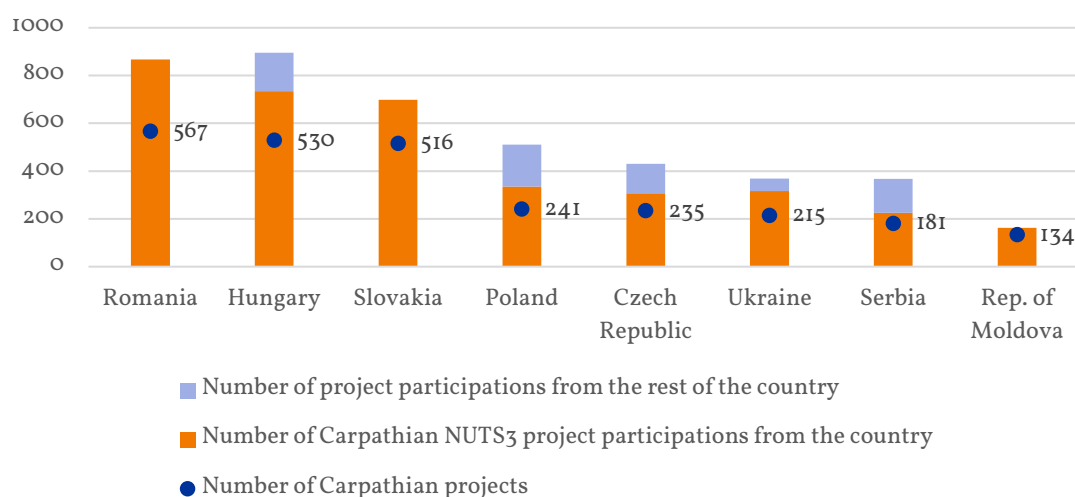
Chart 5.3
Carpathian projects' budgets – EU funding, 2014-2020



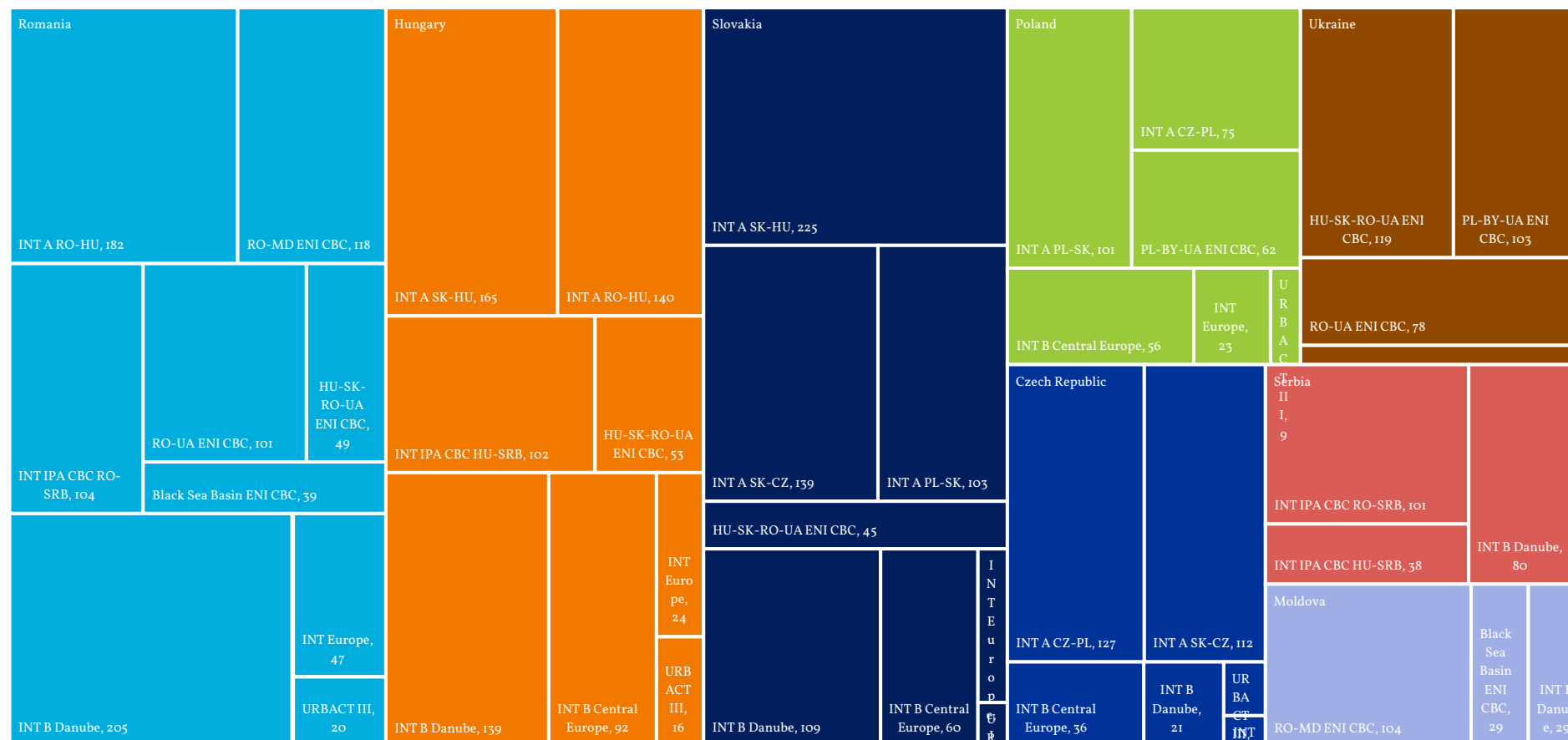
* Programmes with less than 5 projects were excluded from the chart.

Source: own elaboration based on keep.eu

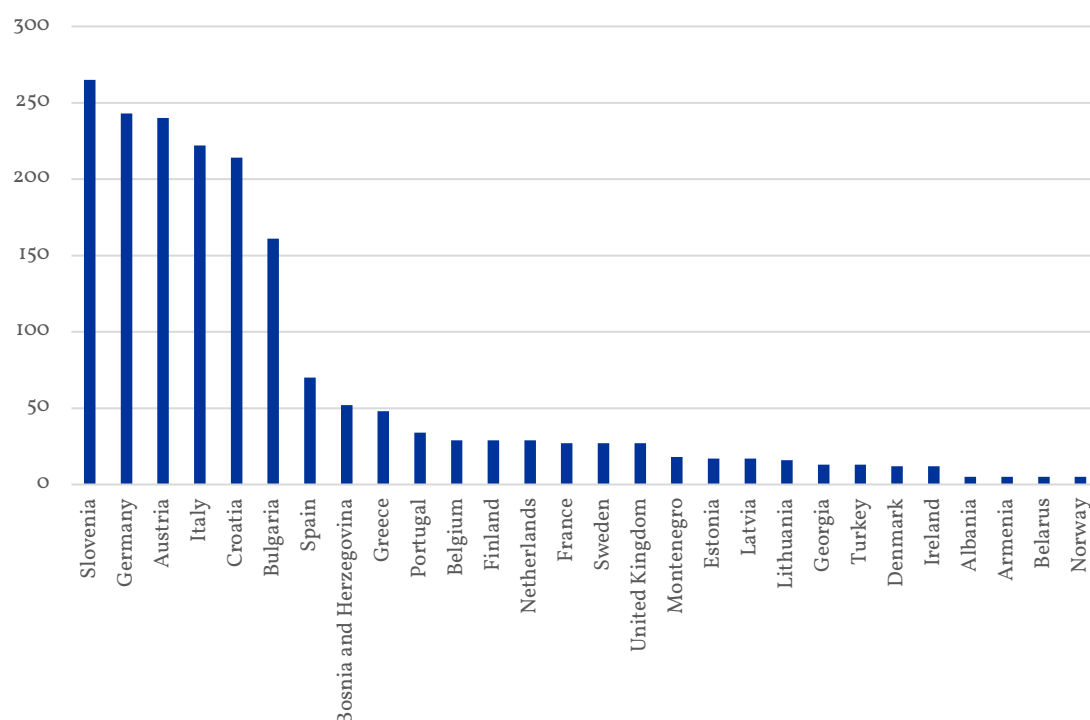
Chart 5.4
Carpathian projects and project participations by country, 2014-2020



Source: own elaboration based on keep.eu (EUROREG)

Figure 5.1**Number of Carpathian NUTS3 project participations, broken down by country and programme, 2014-2020**

Source: own elaboration based on keep.eu (EUROREG)

Chart 5.5**Project participations from other countries in Carpathian projects, 2014-2020**

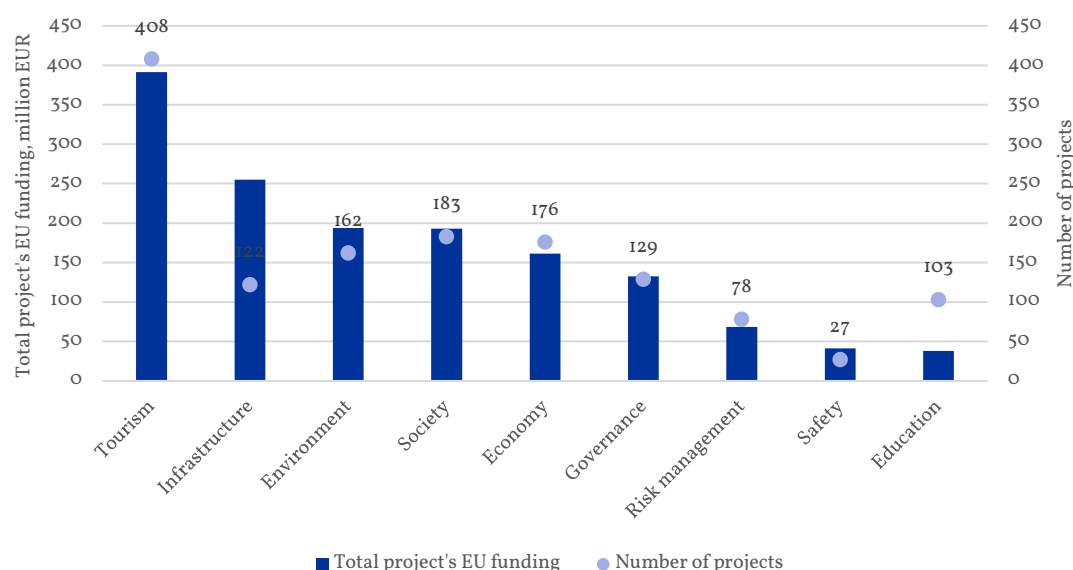
* Countries with less than 5 project participations were excluded

Source: own elaboration based on keep.eu

The engagement of Carpathian countries (measured by the proportion of partners and the number of projects with their participation) in various strands of Interreg cooperation differs. For Ukrainian entities, the Carpathian cooperation was almost entirely the strand A - cross-border type (as a consequence of Interreg eligibility rules). Meanwhile, Serbian, Hungarian and Slovakian NUTS3 Carpathian entities implemented a significant share (over 20%) of their Carpathian projects in the transnational format (strand B). The share of the interregional component (strand C) was higher than noted in other countries in the case of Polish, Romanian and Hungarian Carpathian NUTS3 project participations (**Fig. 5.1**).

The biggest number of partners outside the Carpathian macroregion, that engaged in transnational and interregional cooperation with Carpathian entities, usually recruited from countries sharing a border with a Carpathian state like Slovenia, Germany, and Austria, but also from Italy that is very active in the ETC programmes (**Chart 5.5**)¹⁵.

¹⁵ According to keep.eu data (<https://keep.eu/statistics/>, accessed on 5.12.2024), Italy participated in the biggest number of projects and the biggest number of partnerships in the ETC 2014-2020 programming period.

Chart 5.6**Carpathian projects' thematic areas and their budgets, 2014-2020**

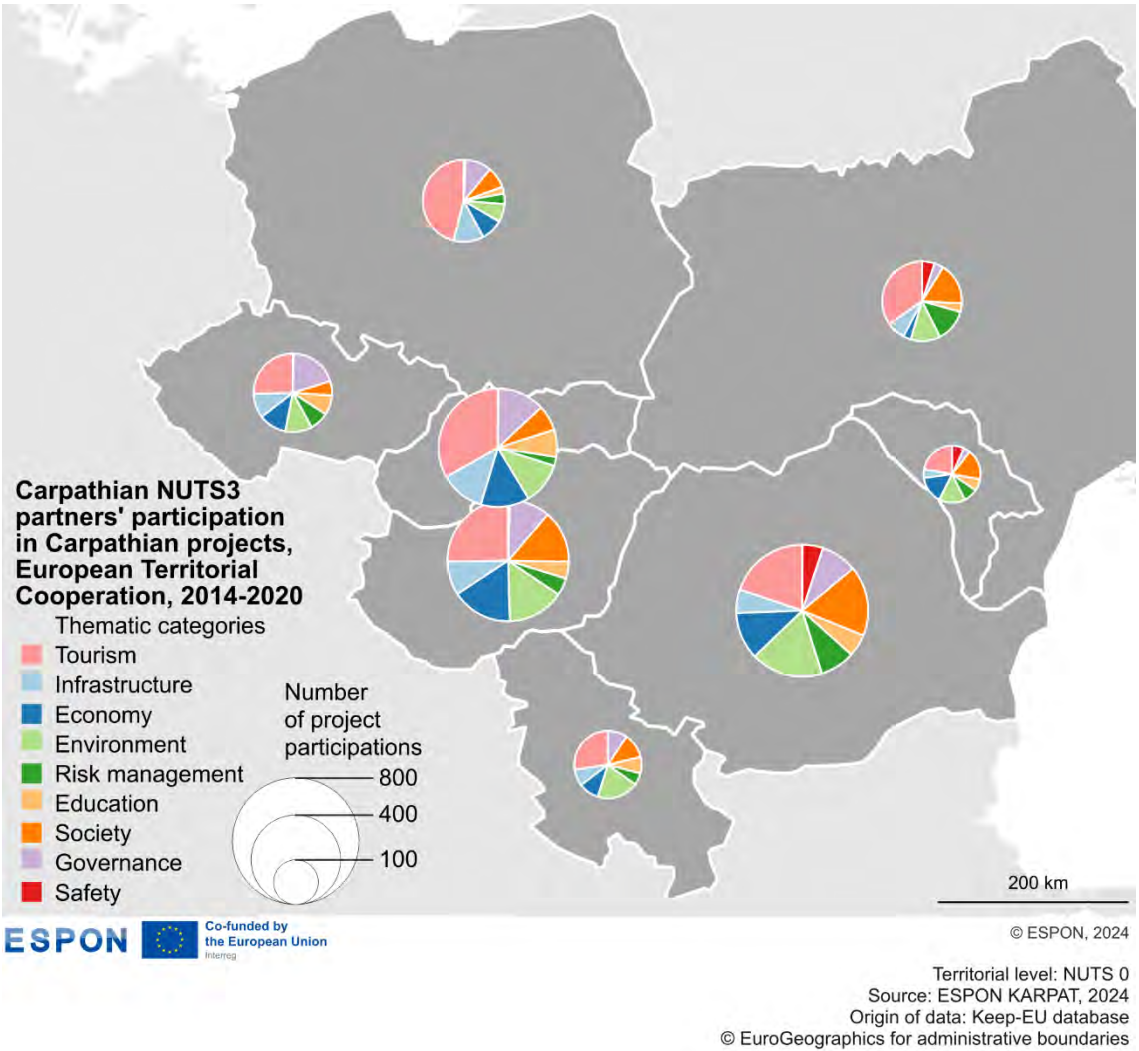
Source: own elaboration based on keep.eu

In order to generate information on the **thematic scope of Carpathian projects**, the collected data required recoding to the uniform thematic classification (**Annex 4**)¹⁶. Nine thematic categories were introduced in the analysis. The most significant number of Carpathian projects and the largest part of the budget were dedicated to the theme of tourism (**Chart 5.6**). Projects in the thematic areas of society and economy were the next most numerous. Projects in the thematic areas of Infrastructure, safety, and environment projects were the most expensive (in terms of average EU funding per project). The part of projects dedicated to tourism accounted for more than half of the Carpathian projects in some programmes (**Chart 5.7**). However, there were also initiatives with a larger share of the social, environmental, or economic areas (while the projects within the ESPON programme focused on governance issues).

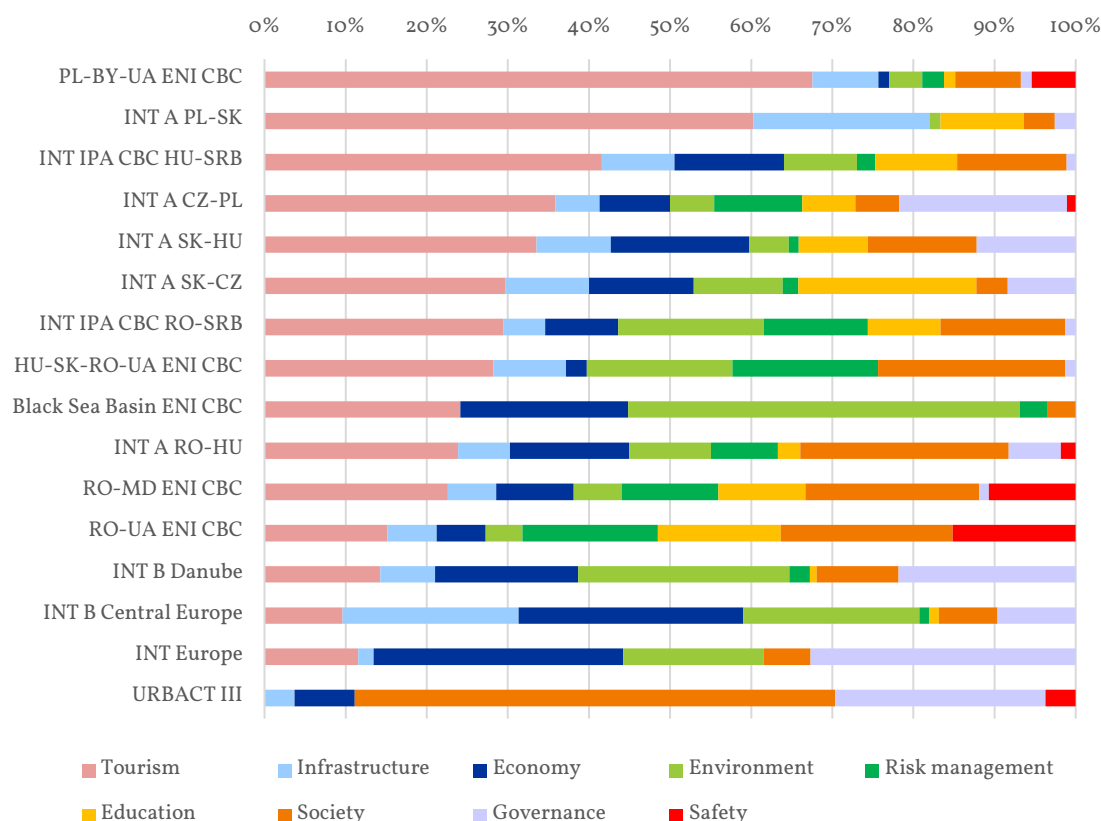
The national thematic profiles can be reflected taking into account the share of various thematic areas within the Carpathian NUTS3 projects participations in each country (**Map. 5.6**). The highest proportions of Carpathian NUTS3 partners who engaged in the touristic field of cooperation were noted in the case of Poland, Ukraine, and Slovakia and they were reflected in the PL-BY-UA ENI CBC and INT A PL-SK Programmes outlines. The share of projects participations in the theme of environment was higher in Serbia and Romania than in the other countries. The proportion of project participations in the thematic category of governance was the highest in the case of Czechia (among the Interreg A programmes, INT A CZ-PL counted the largest number of Carpathian governance projects). The society area involved significant shares of Carpathian NUTS3 partners in the Republic of Moldova, Romania, and Ukraine, the same countries noting important project participations shares in the thematic category of safety (programmes with the biggest share of Carpathian safety projects were RO-UA ENI CBC and RO-MD ENI CBC). A larger proportion of Hungarian Carpathian NUTS3 entities engaged in economic projects than in the other countries.

¹⁶ The thematic categories were based on the information available in keep.eu. For the purpose of this analysis, only the primary project theme was considered in cases where projects had multiple thematic affiliations.

Map 5.6
Thematic categories of Carpathian NUTS3 projects participations, 2014-2020



Source: own elaboration based on keep.eu

Chart 5.7**Thematic areas of Carpathian projects in ETC Interreg programmes, 2014-2020**

* Programmes with less than 5 projects were excluded from the chart.

Source: own elaboration based on keep.eu

In the 2021–2027 programming period, the Interreg programs have largely continued in their previous form (Table 5.1). The most important changes were (1) exclusion of Belarus from Poland – Ukraine CBC Programme that became bilateral, (2) the transfer of the Black Sea Basin Programme from Interreg strand A to B, (3) inclusion of new countries in the Interreg Europe Programme. The Interreg framework within Strand A (CBC) and Strand B (Transnational) still does not enable participation of partners from all Carpathian countries at once. They dispose of various bilateral and one quadruple (Hungary – Slovakia – Romania – Ukraine) cross-border initiatives and some possibilities of transnational cooperation (not covering all the countries in one programme). As far as interregional programmes are concerned – Ukraine, Serbia, and the Republic of Moldova were included, at the end of 2023¹⁷, in the Interreg Europe Programme. It creates a new cooperation opportunity in the field of the exchange of experience and sharing of practices among regions. It is also possible for all the countries to take part in the 2021–2027 URBACT activities.

¹⁷ <https://www.interregeurope.eu/news-and-events/news/announcing-a-restricted-call-for-project-proposals>, accessed on 2/12/2024. Before that day, two calls for projects were announced within the programme.

Table 5.1**2021-2027 Interreg Programmes relevant for the Carpathian cooperation opportunities**

Type	Programme	Total budget including technical assistance (mln EUR)	EU funding including technical assistance (mln EUR)
Cross-border	2021 - 2027 Interreg VI-A Czechia-Poland	223.6	178.9
Cross-border	2021 - 2027 Interreg VI-A Hungary-Slovakia	165.5	133.3
Cross-border	2021 - 2027 Interreg VI-A Poland-Slovakia	239.3	139.3
Cross-border	2021 - 2027 Interreg VI-A Romania-Hungary	175.9	140.8
Cross-border	2021 - 2027 Interreg VI-A Slovakia-Czechia	106.7	85.3
Cross-border	2021 - 2027 Interreg VI-A IPA Hungary Serbia	74.8	63.6
Cross-border	2021 - 2027 Interreg VI-A IPA Romania Serbia	87.7	74.6
Cross-border	2021 - 2027 Interreg VI-A NEXT Hungary - Slovakia - Romania - Ukraine	94	83.2
Cross-border	2021 - 2027 Interreg VI-A NEXT Poland - Ukraine	266.6	235.9
Cross-border	2021 - 2027 Interreg VI-A NEXT Romania – Republic of Moldova	109.9	97.3
Cross-border	2021 - 2027 Interreg VI-A NEXT Romania - Ukraine	76.9	68
Transnational	2021 - 2027 Interreg VI-B NEXT Black Sea Basin	94.5	85
Transnational	2021 - 2027 Interreg VI-B Central Europe	280.8	224.6
Transnational	2021 - 2027 Interreg VI-B Danube	278.4	224.6
Interregional	2021 - 2027 Interreg VI-C ESPON 2030	60	48
Interregional	2021 - 2027 Interreg VI-C Interreg Europe	479.4	384.5
Interregional	2021 - 2027 Interreg VI-C URBACT IV	110.1	86.8
Interregional	2021 - 2027 Interreg VI-C Interact	56.4	45

Source: own elaboration based on keep.eu (EUROREG)

5.2.2 Cooperation practices and networks

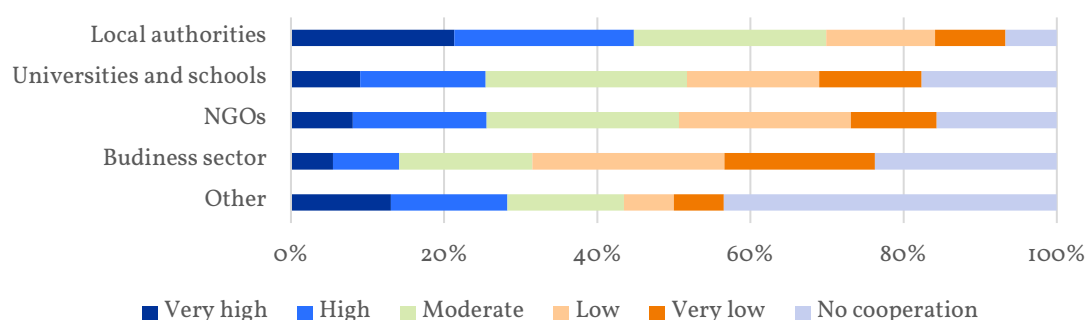
This chapter presents the results of the survey, focusing on three key areas. First, it examines the intensity and types of actors involved in cross-border cooperation, offering a detailed analysis of how organisations across the region engage with their counterparts in neighbouring countries. Second, it explores the extent to which stakeholders are connected to transnational organisations and benefit from programmes supporting collaboration within the Carpathian macroregion.

Chart 5.8 provides insights into the **intensity of cross-border cooperation** with various types of institutions as reported by survey respondents. Local authorities emerge as the most important collaboration partner, as around 45% of respondents report "very high" and "high" levels of cooperation with these institutions, emphasising their central role in facilitating transnational partnerships. Universities and schools as well as NGOs are secondary collaboration partners in terms of significance and intensity. The business sector is seen predominantly as "low" and "very low" in terms of cooperation intensity, highlighting limited interactions with respondents. Institutions grouped as "Other" exhibit the lowest levels of engagement, with "no cooperation" being the most frequently cited response. These results underscore the prominence of public institutions, particularly local authorities, as the primary partners in cross-border initiatives, while private and less-

defined actors play a more peripheral role. A more detailed insight into collaboration patterns based on cross-referencing the type of institution surveyed and collaboration partners indicated by these, uncovers a more nuanced picture.

Chart 5.8

Intensity of respondents' cross-border cooperation by type of institutional partner - general



Source: own elaboration based on KARPAT survey [N=337] (EUROREG)

Chart 5.9 illustrates how different types of institutions perceive the intensity of their cross-border collaborations with other institutional types. From the perspective of local authorities the strongest collaboration intensity is with other local authorities, suggesting a preference for working within their own sector. Collaboration with NGOs, universities and schools is significant but less pronounced, while partnerships with the business sector are moderate. Interaction with "other" institutions is minimal, indicating limited engagement with less traditional partners.

The second graph (top-right) represents the perspective of NGOs, which are least active in cross-border collaboration out of all institutional types. They report their strongest collaboration intensity with other NGOs and local authorities. NGOs also demonstrate moderate engagement with, universities and schools. These findings indicate that NGOs balance their moderate efforts between intra-sectoral and cross-sectoral collaboration.

The third graph (bottom-left) captures the perspective of ministries and government agencies. This group shows a strong preference for collaboration with local authorities, NGOs and universities, likely due to their shared mandate for governance and policy implementation as well as appreciation of strategic expertise. Interaction with the business sector and the "other" category is less frequent. Ministries and Government Agencies therefore favour public, non-profit and academic partnerships over those with non-public sector entities.

The fourth graph (bottom-right) provides the perspective of the "other" institutions, which include a diverse array of entities such as municipalities, public service providers, schools, hospitals, museums, sports and cultural associations, individual experts, EGTCs, international organizations, and civil society organizations. These institutions show the highest intensity of collaboration, most significantly with local authorities, universities and schools as crucial partners. Collaboration with NGOs and the business sector is less pronounced. Partnerships within the "other" category are relatively limited, likely due to the diverse and fragmented nature of this group.

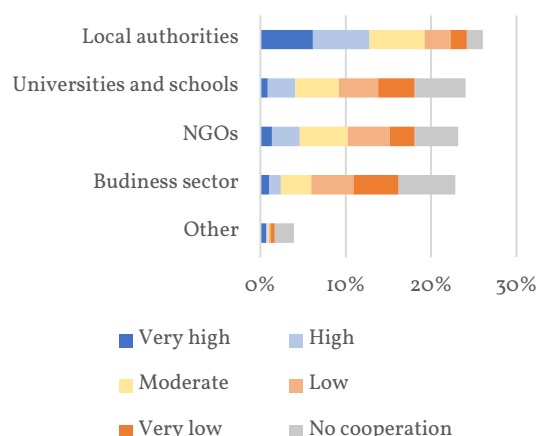
The data reveal that public institutions generally prioritize collaborations with each-other (ministries with local authorities and universities) and with the same type (local governments with local authorities). Local authorities consistently emerge as key partners across all institutional types, reflecting their role as central facilitators of cross-border collaborations. Universities and schools also play a critical role, as they are consistently ranked among the top collaborators, underscoring their importance in providing knowledge, research, and capacity-building support. NGOs and the business sector receive moderate attention overall, with NGOs

slightly outperforming businesses as cross-border partners. The "other" institutions demonstrate the least internal collaboration, likely due to their diverse and fragmented nature.

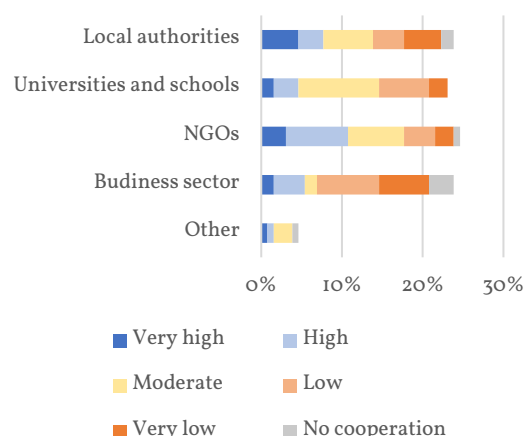
Chart 5.9

Intensity of cross-border collaboration by type of institutional partner – by type of respondent

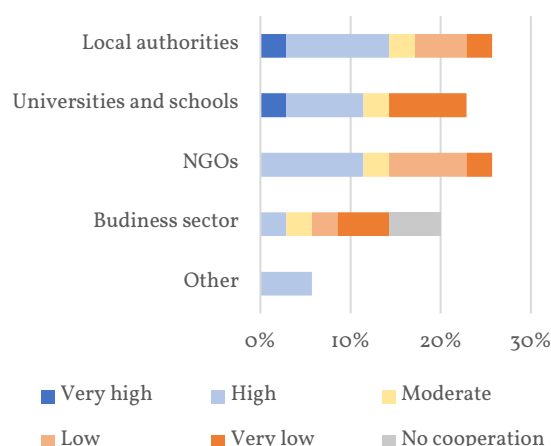
Local government [N=232]



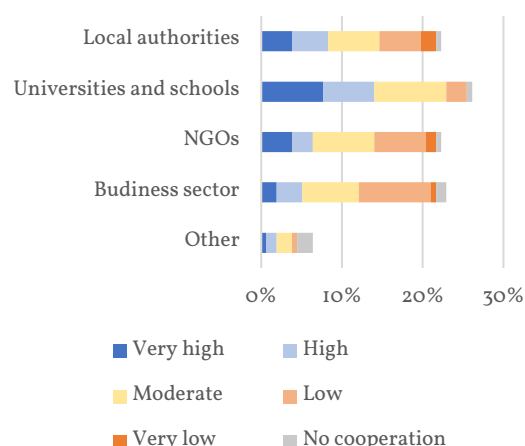
NGOs [N=39]



Ministries and governmental agencies [N=16]



Other [N=43]



Source: own elaboration based on KARPAT survey [N=337] (EUROREG)

Involvement of Carpathian stakeholders with various cooperation frameworks highlights various levels of participation across different countries. Slovakia, Poland, and Hungary emerge as the most active participants in international cooperation initiatives. As illustrated in Chart 5.11 centrally located Hungary shows the most diverse and robust involvement in territorial cooperation, especially Cross-Border Cooperation (CBC) Programs, Transnational Cooperation Programs (TCP) with notable participation in Euroregions, EGTCs and Visegrad Fund. Only 10% of Hungarian respondents haven't declared any experience in transnational collaboration. Slovakia demonstrates diverse engagement across all categories, particularly in CBC and Euroregions, with moderate involvement in TCP, EGTC and Visegrad Fund. Poland and Czechia share similar cooperation patterns with significant activity within Euroregions and CBC, a strong presence in TCP and Visegrad Fund, however almost 40% of Polish respondents declared lack of cooperation experience. Romania

stands out for only 50% of cooperation engagement, which is equally divided between CBC, TCP and Euroregions, though its engagement in EGTCs or Euromontana is more limited.

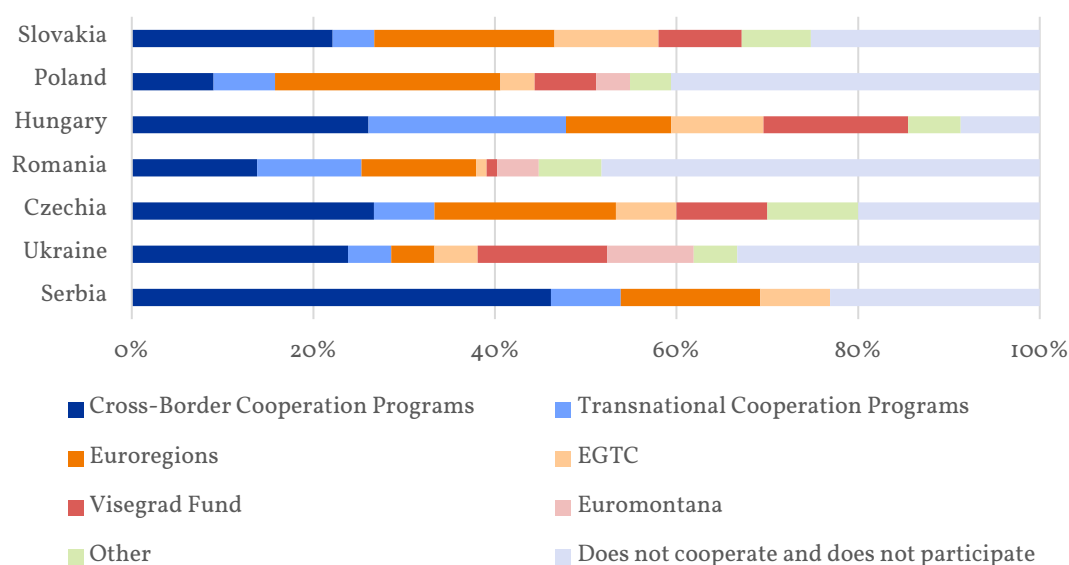
Ukraine and Serbia participate mainly in CBC Programs and have some involvement in TCP Programs, with minimal presence in other frameworks like Euromontana for Ukraine and Euroregions and EGTCs for Serbia.

From the institutional point of view the experience of Carpathian stakeholders in various transnational cooperation frameworks has some distinct patterns. Local governments demonstrate significant involvement in CBC and Euroregions, as these frameworks are particularly suited to addressing local and regional needs in a cross-border context. Their participation in TCP is notable but less dominant, reflecting a focus on immediate geographical and functional priorities. The involvement of local governments in other frameworks, such as the Visegrad Fund or EGTC, is comparatively limited.

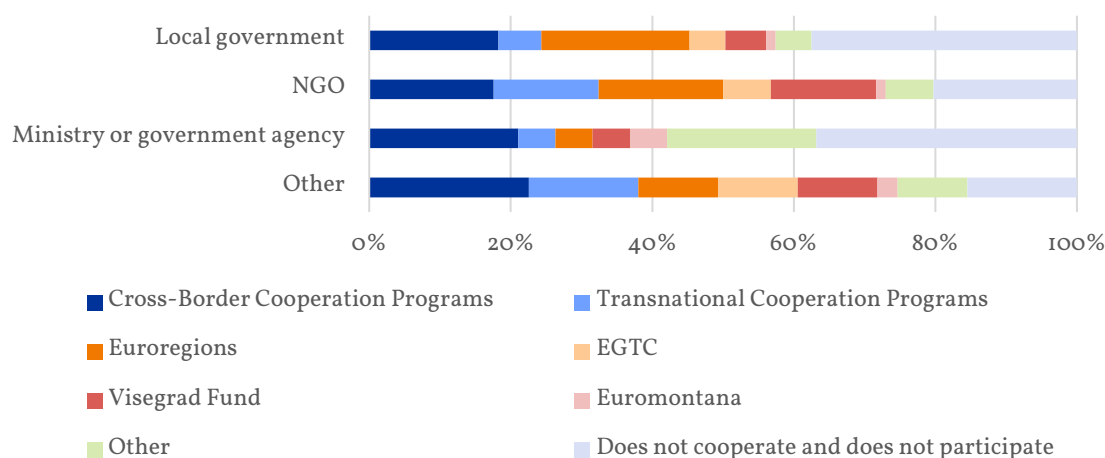
NGOs, on the other hand, are comparatively engaged in CBC, TCP programs and Euroregions, similar to local governments, but also show significant participation in other frameworks like the Visegrad Fund. Ministries and government agencies are primarily involved in CBC programs and other (bilateral) cooperation frameworks with similarly limited engagement in other types of cooperation. The "other" category which encompasses diverse array of entities such as municipalities, public service providers, schools, hospitals, museums, sports and cultural associations, individual experts, EGTCs, international organizations, and civil society organizations is notably strong in cross-border cooperation programs and Euroregions, mirroring the trends of the other groups with a balanced engagement in various frameworks..

Chart 5.10

Experience in transborder cooperation frameworks according to country of origin



Source: own elaboration based on KARPAT survey [N=337] (EUROREG)

Chart 5.11**Experience in transborder cooperation frameworks according to organisational background.**

Source: own elaboration based on KARPAT survey [N=337] (EUROREG)

Analysis of survey results backed up by desk research reveals a more detailed insight into participation patterns in transnational cooperation frameworks of Carpathian stakeholders. The Carpathian macroregion can be seen as a smaller subdivision of the Euromontana organisation which is dominated by the institutions from the Alpine microregion. It is therefore worth mentioning that current Euromontana membership representing Carpathian macroregion is relatively new and dominated by Polish and Romanian institutions, including regional governments like the Malopolska, Podkarpackie and the Maramures County Council, and organizations such as Romontana, Open Fields Foundation, and Highclere Consulting in Romania. The absence of representatives from Slovakia, Hungary, and Ukraine presents a significant challenge, undermining the network's ability to address the region's needs comprehensively.

A closer look at participation in international projects reveals that the engagement of Carpathian institutions, particularly from Poland and Romania, remains limited compared to other Euromontana members. Out of seven ongoing Euromontana projects (Horizon Europe and ESPON), Polish and Romanian institutions from the Carpathian macroregion (Podkarpackie and Rau Sadului) are partners in only one: MountResilience, which focuses on transformative climate adaptation in European mountain areas. This modest level of involvement restricts the influence of Carpathian members in shaping research and policies for mountain regions, reflecting an overall lack of activeness in non-interreg based transnational collaboration. Carpathian institutions have participated in several high-profile Euromontana projects, reflecting a more robust level of engagement in the past, whereas current participation appears to have waned, leaving underutilized the potential for Carpathian actors to influence contemporary initiatives.

Survey results reveal major differences in types of Euroregions that Carpathian stakeholders are involved in. Out of all respondents that indicated their experience in Euroregions the most frequently mentioned is Euroregion Karpacki, with 25 references. Euroregion Tatry follows with 12 mentions, also reflecting its strong influence in the border areas between Poland and Slovakia. Other Euroregions such as Euroregion Beskydy (5 mentions) and Euroregion Śląsk Cieszyński (2 mentions) are also significant, contributing to regional development and integration. Additionally, Euroregion Silesia and The Danube-Kris-Mures-Tisa Regional Cooperation each appear twice, further emphasizing the importance of these cross-border initiatives in regions involving Poland, Czechia, Slovakia, and Hungary.

Out of all surveyed stakeholders that have EGTC experience the most frequently mentioned EGTC is Tatry, with 7 references, followed by Via Carpatia, which appears 4 times. Other EGTCs such as Tisza, Rába-Duna, Ipold, Tritia, Novum and Mura are mentioned once each, indicating smaller or more specific regional partnerships.

The most frequently mentioned cross-border framework is Interreg PL-SK (8 mentions), Interreg PL-UA (3 mentions), and others involving countries like Hungary, Slovakia, Romania, and Serbia. Several Interreg NEXT and Interreg IPA programs focus on cross-border cooperation in regions like Romania-Serbia and Hungary-Slovakia. Other regional cooperation efforts include HUSKROUA, ROHU, and specific programs like LEADER pályázat. Other initiatives like Erasmus+, Euroregión Beskydy, and Europe for Citizens also contribute to broader regional partnerships. Additionally, programs such as Europe for Citizens, Euroregión Beskydy, and Erasmus+ represent cross-border and regional efforts focused on societal development and education. The diversity in programs reflects the complex network of transnational, cross-border, and intergovernmental cooperation efforts within Europe and beyond.

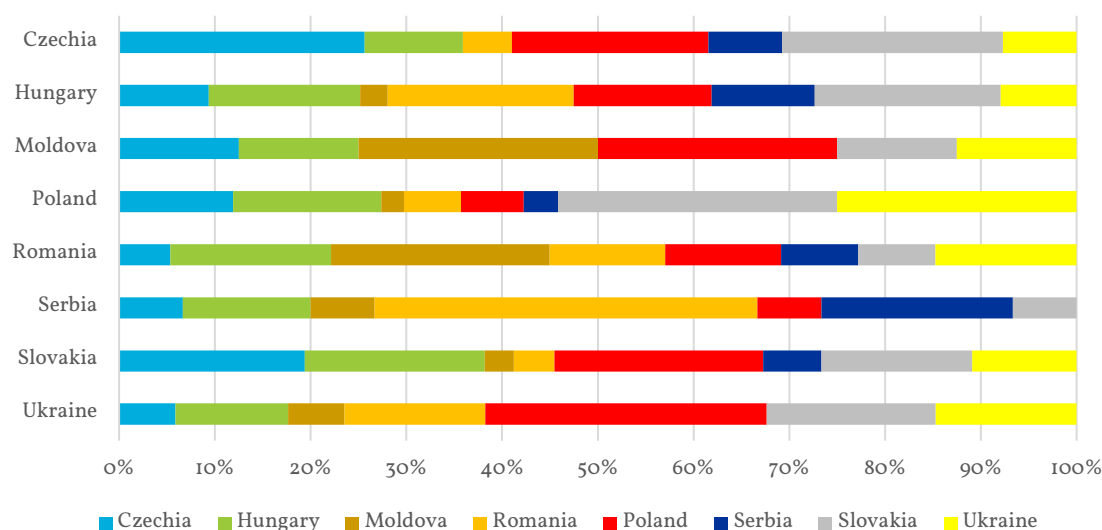
Out of transnational and interregional programs survey respondents most frequently mentioned Interreg Europe (4 mentions), Interreg Central Europe (5 mentions), Interreg Danube Programme (2 mentions) and Baltic Sea. Other regional cooperation efforts include Interreg NEXT Black Sea Basin Programme and Urbact.

The list of other programs mentioned by survey respondents includes a wide range of initiatives aimed at fostering cooperation across European and neighbouring regions. Educational and cultural initiatives like Erasmus+ and Horizon Europe are prominent, with Erasmus+ mentioned 4 times. Non-EU and broader regional programs include UNEP/NORAD, SlovakAid, the Swiss Financial Mechanism, and the Carpathian Convention Secretariat. The Three Seas Initiative and its network are emphasized twice, with singular mentions of programs such as the Visegrad Fund, Norwegian Funds, and Carpathian Civil Society Platform.

5.2.3 Networks of cooperation

Analysis of territorial networks of collaboration in the Carpathian macroregion reveals the diverse territorial patterns highlighting how geographic proximity, historical ties, and institutional dynamics shape collaboration among countries. These patterns underscore the complexity of cooperation in the Carpathian macroregion, where historical legacies and current geopolitical dynamics intersect with institutional capacities. By examining these territorial trends, this section provides insight into both the strengths and challenges of fostering cohesive and inclusive collaboration across the region.

Chart 5.12
Cooperation partners by country

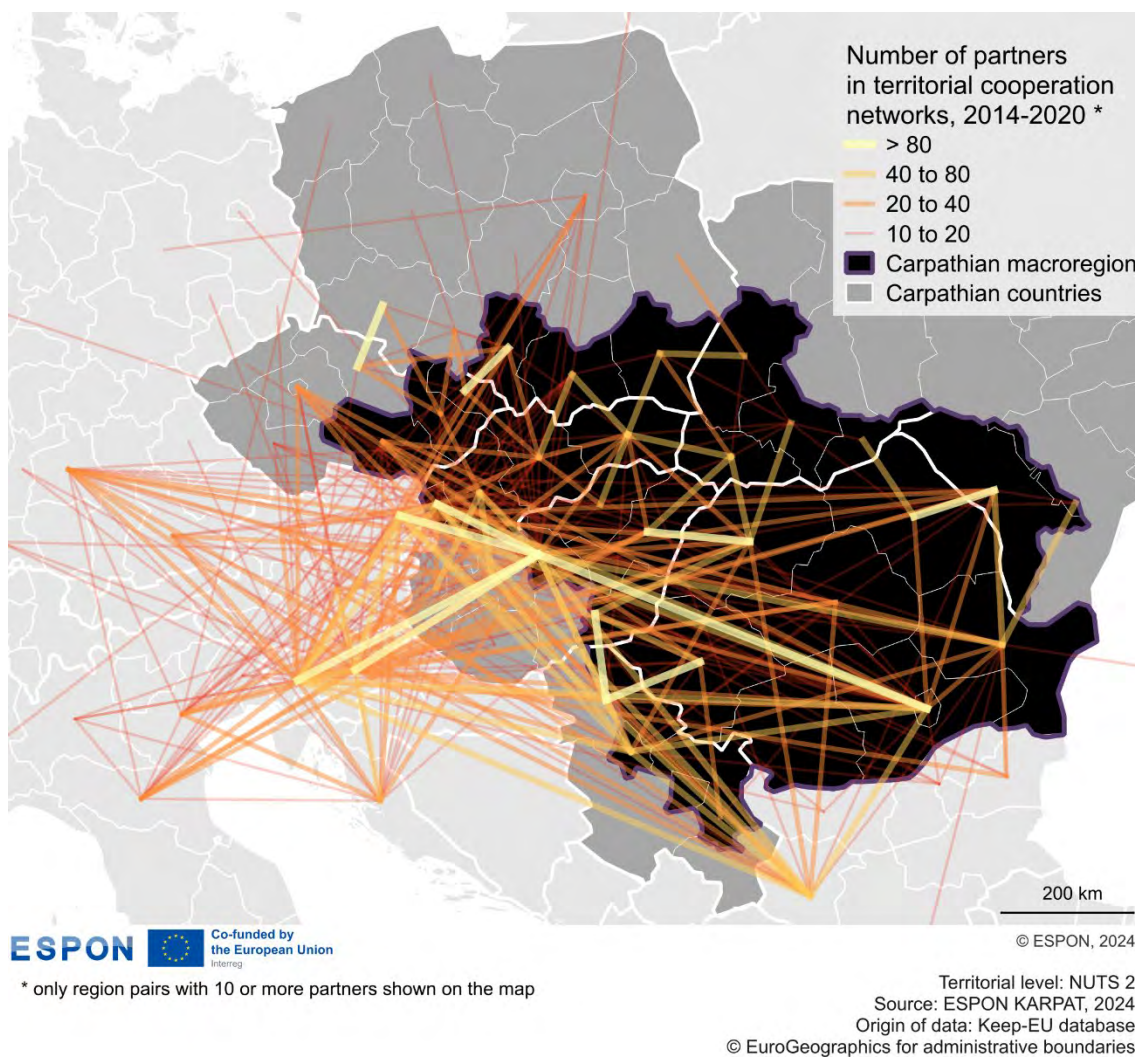


Source: own elaboration based on KARPAT survey [N=337] (EUROREG)

Chart 5.12. reveals distinct typologies of collaboration across the Carpathian microregion as indicated by survey respondents based on their actual collaboration experience. **Localised collaboration** is evident in the

case of stakeholders from countries like Czechia, Slovakia, Serbia, and Romania as these countries exhibit a focus on collaboration with immediate neighbours, driven by geographical proximity and historical ties. Czech respondents prioritise Slovakia and Poland, while engaging minimally with distant countries like Romania or the Republic of Moldova. Slovak collaboration is focussed towards Czechia and Poland, followed by Hungary and Ukraine. Serbian stakeholders have strong ties with Hungary and Romania while showing limited interaction with more distant Carpathian partners. Romania's collaboration is dominated by the Republic of Moldova and Serbia, while relationships with Hungary, Poland, and Ukraine are moderate.

Map 5.7
Territorial cooperation networks, 2014-2020



Source: own elaboration based on keep.eu (EUROREG)

Regional mediator represented by Hungary and Poland, showcases the most balanced cooperation network in the Carpathian macroregion. Hungary maintains moderate to strong ties with all countries, including neighbours like Romania, Slovakia, and Ukraine, as well as more distant partners such as Czechia and the Republic of Moldova. This even distribution of partnerships positions Hungary as a central player in regional cooperation and demonstrates strategic outreach and a commitment to enhancing integration across the macroregion. Polish collaboration patterns strike a balance between strong neighbourly ties (Ukraine, Slovakia, and Czechia) and broader regional outreach (Romania). Interaction with more distant partners, such

as Serbia and the Republic of Moldova, is weaker but evident, showcasing Poland's role in fostering a mix of localized and macroregional collaboration.

Stakeholders from Ukraine rely heavily on a few key partners showcasing **asymmetric interdependencies** and limiting their broader engagement within the region. Ukrainian partnerships are dominated by Poland and Romania. Hungary and Slovakia emerge as secondary partners for Ukraine, while ties with Serbia, the Republic of Moldova, and Czechia remain weak.

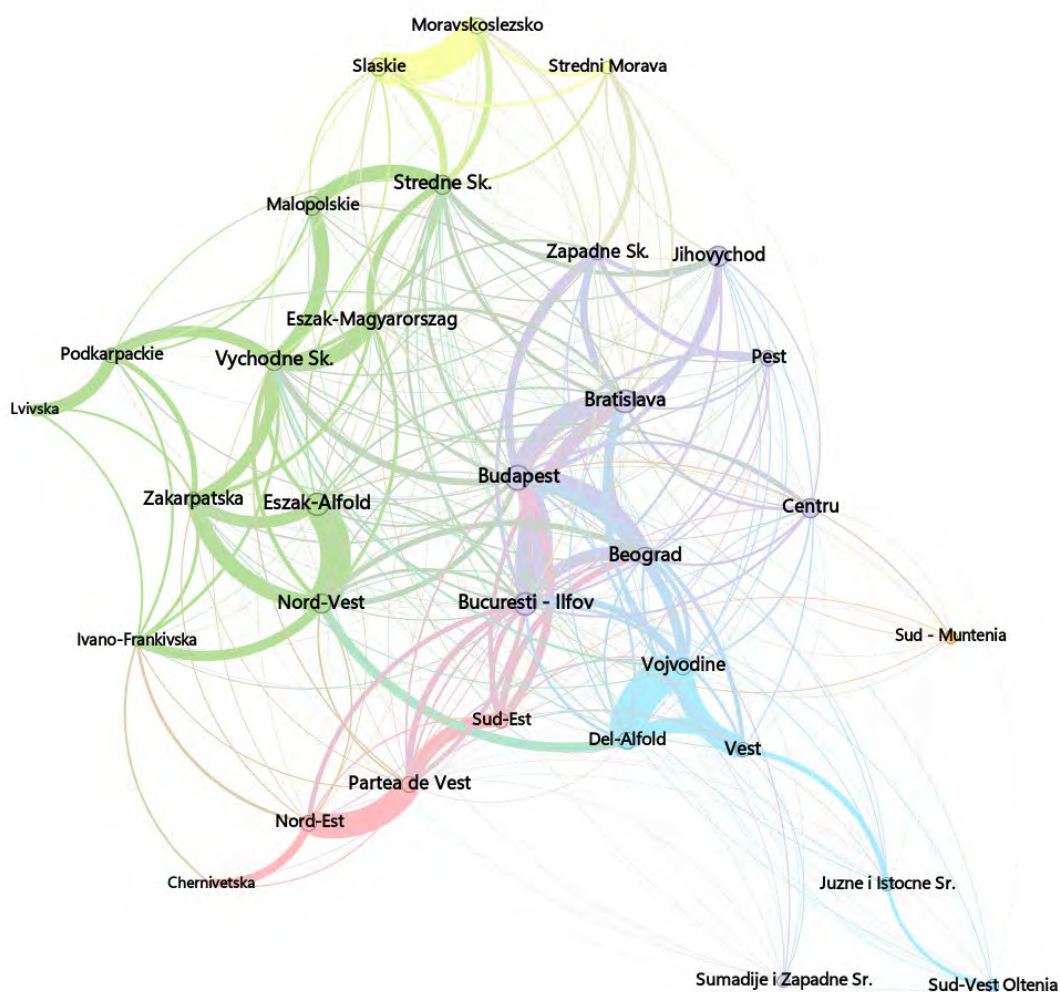
A more detailed network analysis of all projects involving Carpathian stakeholders in keep.eu database reveals interesting territorial patterns of cooperation at NUTS2 level presented in **Map 5.7**.

Budapest, Bratislava, Bucharest-Ilfov are dominant collaboration hubs in the Carpathian macroregion with strong connections to nearby Vienna. These regions serve as central nodes with high numbers of connections as major drivers of regional cooperation. Del-Alföld, Nord-Vest, and Vest also exhibit strong connectivity, acting as secondary hubs that link peripheral regions to the core network. The collaboration network is strongest in the central and western parts of the macroregion, particularly in Hungary, Slovakia and Romania. Eastern and southeastern parts have weaker participation in projects (e.g., Ukraine, the Republic of Moldova and peripheral Romanian regions). There are strong cross-border connections, particularly between Hungary, Slovakia, Romania, and Serbia. This network reflects a highly interconnected and clustered system with strong collaborative dynamics.

Network analysis of the same database performed in Gephi network analysis and visualisation tool reveals further information regarding collaboration network structures illustrated in **Figure 5.2** The network is densely connected in the core, indicating a strong level of collaboration among central regions, while peripheral regions have fewer and weaker connections. The absence of directionality in the edges suggests mutual collaboration rather than dominance or unilateral influence. On average each region is connected to 20 others suggesting robust connectivity and active participation in partnerships. The modularity score of 0.357 shows moderate community structure, with distinct clusters of regions collaborating through inter-cluster links, significant for broader integration. The high clustering coefficient (0.806) demonstrates a high level of local interconnectedness, with over 80% of a region's neighbours also collaborating with each other. This suggests strong local partnerships and cohesive regional clusters.

The **central Carpathian cluster** indicated in **purple** is dominated by Budapest, Bratislava, and surrounding regions like Pest and Zapadne Slovensko. It exhibits the densest and most interconnected structure, emphasising its key role in the macroregion. As the hub of the network, it not only facilitates collaboration within its own cluster but also serves as a bridge linking the other clusters, underscoring its central importance in regional integration. The **north-eastern (green) cluster**, consisting of regions such as Podkarpackie, Zakarpatska, Východné Slovensko, and Lvivska, is characterized by its focus on cross-border collaboration in the north-eastern part of the Carpathian macroregion. It demonstrates strong internal cohesion and is closely linked to Budapest, emphasizing the central node's role in connecting these peripheral regions to the larger collaboration network. The **north-western (yellow) cluster**, including regions like Moravskoslezsko, Śląskie, Střední Morava, and Malopolskie, is also cohesive, with many internal connections reflecting robust collaboration. However, unlike the north-western cluster, it exhibits a greater focus on intra-national and western-oriented partnerships. While it maintains strong connections with Budapest and Bratislava, it remains distinct in its focus and scope of collaboration. The **Romanian (pink) cluster**, representing regions such as Nord-Vest, Bucuresti-Ilfov, and Nord-Est, is moderately cohesive. Its internal connections are notable, but it is less integrated into the overall network compared to the central purple cluster. The **southern (blue) cluster**, encompassing southern regions such as Vojvodine, Sud-Vest Oltenia, and Južne i Istočne Srbije, is the least cohesive. Its connections are more distributed and sparser compared to other clusters, indicating a weaker network of collaboration. Positioned on the periphery, this cluster shows signs of emerging participation in EU projects but remains less integrated into the broader network.

Figure 5.2
Network structure and clustering, 2014-2020



Source: own elaboration based on keep.eu (EUROREG)

5.3 Barriers and opportunities for transnational cooperation

The importance and developmental impact of territorial cooperation recognised by the EU is reflected in setting, since the 2007-2013 programming period, the European Territorial Cooperation (Interreg) as one of the goals of the Cohesion Policy. It is to play a crucial role in promoting Territorial Cohesion – formally introduced in Article 174 of the Treaty on the Functioning of the European Union, with the aim of “reducing disparities between the levels of development of the various regions and the backwardness of the least favoured regions”, special attention being paid inter alia to mountain regions (Territorial Cohesion – The Story, 2023).

The Carpathian cooperation financed by the EU represents a part of the universe described in chapter four. Due to its organisational framework allowing for comparative and longitudinal studies, the cooperation grounded in the EU financial and legal instruments is also an important subject of analysis. The main EU instruments that should be considered regarding the potential for Carpathian cooperation are ETC, EGTCs, and macroregional strategies. Nevertheless, as some IDI respondents did, it should be underlined that bottom-up cooperation is crucial and the existing regulatory framework should follow and facilitate it.

The chapter will utilise the territorial cooperation literature to outline various barriers hindering it. On the other hand, the survey results concerning specifically the Carpathian cooperation, conducted amongst stakeholders, will be presented, along with the findings and examples given by the in-depth interview respondents¹⁸. Based on collected data, the opportunities to develop the cooperation potential will be described and recommendations will be formulated towards different levels of Carpathian stakeholders – European Union, national states, regional and local entities.

Robert Knippschild (2011) describes the process of an evolution of cross-border cooperation in spatial development between Czech, German and Polish entities, pointing out that at the beginning language and cultural barriers are perceived as hindering collaboration. It changes with time, experience and raising organisational structures. Initially seen as obstacles, cultural differences become appreciated as an asset (Knippschild, 2011). The study's data empirically confirms that cultural barriers are not perceived to be important in Carpathian cooperation.¹⁹ The survey respondents placed them at the end of the list (**Chart 5.13**) with less than 10% of indications identifying them as a high barrier. The interviewed stakeholders not only acknowledged the cultural obstacles had little importance, but some of them spontaneously underlined that: „Cultural diversity can become an asset in regional collaboration”, and “our strength”. Yet, as elaborated by one of the respondents, “sometimes propensity to cooperate and culture of cooperation is low”, with persisting mistrust towards the other party. Another person mentioned historical tensions and separatisms in the region as occasionally posing problems in cooperation that still needs experience and time to become a habit..

The language differences, according to the survey carried out in 2020 by the Gallup International network amongst the inhabitants of the EU-member states border regions covered by the Interreg A programmes²⁰, are listed as the first place of problems for cooperation between their country and its partner countries. The EU addresses this issue by promoting border multilingualism.²¹ The Carpathian interviewers sometimes brought up the language barrier as existing also in the institutional cooperation, others claiming that knowledge of English is sufficient for common project implementation.

The Carpathian cooperation, having already passed the initial phase during which the cultural obstacles might have played a more important role, seems to be at the stage where the lack of resources and legal framework becomes a crucial impediment to collaboration. Respondents to the online survey identified the **financial barrier** as the most important factor hindering cross-border projects and initiatives (**Chart 5.13**). There are two equally important aspects of the financial barrier: external, related to difficulties in obtaining funding from, e.g., European Union programmes, and internal, resulting from a lack of own resources.

The financial barrier is mentioned in the literature concerning Carpathian territory i.e. in the context of EGTC (Lewkowicz, 2015; Lemko, 2021) and Euroregions (Shuliak and Shuliak, 2021) functioning or Ukraine's (an example of a non-EU member country) cooperation with the neighbouring entities (Parkhomenko, 2021), and postulates of creating special funds and supporting the transborder cooperation are formulated. They align with Knippschild's assessment of the need for external funding to compensate for the transaction costs, particularly at the beginning of collaboration. However, as the author admits, the cooperating entities should also commit their own resources (Knippschild, 2011). Once again, this vision corresponds well with the empirical findings from the online survey.

While securing EU **funding for Carpathian cooperation presents a significant potential/opportunity**, it is necessary to take into consideration the different formal statuses of Carpathian countries. They are reflected by various sources of funding: European Regional Development Fund (ERDF), Pre-Accession Assistance (IPA) and the Neighbourhood, Development and International Cooperation Instrument (NDICI). As the

¹⁸ The in-depth-interviews were conducted in May–October 2024 with the representatives of Carpathian stakeholders (the representatives of Carpathians interregional group of the European Committee of the Regions, Euroregions, Interreg Programmes, policy think-tank, non-profit associations).

¹⁹ Finding coherent with, for instance, Lačný, 2021; Benchak et al., 2023.

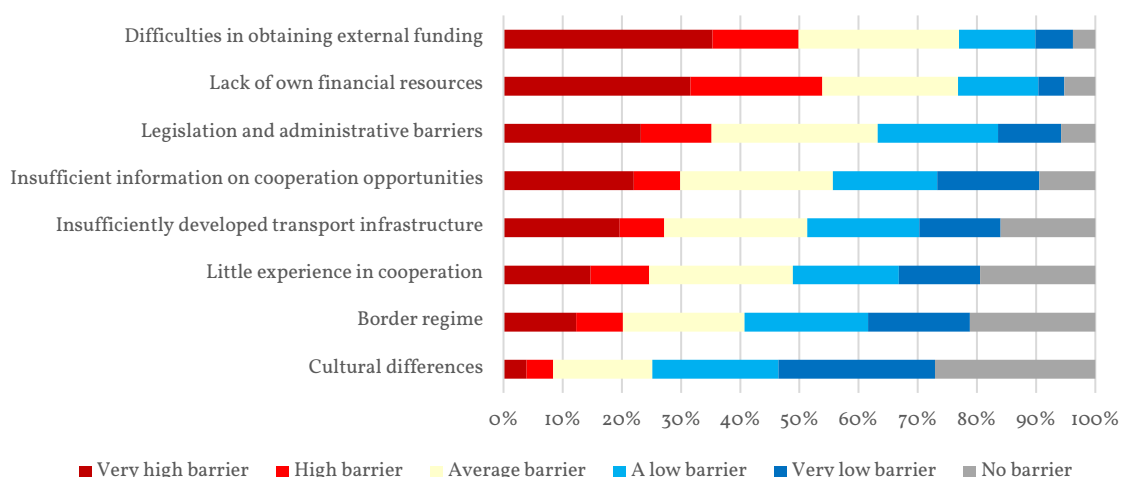
²⁰ Gallup International, 2020. Apart from 27 Member States of the European Union, the United Kingdom, Norway, Switzerland, Andorra and Liechtenstein were covered by the survey.

²¹ 'Communication from the European Commission "Boosting Growth and Cohesion in EU Border Regions". COM/2017/0534 Final'.

analysis of ETC shows, the Interreg strand A or B do not foresee projects involving all Carpathian countries at once²². For that reason, the stakeholders formulate the recommendations for establishing the Carpathian transborder cooperation programme or better aligning existing financing sources to the needs of the macro-region. As explained by one of the interviewees, at the beginning of the nineties, there was a local cooperation initiative in the Carpathian macro-region that wasn't followed by the national and EU level and was not reflected in the structure of the current Interreg, that separated Poland from the other four countries cooperating together in the one of the strand A programmes ("EU funding destroyed these natural structures that initiated (...) bottom-up activities"). The Interreg B Carpathian programme would enable such cooperation.

Chart 5.13

Importance of barriers to involvement in cross-border projects or initiatives



Source: own elaboration based on KARPAT survey [N=355] (EUROREG)

On the other hand, the need to establish stable cooperation structures, independent from temporary EU project funding, is underlined. Other remarks concern developing cooperation that is economically profitable and operational without external financing, or using other than ETC sources to finance valuable projects, also in collaboration with entities outside the Carpathian macro-region. Some IDI respondents point out that the Interreg part of the EU budget is very small and it should not be seen as the only source for cooperation projects. The regional and local entities should look into the EU communitarian (horizontal) programmes and learn how to use them to develop the macro-region. Their thematic scope may be well suited to respond to the needs of the local population and self-government competencies, but there is very little knowledge of how to use them (the information and competence gaps relate to the institutional barrier in the cooperation that will be discussed later).

The lack of own resources impedes reaching out for external funding as it requires a skilled staff and financing of the project initiation and development. For that reason, an interviewee proposed i.e. considering some financial and organizational **support for EGTCs** from the central governments. Regardless of the legal regulatory framework institutionalising the EGTCs, they still struggle with differences in national laws and complex procedures and rely on external financing to some extent (Evrard and Engl, 2018).

During other interviews, it was pointed out that the cooperation initiated within EU-funded projects sometimes is limited to the project's duration ("there is a lot of fiction in this Carpathian cooperation and (...) which

²² The literature recognised it as a problem in the cooperation as well, for example in the case of the Carpathian Euroregion: Lytvyn and Tyushka, 2020.

is not fiction, is limited to project impact, which, when it ends, simply ends the cooperation"). In that context, it is important to initiate economically beneficial projects – "we need to set in motion actions which (...) will trigger economic processes". As an interviewee says, it is not always in line with the EU funding that does not promote business profits from the projects. Another person gives an example of an EU programme in which the entrepreneurs were not eligible in the past and underlines the need for greater involvement of businesses. The low level of participation of entrepreneurs in the cooperation was also brought up by researchers.²³

According to the online survey results, **legal and administrative barriers** also constitute a serious obstacle to cooperation (**Chart 5.13**), exacerbated by the existence of the border regime (EU and non-EU countries, not all covered by the Schengen Agreement) and the mismatch of political, decision-making and financial competencies between different administrative levels on both sides of the border²⁴. T. Lundén observes that in the case of hierarchical asymmetries (discords, misfits) between the states, local cooperation issues finish being referred to at a higher level, where they are not perceived as the most important ones (Lundén, 2018). According to the interview's findings, the above-mentioned problem was noticed in the collaboration with regional authorities in Hungary and Ukraine – in the latter case accentuated by the martial law and military state administration. Overall, referring to all the countries, the following, difficult-to-deal-with discords between the same administrative level authorities were spotted: different competencies, levels of autonomy, size, available budgets, organizational structures, and data collection rules. The misfits may overlap as in cases when decisive powers do not go in paired with budgetary capacities and the level of decentralisation sometimes follows political changes at the national level.

Researchers studying Carpathian countries point out similar problems of differences in the levels of decentralization and the legal systems, particularly in the case of non-EU members (Shuliak and Shuliak, 2021; Lytvyn and Tyushka, 2020). They impede the common project implementation and restrain the ambitions of being its leader, if the national law is not in line with the EU regulations (i.e. in the framework of ETC programmes – "We got used to European laws and they are not yet used to that"). The interview respondents mentioned some field-related differences in the form of ownership in agriculture, forests, or roads, but they do not perceive them as insurmountable obstacles.

As the problem of legal and administrative barriers persisting between member states is well known in the EU²⁵, there are special instruments in place that aim at easing legal obstacles caused by i.a. inadequate EU legislation and shortcomings in the transposition of EU legislation into national law, incoherent national laws, or administrative barriers and incompatible competences²⁶. Among them, the *b-solutions* initiative (mentioned as a good practice in the interview) has been developed since 2018, helping public authorities identify and solve border obstacles²⁷. The KARPAT interviews provided some examples of legal problems that have to be tackled at the national level – without the state governments' involvement they will continue to inhibit regional cooperation.

According to our research findings, apart from the necessary efforts to alleviate legal and administrative barriers, it is also important to gather and share information about them, for instance, concerning various

²³ At the same time they point out the low level of NGOs involvement - Sienkiewicz, 2021; Shuliak and Shuliak, 2021.

²⁴ F. Durand and A. Decoville class different state organisations and distribution of competencies according to administrative levels as institutional obstacles - (Durand and Decoville, 2018). For the sake of clarity, they are discussed in the chapter among legal and administrative barriers.

²⁵ For instance, the high position of legal and administrative barriers in the 2020 survey conducted in the European border regions (Gallup International, 2020) or indications that diverging national rules and conflicts between national legislations represent the leading obstacle to cross-border cooperation, according to the European Committee of the Regions public consultations (European Parliament. Directorate General for Parliamentary Research Services., 2023).

²⁶ Metis GmbH. et al., 2017. Worth mentioning is the European Commission proposal on a mechanism to resolve legal and administrative obstacles in a cross-border context, including Cross-border coordination points and the Cross-Border Facilitation Tool - *Amended proposal for a regulation of the European Parliament and of the Council on a mechanism to resolve legal and administrative obstacles in a cross-border context* (COM(2023) 790 final – 2018/0198 (COD)).

²⁷ The fourth compendium was published in 2024: Association of European Border Regions, 2024.

regulatory regimes effective in a specific policy field on both sides of the border or differences in competencies of regional and local authorities. The interview respondents brought up that difficulties in gathering such information and shortages in knowledge of how to deal with them may restrain cooperation opportunities. Establishing a contact point for performing this task would be beneficial.

Insufficiently developed transport infrastructure is perceived as a less significant obstacle to cooperation than administrative and legal barriers – by the Carpathian survey participants (**Chart 5.14**) as well as the inhabitants of the EU member states border regions²⁸. However, it could hinder some cooperation opportunities, as was mentioned during the interviews (“because cooperation in a way requires personal contact and flows”), also in connection with the border regime infrastructure limits. Its shortages could be obstructive to inhabitants, tourists and economic activities. In certain locations, the development of transport connection happened to be hampered during COVID-19 pandemics.

Referring to the **institutional barriers** existing in the Carpathian macroregion, deficiencies in organisational structures coordinating cooperation and the weakness of stakeholders undertaking cooperation initiatives are pointed out (Jakubowski and Seidlová, 2022). It is related to the limited resources the cooperating entities dispose of (linked to the internal facet of a financial barrier already discussed). The institutional obstacles encompass organisational aspects (stability of functioning, external relations, access to information) as well as capacities (staff, experience in transborder cooperation and managing projects (Parkhomenko, 2021)). The **lack of adequate information on cooperation initiatives and capacity shortages** were mentioned by the respondents to the survey (**Chart 5.13**) and the interviews as factors restraining the cooperation potential.

The shortages in the institutionalised forms of cooperation are reflected by the reported need to support and develop them, financially and professionally, and to establish stable, long-term structures (“the institutional capacity is fundamental”). One of the respondents underlined that there is sometimes a need for a more experienced and leading in excellence “driver behind the collaboration” that is not always possible to find in the macro-region. It is worth searching for the best practices and the most advanced networks of collaboration, not necessarily present in the Carpathians. The access to “natural informal existing networks” also requires informational and organisational resources. Difficulties in carrying out project development and management are encountered by organisations specialised in a policy field but without a dedicated budget and permanent staff operating daily in an administrative, EU-funding complex environment.

The existence of institutional coordination and support for cooperation activities is important in this context. The online survey respondents indicated the available and preferred **forms of support** expected from the transnational organisations (**Chart 5.14**). The most frequent forms of support offered by the Carpathian transnational organisations/programmes that are used by the respondents facilitate the search for partners, the financing of activities, and the provision of information on implemented projects/activities. The highest expectations of the respondents are related to the increase of funds for actions, which is in line with their perception of financial barriers as the most important for Carpathian cooperation.

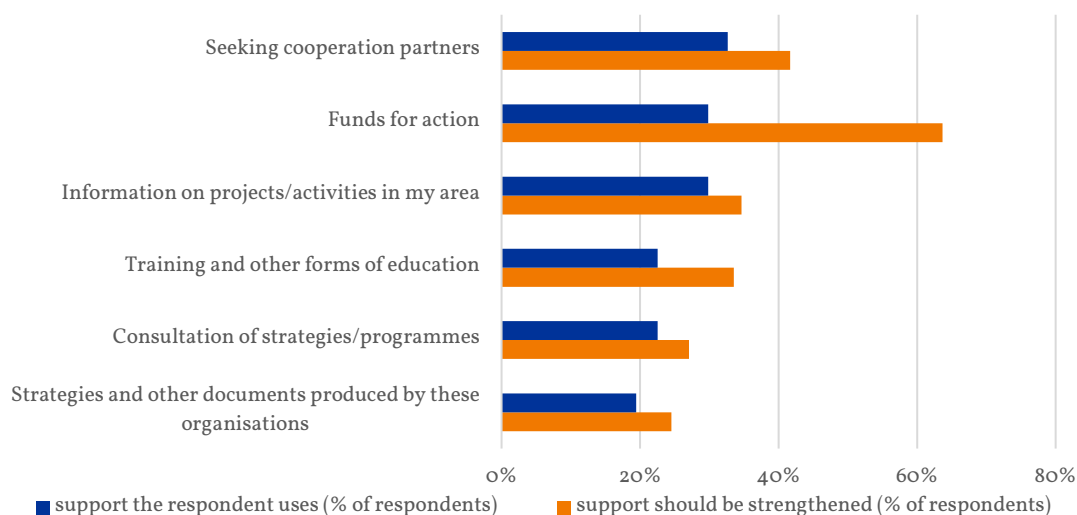
Development of the support in the most needed forms presents an opportunity to strengthen the Carpathian cooperation potential. It could be implemented along with the establishment of the specialised **Carpathian contact point** – a “one-stop” informational point on various Carpathian cooperation forms. The proposition of its creation was discussed during the interviews and, based on propositions submitted by the respondents, a catalogue of its possible functions was composed, to answer the relational, informational and educational needs of Carpathian entities. The proposed list of tasks included: (1) gathering in one place information on current funding opportunities for international cooperation in different EU-funded programmes and other Carpathian initiatives (“**funding inventory**”) (2) maintaining a database of already implemented Carpathian projects in different thematic areas and programmes (“**projects inventory**”) (3) maintaining a partner search platform with contact details and areas of activity of Carpathian actors (“**partners inventory**”), (4) collecting and standardizing statistical data on the Carpathian macro-region (“**data platform**”), (5) organising sectoral cooperation days and other opportunities to get in touch with potential cooperation partners (“**networking**”).

²⁸ The accessibility (for example geographical barriers or transport infrastructure) was seen by 30% of respondents as a problem for cooperation between their country and its partner country or countries (Gallup International, 2020).

platform"), (6) consultation of various strategies and policies, creation of working groups, elaboration of common thematic and territorial documents ("**knowledge platform**"), (7) providing guidance on application rules in the framework of EU programmes ("**application support**"), (8) providing information on institutions operating in relevant fields in different countries at various administrative levels and on the differences in law regulations ("**administrative support**"), (9) organising training and workshops for Carpathian organisations ("**training support**"), (10) promotion of the Carpathian macro-region ("**promotional support**").

Chart 5.14

**Forms of support from the Carpathian transnational organisations or programmes
(multiple answers allowed)**



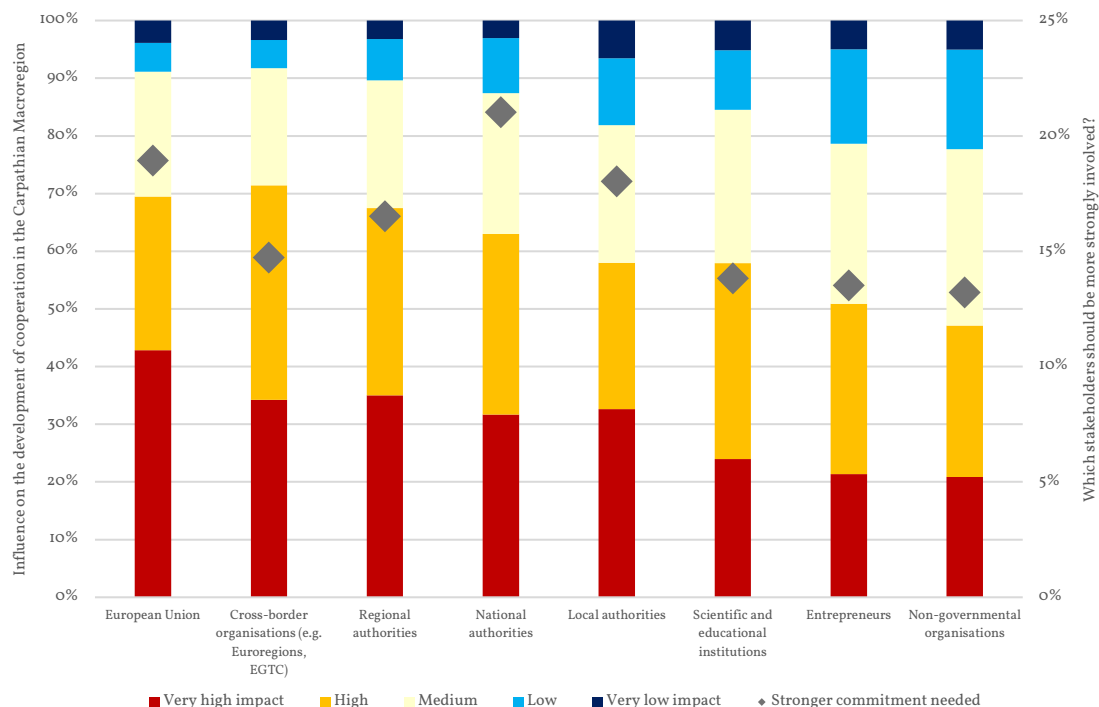
Source: own elaboration based on KARPAT survey [N=355] (EUROREG)

The second workshop participants assessed their importance and highlighted the networking platform, followed by funding and projects inventories as the most valuable (**Annex 5**). It would enable organisations to contact, plan common projects and exchange good practices, taking into account the national specificities and facilitating the process of cooperation. Apart from the support of the contact point, there is still a need to invest in building up local capacities as the human resources, their stability and skills are seen by researchers as the factor impeding the transborder cooperation potential (Knippschild, 2011; Lytvyn and Tyushka, 2020).

Another aspect of the Carpathian institutional environment, that may be seen as a **political barrier**²⁹, is the insufficient political commitment or engagement of various stakeholders, giving territorial cooperation little priority (Sienkiewicz, 2021; Shuliak and Shuliak, 2021).

Respondents to the online survey consider the **European Union to be the most influential actor** in the development of cooperation in the Carpathian macroregion (**Chart 5.15**). However, it is closely followed by cross-border organisations such as Euroregions or EGTCs and regional authorities. National authorities come forth in terms of their influence on cooperation, but are seen as the actors whose involvement should be strengthened the most. In the next places, the European Union and the local and regional authorities are expected to be more involved in the Carpathian cooperation development by the survey respondents. Those four levels of political agency will be addressed in the table of recommendations (as the process requires coordinated action at multiple levels) presented in chapter seven and based extensively on the postulates raised by the Carpathian stakeholders.

²⁹ F. Durand and A. Decoville define as political obstacles divergences in planning visions or overweighting of national priorities (Durand and Decoville, 2018).

Chart 5.15**Stakeholder influence on Carpathian cooperation and areas needing stronger commitment**

Source: own elaboration based on KARPAT survey [N=355] (EUROREG)

The **need for greater involvement of the national-level institutions**, also expressed by the interview respondents, is related to their role in shaping the cooperation environment, and the legal and financial framework of collaboration. Without the endorsement and acceptance of all countries, it is difficult to proceed with the Carpathian cooperation at the strategic level. One of the IDI respondents brought attention to the fact that, without effective enforcement powers, the elaborated recommendations remain declarative and, for instance, the socio-economic transformation of the Carpathian territory stays an uncontrolled process, prone to particularisms, without a common vision.

At the same time, the national-level involvement must follow the bottom-up initiatives and local-level needs. As reported by another KARPAT interviewee, it could be detrimental if there are conflicting interests and diverging priorities between administrative levels and the states shape the cooperation in the region according to their political orientation and regardless of initial impetus. He pointed out that the core responsibilities and interests of local and regional actors lie in improving the quality of life of their populations through health, education, social, employment and innovation policies. The strategic planning including the cross-border services to the picture may unlock the cooperation potential, but it needs to go beyond the ETC projects, combine other financing sources and involve coordinating other actors' activities.

The interview respondents brought up the question of missing vision and strategy for the Carpathian macroregion that should be endorsed by all the national states and the need for a systematic approach, and coherent common plan to replace the ad-hoc projects. The cooperation potential of developing common strategies is underlined also in the literature (Shuliak and Shuliak, 2021; Sytnyk et al., 2020). Within the EU regulatory framework, the corresponding instrument would be a **macroregional strategy**. To that point, the significant involvement of relevant stakeholders is crucial – as F. Sielker puts it, macro-regions are stakeholder-

based.³⁰ KARPAT interviews respondents underline that the engagement of regions is fundamental in strategy drafting. In the case of the Alpine macro-region, to which the Carpathian one is sometimes compared, the EU Strategy was initiated by the regions, not at the state level (Schuh et al., 2015). Despite the existing efforts to develop one for the Carpathian macro-region, its establishment is not certain. For that reason, it is appropriate to consider, when issuing the recommendations, the scenario without a formal EU common strategy. In that case, crucial would be elaborating at least a coherent definition/story of the macro-region (resuming its particular character and common development aims), shared by all countries involved, that could be promoted within and outside the region. Another important starting point would be the selection and implementation of specific **pilot projects** in the areas already agreed upon by the Carpathian entities.

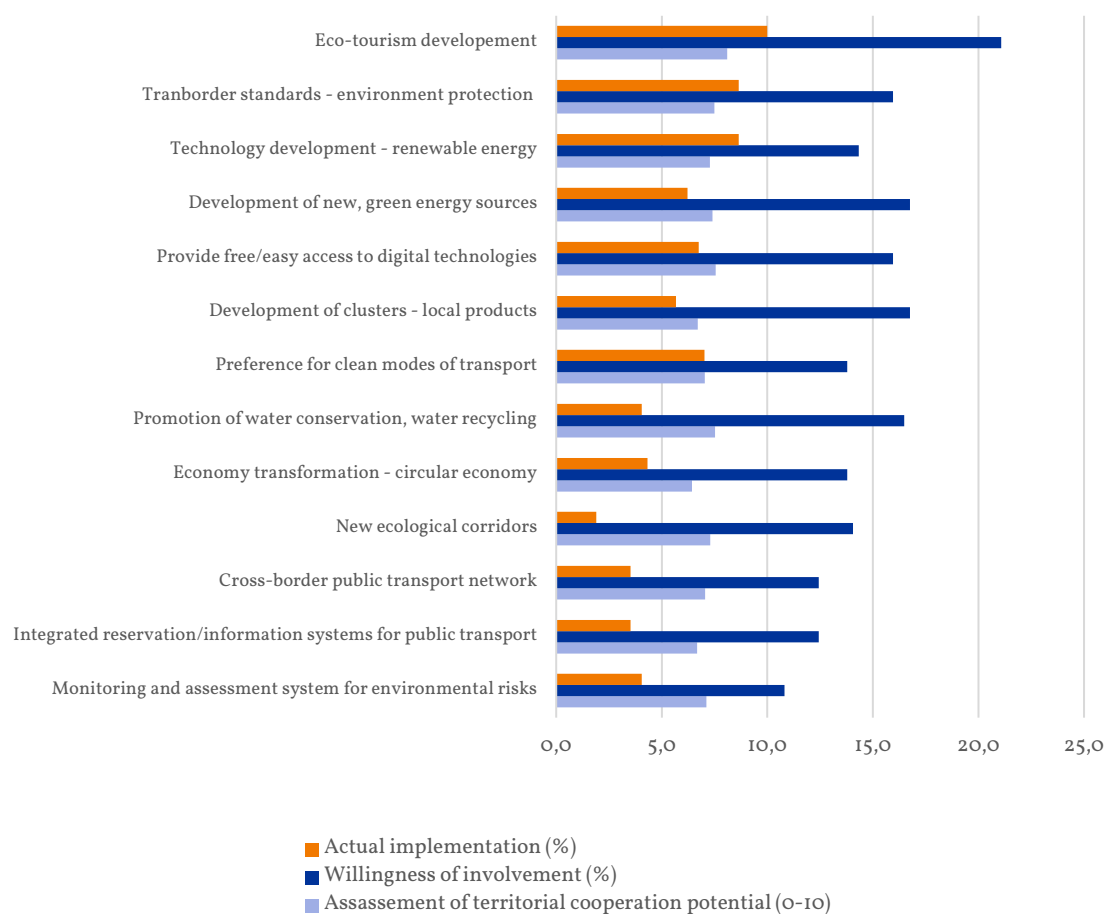
As part of research conducted for the Carpathian Strategy project (Smętkowski et al., 2021), a selection of activities was identified that particularly align with the needs of the macroregion and adhere to EU strategies on environmental protection (Green Deal), the Recovery Fund (Next Generation), and EU digital objectives. Thirteen prospective activities were chosen, all of which address the three strategic development goals of the macroregion, expressed as "Competitive," "Green," and "Cohesive" Carpathians. Respondents in the ESPON Carpathian project were asked, first, to declare whether they are currently involved or plan to engage in any of these activities in the future, and second, to assess the potential for implementing these activities through cross-border cooperation.

Based on the results there was significant interest in all proposed topics (Chart 5.16). At least a dozen respondents indicated participation in these activities (except for creating ecological corridors, noted by 7 respondents), while at least 40 respondents per activity expressed plans to engage, representing no less than 10% of all survey participants. This even distribution of interest might be attributed to the balanced representation of thematic areas within the research sample.

The most represented area of engagement was sustainable tourism, with 10% of respondents (N=37) currently engaged and over 20% (N=78) expressing interest in future involvement. Similarly, high interest was observed in activities aimed at environmental protection, particularly in establishing coherent cross-border standards. Renewable energy development and implementation, including the generation of "green" energy, also emerged as a priority. Respondents expressed the need to provide residents with free and easy access to digital technologies to support the development of an information society. Lastly, there was notable interest in creating and supporting local clusters, especially those related to the production of local goods, despite limited current involvement in this area. Also activities such as promoting clean transport, managing water resources, developing a circular economy, and creating ecological corridors, although less common in current operations, garnered substantial interest for future initiatives. Meanwhile fewer respondents (but still over 10%) declared plans to engage in cross-border transport initiatives, such as improving passenger facilities and monitoring environmental risks.

All activities were rated relatively high in terms of potential for cross-border cooperation, with many scoring near 8 out of 10 on average. The standout area was eco-tourism, which was rated significantly higher than other sectors. Conversely, circular economy initiatives, cross-border ticketing systems (likely reflecting underdeveloped public transport connections in the Carpathians), and local product clusters were seen as having relatively lower potential. The latter might indicate potential regional competition in certain fields of activities. In general aligning with survey preferences, the three top-ranked areas for the future Carpathian Strategy transnational cooperation are environmental protection, tourism, and clean, "green" industries.

³⁰ The author claims: One reason macroregions developed successfully in some regions, whereas in other regions the same type of cooperation has not emerged, is that MRSs were not seen as useful for agenda-setting by (enough) influential stakeholders (Sielker, 2016).

Chart 5.16**Implementation of key activities and their potential for development of transnational cooperation**

* assessment was rescaled for the purpose of better visualisation from 1-5 to 2-10

Source: own elaboration based on KARPAT survey [N=370] (EUROREG)

Apart from the formal settings, the KARPAT interviewees indicate **working groups** (present i.e. in other macro-regional strategies institutional frameworks) as a useful tool to bring together relevant actors and work on common-interest issues. Various forms of networking, inside and outside the region, are perceived as indispensable to providing cooperation opportunities. During the interviews, the subject of ongoing Russian aggression against Ukraine was mentioned – as a specific barrier, but also as a factor stimulating reflection on Ukraine's integration into the EU that may be facilitated through macro-regional cooperation.

6 Good practices of territorial cooperation

In the topics identified as particularly promising for the development of transborder cooperation in the Carpathian macroregion, an analysis of case studies was conducted to showcase good practices that support achieving the intended goals. The compilation of territorial cooperation good practices in the Carpathian macroregion was carried out using the following methods:

- Screening of online sources, such as the Euromontana webpage and the INTERREG portal, to identify documented good practices in territorial cooperation,
- Survey of Carpathian stakeholders, including the ongoing reporting of good practices and a 'self-assessment' process where stakeholders evaluate their own practices,
- Stakeholder workshop, where good practices suggested during workshop discussions were also taken into account.

Consultations with project stakeholders resulted in a shortlist of good practice case studies to illustrate topics considered most promising for the development of transnational cooperation in the Carpathian macroregion. These topics include environmental protection, sustainable tourism, and sustainable transport. Additionally, the list was complemented with a good practice rooted in governance focused on elimination of legal and administrative barriers and one related to scientific cooperation focused on the Carpathian macroregion. Basic information about these good practices is presented in **Table 6.1**.

Table 6.1
"Good Practice" case studies basic information

Theme:	Environment protection	Sustainable tourism	Sustainable transport	Governance	Scientific cooperation
Title:	CENTRAL PARKS	The Route of the Wallachian Culture	Holiday tourist train 'Wojak Szwejk' / 'Vlak Wojak Švejk'	#ACCESS - Promotion of legal accessibility across the Slovak-Hungarian border	S4C-Science for Carpathians
Countries:	AT, CZ, HU, IT, PL, RO, SK	Borderland: PL-SK	Borderland: PL-SK	Borderland: HU-SK	UA, PL, RO, SK, HU, DE, SE, CZ, IT, AU, UK, RS
Lead beneficiary:	European Academy of Bolzano/Bozen - Eurac Research	Association for the Development and Promotion of Subcarpathia "Pro Carpathia"	Podkarpackie Marshal's Office	Central European Service for Cross-Border Initiatives (CESCI)	Academic Institutions from Carpathian macroregion and beyond
Size (finances):	1 600 000 EUR	1 849 000 EUR	c.a. 1 081 000 EUR	1 752 000 EUR	n/a
Programme/Fund:	INTERREG Central Europe 2014-2020	INTERREG PL-SK 2014-2020	The Fund for the Development of Public Utility Bus Transport	INTERREG HU-SK 2021-27	co-financed by the Governments CZ, HU, PL, SK through Visegrad Fund
Dates	2019-2022	2017-2018 and follow up activities	2020-2024	2023-2029	2008-to date
Source of good practice	Stakeholder Survey, Interviews	Stakeholder Survey	Stakeholder Survey	Stakeholder Survey	Desk research

Source: own elaboration (EUROREG)

6.1 Environment protection initiative: CENTRAL PARKS

6.1.1 Context of intervention and project objectives

The CENTRALPARKS project, spanning the years 2019-2022, was initiated to enhance the management and networking capacities of protected areas within the Carpathian region. The project stemmed from an analysis of national parks and smaller protected areas, revealing deficiencies in management skills and cooperation among stakeholders. CENTRALPARKS aimed to address these gaps by fostering collaboration and knowledge exchange across the region's diverse conservation sites. Additionally, the project responded to the Carpathian Convention Secretariat's need to consolidate efforts in protected areas that had been part of earlier initiatives, such as the BioRegio project. As a successor to BioRegio, CENTRALPARKS built on its foundation, reinvigorating concepts like the Carpathian Network of Protected Areas (CNPA), which had been dormant for years.

To achieve the aforementioned objectives, the project implemented training workshops targeting three critical areas. First and foremost, it addressed landscape management, which constituted a pressing issue, provided that many national parks faced challenges such as unregulated infrastructure development. The project thus aimed to curb such practices by empowering managers with strategies for improved oversight. Second of all, the initiative tackled the management of mass tourism, helping protected areas devise strategies to balance visitor presence with conservation goals. Last but not least, the project emphasised the need for new data to inform management decisions. Using advanced technologies like LiDAR, it mapped key areas such as the Duna-Ipoly National Park in Hungary, collecting data on forests and cultural heritage. These efforts brought about the creation of a new categorisation of ecosystem services data, spearheaded by the State Nature Conservancy of the Slovak Republic, underscoring the project's commitment to sustainable management practices.

6.1.2 Adopted Policy Measures/Actions and its effects

A key initial step was the development of a comprehensive communication strategy to ensure clear messaging, and balance diverse economic and conservation interests. Practical measures included the formation of three thematic transnational task forces focused on tourism management, biodiversity issues, and data collection. These task forces, composed of external experts and project partners, worked in tandem to prioritize interventions and share results. Advanced technologies, such as LiDAR, were introduced to local managers for data collection and analysis through workshops and training sessions. As a key outcome, the project delivered a multilingual ecosystem services toolkit to guide the categorisation and management of ecosystem services across the region. With a budget of €1,599,440, the project was funded by Interreg Central Europe, a new funding initiative for Central European projects.

Implementation of the CENTRALPARKS project encountered notable challenges, primarily rooted in the socioeconomic realities of the target regions. A key difficulty lies in addressing the tension between economic imperatives and environmental conservation, particularly in low-income areas where local stakeholders prioritised immediate financial needs over long-term biodiversity protection. For instance, some protected areas, including national parks in Poland, allowed infrastructure development in sensitive zones to support economic growth, despite its ecological implications. Efforts to shift this perspective through workshops and alternative approaches met limited success, as economic concerns remained dominant. Additionally, as an external initiative, the project faced trust issues, with local stakeholders often perceiving project representatives as outsiders. This lack of local integration complicated the process of fostering collaborative relationships and implementing proposed measures. Despite these challenges, the project managed to structure its activities effectively in several areas, minimising logistical implementation difficulties overall.

The direct effects of the CENTRALPARKS project included the generation of new data, which updated internal databases in parks and protected areas, and the establishment of a robust communication network among stakeholders that remains active. Additionally, pilot actions resulted in two signed protocols—one on biodiversity and the other on sustainable tourism—endorsed by the Carpathian Convention, with commitments to integrate these priorities into management plans for national parks and protected areas. Indirectly, the project fostered a knock-on effect, with its approaches being adopted by other regions, including training sessions organised by external stakeholders like AeroPark. The engagement of local communities and administrators led to practical impacts, such as the signing of letters of intent in Poland to prioritize landscape management in municipal planning. The project's broader impact included raising awareness among managers

and communities, fostering collaboration, and providing ongoing support. Finally, the Carpathian Ecosystem Services Toolkit, adopted by the State Nature Conservancy of the Slovak Republic, serves as a decision-making framework for assessing management choices. Unexpectedly though, the project sparked significant interest beyond its initial local scale, attracting attention from other protected areas within the Carpathian community. This led to new opportunities for collaboration, with stakeholders expressing a concrete willingness to adopt similar approaches and integrate them into their own management practices. The effects of the project demonstrate a certain potential for sustainability, as several outputs, such as the ecosystem services toolkit, have been adopted at the national level by the State Nature Conservancy of the Slovak Republic and other national administrators. Other project outcomes, including the use of LiDAR technology and strategies for communication and sustainable tourism management, have shown potential for regional and local application, potentially making a foundation for further initiatives across different governance levels..

Figure 6.1

The 2019 Interreg Communications Workshop in Budapest



Source: centralparks.eu

6.1.3 Territorial governance and potential for transferability

The CENTRALPARKS project was initiated in response to the Carpathian Convention's call to enhance biodiversity protection and revitalize the Carpathian Network of Protected Areas (CNPA), with leadership from partners like the State Nature Conservancy of Slovakia, Duna-Ipoly National Park, and the Piatra Craiului National Park in Romania. Collaboration extended to key ministries of environment from countries such as Poland, Hungary, Slovakia, and Italy, alongside organisations like the Ecopsychology Society from Zakopane. Despite challenges like cultural differences, language barriers, and decentralized monitoring, trust and flexibility among partners ensured effective cooperation and local engagement. The project's impact persists

through initiatives such as the Central Mountains project, which involves former partners and builds on the methodologies developed in CENTRALPARKS.

Table 6.2
Partners of the CENTRALPARKS project

Country	Project partners	Associated strategic partners
Italy	European Academy of Bozen-Bolzano (Eurac Research) – Lead Partner	Ministry for the Environment, Land and Sea – IMELS
Slovakia	The State Nature Conservancy of the Slovak Republic Pronatur NGO	Ministry of Environment of the Slovak Republic
Poland	Ekopsychology Society	Ministry of Environment
Romania	NFA-Romsilva-Piatra Craiului National Park Administration R.A.	Ministry of Environment
Hungary	Danube-Ipoly National Park Directorate	CEEweb for Biodiversity
Austria	European Wilderness Society	DANUBEPARKS
Czech Republic	Education and Information Centre of Bílé Karpaty Mountains	
Germany		European Beech Forest Network
Ukraine		Ministry of Ecology and Natural Resources of Ukraine

Source: centralparks.eu

The strategies developed during CENTRALPARKS have also been referenced in Horizon projects, demonstrating their applicability beyond the Carpathian region. Additionally, the Ecosystem Services Toolkit has been adopted by national agencies and incorporated into the Carpathian Convention's biodiversity working group, indicating a degree of integration into broader conservation efforts.

6.2 Sustainable tourism initiative: The Route of the Wallachian Culture

6.2.1 Context of intervention and project objectives

The initiative arose from the need to preserve the cultural heritage of the Wallachians, which is a common element in the culture of the Carpathian regions. The Vlachs were a pastoral people originating from areas of present-day Romania and the Balkans, who migrated northwards along the Carpathian chain from the Middle Ages. Known for their skills in sheep and cattle breeding, they contributed to the development of the pastoral economy in the mountainous areas. Their influence can be seen not only in their culture and traditions, but also in the organisation of settlements, often associated with the so-called Wallachian law. Many elements of their heritage have survived to this day in the culture of the Carpathian highlanders.

The Wallachian Cultural Trail initiative was initiated by local circles (the Podhale Association and the Cracow University of Technology), with the Pro-Carpathia Association joining in at the next stage. The main aim of the project is to preserve pastoral culture and promote Wallachian heritage as an element linking various regions of the Carpathians. The project is intended to foster the development of tourism by highlighting the natural and cultural values of the Carpathians. The trail is intended not only to encourage tourists to discover the authentic pastoral heritage, but also to inspire the development of tourism services, including gastronomy, and to promote sustainable tourism development in the region. The project assumes that heritage-based tourism will become a catalyst for regional growth and integration of communities living in different parts of the Carpathians.

6.2.2 Adopted Policy Measures/Actions and its effects

Significant activities related to the development of the Wallachian Cultural Trail were undertaken on a larger scale thanks to the raising of funds from the INTERREG PL-SK 2014-2020 project to the value of approximately EUR 1.85 million (of which approximately EUR 1.5 million from European funds). The project was implemented in the Polish-Slovak border area between 2017 and 2018. In particular, it involved the creation of small-scale tourist infrastructure (e.g. information boards, shepherd displays, a café) in five border regions, i.e. the Małopolskie, Podkarpackie and Silesian voivodeships in Poland and the Žilina and Prešov region in Slovakia. In addition, a number of events promoting pastoral culture and local heritage were organised, and this heritage was popularised through publications, including popular science and workshops, and films. In each of the five regions, proposals for tourist routes have been developed in the form of guidebooks, which present selected elements of Wallachian pastoral culture.

The trail has a multilinear character, i.e. there is no single line of the trail, but it indicates places of natural and cultural value associated with this culture. A visual illustration of the trail is the Rydyk route, i.e. a cross-border transhumance of sheep (three hundred sheep, shepherd dogs, donkeys and horses (as pack animals) and 7 shepherds (two Czabans from Romania, two Hutsuls from Ukraine and three shepherds from Poland) realised in 2013 on the initiative of the Transhumance Foundation (**Fig. 6.2**).

Figure 6.2
Wallachian Cultural Route



Source: <https://szlakwoloski.eu/>

The result of these projects was the creation of the Wallachian Cultural Trail as a sustainable tourism product and a tool for promoting the region. The sustainability of the activities is fostered by ventures carried out within the framework of competitions organised by the ProCarpathia Association (financed from Polish government funds) for local Carpathian initiatives (funding of up to EUR 2,500. Within the framework of these, projects related to the Wallachian Cultural Trail are scored when projects are selected. Examples of such activities include meetings of shepherds, the organization of excursions to places associated with shepherd culture, and handicraft workshops. The Trail has thus become a platform open to new activities and projects. Moreover, the knock-on effect is that numerous institutions and organisations have started to undertake initiatives related to Wallachian culture independently of the main project. Initiatives associated with the trail are also being extended to other countries, including a micro-project under the Interreg programme Poland, Belarus, Ukraine 2014-2020, which set up information boards on the trail in the Ukrainian region of Chornohora. On the other hand, efforts to create a European cultural trail encompassing three countries (PL, SK, UA) encountered a barrier in the form of Russian aggression against Ukraine.

Figure 6.3

Lemko Culture Museum - Zyndranowa: information boards (Poland, Podkarpackie Voivodeship)



Source: M. Smętkowski (2024)

Figure 6.4

Border crossing between Korbielów (PL, Silesian Voivodeship) - Oravska Polhora (SK, Žilina Region): information boards and cafe shop



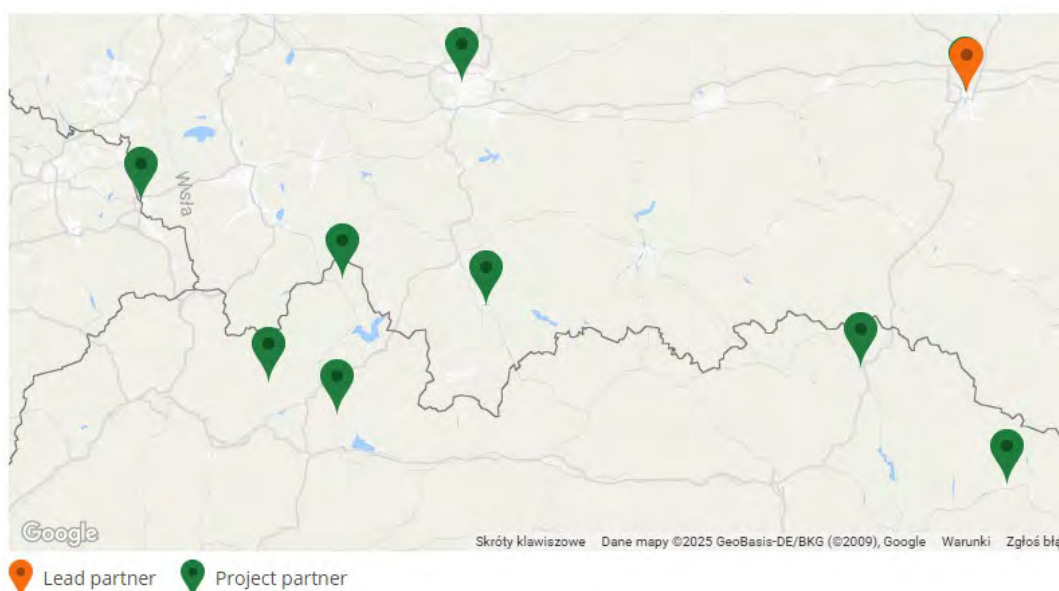
Source: M. Smętkowski (2024)

Figure 6.5**Exhibition in a Boyko hut in Zatwarnica (PL, Podkarpackie Voivodeship)**

Source: M. Smętkowski (2024)

6.2.3 Territorial governance and potential for transferability

Realising the idea of the Route of the Wallachian Culture required cross-border cooperation. The main project INTRREG PL-SK 2014-2020 "The Route of the Wallachian Culture" involved ten partners, five from Poland, five from Slovakia (**Fig. 6.6**).

Figure 6.6**Partners of the Wallachian Cultural Trail project**

Source: keep.eu

public funding, especially project funding under EU cross-border cooperation programmes. Efforts are being made to obtain the status of a European Cultural Route, but this requires revitalising the route by building a range of services around it, including the involvement of entrepreneurs from various tourism sectors. Other

initiatives in operation, such as the Oscypek Trail (a regional cheese product) in the Małopolskie Voivodeship, which is promoted as part of the Wallachian Culture Trail, are also being used to this end.

The strengths of the project include the promotion of the Carpathian macroregion through reference to authentic cultural heritage. In addition, the project serves to integrate local activities into an international platform for cooperation. The flexible partnership structure and the use of local cultural potential serve to achieve results. As a result, the model of the Wallachian Cultural Route can be adapted to other regions and cultures with a similar heritage, with an appropriate approach to integrating local communities and exploiting the potential for tourism.

6.3 Sustainable transport initiative: Holiday tourist train 'Wojak Szwejk' / 'Vlak Vojak Švejk'

6.3.1 Context of intervention and project objectives

Railway line No. 107 is one of three railway routes connecting Poland and Slovakia. Despite this, there were no connections on it for many years. The transport offer was gradually reduced when it comes to passenger transport. In order to change this situation, local activists from the Sanok and Bieszczady districts have established an informal group "I Love the Railway". The argument was not only about transport needs, but also the fact that the railway line 107 is one of the most picturesquely located railway lines in Poland. The initiative also has a historical origin, as it is part of the first Hungarian-Galician railway and attracts lovers of cultural tourism.

Figure 6.7

Railway line no. 107. Holiday tourist train 'Wojak Szwejk' / 'Vlak Vojak Švejk'



Source: ezapiski24.blogspot.com

In 2015, it was possible to convince the Board of the Podkarpackie Voivodeship to launch such weekend connections on the Jasło-Komańcza route on a line on which there had been no connections since 2011. In July 2015 a decision was made to launch these trains. And it turned out to be a bull's eye, because many times there were no free seats. The interest of passengers showed the huge potential of this tourist line.

Figure 6.8
Łupków border station, Railway line 107



Source: Stowarzyszenie Kolejowych Przewozów Lokalnych

Figure 6.9
Inaugural passage of the train Wojak Švejšk, Miedzilaborce 27.08.2016



Source: bieszczadzkiaczek.blogspot.com

A group of activists convinced a group of partners to enclose the transport with a promotional and discount system, the basis of which was a train ticket. Its holders could take advantage of the offer of cooperating institutions, hotels, agritourism lodgings and restaurants.

The train has also created additional opportunities for cyclists. Rail and bicycles complement each other very well and new connections have become an important element in the development of bicycle tourism. Bicycle paths leading to stations and stops have been prepared. The idea was picked up by active tourism organizers and guides.

The development of the offer was also supported by the authorities of the Sanok district, which in the following years, in cooperation with the Marshal's Office and local municipalities, allocated its own funds to launch

daily trains on the Polish side of the border. The district trains complemented the offer of these trains "Vojak Švejk" and in this way the all-week service of the line.

6.3.2 Adopted Policy Measures/Actions and its effects

The first stage of development was the launch of a special train dedicated to students living in the Bieszczady Mountains. The first train with this name went in December 2015. The great interest in transport caused the idea of extending trains to the border station in Łupków, and then to Slovakia. The implementation of this plan was accelerated by an off-site meeting of the Infrastructure Committee of the Sejm of the Republic of Poland in May 2016. It was held partly on the Polish side and partly on the Slovak side, with the participation of regional authorities, local governments and the social side. It was an impulse for cooperation and after a month, the first train set off on the route.

Figure 6.10
Signing of the Carpathian Euroregional Railway Declaration



Source: PKP Polskie Linie Kolejowe S.A.

On the Polish side, the financing of the train is provided by the local government of the Podkarpackie Voivodeship. On the Slovak side, the Ministry of Transport of Slovakia.

After the launch of the "Vojak Švejk" trains and holiday connections on the Polish side, line 107 returned to such social and media circulation. The reactivation of connections from Polish to Slovakia was reported by regional and national media on both sides of the border.

Social activities resulted in the concept of the Carpathian Euroregional Railway. In June 2017, the Marshal of the Voivodeship gave his honorary patronage to the initiative and the first train towards Ukraine went to the inauguration. After 7 years the border crossed into Krościenko, and further to the side of Ukraine.

Thanks to the efforts of the social and local governments, the Carpathian Euroregional Railway has been included in the development strategy of the Podkarpackie Voivodeship until 2030. It was another confirmation that cross-border railways should develop and increase the attractiveness of this part of the Carpathians. It has a major role to play in the promotion of passenger rail transport and cross-border traffic, including with Ukraine.

The latest stage of development directions has also been shown by the war in Ukraine. The first evacuation trains were launched in the region, transporting Ukrainians from the border crossing in Krościenko into Polish. The situation has shown that at the beginning the goal was mainly tourism, while the role of railways can be much more extensive and in a crisis situation it becomes one of the basic elements of logistics and security in the international system.

Figure 6.11
Evacuation train for refugees from Ukraine, 4.03.2022



Source: PKP Polskie Linie Kolejowe S.A.

6.3.3 Territorial governance and potential for transferability

For local authorities, entrepreneurs, non-governmental organizations and residents of border areas, it is important to intensify contacts and reduce barriers to crossing the border. With the launch of the connections, institutional cooperation between the Polish and Slovak sides began. The municipality of Zagórz, the city of Medzilaborce has prepared projects whose axis is the railway line 107.

In the next stage, a project was prepared and submitted to the Poland-Slovakia INTERREG programme. The leader of the project is the Bieszczady district, and the partners are the municipality of Zagórz and the municipality of Medzilaborce in Slovakia. The funds obtained were used to promote cross-border connections and investments in both countries.

There is a plan to prepare an INTERREG cross-border cooperation project, and to find a carrier that will guarantee us the ability to handle cross-border traffic not only from Polish to Slovakia but further to Hungary. This will be another element of building a classic tourist attraction, where the basis is an attractive railway line surrounded by various attractions in subsequent towns.

There is also an idea to prepare a retro train and take tourists to the mountains. There would be a chance to travel by such an occasional train to Hungary and promote the „Vineyard route” from Jasło to Sárospatak.

The initiative to launch the "Vojak Švejk" train gradually evolved and expanded to other areas of cooperation. Entities involved in the one-off project noticed a very large potential to transform a holiday tourist attraction into regular connections for cross-border travel. It was also stated that trains should also run in the Ukrainian direction.

The Carpathian Euroregional Railway is to eventually serve the areas at the junction of Poland, Slovakia and Ukraine from Jasło in the west, to Medzilaborce in the south and to Chyrov in the east. Ultimately, it may also provide a connection across Ukrainian territory to Przemyśl. It would be a communication system connecting the territory of three countries of decidedly supra-local importance.

The implementation of the idea of launching cross-border rail connections between Poland and Slovakia and the first test runs to Ukraine required the cooperation of many entities. The partners included non-governmental organisations, as well as local and regional governments from Polish, Slovakia and Ukraine. Local activists, tourist agencies, entrepreneurs and cultural institutions are involved in the project. Efforts are being made to expand cooperation to include Hungarian partners.

The strength of the project is the involvement of many actors and the combination of the tourist and infrastructural aspects. As a result, a good practice has been created to promote the integration of the Carpathian macroregion in a sustainable way. The project grew organically, from the local level, through a series of initiatives funded by local governments, followed by cross-border projects. Finally, its innovativeness was noticed at the parliamentary level and recognized as a model example of the practical implementation of the concept of building a "Europe of the Carpathians". As a result, the restoration of railway connections and the launch of the tourist train "Vojak Švejk" can be successfully used as an example for other connections and regions, combining their tourist potential and, in the long run, interfering with infrastructure networks.

6.4 Governance initiative: #ACCESS - Promotion of legal accessibility across the Slovak-Hungarian border

6.4.1 Context of intervention and project objectives

The initiative arose from the need to **address legal and administrative barriers** hindering integration and cooperation along the Hungary-Slovakia border. Since EU accession, the region has seen remarkable progress: foreign trade reached 17 billion euros in 2022, nearly 40 road border crossings now operate 24/7 (up from six before the change), and cross-border commuting has become common, involving tens of thousands of workers. Over 1,000 Slovak students attend Hungarian schools, nearly 20,000 Slovak citizens reside in Hungary, and shopping tourism flourishes, with Slovak customers generating 75% of turnover in Hungarian border shopping centres.

The '*Promotion of Legal Accessibility along the Slovak-Hungarian Border*' (#ACCESS) initiative, launched by CESC in Budapest and CESC Carpathia in Košice, runs from May 1, 2023, to April 30, 2029 within the **Interreg Hungary – Slovakia** Programme (Priority axis PA3 – Institutional cooperation > Specific objective SO3.1 Strengthening more effective public administration by means of rights and administrative cooperation > Activity 3.1.1 – Elimination of cross-border obstacles) with a total budget of 1.401.837,96 EUR.

It aims to identify and eliminate legal and administrative obstacles that complicate cross-border mobility and cooperation. These include restrictions on ambulance services, complex rules for selling local produce, lack of qualifications recognition, and challenges in employment and social security administration. The project focuses on two key interventions: **obstacle monitoring and management**. Its outcomes include a legal obstacles database, targeted solutions, legal recommendations, and an awareness campaign for authorities. By addressing these barriers, the initiative seeks to enhance residents' quality of life, stimulate economic growth, and strengthen cross-border collaboration.

6.4.2 Adopted Policy Measures/Actions and its effects

The #ACCESS project adopted a combination of surveys, expert consultations, and community workshops to identify and address cross-border obstacles. A survey of 1.609 border residents revealed critical challenges in mobility, cooperation, and daily activities, including issues with legal frameworks, language barriers, and access to services such as banking, healthcare, and education.

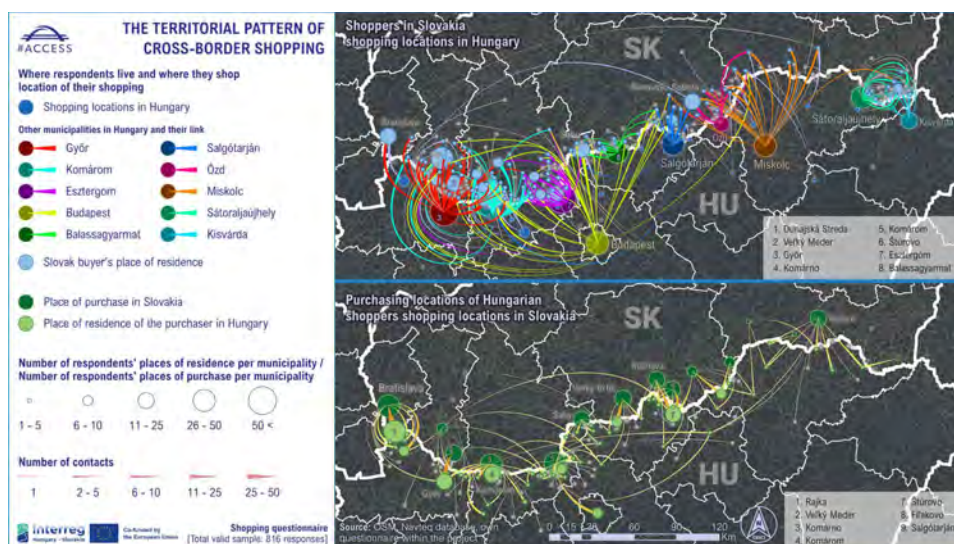
Expert interviews with Hungarian and Slovak professionals provided additional insights, highlighting persistent legal and administrative hurdles, particularly in urban centres like Bratislava and Košice. Complementing these efforts, workshops in nine regions engaged local leaders to focus on mobility, public services, and administrative difficulties faced by Slovak citizens residing in Hungary. This resulted in 9 comprehensive sets of **background materials for each of the reference groups** which provide information on functional urban dynamics of the area, its positioning in the larger scheme of cross-border and metropolitan collaboration, strategies for enhancing cross-border integration and cooperation, pinpointing opportunities to improve Slovak-Hungarian relations.

Figure 6.12
Survey among border residents - fieldwork



Source: CESCI. (2024b)

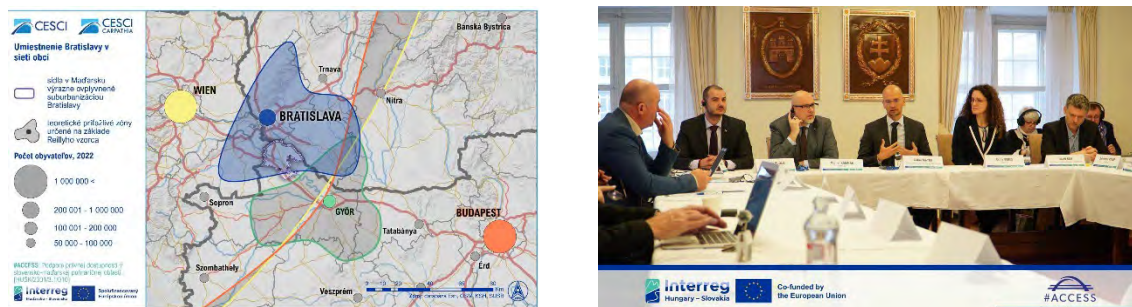
Figure 6.13
Survey among border residents – results of “shopping” questionnaire



Source: CESCI. (2024b)

However the most innovative tool of the #ACCESS project is **the platform for reporting obstacles** - a critical tool designed to address and mitigate the legal and administrative barriers directly experienced by citizens in the Hungarian-Slovak border region. Each intervention is based on a cycle of reporting, analysis, action, feedback and long-term advocacy.

Figure 6.14
Reference group material and workshop - Bratislava



Source: CESC. (2024c)

Citizens fill in a short and simple obstacle report form detailing the legal or administrative issues they encounter, specifying locations, dates, and the personal impact of the obstacle. Upon receiving a report, legal experts and practitioners investigate the issue by reviewing legislation, consulting with relevant authorities, and leveraging their expertise in cross-border matters. Reporters who provide contact information receive initial feedback within four weeks, detailing the preliminary steps taken to address their issue. The answer is also published in the **solution gateway** section of the #ACCESS website.

Figure 6.15
Obstacle reporting platform and solution gateway

Source: <https://hu-sk.eu/en/>

While immediate solutions may not always be available, this transparent communication keeps citizens informed about the process and the feasibility of addressing the reported obstacle. Obstacles reported through the platform are systematically documented and included in brochures published periodically until the project's conclusion in 2029.

The platform is an example of innovation through its citizen-centric approach, empowering residents to actively report and address cross-border obstacles based on their actual experiences. Its integrated problem-solving mechanism ensures a holistic workflow, combining data collection, expert analysis, feedback, and advocacy for systemic improvements. Transparency is prioritised, with preliminary feedback provided within four weeks to build trust and accountability. Long-term data utilisation through systematic documentation supports evidence-based policymaking and continuity in tackling cross-border issues. Additionally, the platform focuses on advocacy for structural changes, targeting legal and administrative harmonization to address the root causes of barriers and promote sustainable integration. Since its launch, 31 obstacles have been documented and are undergoing legal analysis, with feedback provided to contributors.

The project's online presence, including a website and an active Facebook page with over 2,900 followers, disseminates information, promotes engagement, and highlights progress, strengthening community support and awareness. The project outreach also foresees a more conventional billboard awareness campaign planned to be placed in carefully selected locations.

6.4.3 Territorial governance and potential for transferability

Building on these activities, the project has classified nearly 300 reported obstacles into thematic categories and shortlisted 12 priority issues for further expert analysis and resolution. This structured and systematic approach ensures targeted interventions while maintaining flexibility with a reserve list of 10 additional challenges.

The #ACCESS project's approach is highly transferable to other cross-border regions facing similar legal and administrative challenges. Its modular framework, including reporting, analysis, and advocacy, can be scaled to accommodate larger or more complex regions. The platform's focus on inclusivity, transparency, and advocacy is adaptable to various contexts, addressing common cross-border issues such as regulatory inconsistencies and administrative inefficiencies. The project's methods, including surveys, workshops, and expert consultations, provide a replicable model for identifying and resolving cross-border obstacles. Additionally, the platform's digital accessibility makes it adaptable to regions with varying levels of technological infrastructure, allowing for easy integration of local languages and regulatory frameworks. By systematically documenting obstacles and solutions, the platform offers a blueprint for replication in other sectors, such as healthcare, education, and transportation. Its community-centric approach ensures that local stakeholders remain central to the process, fostering long-term relevance and sustainability. Ultimately, the #ACCESS model offers a tested framework that can be successfully adopted by other regions with similar cross-border challenges.

6.5 Scientific cooperation initiative: Science for the Carpathians (S4C) platform

6.5.1 Context of intervention and project objectives

The Science for the Carpathians (S4C) platform emerged in 2008 as an informal, voluntary research network of scientists working on Carpathian-related issues. While S4C has been dominated by natural scientists, including geographers, hydrologists, GIS experts, and forest biologists, it actively strives to integrate social sciences into its activities to complement its existing strengths. The network also connects scientists and practitioners focused on sustainable development and environmental protection within the Carpathian macroregion.

S4C aims to enhance scientific collaboration on regional priorities and advance innovative solutions for sustainable growth. Its objectives include developing and implementing a research framework for the Carpathians, promoting research collaborations—such as peer-reviewed papers and synthesis articles—across disciplines and national boundaries, and fostering dialogue between research, policy, and practice. The platform facilitates interdisciplinary research across countries such as Poland, Slovakia, Ukraine, Hungary, and others, including Sweden, Austria, Italy, the United Kingdom, and Germany..

6.5.2 Adopted Policy Measures/Actions and its effects

A cornerstone of S4C's activities is the development of the S4C Research Agenda 2022–2030, financially supported by the governments of Poland, the Czech Republic, Hungary, and Slovakia through the Visegrad Fund. The strategic document prioritises research areas such as climate change, water resource management, social innovation, education for sustainable development, and land-use transitions. The agenda incorporates updates to address evolving challenges, including the war in Ukraine and the COVID-19 pandemic. It emphasises biodiversity conservation, climate change mitigation, and sustainable socio-economic development, fostering knowledge exchange among academic, governmental, and non-governmental institutions. The agenda has led to interdisciplinary research collaborations, enhancing the scientific understanding of the Carpathians.

A key initiative under S4C is the Forum Carpathicum conference series, held biennially since 2010, attracting 100–200 participants. Recent editions include Forum Carpathicum 2023: Connecting Science with Practice (Kraków, Poland), Forum Carpathicum 2021: Linking Environmental, Political, and Socio-Cultural Dimensions (on-line), and Forum Carpathicum 2018: Adapting to Environmental and Social Changes (Eger, Hungary). These events serve as platforms for knowledge exchange, identifying new research directions, and fostering cross-border partnerships. The forum's thematic evolution spans sustainable landscape management, climate issues, social innovation, and biodiversity conservation.

S4C also produces scientific recommendations integrated into the work of Carpathian Convention groups and decision-making processes. They aim for transboundary nature conservation and enhanced collaboration in protected area management. S4C's recommendations address sustainable development education, water management, and climate adaptation, aligning with broader biodiversity conservation goals. The network plays a critical advisory role for the Carpathian Convention Secretariat, formalised through a Memorandum of Understanding. This collaboration ensures the integration of scientific findings into policy processes and regional management strategies, including biodiversity conservation and transboundary park initiatives.

The network supports educational programs, such as summer and winter schools, to advance young researchers' skills and promote interdisciplinary approaches to Carpathian studies. These programs focus on integrating knowledge across disciplines and fostering international cooperation. Funding comes primarily from the Visegrad Fund, participant fees, and grants secured through members' home institutions, such as Jagiellonian University.

S4C's activities have significantly increased interdisciplinary publications on the Carpathians, strengthening scientific and societal understanding of the region. The network encourages joint scientific publications and synthesis articles that integrate knowledge across countries and disciplines, enhancing its practical applications. Another key achievement is the establishment of an expert network on sustainable development education, which supports environmental awareness, traditional ecological knowledge, and interdisciplinary academic programs. These efforts provide a foundation for implementing sustainable development practices in regional administration and policy. Through initiatives like the Forum Carpathicum and international partnerships, S4C strengthens collaboration between scientists and practitioners across borders.

6.5.3 Territorial governance and potential for transferability

Science for the Carpathians operates as an informal network, relying on the voluntary engagement of its members. The network includes an Executive Board and a Scientific Steering Committee comprising approximately 40 members representing various countries and scientific disciplines. Currently, the network is restructuring to enhance young researchers' involvement and expand representation from the social sciences. These changes aim to enrich interdisciplinary perspectives and strengthen the network's capacity to address evolving regional and global challenges, such as climate change impacts, socio-economic transitions in the Carpathians, and the ongoing war in Ukraine. The restructuring process also seeks innovative approaches to member engagement and the implementation of more effective collaboration mechanisms, enabling the execution of larger-scale and higher-impact projects.

The S4C initiative faces several challenges, currently under active discussion and slated for further evaluation during the Carpathian Forum in Bratislava in September 2025³¹. The first challenge concerns the network's institutional and legal framework. As an informal research network, S4C lacks legal personality, a central budget, and permanent staff, making it difficult to formalise agreements, apply for large-scale grants, or manage long-term projects. It primarily relies on temporary grants, such as Visegrad Fund resources, conference fees, and support from the home institutions of its members, leaving the network vulnerable to resource and priority fluctuations.

The second challenge stems from the perceived marginality of the Carpathians in the global scientific discourse, which diminishes the attractiveness of research and publications about the region. Scientific work on the Carpathians often suffers from limited visibility and low valuation in international assessment systems,

³¹ <https://fses.uniba.sk/zahranicne-vztahy/forum-carpathicum-2025/>

discouraging researchers from pursuing regional topics. Insufficient support for regional research and a lack of high-impact publishing platforms further hinder knowledge development and the implementation of innovative solutions locally and internationally.

The third challenge involves the complexity of cross-border collaboration. Project implementation in the Carpathians is often hampered by administrative, economic, and political disparities among the region's countries. For example, collaboration between Ukraine and Romania faces difficulties due to differing governance systems and political priorities, complicating transboundary coordination. These barriers restrict the development of integrated projects and the establishment of common strategies for environmental protection and sustainable development.

Despite those challenges, the Science for the Carpathians model has inspired initiatives in the Caucasus region. Presently, the network collaborates with the Scientific Network for the Caucasus Mountain Region (SNC-mt)³² to exchange experiences and adapt solutions developed in the Carpathians to address the specific challenges of the Caucasus. The model also holds potential for application by The Consortium for the Sustainable Development of the Andean Ecoregion – CONDESAN³³, where similar issues, such as mountain ecosystem conservation, climate change mitigation, and effective resource management, can benefit from the proven approaches refined in the Carpathians. Its flexible structure allows adaptation to local social and environmental conditions, making it a potentially universal tool for integrating scientists and practitioners across other mountainous regions.

6.6 Summary of good practices

The analysis of identified best practices revealed that they encompassed various forms of the four developmental capitals, as well as horizontal territorial governance, including cross-border cooperation. Furthermore, these examples demonstrated diverse interactions between those elements. For instance, there is an evident relationship between social/natural capital and economic capital in the case of the Wallachian Culture Trail initiative, which aims to sustainably utilize socio-cultural assets for tourism development. Similarly, the S4C (Science for Carpathians) project showcased positive interactions between human capital (in the form of knowledge and intellectual capital) and natural and economic capital. In contrast, the railway transport development project highlighted interactions within economic capital, leveraging existing transport infrastructure to boost tourism. The Central Parks project demonstrated that effective management of natural capital could yield not only environmental benefits but also contribute positively to the sustainable development of economic capital. Finally #ACCESS demonstrates how use of social capital potential can unleash hindered potential of economic and human capitals.

The initiatives examined underlined the importance of cross-border cooperation and territorial governance as keys to the success of implemented projects. This included engagement across various levels of administration, from central to local, as well as collaboration involving diverse actors, ranging from government agencies to non-governmental organizations. Governance issues were at core of the #ACCESS project and its results developed a cross-border multi-actor and multi-level governance model based on solutions inspired by Nordic Council practices as well as bilateral collaboration experience from Central Europe and Visegrad countries. Issues of territorial governance were particularly evident in the Central Parks project. The Wallachian Culture Trail initiative, on the other hand, created a platform for collaboration between regional and local actors. The involvement of the scientific sector in development management and the sustainable utilization of resources proved crucial in the S4C initiative, while the cross-border railway connection development project showcased the effective mobilization of local social potential for regional-level transport development through cross-border cooperation.

In terms of innovation, the projects demonstrated notable achievements. For example, the Central Parks project led to the implementation of practical solutions, and the promotional event for the "Wojak Szwejk" train was successfully transformed into a permanent transportation service. On the other hand #ACCESS project

³² <https://www.caucasus-mt.net/news>

³³ <https://condesan.org/>

and its obstacle reporting platform is an example of innovation through citizen-centric approach, empowering residents to actively report through integrated problem-solving mechanisms that ensures a holistic workflow, combining data collection, expert analysis, feedback, and advocacy for systemic improvements. Elements of sustainability were well-illustrated in the case of the Wallachian Culture Trail, which continued through various initiatives building upon the original idea. The sustainability of the Central Parks project was achieved by incorporating its solutions into the practices of a biodiversity working group within the Carpathian Convention. This project also highlighted the potential for knowledge transfer, serving as a foundation for further research initiatives under the Horizon Europe program. The transferability of best practices was also evident in the S4C initiative, which was replicated in other mountainous areas. Moreover, #ACCESS initiative also offers high transferability of results, especially the modular framework of obstacle reporting platform, including reporting, analysis, and advocacy, which can be scaled to accommodate larger or more complex regions. Finally, the Wallachian Culture Trail's expansion to additional countries is facilitated by ongoing efforts to promote the initiative.

Overall, the analysis demonstrates that effective cross-border cooperation, territorial governance, innovation, and sustainability are integral to the success of these projects. These practices not only enhance regional development but also contribute to the broader goals of sustainable growth and resource management

Table 6.3**Good Practices basic information and summary: thematic, cooperation/governance, innovativeness/transferability/sustainability highlights**

Theme:	Environment protection	Sustainable tourism	Sustainable transport	Governance	Scientific cooperation
Title:	Central Parks - project	The Route of the Wallachian Culture	Holiday tourist train 'Wojak Szwejk' / 'Vlak Wojak Švejk'	#ACCESS - Promotion of legal accessibility across the Slovak-Hungarian border	S4C-Science for Carpathians
Lead beneficiary, Countries:	European Academy of Bolzano/Bozen - Eurac Research, AT, CZ, HU, IT, PL, RO, SK	Association for the Development and Promotion of Subcarpathia "Pro Carpathia", PL-SK	Podkarpackie Marshal's Office, PL-SK	Central European Service for Cross-Border Initiatives (CESCI), HU-SK	Academic Institutions from Carpathian macroregion and beyond, UA,PL, RO, SK, HU, DE, SE, CZ, IT, AU, UK, RS
Programme/ Fund:	INTERREG Central Europe 2014-2020	INTERREG PL-SK 2014-2020	The Fund for the Development of Public Utility Bus Transport	INTERREG HU-SK 2021-27	co-financed by the Governments CZ, HU, PL, SK through Visegrad Fund
Dates	2019-2022	2017-2018 and follow up activities	2020-2024	2023-2029	2008-to date
Focus of thematic territorial cooperation	Development and implementation of strategies for sustainable management of protected areas in the Carpathian region, including the Ecosystem Services Toolkit and protocols on biodiversity and sustainable tourism (natural capital management)	Tourist route based on authentic cultural heritage common to mountain areas of Carpathian Range (interaction between social/natural and economic capital)	New railway connection providing access to tourist attractions and offering cross-border public transport services for tourists, cyclists and residents (economic capital interactions)	Unfolding and eliminating legal and administrative obstacles hindering stronger integration and higher level of cooperation across the SK-HU border	Interdisciplinary scientific platform advancing sustainable development and environmental protection in the Carpathians (scientific expertise (human capital) – regional resilience (economic and natural capitals).
Transnational co-operation/ Governance – highlight	Collaboration among diverse stakeholders, including national parks, ministries of environment, and NGOs across eight countries	Integration of local activities in order to establish flexible platform of cooperation (integration between local and regional level)	Cross-border cooperation of local authorities and NGOs in the field of transport and integration of tourism services at the interface between neighbouring countries.	Cross-border cooperation of two expert think-tanks (NGOs) from bordering countries – two branches of the same organisation .	Cross-border cooperation through collaboration with key regional bodies, enhancing governance and conservation practices (policy integration – environmental stewardship)
Innovativeness/ Transferability/ Sustainability	Adoption of project outputs by national agencies and their incorporation into the Carpathian Convention's biodiversity working group	Follow up initiatives focused on local cultural heritage based on other sources of fundings (sustainability)	Project developing from a one-time promotional event through holiday attraction to a permanent transport service for tourists and residents	Adoption of highly transferable and scalable project results as comprehensive model of citizen-administration platform for reporting, classifying, and resolving legal and administrative cross-border obstacles.	Inspiring similar initiatives in other mountain regions, fostering knowledge transfer and adaptation of proven solutions (scalable model – international impact)

7 Spatial development visions and territorial guidance for functional areas

7.1 Spatial development visions for Carpathian macroregion

The determinants and opportunities identified in Chapters 2 and 3 provide a foundation for formulating visions for the future spatial development of the Carpathian macroregion. These visions were discussed with macroregional stakeholders during the second policy workshop, which was attended by representatives of public and non-public sectors at various levels, dealing with a range of thematic areas (regional development, environment and climate, transport, tourism, agriculture, and cross-border cooperation).

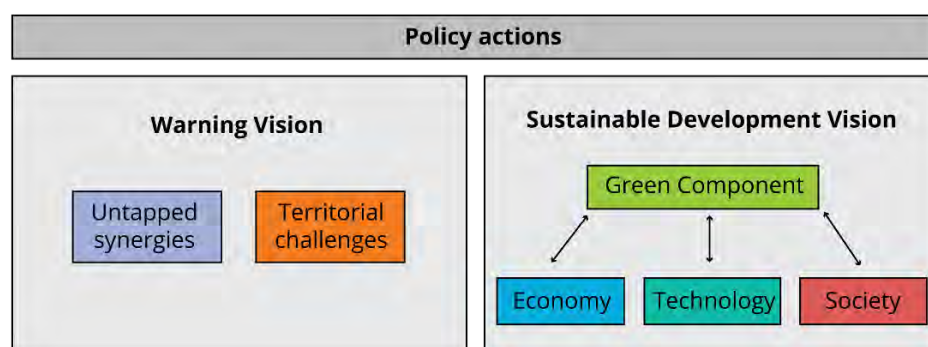
As a first step, it was decided that the development visions would be grounded in the activities of public authorities, whose actions largely determine the outcomes of current spatial trends and the region's ability to respond to external challenges. Based on this premise, two distinct visions were formulated: on the one hand, a "Warning Spatial Development Vision," emphasizing potential risks and negative trajectories; and on the other hand, a "Sustainable Spatial Development Vision," which highlights the opportunities associated with achieving sustainable development (**Figure 7.1**).

The **Warning Spatial Development Vision** assumes that, in the face of ineffective public policies, certain adverse trends may persist or even intensify, posing specific territorial challenges. These include, for example, the depopulation of peripheral areas, uncontrolled urban sprawl, the unsustainable use of natural resources, and persistently low levels of innovation. At the same time, this vision highlights untapped development potentials associated with existing resources that are not always adequately organized or utilized. Examples include underexploited agglomeration effects - missed opportunities for collaboration and efficiency in densely populated areas (e.g. weak urban-rural linkages, fragmented service provision, limited growth diffusion to urban broader regions), or environmental assets being used in unsustainable ways. Thus, the Warning Spatial Development Vision serves not only as a projection of territorial risks and overlooked potentials, but also as a call for strategic intervention aimed at reversing negative trends and better harnessing the region's inherent development assets.

In contrast, the **Sustainable Spatial Development Vision** is built on the interactions between four key types of capital: natural, economic, technological, and social. Particular emphasis was placed on the natural environment, which—according to research results—plays a foundational role in shaping the identity and development potential of the Carpathian macroregion. It was acknowledged that the condition of the natural environment sets the preconditions for achieving broader, cross-sectoral territorial development goals. This vision laid the groundwork for the development of three complementary sub-visions, each combining the natural environment with a different dimension of sustainability: "Natural Environment & Economy," "Natural Environment & Technology," and "Natural Environment & Society." These sub-visions were designed to leverage the region's endogenous potential while also addressing exogenous development stimuli, such as technological shifts, global market trends, and climate challenges.

The creation of maps illustrating the above visions was based on selected results from the analyses presented in Chapters 2 and 3, supplemented with relevant contextual information. This included insights gathered during the first and second policy workshops. The first workshop focused among others on identifying conflicts and synergies between different forms of capital (**Annex 3**). The second workshop contributed additional contextual knowledge regarding existing frameworks of territorial collaboration, future territorial visions, and practical strategies for operationalising the Carpathian strategic territorial collaboration. Moreover, participatory methods enabled a critical revision of maps representing various territorial visions for the future of the macroregion. The maps were designed to reveal the spatial differentiation of opportunities and threats (in certain cases in a schematic way) facing specific territories across the Carpathian macroregion, thus supporting a more territorially sensitive approach to planning and decision-making.

Figure 7.1
Spatial development visions for Carpathian macroregion



Source: Own elaboration (EUROREG).

7.1.1 “Warning” spatial development vision

The warning vision is confined by the assumption that the current negative trends without major changes in economic, technological, social and environmental policies will linger. Within this vision countries and regions within the Carpathian macroregion are not at the forefront of innovations or sustainable development strategies, which may cause their ineffectiveness and lead to both economic and social stagnation, as well as compound their existing environmental and social issues. The lack of effective action in the areas of spatial planning, environmental protection, technological development, and efforts to halt population outflow leads to serious consequences for the economy, society, and the natural environment.

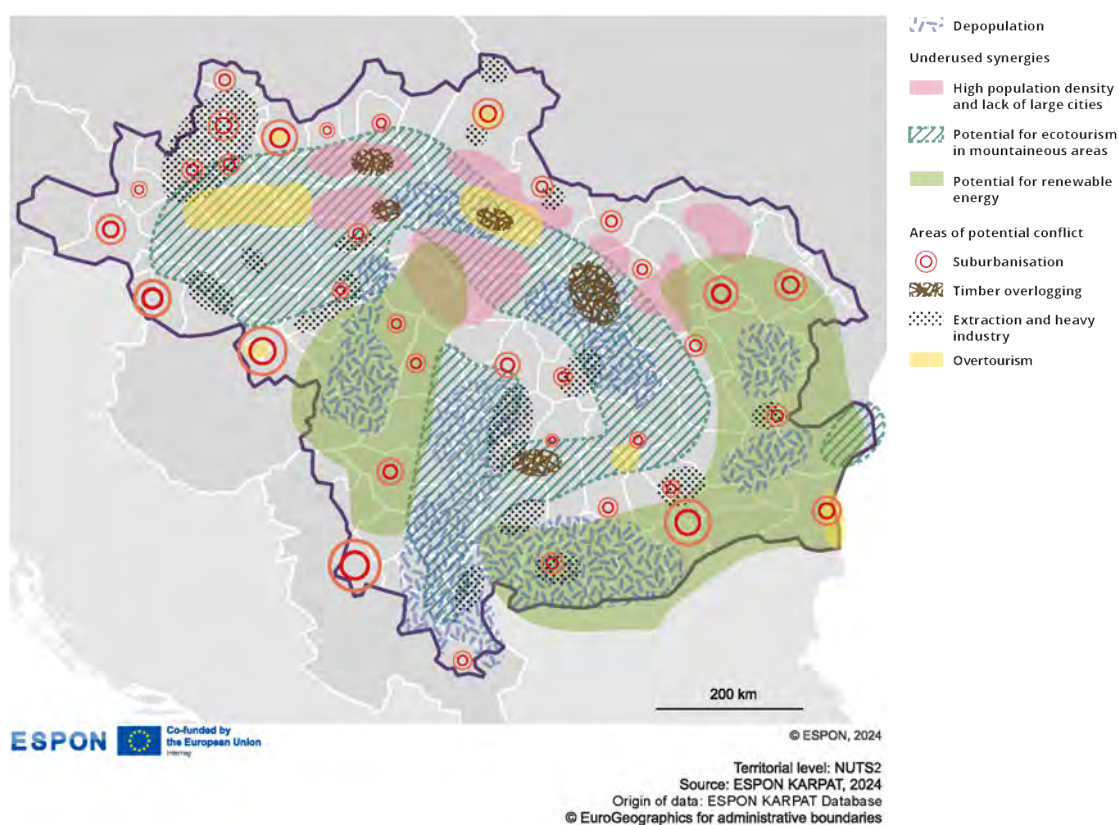
Main assumptions of the warning vision:

- **Limited innovation and investment:** The region is trailing behind technology-wise. Despite existing potential, the region enjoys low competitiveness on the national and international arena. Foreign investment stands at low levels and the economy is founded upon the traditional sectors of industry, such as agriculture and tourism.
- **Loss of human capital and depopulation:** Young, well-educated people are leaving the region in pursuit of better professional and educational opportunities. The shortage of suitable skilled job openings and the low level of technological advancement contribute to the loss of human capital. The region's peripheral areas bear the brunt of the ongoing depopulation; however, the population growth of metropolitan areas is also hampered by demographic processes.
- **Untapped synergies between territorial capitals:** The region does not take advantage of the synergies between natural, cultural, social, and human resources, as no linkages between economic, environmental and social sectors exist. The mismanagement of protected areas dampens their potential, not rarely brining about the overexploitation of natural resources and degradation of ecosystems.
- **Lack of coherent environmental policy:** The overexploitation of natural resources of the region, especially the mountain areas and the river valleys, continues. Excessive tourism, including the construction of second homes in naturally valuable areas, and uncontrolled suburbanisation cause degradation of the landscape and ecosystems. The lack of large investments in renewable energy sources underpins the primary role of carbon-intensive industries in the economy.
- **Conflicts between territorial capitals:** No harmony between the different forms of territorial capital (natural, human, social and economic) causes conflicts to grow further. Exploitation of nature, urbanisation pressures and, most importantly, conflicts of interest between investors and local communities create tensions that curtail the macroregion's development potential.

Effects of the warning vision for the Carpathian macroregion might be the following:

- **Economic stagnation:** The region's attractiveness for domestic and foreign investors wanes. Its economy, based on traditional sectors such as mining and mineral extraction, intensive agriculture and mass tourism, is consigned to economic stagnation, especially in peripheral areas. Limited innovation and low levels of investment translate into the region increasingly hinging upon external suppliers of modern technology.
- **High unemployment:** The scarcity of new job opportunities in innovative sectors coupled with economic stagnation fuels joblessness. Rural areas and smaller towns, stripped of access to sufficient new investment, are particularly affected. Skilled workers go abroad, weakening the region's human potential.
- **Depopulation and population outflow:** People, especially the young and educated, are leaving the region due to a lack of job and educational prospects. As a consequence, there is an ageing population in the region, leading to an increase in the social costs of caring for the elderly.

Map 7.1
Warning spatial development vision



- **Weakening social ties in local communities:** Local communities are increasingly less integrated. Weak social ties and reduced involvement of residents in local life lead to a weakening of regional and cultural identity. Towns and villages are becoming increasingly unattractive to live in, further exacerbating the problem of depopulation.
- **Degradation of natural resources:** Overexploitation of natural resources, especially in protected and mountainous areas, result in ecosystem degradation. Climate change and lack of action to protect mountain areas and renaturalise river valleys exacerbate environmental threats.
- **Low investment in renewable energy sources:** The share of renewable energy in the energy mix is low and the region relies heavily on carbon-intensive energy sources. This further increases greenhouse gas emissions and worsens air quality (including from low emissions).

Spatially, the following elements can be highlighted (**Map 7.1**):

- Key areas of depopulation grounded on population change over the last 20 years based on analysis of census data.
- Selected areas of untapped or underutilised synergies between territorial capitals such as: a) areas with high population density but a relatively dispersed settlement network with no large urban centres b) areas with potential for sustainable tourism development in mountainous areas, c) areas with relatively high potential for renewable energy development
- Selected areas of major conflicts between territorial capitals a) suburbanisation taking place in the surroundings of major urban centres b) risks associated with the extraction of natural resources c) risks associated with excessive timber extraction from mountain forests d) excessive tourism degrading the environmental and cultural values of the macroregion.

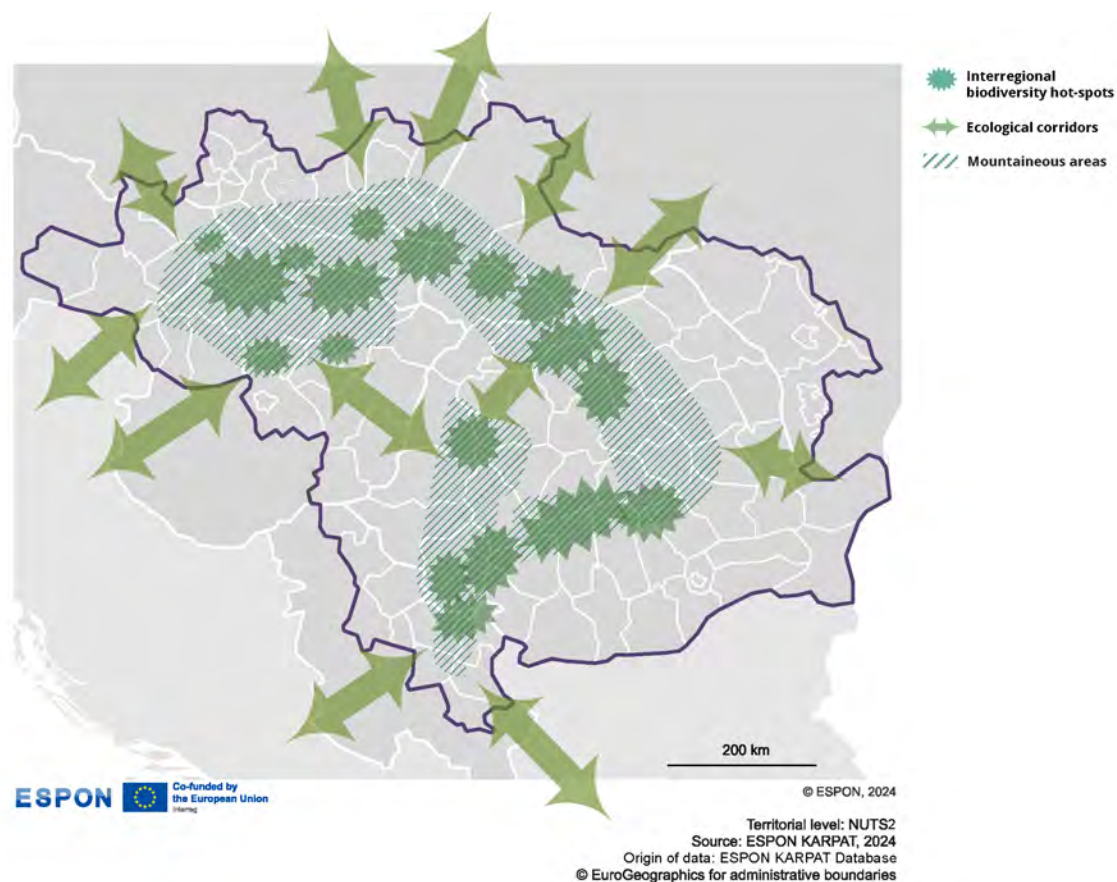
7.1.2 Sustainable spatial development vision – "natural environment" component

The classical conservationist approach to nature protection is insufficient to address the intertwined biodiversity and climate crises, as that would demand a more comprehensive strategy. Tackling pressures beyond boundaries of sparsely distributed protection zones calls for the framework of an ecological network comprising functionally connected nodes.

These nodes, or core areas, are biodiversity-rich zones with minimal human impact, acting as reservoirs of genetic diversity and ensuring the sustainable provision of critical ecosystem services. Ecological corridors connect these nodes, facilitating species movement, genetic flow, and allowing for adaptation across fragmented landscapes. Together, these interconnected networks bolster ecosystem resilience and sustain biodiversity amid accelerating ecological and climate crises.

The Carpathians as a whole represents a critical node within the Pan-European Ecological Network, and as such necessitates special measures for effective environment protection. To this end, intra-regional biodiversity hotspots should be identified. These hotspots include highly natural, biodiverse, large-scale, and unfragmented parts of the Carpathian ecosystem, irrespective of their current protection status. Their identification is based on data concerning (1) the conservation status of indicator species for natural ecosystems in Natura 2000 sites, (2) the locations of strictly protected areas designated under national conservation frameworks, and (3) the distribution of intact forest ecosystems according to the Carpathian Virgin Forest Inventory elaborated under the Carpathian Convention. These nodes are vital for ecosystem restoration in Carpathians and beyond, preserving rare species, genetic diversity, and natural habitats that have been degraded elsewhere. Thanks to their natural richness, these areas show resilience in face of climate and ecological challenges, being a source of key ecosystem services for the population of the region, such as carbon sequestration, water retention, and flood mitigation. By 2050, these core areas should be thoroughly studied and mapped (using new technologies, including remote sensing), effectively protected (new protected areas will be established and some of the existing ones will have stricter protection regime), and supported by extensive buffer zones. Strict protection of the nodes will allow for renaturalisation in the neighbouring areas, and integrated management at the landscape level will foster sustainable coexistence between human communities and wild nature.

Viewing the Carpathians through a multi-scale lens highlights their importance within a broader ecological network, interconnected by green corridors, essential for connectivity and resilience. Using data from the Pan-European Ecological Network (Mücher et al. 2004) project and analysing key ecosystems and protected areas in Central Europe, we identify vital corridors that link the Carpathians with other significant nodes – such as large protected areas, biodiversity hotspots, and key landscape features. The key linkages lead to the mountain ranges: Alps, Sudetes, Dinaric Alps, Balkan Mountains, and extensive wetlands such as Polesie and the Danube Delta. Enhancing connectivity between these areas is essential to support species migration, preserve biodiversity, and strengthen resilience to climate change, as emphasised in the Convention on Biological Diversity (Council of the EU 1993) and the EU Biodiversity Strategy (European Commission 2020). Shifts in habitat and species distributions due to climate change make adaptive capacity crucial for biodiversity protection.

Map 7.2**"Natural environment" component of sustainable development sub-vision**

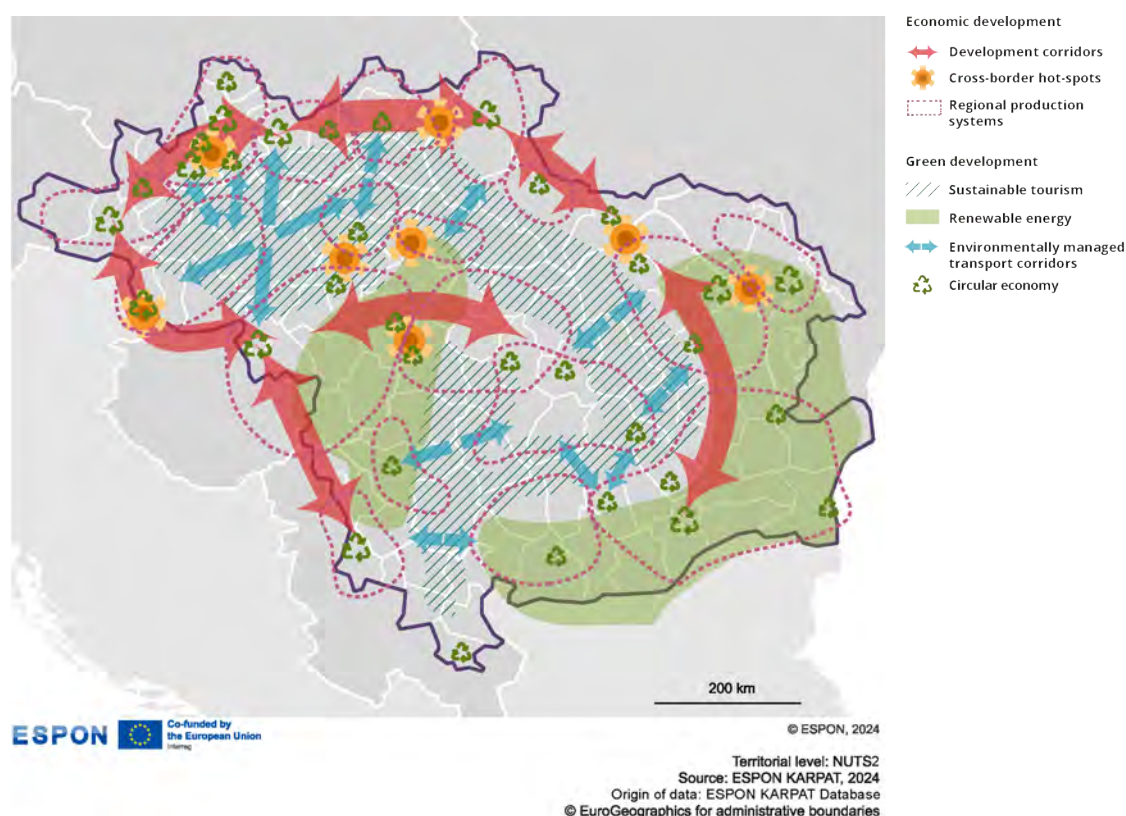
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7.1.3 "Natural environment – Economy" sustainable development sub-vision

The "Natural environment-Economy" sub-vision focuses on environmentally sustainable economic development with an emphasis on job creation, attracting foreign investment and strengthening regional production systems, which emphasises reducing the negative environmental impact of economic processes. This vision also assumes the development of infrastructure, especially transport infrastructure, which will improve integration between metropolises as well as cities and rural areas. As a result, the mobility of the population should increase, trade in goods should increase and the region should become more attractive to investors.

Key assumptions of the "Natural environment-Economy" sub-vision:

- **Foreign investment inflow:** The region benefits from the process of nearshoring, i.e. the relocation of manufacturing activities to closer locations in Europe. The Carpathian macroregion is attracting foreign companies that are looking for new locations for their production, especially in sectors related to the green economy, renewable energy and green technologies.
- **Development of regional production systems:** The creation of local supply chains and the development of regional production systems promotes cooperation between companies, which increases the economic autonomy of the region and reduces dependence on imports from distant markets.
- **Circular economy:** Implementing the principles of a closed (circular) economy reduces the consumption of raw materials and waste, while increasing production efficiency and environmental protection. Minimising the loss of raw materials and emissions is a priority, especially in sectors related to industry, agriculture and energy.
- **Development of transport infrastructure:** The development of road and rail infrastructure (including with environmentally friendly modes of transport), especially links between the region's main cities, increases the mobility of people and goods, which supports trade, tourism and the regional economy.
- **Reducing CO₂ emissions:** Reducing carbon-intensive industries, promoting renewable energy sources (especially solar energy) and implementing modern low-carbon technologies in production.

Map 7.3**“Natural environment-Economy” spatial development sub-vision**

Potential effects of the “Natural environment-Economy” sub-vision for the Carpathian macroregion:

- **Strong economic development:** The Carpathian macroregion is becoming attractive to external investors, especially in the context of the nearshoring process. Attracting investment from the sustainable manufacturing, renewable energy and green technology sectors promotes job creation, growth in the region's GDP and its international competitiveness.

- Reducing the consumption of natural resources: Increasing production efficiency that in turn increase macroregional competitiveness coincides with reducing waste and reusing raw materials that improve the environment and promotes sustainability.
- Job creation: Increased investment and the development of regional production systems lead to the creation of new, stable jobs in the sustainable production, renewable energy and green technology sectors. This in turn leads to a reduction in unemployment, especially in rural areas and smaller towns.
- Halting depopulation: With new jobs, especially for skilled labour, the region stops losing inhabitants. Young people see career opportunities in the region and stop leaving in search of better opportunities abroad. Stopping brain drain promotes the strengthening of the region's human capital.
- Increased social mobility: With better transport infrastructure, residents have better access to work, education and public services. Connections between cities and rural areas foster greater social integration and improve accessibility to various resources.
- Reducing emissions and protecting the environment: Reducing carbon-intensive industries and investing in renewable energy sources lead to a reduction in greenhouse gas emissions. Investments in solar, wind and other low-carbon technologies support the sustainable development of the region.
- Conservation of natural resources: Although the main focus is on economic development, the protection of natural environmental resources is becoming an integral part of the region's strategy. The sustainable exploitation of resources, especially in mountainous and agricultural areas, contributes to improving the quality of soils and water and reduces pressure on the environment.

In spatial terms (**Map. 4.3**), this makes it possible, among other things, to distinguish:

- Development corridors in which economic integration processes may be particularly attractive for the inflow of new investments,
- Transport corridors passing through environmentally valuable areas and crossing existing ecological corridors that will require integrated environmental and landscape management to minimise the environmental impact of infrastructure development,
- Cross-border economic integration areas in which the degree of use of complementary development resources will depend on the scale of the various administrative and legal barriers
- Regional production systems, which will be based on links between major urban centres and medium-sized and small towns leaving their sphere of influence
- Areas for the development of sustainable tourism, especially in mountain and foothill areas based on the region's natural resources (including, inter alia, spa tourism, ecotourism, agrotourism, ecotourism)
- Areas identified for renewable energy development—particularly zones with intensive agriculture and favourable conditions for photovoltaics and wind power—offer opportunities to integrate clean energy production without significantly disrupting current land uses. This approach supports the diversification of the regional energy mix while promoting sustainable land use.

7.1.4 “Natural environment – Technology” sustainable development sub-vision

The “Natural environment-Technology” sub-vision envisions a transformation towards sustainable economic growth driven by technology, implemented in line with the Quadruple Helix model, engaging companies, scientific institutions, local authorities, society, and ecological stakeholders. The vision emphasises the development of regional innovation systems that encourage collaboration among diverse actors, fostering the advancement of green technologies in renewable energy, modern agriculture, and sustainable transport. As a result, the region will experience dynamic investment growth, the emergence of innovative start-ups, and the retention of skilled residents, boosting the macroregion's competitiveness and resilience.

Main assumptions of the “Natural environment-Technology” sub-vision:

- **Development of regional innovation systems:** The Carpathian macroregion is becoming an innovation hub through collaboration among companies, scientific institutions, local authorities, civil society, and environmental stakeholders following the Quadruple Helix model. The regional innovation systems support the development of technologies in renewable energy, precision agriculture, environmental protection, and sustainable transport, fostering long-term regional growth and competitiveness. The emergence of dynamic start-up initiatives further enriches this landscape, contributing to the advancement and implementation of green technologies.
- **Academic cooperation networks:** The Carpathian macroregion is becoming a key factor in an academic collaboration network that connects universities, research institutions, and technology centres to advance green technologies and sustainable solutions for mountainous areas. This network facilitates joint research, knowledge exchange, and innovation in the fields of renewable energy, climate resilience, and environmental protection while fostering spin-off companies' growth that transform research outcomes into practical, market-ready solutions.
- **Smart specialisations:** The region leverages its unique natural resources to develop smart specialisations, focusing on sectors with the highest growth potential and competitive advantage. Key areas include among others renewable energy technologies, sustainable water and soil management, and the renaturalisation of ecosystems. These targeted specialisations drive innovation, enhance resource efficiency, and promote sustainable development by aligning regional strengths with global environmental and economic trends.
- **Green Technologies:** The priority is to implement green technologies horizontally across various sectors of the economy, enabling reduced emissions, more efficient energy management, and the protection of natural resources. Agriculture, renewable energy, and industry are the main sectors driving this shift. This cross-sectoral approach enhances regional competitiveness and accelerates the transition towards sustainable, resilient economies that can effectively adapt to environmental challenges and drive long-term growth.
- **Interdisciplinary Educational Programs:** Universities and colleges in the region are becoming leaders in creating educational programmes that combine natural sciences, engineering, social sciences and economics. The development of these programmes and youth exchange initiatives attracts students and scientists, strengthening the region's human capital. The universities' offerings will also be directed at diverse resident groups – adults, seniors, and children – to raise awareness of green technology development and enhance skills.

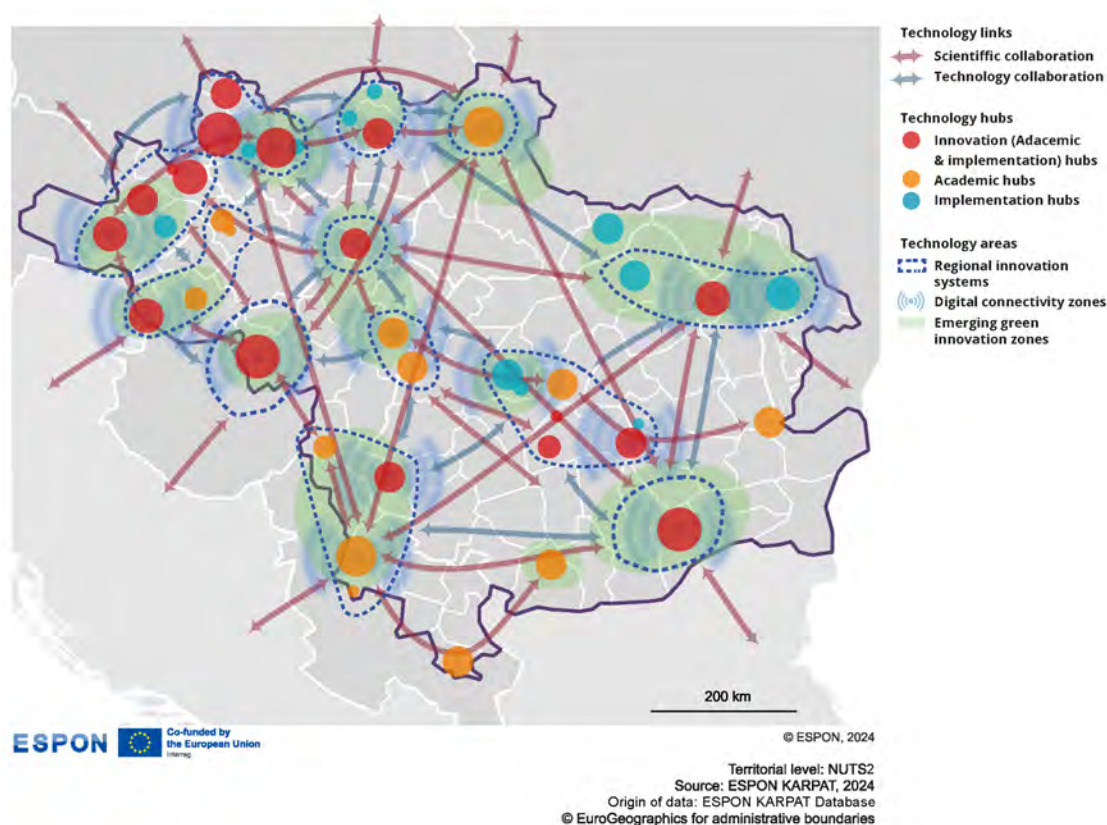
Effects of the “Natural environment-Technology” sub-vision for the Carpathian macroregion may be the following:

- **Modern economy based on innovation:** The Carpathian macroregion is becoming a centre of technological innovation in Central and Eastern Europe. Investments in research and development and the use of green technologies increase the region's competitiveness in international markets.
- **Dynamic growth of investments:** Thanks to favourable conditions for the development of innovation (renewable energy technologies, sustainable water and soil management, and the renaturalisation of ecosystems), the region attracts domestic and foreign investors who invest their capital in sectors related to green technologies. The region is becoming an attractive place for investment, accelerating the development of companies operating in sustainable development industries.
- **Retention of talents:** The region retains young talent and skilled residents thanks to interdisciplinary educational programmes and cooperation with universities and research institutes. Innovation sectors offer career growth for youth, while mature residents can redefine their paths through reskilling and upskilling programmes driven by new technologies, fostering active participation in the evolving economy.
- **Innovative society:** Growing ecological and technological awareness among the inhabitants, supported by educational institutions, leads to the creation of innovative communities actively involved in the region's development. This foundation fosters a society open to new technologies and projects related to the green economy and innovation.

- Sustainable resource management: The use of advanced technologies in managing natural resources, especially water, soil and forests, contributes to their protection and efficient use. Modern technologies allow for better protection of resources and the development of smart specialisations. Investments in renewable energy technologies and sustainable production contribute to a significant reduction of greenhouse gas emissions in the region.

Map 7.4

“Natural environment-Technology” spatial development sub-vision



Spatial effects of the “Natural environment-Technology” sub-vision for the Carpathian macroregion might be the following:

- Metropolises as centres of technological innovation: Metropolises in the region, such as larger cities in the Carpathians, are becoming major innovation hubs. The development of R&D centres, technical universities, and technology enterprises transforms them into technological nodes in the region. These centres attract investors, specialists and students from other countries, contributing to their dynamic growth. Additionally, they foster international scientific collaboration, enabling the exchange of knowledge, joint research projects, and the development of cutting-edge technologies.
- Smaller cities as centres of technological support and production: Although they do not play a central role in the innovation process, they are becoming important support centres for technological hubs. They can play a key role in local production and services related to the implementation of new technologies, especially in precision agriculture and renewable energy.
- Emerging green innovation zones: Emerging zones around metropolitan areas and smaller cities act as incubators and diffusion points for green innovations in agriculture, industry, and tourism. These zones foster the initial development and spread of green technologies, radiating innovation outward from urban centres and gradually integrating surrounding areas into the green transition.

- **Technological collaborations:** New technological corridors are emerging between regions, facilitating the creation of innovation systems, including cross-border. These corridors enhance knowledge, technology, and resources flow, strengthening regional cooperation and fostering sustainable development through shared innovation initiatives.
- **Digital connectivity zones:** Investments in digital infrastructure, such as broadband internet, environmental monitoring systems, and renewable energy networks, create digital connectivity zones that enhance the functioning of cities, towns, and rural communities. These zones ensure equitable access to technology, bridging the digital divide and fostering inclusive development. By supporting the development of human capital, these investments empower individuals and communities to fully participate (including remote working) in the digital economy, driving innovation and long-term growth.
- **Regional innovation systems:** Links between metropolises, smaller towns and rural areas are supported by the development of regional innovation systems that connect businesses, research institutions and local authorities. Within these ecosystems, new products and technologies related to environmental protection, precision agriculture and renewable energy are developed. Strong links between scientific institutions and industry allow for knowledge transfer, accelerating the implementation of innovations in various sectors of the economy.

7.1.5 “Natural environment – Society” sustainable development sub-vision

The “Natural environment-Society” sub-vision focuses on building a sustainable society based on local communities, strong social ties, trust and sustainable spatial management. The priority of this vision is to strengthen local communities, develop sustainable agriculture and strive for greater participation of residents in the management of the region. In this vision, the Carpathian macroregion becomes an example of a community development model, in which decisions are made jointly by local communities, and the protection of natural and cultural resources goes hand in hand with economic development. Local economic initiatives, organic farming and the development of participatory cities are of key importance here, where residents have a direct influence on decisions regarding spatial planning and resource management. Improving quality of local governance assures fairness in economic and climate transition preventing most vulnerable social groups from harmful effects.

The sub-vision emphasizes the importance of strengthening urban-rural links to ensure balanced development and equitable sharing of the benefits of sustainable growth. Rural areas contribute high-quality, sustainably produced food and ecosystem services, while urban areas act as hubs for education, innovation, and markets, supported by improved transport networks and digital infrastructure. Addressing the socio-economic challenges of a green transformation, this vision incorporates fair transition policy programmes designed to assist communities and workers dependent on carbon-intensive industries and facing limited growth opportunities due to nature conservation. These programmes include reskilling opportunities, financial support for green job creation, and measures to ensure inclusivity and prevent social inequalities.

Additionally, the sub-vision highlights the role of targeted cohesion programmes in assuring social inclusion such as housing accessibility in urban areas or social and economic deprivation in peripheral regions, improving access to education, healthcare, and employment while fostering sustainable livelihoods and reducing regional disparities. This holistic approach weaves together sustainable community development, ecological stewardship, and equitable socio-economic opportunities to create a resilient and inclusive society in the Carpathian macroregion.

Key assumptions of the “Natural environment-Society” sub-vision:

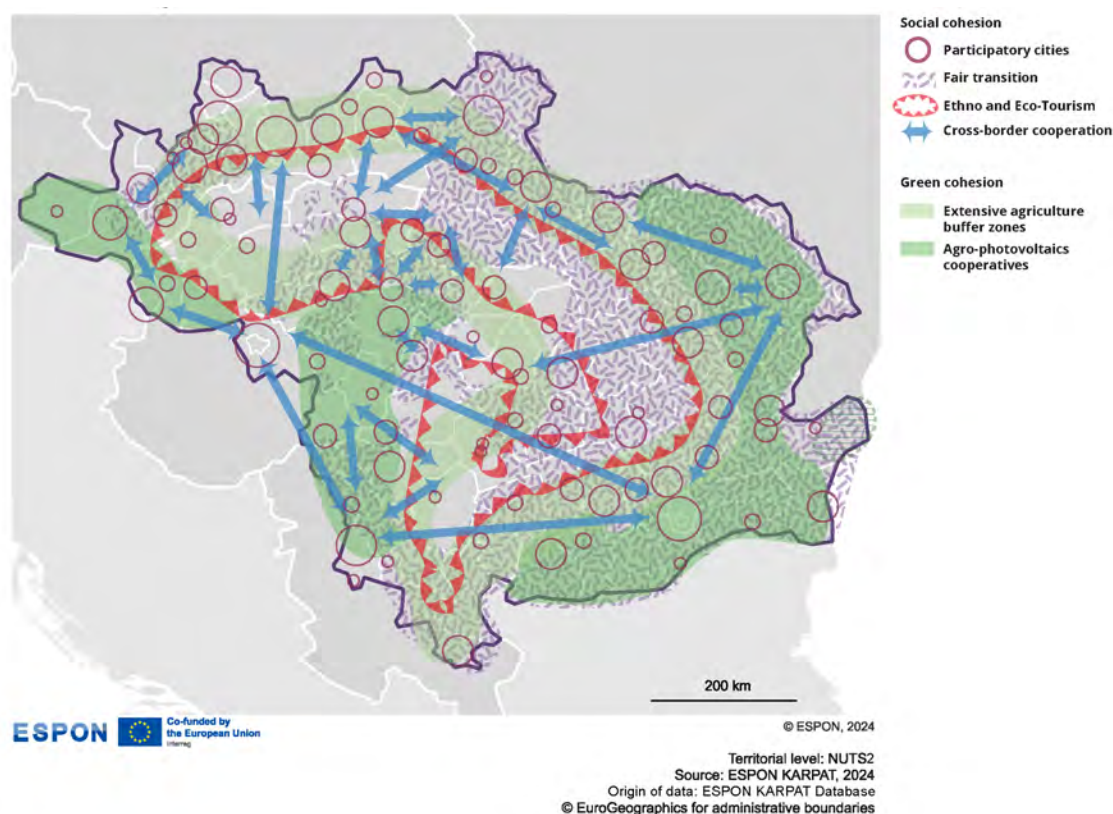
- **Strengthening local communities:** In this sub-vision, the main goal is to strengthen social ties and regional identity, especially in small towns and rural areas. Local communities become responsible for resource management and economic development of the region, which promotes building bonds between residents. Cooperatives are significant element of bridging entrepreneurship, participation and inclusion.
- **Participatory cities:** In cities and smaller towns, a model of participatory cities is developing, in which residents actively participate in decision-making processes, especially in the context of

spatial management, environmental protection and local economy. With growing international immigration cities provide necessary governance frameworks for integrating migrants in social participation via schools, cultural institutions and local community centres.

- **Organic and sustainable agriculture:** Organic and extensive agriculture is becoming the dominant economic model in rural areas integrating food producers in cooperatives. Farmers tap into renewable energy potential by developing renewable energy cooperatives in rural areas. This type of agriculture not only protects natural resources, but also helps build local supply chains that support the development of the regional economy.
- **Protection of cultural resources and regional identity:** The vision assumes the promotion and use of cultural resources of the region to strengthen the Carpathian identity and the development of tourism based on local culture and traditions, which promotes greater involvement of residents and their pride in the region. Heritage-based cultural tourism is linked with sustainable tourism based on natural attractions.

Map 7.5

“Natural environment-Society” spatial development sub-vision



Potential effects of the “Natural environment-society” sub-vision for the Carpathian macroregion:

- **Resilient Local Economies based on SMEs:** The main economic driver in this vision are local economic initiatives, including small and medium-sized enterprises that are strongly linked to local resources, such as organic farming, handicrafts, local processing, renewable energy cooperatives and sustainable tourism.
- **Green jobs in sustainable agriculture and services:** Rural areas thrive on organic and extensive farming, which protects natural resources while providing high-quality local products. The growth of short supply chains and direct sales strengthens the regional economy while reducing the negative

impact on the environment. Investments in reskilling and green industries diversify local economies, particularly for workers transitioning from traditional sectors.

- **Eco-Tourism:** The macroregion is becoming an attractive destination for ecotourists who are looking for authentic cultural and natural experiences. The development of tourism based on local culture, traditions and natural resources supports local communities and provides sustainable income. Sustainable, heritage-based tourism increases regional income while protecting cultural and natural resources, reinforcing pride in local traditions.
- **Strong local communities and greater involvement of residents:** The society of the region becomes strongly integrated, and residents actively participate in decision-making processes at the local level. Participatory cities become places where residents have a direct influence on local policies, especially in the areas of spatial management, environmental protection and resource management.
- **Carpathian identity:** Strengthening the Carpathian identity and rejuvenating local culture leads to greater involvement of residents in the life of the region. Cultural development and promotion of traditions help build regional pride and improve the quality of life in the region.
- **Protection of natural resources through extensive agriculture:** Thanks to the development of extensive and ecological agriculture, the natural environment is effectively protected. Extensive forms of farming support biodiversity and the protection of natural resources, including water, soil and forests.
- **Fair and inclusive green transition:** The region focuses on the renaturalisation of degraded areas, especially river valleys and mountain areas. The introduction of financial support programmes for areas that perform key ecosystem functions, such as water retention, additionally promotes nature conservation. Fair green transition policies and cohesion programmes address inequalities, ensuring vulnerable groups are included in governance and economic opportunities.

Spatial effects of the “Natural environment-Society” sub-vision for the Carpathian macroregion might be the following:

- **Extensive agriculture buffer zones:** Extensive agriculture zones act as ecological buffers, preserving biodiversity and protecting natural resources such as water, soil, and forests. These areas prioritize organic and low-intensity farming methods that coexist harmoniously with the surrounding environment. By integrating local farmers into cooperatives, these zones support regional food security and build resilience against climate change. Their strategic placement helps mitigate urban sprawl, safeguard ecosystems, and enhance the connectivity of green infrastructure in the Carpathian macroregion.
- **Local energy and agriculture cooperatives / Intensive agriculture:** Local cooperatives are the cornerstone of sustainable rural economies, bringing together farmers, renewable energy producers, and small businesses to pool resources and share benefits. These cooperatives promote renewable energy solutions, such as solar or biomass projects, while supporting sustainable agricultural practices. They also strengthen local supply chains, enabling farmers and producers to directly reach markets, reduce waste, and increase economic self-sufficiency. The cooperative model enhances social ties and ensures fair economic participation for all community members.
- **Participatory cities:** Cities in the Carpathian macroregion adopt participatory governance models, allowing residents to actively engage in spatial planning, resource management, and local economic decisions. These urban areas serve as hubs for innovation, education, and multicultural integration, fostering strong connections between local and international communities. Participatory cities also integrate sustainable infrastructure, including improved public transport and green spaces, and provide frameworks for equitable access to housing and services, enhancing overall urban resilience.
- **Eco-Tourism hotspots:** Focused on heritage-based and nature-friendly tourism, these hotspots celebrate the Carpathian region's rich cultural and ecological diversity. They integrate local traditions, crafts, and gastronomy with sustainable tourism practices, drawing visitors to authentic experiences such as eco-lodges, cultural festivals, and guided nature tours. These hotspots generate sustainable

income for local communities while promoting environmental conservation and pride in regional identity, ensuring minimal ecological footprint and long-term socio-economic benefits.

- **Fair transition zones:** Transition zones are designed to support communities and workers affected by the shift from traditional sectors to green economies. These areas prioritize inclusive development through reskilling programmes, financial assistance for green job creation, and investments in nature-based solutions. By focusing on the revitalization of degraded lands and promoting ecosystem services such as water retention, these zones ensure a just transition for vulnerable populations while contributing to the region's climate adaptation goals.
- **Cross-border governance clusters:** These make the top-down and bottom-up foundations of collaboration between Carpathian regions and countries emphasizing coordinated efforts in economic development, social integration and ecological conservation. These clusters enhance regional connectivity through improved transport and digital infrastructure while harmonizing policies to address shared challenges such as cross-border access to services of general interest, cross-border collaboration in providing emergency services, labour mobility, entrepreneurship, biodiversity protection, water management, and climate resilience. This cooperative approach strengthens social cohesion, resilience, and the overall quality of life for communities across the region, reinforcing the Carpathians as a model of transnational sustainability and inclusivity.

7.2 Development directions in different types of functional areas

In the chapter 3 synthesizing regional differentiation in the Carpathian macroregion, it is necessary to focus on identifying the development directions of various functional areas (see below) in light of the three distinguished variants of a sustainable development spatial sub-visions. Functional areas were distinguished on one hand based on their role within the settlement system structure (metropolitan areas, small and medium-sized cities, rural areas) and on the other hand, specific characteristics stemming from their unique location (border areas), resources (mountain areas), or legal status (protected areas). For each of them, desirable development directions were identified, considering economic, technological, and social aspects, with the aim of mitigating risks and leveraging underutilised potentials highlighted in the warning spatial development vision (Table 4.1).

Table 7.1
Sustainable spatial development vision in different functional areas: effects and development directions

Functional areas	Sustainable Spatial Development Vision		
	“Natural environment – Economy”	“Natural environment – Technology”	“Natural environment – Society”
Metropolitan areas	Owing to the inflow of foreign investment and the development of local production systems, metropolises are becoming economic centres where innovative activities in manufacturing and services are concentrated. Modern business centres and technology parks are emerging. The renewable energy, green technology and sustainable production sectors are developing.	Due to their established leadership in knowledge production and technological advancements, metropolitan areas are pivotal drivers of technology-driven regional growth. These cities attract investors and talent, fostering dynamic collaborations within regional innovation systems that connect businesses, academic institutions, and local authorities. They will evolve into technological hubs that enhance the region's competitiveness and accelerate the diffusion of technologies, especially in renewable energy, sustainable transport, and precision agriculture.	Metropolitan areas are leaders of economic growth, access to education opportunities, innovative jobs and affordable housing. In metropolitan areas and cities, both larger and smaller, a model of participatory cities is developing, in which residents have a greater influence on spatial management and planning. The increased involvement of local communities in decision-making leads to better spatial planning, sustainable urban development and care for the quality of life in cities.

Functional areas	Sustainable Spatial Development Vision		
	“Natural environment – Economy”	“Natural environment – Technology”	“Natural environment – Society”
Small and Medium size cities	Smaller urban centres are an integral part of regional production systems, which counteracts their peripheralisation and loss of function. Logistical functions and manufacturing activities, including agri-food industries thanks to their links with rural areas, are developing in them.	Smaller cities will play a crucial role as support centres for technological hubs, mainly focusing on precision agriculture and renewable energy. They will provide essential local production and services tied to the implementation of advanced technologies, bridging the gap between large innovation centres and rural areas.	Smaller and medium sized cities and towns are becoming important community centres, where the local economy, based on small businesses, plays a key role. Residents of cities cooperate in cooperatives and other local economic initiatives, which increases their self-sufficiency and promotes economic development without overexploitation of natural resources.
Rural areas	Areas of intensive agriculture are being modernised with the introduction of precision farming technology and elements of circular economy, which promotes a reduction in the use of water, pesticides and chemical fertilisers. In extensively farmed areas, organic farming is being developed, which minimises environmental impacts and promotes biodiversity. Investments in agricultural infrastructure, farmer education and organic certification help to increase the profitability of these areas. At the same time, afforestation and restoration of parts of the land, such as river valleys, is being promoted.	Through strengthened collaboration between local communities, agricultural stakeholders, and scientific institutions, rural areas will benefit from a knowledge transfer focused on sustainable agriculture, renewable energy, and ecosystem protection. These areas will become practical testing grounds for innovative resource management solutions, such as sustainable water and soil management practices, which can then be scaled to other regions. Rural areas might enhance regional resilience and drive community-based innovations by fostering job creation linked to sustainable industries.	The use of sustainable agricultural practices, such as crop rotation, agroforestry and minimal use of chemicals, helps protect the environment while increasing production efficiency. Extensive agricultural areas are supported by programmes for the development of organic agriculture and local economic initiatives. Thanks to sustainable agriculture, these areas become more self-sufficient, and the development of local supply chains provides better access to markets for small farmers. Local communities are becoming more self-sufficient and autonomous, which encourages the development of small economic centres and reduces the problem of depopulation.
Mountain areas	Exploitation of resources in mountain areas is reduced, their impact minimised. Emphasis is placed on developing modes of development that do not damage the environment (e.g. ecotourism, agritourism). The increase in renewable energy reduces pressure on traditional natural resources.	Mountain areas will leverage specialised knowledge and technologies from regional innovation systems to address their unique environmental challenges effectively. Academic collaboration will facilitate the development and implementation of technologies for the renaturalisation of river and mountain ecosystems, reducing environmental impact, increasing resource efficiency, and supporting sustainable development.	Natural resources, especially mountain areas and river valleys, are protected through the support of sustainable development programmes and organic farming. These resources become the basis for ecotourism and the development of local economic initiatives, drawing inspiration from the traditional culture of the Wallachian people in the Carpathians, which emphasized harmony with nature and sustainable pastoral practices.

Functional areas	Sustainable Spatial Development Vision		
	“Natural environment – Economy”	“Natural environment – Technology”	“Natural environment – Society”
Border areas	Cross-border cooperation is being developed in border areas, particularly in the context of sustainable economic development. Investment in local infrastructure and joint projects related to the green economy. Border areas are becoming more integrated through improved cross-border transport links and cooperation on nature conservation.	In border areas, the establishment of cross-border innovation corridors will strengthen regional cooperation and facilitate the exchange of knowledge and technology across national borders, supporting the integration of sustainable technologies in sectors such as renewable energy and eco-friendly industries.	Local networks of cross-border cooperation are being created, which promote joint economic and social initiatives. Cooperation with neighbouring regions promotes the exchange of experiences, technologies and resources, especially in the field of sustainable management of natural resources (e.g. protection of water and forests in border areas). Thanks to this, border areas become well-integrated elements of the macroregion, and their marginalisation is effectively limited.
Protected areas	The protection of natural areas is strengthened, including the introduction of extensive forms of development (e.g. sustainable tourism) in the buffer zones of protected areas. A system of subsidies for areas providing ecosystem services is introduced.	In protected areas, technological innovations will play a critical role in optimising the management of natural resources, ensuring efficient conservation efforts, and promoting sustainable use of water, soil, and forests. These areas will benefit from cutting-edge solutions such as smart monitoring systems and sustainable tourism practices, enhancing ecological preservation and economic sustainability.	Local communities, in cooperation with regional authorities, carry out renaturalisation initiatives that help preserve biodiversity and improve the quality of the natural environment. These include creation of ecological corridors and the protection of natural areas, especially in mountain and river areas. The links between settlement nodes and protected areas are strengthened by the development of ecotourism, which is becoming an important element of the local economy, while contributing to environmental protection.

Source: Own elaboration (EUROREG).

7.3 Recommendations for territorial cooperation and governance structure

A set of strategic recommendations aimed at overcoming existing barriers and unlocking the territorial cooperation potential of the Carpathian macroregion are focused both on **governance structure and territorial cooperation**. These recommendations take into account different dimensions of governance, including institutional structures, coordination mechanisms, and thematic orientation. Their formulation is grounded in the analysis of cooperation barriers and opportunities outlined in Chapter 5 based on stakeholder surveys and in-depth interviews, with an emphasis on both structural (framework of cooperation) and functional (practical cooperation) aspects of macroregional cooperation.

The **recommendations for governance structure** are presented across three interrelated levels of intervention (Table 7.2). The first group focuses on key **strategic choices necessary for establishing an integrated framework for territorial cooperation**. These are addressed through a dual-track approach: on the one hand, recommendations that support the pathway toward the formalisation of a Carpathian macroregional strategy requested by the stakeholders participating in the ESPON KARPAT project; on the other, recommendations that offer alternative directions which may be pursued even in the absence of such a formalised framework. The **second group of proposals concerns the institutions, mainly enforcing already existing ones**. Even the Carpathian contact point may be established within the institutional framework already in place. The potential scope of such a Carpathian contact point's activities (if it was to be established) was one of the topics discussed during the policy-focused workshop (see Annex 5). The last part is **addressing the**

operational level focused on various instruments and activities, involving different types of stakeholders, that would facilitate Carpathian cooperation progress and reach for its untapped opportunities.

It is important to note that a draft of the macroregional strategy has been already developed by macroregional stakeholders (**Strategy 2018**); however, it has not yet been adopted at the intergovernmental level. Therefore, the proposed course of action should take into account both the potential implementation of this draft strategy and the feasibility of initiating cooperation measures independently of its formal adoption. In this context, the recommendations also specify the levels of public authorities that should be involved in initiating and implementing the proposed actions—ranging from the European level, through national, to regional and local levels.

At the strategic level, the recommendations emphasize the need for a shared vision and collective objectives to guide the development of the Carpathian macroregion. This entails the development and adoption of a macroregional Strategy as agreed by the stakeholders of this ESPON project, which should be developed in collaboration with all participating countries and with input from regional stakeholders. This strategy would act as a framework, ensuring alignment of national and regional priorities with broader European Union objectives. **An essential component of this effort is the formal endorsement and acceptance of the strategy by all involved countries and the European Union.** This endorsement would establish a foundation for coordinated action, providing the legitimacy and support needed to mobilize resources and implement projects. The need for a greater involvement of national states and the European Union in the Carpathian cooperation was made apparent in the results of the KARPAT survey. The Individual In-depth Interviews results shed additional light on this question. The respondents pointed out the necessity of drawing a cohesive strategic vision and creating the framework that will ensure its implementation as well as regular institutional activities, systematically monitored in terms of the objectives achieved. Another aspect of the involvement of national states is linked to the elimination of legal and administrative barriers to cooperation (i.e. law and regulations adjustments at the national level) that are not possible to overcome at the local level.

As it was stated in the Subchapter 6.3, it would be a good practise to rely on the EU experience and special instruments concentrated on finding solutions well suited to particular cases of barriers, elaborated in the thorough process of analysis with the participation of various stakeholders.

Additionally, especially while the formal strategy is not in place, it is important to create a **shared narrative or identity for the Carpathian macroregion, based on its unique characteristics and the goals all the parties are devoted to.** Such a unifying story would not only promote the region internationally but also foster a sense of shared purpose among stakeholders. The selection and implementation of pilot projects in areas already agreed upon by Carpathian entities further operationalizes this vision, providing tangible examples of cooperation and success. Both those aspects are worth being internationally promoted.

The institutional recommendations focus on establishing and maintaining stable governance structures that are independent of external project funding. This stability is critical for ensuring long-term cooperation and the effective implementation of strategic goals. **A central Carpathian contact point is a possible way to facilitate coordination and communication across various levels and stakeholders.** It would respond to the informational needs of stakeholders and help overcome one of the barriers that were subject of the study analysis. In order to operationalise the recommendation concerning the Carpathian contact point, its potential activities' scope was discussed in detail during the IDIs. On that basis, the list of possible functions was composed and their importance was validated by the participants of the second workshop, giving the priority to the networking platform, followed by funding and projects inventories as the most valuable (the process described in detail in the Scientific Report of the ESPON KARPAT project). Regular and structured operations of strategy-related institutions are essential (in case the strategy is formalised). These institutions should have clear mandates for coordination, monitoring, evaluation, and decision-making and should actively involve all relevant members. The formation of working groups in thematic areas is also recommended, with a focus on sector-specific networking and problem-solving.

Table 7.2**Recommendations for enhancing Carpathian governance structure for transnational cooperation**

Organisational level	Recommendations				
		Euro-pean	Na-tional	Re-gional	Lo-cal
Strategic level–endorsed by the ESPON KARPAT stakeholders : <i>- to share a common vision of the Carpathian macroregion and objectives for its development,</i> <i>- to diagnose and pursue the joint implementation of specific pilot initiatives within the adopted strategic framework</i>	Development of the Macroregional Strategy in cooperation with all countries involved and with the participation of the regions		x	x	
	Endorsement and acceptance of the Macroregional Strategy by the EU and all countries	x	x		
	Elaboration of the definition/story of the macroregion, shared by all countries involved (useful also for the international promotional purposes)		x	x	
	Selection and implementation of specific pilot actions in the areas already agreed upon by the Carpathian entities		x	x	x
Institutional level – endorsed by the ESPON KARPAT stakeholders: <i>- to invest in stable Carpathian governance structures and platforms that are not dependent on external project funding,</i> <i>-to stimulate thinking and acting in the framework of common Carpathian initiatives at local and regional level</i> <i>-to strengthen institutions engaged in Carpathian co-operation</i>	Establishing a central Carpathian contact point		x	x	
	Ensuring regular and stable operation of Strategy-related institutions with coordination, monitoring and decisive powers, involving all relevant members	x	x	x	
	Setting up Strategy-related working groups in different thematic areas with regular meetings (sectorial networking)		x	x	x
	Engaging and coordinating different local/regional stakeholders, increasing their participation (e.g. enterprises, NGOs, local communities) and facilitating joint cross-border problem-solving			x	x
	Providing support to EGTCs, Euroregions and other cross-border structures		x	x	
	Developing the Carpathian Convention's activities and impact	x	x	x	x
	Participating and bringing together Carpathian actors in different networks, e.g. city networks			x	x
	Involvement in international organisations, e.g. Euromontana, to share knowledge and find specific solutions for the mountain areas			x	x
	Engaging experts and scientists in the development of policy solutions in the Carpathian macroregion, increasing the role of research and educational institutions		x	x	

Organisational level	Recommendations				
		Euro-pean	Na-tional	Re-gional	Lo-cal
Operational level – endorsed by the ESPON KARPAT stakeholders : <i>-to ensure legal, financial, and organisational framework supporting the implementation of Carpathian projects, according to the needs, and involving actors from all relevant territories</i>	Establishing a transnational Carpathian Interreg Programme	x	x		
	Coordinating and introducing changes in different EU-funded programmes to find a way to finance Carpathian projects with the participation of all Carpathian countries	x	x	x	
	Facilitating the creation of functional cross-border areas, implementing a territorially integrated approach		x	x	x
	Adjusting legal regulations to minimise the barriers in Carpathian cooperation (intergovernmental agreements, laws, border regime)		x		
	Encouraging and financing the cooperation of Carpathian entities with more advanced units outside the region to facilitate knowledge-sharing	x	x	x	x
	Encouraging businesses and employers to seize opportunities for profitable cross-border economic cooperation, strengthening public-private partnerships			x	x
	Providing information on the Carpathian macroregion and cooperation opportunities to all relevant stakeholders			x	x
	Establishing a fund for preparatory activities and stable functioning of common institutions during the period when the Carpathian Strategy/Programme is not adopted	x	x		

Source: Own elaboration (EUROREG).

Stakeholder engagement plays a pivotal role at this level. The recommendations emphasise the **importance of engaging local and regional governments and actors, such as enterprises, non-governmental organizations, and local communities, in joint problem-solving and cross-border initiatives**. This approach not only increases participation but also fosters ownership and commitment to regional development goals. Support for existing cross-border structures, such as European Groupings of Territorial Cooperation (EGTCs) and Euroregions, should be highlighted, alongside strengthening the activities of the Carpathian Convention. These measures aim to enhance institutional capacity and foster collaboration across borders.

The recommendations also advocate for **participation in international organisations, such as Euromontana, to facilitate knowledge exchange and the development of innovative solutions for the challenges faced by mountain areas**. Finally, the involvement of experts and scientists in policy development is important. By leveraging the expertise of research and educational institutions, the region can create evidence-based solutions and strengthen the role of knowledge in decision-making.

The operational recommendations address the practical aspects of implementing projects and ensuring cooperation within the region. As the KARPAT survey results clearly pointed out, the financial barrier is seen as the most important factor hindering cross-border projects and initiatives. The analysis of the Carpathian projects in the Interreg programmes in the 2014-2020 programming period showed their mostly cross-border (CBC) character. The possibilities of the transnational cooperation in the macroregion were limited by the lack of one Interreg B programme in which all the Carpathian countries could have participated

together. At the same time, the prevailing influence of the EU (the biggest number of answers to the question which actor has the greatest influence on the development of cooperation in the Carpathian macroregion pointing at the EU – see Chart 5.15) and an expectation of its greater involvement in the Carpathian cooperation, was expressed by the stakeholders in the KARPAT survey. In this context, the establishment of a transnational Carpathian Interreg Programme would be a key recommendation endorsed by the ESPON KARPAT stakeholders, providing a dedicated mechanism for financing projects that involve all Carpathian countries, explicitly taking into account the specific needs of the Carpathian macroregion to which the programme would be devoted – something that is not feasible under the current framework. In the absence of such a mechanism, adjustments to existing EU-funded programmes European Territorial Cohesion and horizontal/community funds are suggested to better align them with the needs and priorities of the Carpathian macroregion. As the ETC forms only a part of the financing options, it is necessary to pay attention to and encourage parallel cooperation formats, depending on other financial mechanisms and sources.

Creating **functional cross-border areas** is another important operational goal. This includes enhancing cross-border mobility, developing shared infrastructure, and coordinating spatial planning across borders. This involves implementing **territorially integrated approaches**, which combine different policy sectors — such as transport, environment, economy, and public services — and promote coordinated action across administrative levels and national borders.

The recommendations also focus on **fostering economic cooperation**, encouraging businesses and employers to explore opportunities for cross-border partnerships. Strengthening public-private partnerships beneficial is assessed to be important by the stakeholders. Providing comprehensive information to stakeholders about the Carpathian macroregion and its cooperation potential is deemed critical for building awareness and driving engagement.

A unique aspect of the operational recommendations is the proposal to dedicated **fund to support preparatory activities and organisational work (i.e. preparing pilot projects)** during periods when the Carpathian Strategy or Programme has not yet been adopted, or is still in its initial phase. This recommendation is based on the experiences of other macroregional strategies. The ARPAP (Alpine Region Preparatory Action Fund) facilitated the development actions of Working Groups within the framework of the EU Strategy for the Alpine Region. In the case that the Carpathian Strategy is not adopted, such a fund would enable the implementation of pilot actions and provide essential support.

The above-mentioned activities may support the development of transnational cooperation in the Carpathian macroregion and are also confirmed by earlier analyses concerning development programming in the area (Smętkowski et al., 2022). Among these activities, one can distinguish those with the greatest potential for enhancing cross-border cooperation, as well as those for which stakeholders expect the most tangible outcomes. In general, they can be grouped into three categories (based on how frequently it was indicated in the survey results):

- **Key actions:** This group emphasizes the importance of **people-to-people cooperation, especially involving youth**. This is closely linked with other proposed measures, such as the **development of cross-border education programmes**, as well as student, pupil, and staff mobility schemes. Another priority identified by stakeholders is the creation of a **joint programme for attracting foreign investments**. According to respondents, the last two actions could bring the most measurable economic outcomes, whereas the first two are seen primarily as laying the groundwork for soft social integration within the macroregion.
- **Important actions:** These include a variety of thematic areas, ranging from the **coordination of healthcare-related activities, training for services responsible for addressing environmental and other risks**, to programmes aimed at **attracting qualified professionals to the macroregion**. Again, stakeholders expect more concrete and quantifiable results from the last two actions in this group compared to the first.
- **Supporting actions:** These refer, on the one hand, to improving the **functioning of border control**—especially relevant in the parts of the macroregion where EU regions interact with candidate countries. On the other hand, they include issues related to **security**, such as the fight against crime, which could benefit from better coordination among relevant services and the development of appropriate digital systems.

From a thematic perspective, the analysis of pilot actions (see also Chapter 6) identifies **several key areas of cross-border cooperation** that align with the principles of the European Green Deal, the EU Next Generation recovery plan, and the EU's digital priorities. These are considered by the ESPON KARPAT stakeholders to be particularly promising in terms of cooperation potential and expected impacts:

- **Economic development**, especially in the field of **sustainable tourism based on local natural and cultural resources** (see good practice on the route of the Wallachian culture), development of **renewable energy and related technologies**, support for resource efficiency through **circular economy models**, and the creation of **local clusters based on regional agricultural and environmental assets**.
- **Environmental protection**, particularly through the implementation of common **cross-border nature conservation standards** (e.g. joint management of national parks and reserves, coordinated protection of migratory species, harmonised rules for tourism and land use in border regions) (see good practice on national parks management), maintaining ecological continuity critical for biodiversity through **ecological corridors**, reducing pollution through the development of **low-emission energy sources** (e.g. solar, wind, hydro, and sustainably sourced biomass and bio-gas), and establishing systems for **monitoring environmental risks**.
- **Transport connectivity**, involving in particular the development of **clean transport modes in cross-border relations** (e.g. rail services, electric public buses, and integrated cycling infrastructure) (see good practice on cross-border rail connections), supported by organisational measures such as the **introduction of unified ticketing systems**, and **improving residents' access to modern digital technologies** (e.g. high-speed internet, e-government services, digital literacy programs, and public access points like telecentres or digital libraries).

In a **horizontal dimension**, the implementation of these activities could be strengthened by enhanced **scientific cooperation** (see good practice on research collaboration), which provides knowledge to increase the effectiveness of joint efforts (e.g. joint biodiversity monitoring programmes, cross-border climate impact studies, or collaborative research on sustainable land and water management), as well as **actions aimed at eliminating remaining administrative and legal barriers to cross-border cooperation** (see good practice example from the Slovak-Hungarian border).

The survey results clearly point to the need for a multilevel and flexible governance structure to support territorial cooperation in the Carpathian macroregion (e.g. coordination platforms between local, regional, and national authorities; cross-border working groups on sustainable development; or joint decision-making bodies involving various stakeholders such as municipalities, NGOs, and scientific institutions). Actions should combine both formalised institutional support—such as the potential establishment of a Carpathian Interreg programme or a cross-border coordination body—with practical, operational measures targeting specific thematic areas (e.g. joint flood prevention systems, harmonised eco-tourism development strategies, coordinated biodiversity monitoring, or shared emergency response protocols in mountainous regions). Co-operation should be driven not only at the national and regional levels but also include active engagement of local authorities and civil society actors. At the same time, promoting people-to-people initiatives and joint programmes in education, investment attraction, and mobility are crucial for building trust, cohesion, and long-term integration. Strengthening existing structures, enhancing coordination, and removing legal and administrative barriers will be key to unlocking the full potential of territorial cooperation in the Carpathians.

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Annexes

Annex 1. List of NUTS3/NUTS2 regions to be covered by analysis

Table A.3

List of NUTS3/NUTS2 regions to be covered by analysis

NUTS3_ID	SNUTS3_ID	NUTS3_NAME_LATN	NUTS2_ID	NUTS2_NAME_LATN	Core	Adja-cent
CZ063	CZ063	Kraj Vysočina	CZ06	Jihovýchod	0	1
CZ064	CZ064	Jihomoravský kraj	CZ06	Jihovýchod	1	0
CZ071	CZ071	Olomoucký kraj	CZ07	Střední Morava	0	1
CZ072	CZ072	Zlínský kraj	CZ07	Střední Morava	1	0
CZ080	CZ080	Moravskoslezský kraj	CZ08	Moravskoslezsko	1	0
HU110	HU110	Budapest	HU11	Budapest	1	0
HU120	HU120	Pest	HU12	Pest	1	0
HU311	HU311	Borsod-Abaúj-Zemplén	HU31	Észak-Magyarország	1	0
HU312	HU312	Heves	HU31	Észak-Magyarország	1	0
HU313	HU313	Nógrád	HU31	Észak-Magyarország	1	0
HU321	HU321	Hajdú-Bihar	HU32	Észak-Alföld	0	1
HU322	HU322	Jász-Nagykun-Szolnok	HU32	Észak-Alföld	0	1
HU323	HU323	Szabolcs-Szatmár-Bereg	HU32	Észak-Alföld	0	1
HU332	HU332	Békés	HU33	Dél-Alföld	0	1
HU333	HU333	Csongrád	HU33	Dél-Alföld	0	1
MD113	MD113	Regiunea Sud	MD11	Partea de Vest	0	1
MD115	MD115	Municipiul Chişinău	MD11	Partea de Vest	0	1
MD111	MD111	Regiunea Nord	MD11	Partea de Vest	0	1
MD112	MD112	Regiunea Centru	MD11	Partea de Vest	0	1
MD114	MD114	Unitatea Teritorială Autonomă Găgăuzia	MD11	Partea de Vest	0	1
MD120	MD120	Partea de Est (partea stîngă a Nistrului)	MD12	Partea de Est (partea stîngă a Nistrului)	0	1
PL213	PL213	Miasto Kraków	PL21	Małopolskie	1	0
PL214	PL214	Krakowski	PL21	Małopolskie	1	0
PL217	PL217	Tarnowski	PL21	Małopolskie	1	0
PL218	PL218	Nowosądecki	PL21	Małopolskie	1	0

NUTS3_ID	SNUTS3_ID	NUTS3_NAME_LATN	NUTS2_ID	NUTS2_NAME_LATN	Core	Adja-cent
PL219	PL219	Nowotarski	PL21	Małopolskie	I	O
PL21A	PL21A	Oświęcimski	PL21	Małopolskie	I	O
PL224	PL224	Częstochowski	PL22	Śląskie	O	I
PL225	PL225	Bielski	PL22	Śląskie	I	O
PL227	PL227	Rybnicki	PL22	Śląskie	O	I
PL228	PL228	Bytomski	PL22	Śląskie	O	I
PL229	PL229	Gliwicki	PL22	Śląskie	O	I
PL22A	PL22A	Katowicki	PL22	Śląskie	O	I
PL22B	PL22B	Sosnowiecki	PL22	Śląskie	O	I
PL22C	PL22C	Tyski	PL22	Śląskie	O	I
PL821	PL821	Krośnieński	PL82	Podkarpackie	I	O
PL822	PL822	Przemyski	PL82	Podkarpackie	I	O
PL823	PL823	Rzeszowski	PL82	Podkarpackie	I	O
PL824	PL824	Tarnobrzegi	PL82	Podkarpackie	I	O
RO111	RO111	Bihor	RO11	Nord-Vest	I	O
RO112	RO112	Bistrița-Năsăud	RO11	Nord-Vest	I	O
RO113	RO113	Cluj	RO11	Nord-Vest	I	O
RO114	RO114	Maramureș	RO11	Nord-Vest	I	O
RO115	RO115	Satu Mare	RO11	Nord-Vest	I	O
RO116	RO116	Sălaj	RO11	Nord-Vest	I	O
RO121	RO121	Alba	RO12	Centru	I	O
RO122	RO122	Brașov	RO12	Centru	I	O
RO123	RO123	Covasna	RO12	Centru	I	O
RO124	RO124	Harghita	RO12	Centru	I	O
RO125	RO125	Mureș	RO12	Centru	I	O
RO126	RO126	Sibiu	RO12	Centru	I	O
RO211	RO211	Bacău	RO21	Nord-Est	I	O
RO212	RO212	Botoșani	RO21	Nord-Est	O	I
RO213	RO213	Iași	RO21	Nord-Est	O	I
RO214	RO214	Neamț	RO21	Nord-Est	I	O
RO215	RO215	Suceava	RO21	Nord-Est	I	O
RO216	RO216	Vaslui	RO21	Nord-Est	O	I
RO221	RO221	Brăila	RO22	Sud-Est	O	I
RO222	RO222	Buzău	RO22	Sud-Est	I	O
RO223	RO223	Constanța	RO22	Sud-Est	O	I

NUTS3_ID	SNUTS3_ID	NUTS3_NAME_LATN	NUTS2_ID	NUTS2_NAME_LATN	Core	Adja-cent
RO224	RO224	Galați	RO22	Sud-Est	o	I
RO225	RO225	Tulcea	RO22	Sud-Est	o	I
RO226	RO226	Vrancea	RO22	Sud-Est	I	o
RO311	RO311	Argeș	RO31	Sud-Muntenia	I	o
RO312	RO312	Călărași	RO31	Sud-Muntenia	o	I
RO313	RO313	Dâmbovița	RO31	Sud-Muntenia	I	o
RO314	RO314	Giurgiu	RO31	Sud-Muntenia	o	I
RO315	RO315	Ialomița	RO31	Sud-Muntenia	o	I
RO316	RO316	Prahova	RO31	Sud-Muntenia	I	o
RO317	RO317	Teleorman	RO31	Sud-Muntenia	o	I
RO321	RO321	București	RO32	București-Ilfov	o	I
RO322	RO322	Ilfov	RO32	București-Ilfov	o	I
RO411	RO411	Dolj	RO41	Sud-Vest Oltenia	o	I
RO412	RO412	Gorj	RO41	Sud-Vest Oltenia	I	o
RO413	RO413	Mehedinți	RO41	Sud-Vest Oltenia	I	o
RO414	RO414	Olt	RO41	Sud-Vest Oltenia	o	I
RO415	RO415	Vâlcea	RO41	Sud-Vest Oltenia	I	o
RO421	RO421	Arad	RO42	Vest	I	o
RO422	RO422	Caraș-Severin	RO42	Vest	I	o
RO423	RO423	Hunedoara	RO42	Vest	I	o
RO424	RO424	Timiș	RO42	Vest	I	o
RS110	RS110	City of Belgrade	RS11	City of Belgrade	o	I
RS122	RS122	Južnobanatska oblast	RS12	Autonomous Province of Vojvodina	o	I
RS124	RS124	Severnobanatska oblast	RS12	Autonomous Province of Vojvodina	o	I
RS126	RS126	Srednjobanatska oblast	RS12	Autonomous Province of Vojvodina	o	I
RS215	RS215	Pomoravska oblast	RS21	Region Šumadije i Zapadne Srbije	I	o
RS221	RS221	Borska oblast	RS22	Region Južne i Istočne Srbije	I	o
RS222	RS222	Braničevska oblast	RS22	Region Južne i Istočne Srbije	I	o
RS223	RS223	Zaječarska oblast	RS22	Region Južne i Istočne Srbije	I	o
RS225	RS225	Nišavska oblast	RS22	Region Južne i Istočne Srbije	o	I

NUTS3_ID	SNUTS3_ID	NUTS3_NAME_LATN	NUTS2_ID	NUTS2_NAME_LATN	Core	Adja-cent
RS227	RS227	Podunavska oblast	RS22	Region Južne i Istočne Srbije	o	I
SKo10	SKo10	Bratislavský kraj	SKo1	Bratislavský kraj	I	o
SKo21	SKo21	Trnavský kraj	SKo2	Západné Slovensko	I	o
SKo22	SKo22	Trenčiansky kraj	SKo2	Západné Slovensko	I	o
SKo23	SKo23	Nitriansky kraj	SKo2	Západné Slovensko	I	o
SKo31	SKo31	Žilinský kraj	SKo3	Stredné Slovensko	I	o
SKo32	SKo32	Banskobystrický kraj	SKo3	Stredné Slovensko	I	o
SKo41	SKo41	Prešovský kraj	SKo4	Východné Slovensko	I	o
SKo42	SKo42	Košický kraj	SKo4	Východné Slovensko	I	o
UA21	UA21	Zakarpatska	UA21	Zakarpatska	I	o
UA73	UA73	Chernivetska	UA73	Chernivetska	I	o
UA26	UA26	Ivano-Frankivska	UA26	Ivano-Frankivska	I	o
UA46	UA46	Lvivska	UA46	Lvivska	I	o

Source: own elaboration

Annex 2. Methodology for estimating tourist attractiveness based on the number of reviews on Google Maps

The methodology leverages data extracted from the Google Places API using standard Python libraries (requests, pandas, time, os) and custom-written Python scripts to interact with the API. To structure the searches and organize the resulting data, the studied region was divided into overlapping circular areas based on a pre-defined grid system. Each grid cell represented a circle with a radius of 50,000 meters. Each circular area was uniquely identified by an area ID, which was included in both the individual raw data files and the resulting combined dataset.

For each area, the search was conducted across multiple predefined Google Places categories. Results were retrieved in batches, with a maximum of 60 records per query, as limited by the API. Each query returned detailed information about the locations in the area, including: name, average rating, total number of reviews, geographic coordinates (latitude, longitude), address, Google ID, and categories assigned to the location. This systematic approach ensured consistent and thorough data collection across the entire study region.

In Google Places, each location can be assigned multiple categories; for example, a historic castle might be categorized as both a “tourist_attraction” and a “museum”. During the data collection process, the following categories were used: amusement_centre, amusement_park, cafe, coffee_shop, hiking_area, museum, national_park, restaurant, tourist_attraction. Among the tested categories, tourist_attraction emerged as the most dominant and consistently relevant category for the locations. This predominance made it unnecessary to include secondary categories, as doing so would introduce redundancy without adding meaningful differentiation to the analysis.

Raw data was initially downloaded into category-specific files; each file had a maximum of 60 records per query due to API limitations. Each data file contained a structured set of columns with attributes. Next, the data was processed to ensure accuracy and usability: data files were merged for each category; rows not consistent with the general structure were flagged and removed; duplicates of locations were removed using key attributes (i.e., name, rating, review count, coordinates), to ensure accurate counting of unique locations. The final cleaned dataset combined data across all categories and removed any residual duplicates.

The methodology as described above ensures a systematic approach to assessing tourist attractiveness using publicly available data and computational tools. However, it is important to acknowledge that the methodology has certain limitations, primarily stemming from the specifics of the Google Places API. First, the Google Places API returns a maximum of 60 records per query, potentially underrepresenting areas with a high density of attractions. Moreover, relevance is a measure used to rank the search results, and it includes the following factors:

1. Proximity: places closer to the specified location (latitude and longitude) are typically ranked higher.
2. Prominence: Google evaluates the prominence of a place based on its popularity and reputation. Prominence is influenced by factors such as:
 - a. number of reviews: places with more reviews tend to be ranked higher;
 - b. average rating: places with higher ratings may also be ranked higher, though this depends on their relevance to the location;
 - c. online mentions and links: if a place is mentioned frequently on the web or linked to from reputable sites, this increases its prominence;
 - d. historical popularity: famous or historically popular places may also rank higher due to longstanding prominence.

User relevance: for certain searches (e.g., with specific keywords or types), Google may weigh in popular user behaviours and preferences. If many users have clicked, reviewed, or frequently visited a certain type of place, this place may rank higher for that type.

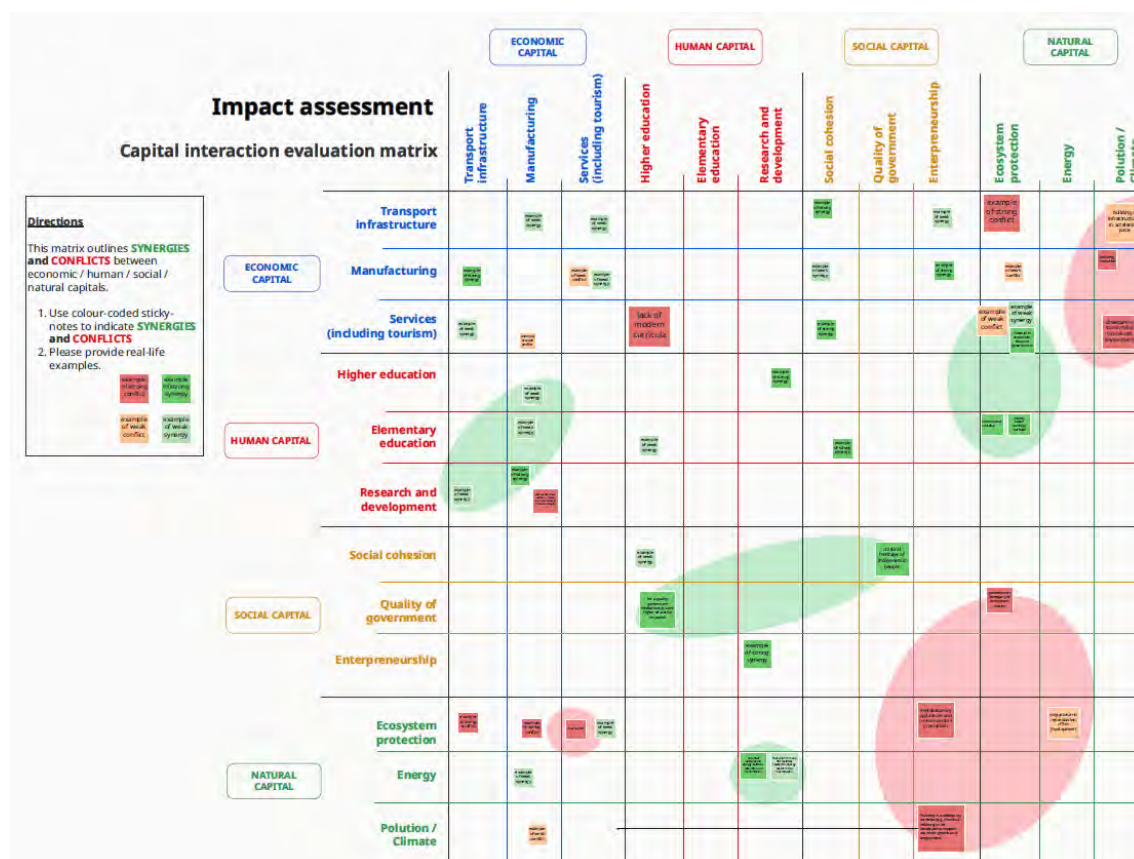
Sources:

<https://developers.google.com/maps/documentation/places/web-service/overview>

<https://developers.google.com/maps/documentation/places/web-service/place-data-fields>

Annex 3. Territorial capital interactions based on Stakeholder Workshop Results

Figure A.2
Capital interaction evaluation matrix



Source: own elaboration.

Annex 4. Carpathian projects thematic categories introduced in the KARPAT project on the basis of the keep.eu themes

Table A.4
Thematic categories of projects

KARPAT project: Thematic categories	keep.eu data on ETC projects: Theme
Economy	Agriculture and fisheries and forestry
Economy	Clustering and economic cooperation
Economy	Green technologies
Economy	Innovation capacity and awareness-raising
Economy	Knowledge and technology transfer
Economy	Labour market and employment

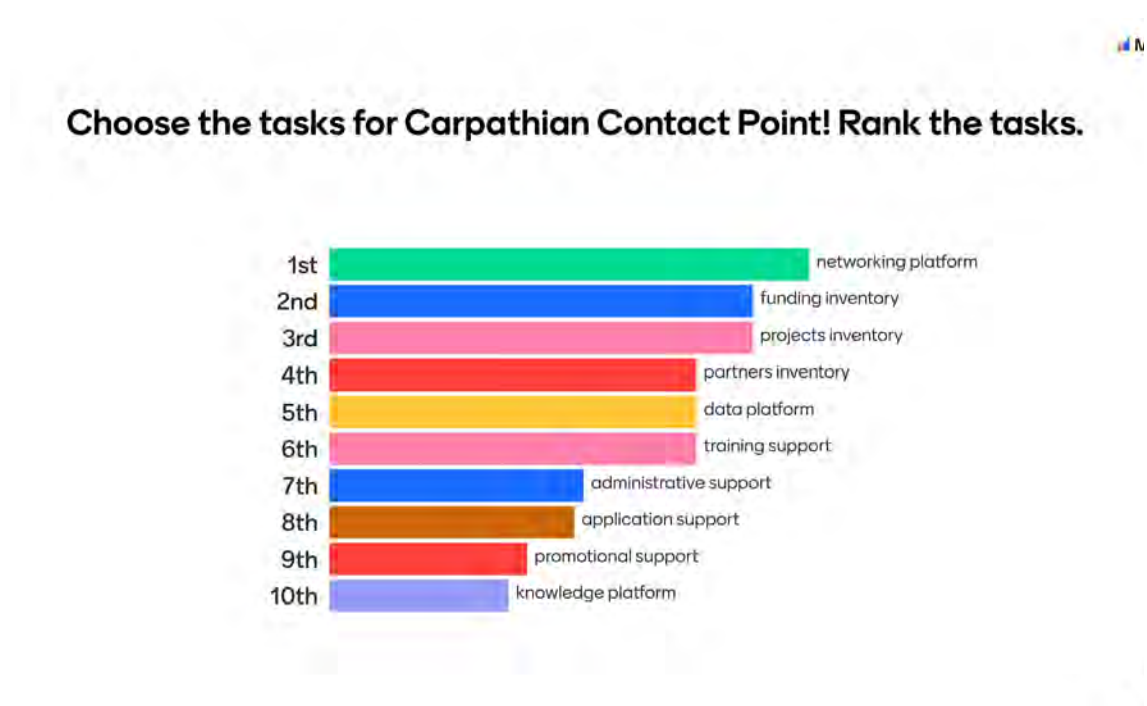
Economy	New products and services
Economy	SME and entrepreneurship
Education	Education and training
Education	Scientific cooperation
Environment	Climate change and biodiversity
Environment	Coastal management and maritime issues
Environment	Energy efficiency
Environment	Renewable energy
Environment	Soil and air quality
Environment	Sustainable management of natural resources
Environment	Waste and pollution
Environment	Water management
Environment	Waterways, lakes and rivers
Governance	Governance, partnership
Governance	Institutional cooperation and cooperation networks
Governance	Regional planning and development
Infrastructure	Construction and renovation
Infrastructure	Improving transport connections
Infrastructure	Infrastructure
Infrastructure	Logistics and freight transport
Infrastructure	Multimodal transport
Infrastructure	Transport and mobility
Risk management	Cooperation between emergency services
Risk management	Managing natural and man-made threats, risk management
Safety	Safety
Society	Community integration and common identity
Society	Demographic change and immigration
Society	Health and social services
Society	ICT and digital society
Society	Social inclusion and equal opportunities
Society	Urban development

Tourism	Cultural heritage and arts
Tourism	Tourism

Source: own elaboration based on keep.eu

Annex 5. Stakeholder Workshop Results: the importance of the proposed Carpathian Contact Point tasks

Figure A.3
Proposed Carpathian Contact Point tasks



Source: own elaboration.

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Disclaimer

This delivery does not necessarily reflect the opinion of the members of the ESPON 2030 Monitoring Committee.