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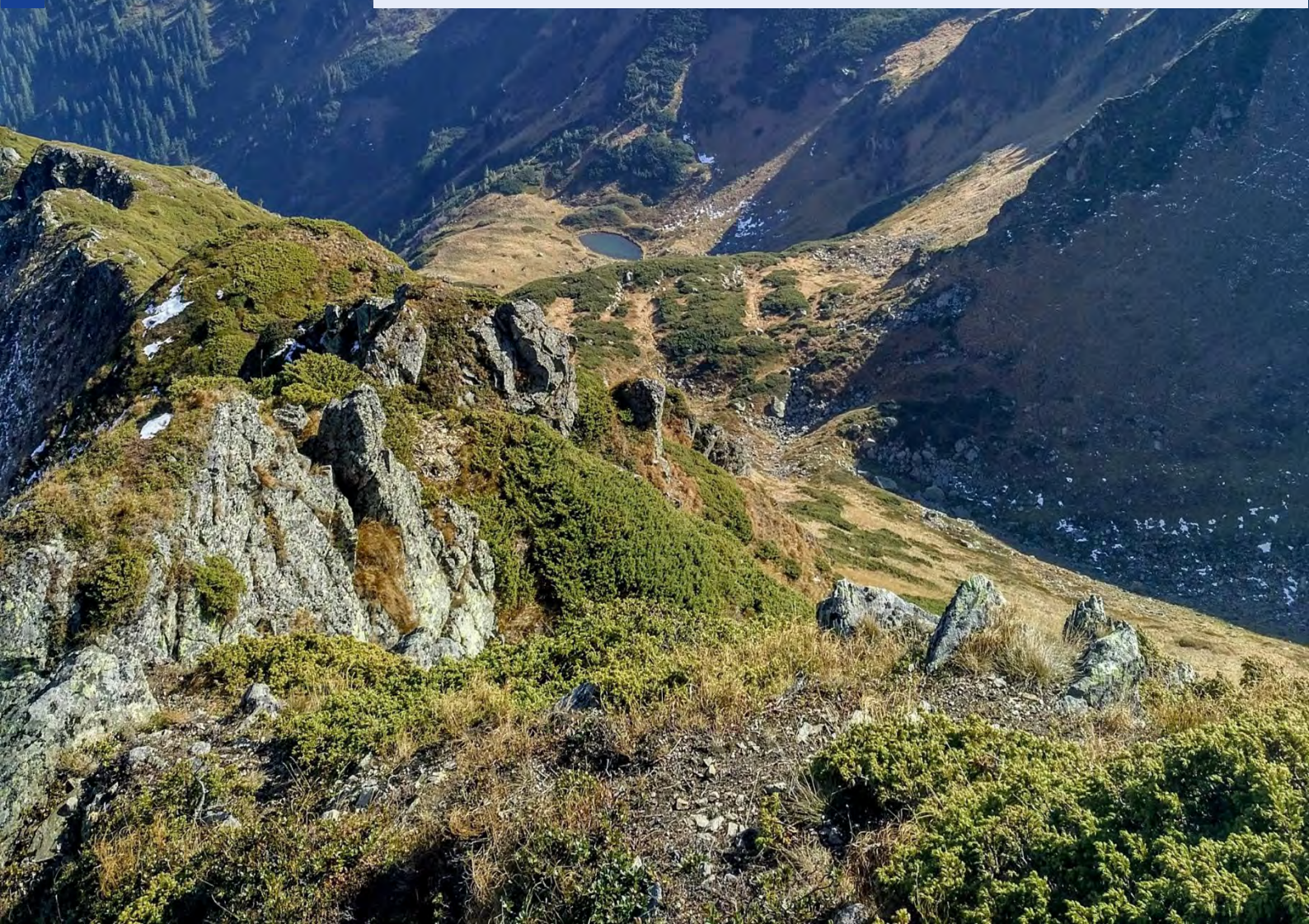
FINAL REPORT

ESPON KARPAT

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

Final Report // June 2025



This Final Report is conducted within the framework of the ESPON 2030 Cooperation Programme, partly financed by the European Regional Development Fund.

The ESPON EGTC is the Single Beneficiary of the ESPON 2030 Cooperation Programme. The Single Operation within the programme is implemented by the ESPON EGTC and co-financed by the European Regional Development Fund, the EU Member States and the Partner States, Iceland, Liechtenstein, Norway and Switzerland.

This delivery does not necessarily reflect the opinions of members of the ESPON 2030 Monitoring Committee.

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ISBN: 978-2-919816-83-5

Layout and graphic design by BGRAPHIC, Denmark

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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
PISA	Programme for International Student Assessment
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

Executive summary

What is the state of affairs and current trends in the Carpathian area's territorial structure related to the selected thematic fields?

The analysis of the state and development trends of the territorial structure of the Carpathian macroregion was based on the Four Capitals Model, which encompasses natural, economic, human, and social capital.

Natural Capital and Economic Sectors Based on Natural Resources in Carpathian macroregion: State and Trends

The Carpathian macroregion possesses exceptionally valuable natural capital, primarily concentrated in mountainous areas characterised by a high degree of naturalness and biodiversity. The Carpathians represent one of the most important ecological hotspots in Europe, home to numerous protected species, extensive forest complexes, and well-preserved ecosystems. A significant part of the region is covered by protected areas, with landscape protection being predominant, while strict protection applies to only a small proportion of the territory. The highest levels of biodiversity are found in the Romanian and Slovakian Carpathians, but also in certain mountainous areas of Ukraine, Poland, and Hungary. At the same time, environmental quality is deteriorating in some parts of the region due to industrial pollution, including particulate matter emissions. Areas with a high concentration of industry and coal-based energy—particularly in Poland, the Czech Republic, Serbia, and Romania—are especially vulnerable. Climate change also presents a major challenge, with temperatures projected to rise by 2.4°C to 3.3°C by 2050 compared to the 1970s baseline, potentially threatening the functioning of local ecosystems.

Economic sectors reliant on natural resources—agriculture, forestry, mining, and energy—exhibit a diverse spatial structure. Mountain areas are highly forested and have a developed forestry sector, while intensive agriculture dominates in lowland regions. In recent years, forest cover has expanded in previously less-forested areas (Hungary, eastern and southern Romania); however, tree dieback (e.g., of spruce forests) has been reported in the Czech Republic and Slovakia. In many parts of the Carpathians, traditional land use practices such as pastoralism and the maintenance of permanent grasslands have been preserved. Agriculture is concentrated in the fertile lowlands of Romania, Ukraine, Serbia, Hungary, and Poland, whereas traditional grazing dominates the mountainous areas. Although spatially limited, mining still plays a significant role in selected areas, often generating serious environmental impacts. The energy sector remains largely based on fossil fuels—especially coal—resulting in high CO_2 emissions. The energy transition is progressing unevenly, with renewable energy developing mainly through hydropower, alongside growing shares of solar and wind energy, particularly in Hungary and Poland. Power plants are primarily located on the peripheries of the macroregion. The greatest untapped potential for renewables is found in south-eastern Romania, especially for photovoltaic development.

Tourism, based on the region's natural and cultural assets, is a dynamically growing sector. However, its intensity—measured by the number of overnight stays per capita—remains significantly lower than in Southern and Western Europe. The region offers numerous attractions, ranging from UNESCO sites to nature- and health-based tourism. The best-known tourist destinations include cities and regions such as Budapest, Kraków and Małopolska, Brno, and Transylvania, while the Eastern Carpathians remain less recognised. The density of cultural heritage and tourism infrastructure varies—regions in the Czech Republic, Slovakia, Poland, and selected parts of Romania are best equipped outside the main cities. Between 2012 and 2019, the macroregion experienced dynamic growth in tourism, only temporarily disrupted by the COVID-19 pandemic. Spatially, the highest tourism intensity is observed in metropolitan areas, health resorts -especially in Hungary - and ski regions, with Slovakia and Poland as major destinations.

Economic Capital of the Carpathian Macroregion: State and trends

The economic capital of the Carpathian macroregion is based on a polycentric settlement structure, comprising numerous medium-sized towns and several metropolitan areas with populations exceeding one million. Major urban centres are predominantly located along the outer arc of the Carpathians, while the central part of the region is characterised by lower population density and smaller towns. Economic development levels vary significantly across the region. The most developed areas are situated in the western and metropolitan parts of the Czech Republic, Slovakia, Poland, Hungary, and Romania, while Ukraine, Moldova, and parts of Romania and Serbia remain less developed. Economic growth is concentrated around large cities, whereas mountainous and rural areas often remain peripheral. Although EU Member States within the Carpathian region are experiencing rapid economic growth, internal disparities are increasing. Investment capital is concentrated in the more developed parts of the region, particularly in the Czech Republic and Hungary, as well as in Slovakia and the western parts of the Polish section of the macroregion. In recent years, Romania has attracted growing investor interest. Public support mechanisms encourage investment in less-developed areas. Overall, the macroregion possesses a substantial base of industrial zones and parks. However, governance quality remains a challenge, although the Czech and Slovak regions perform relatively well in this regard.

The structure of the economy reflects existing regional disparities. Agriculture plays a marginal role in the Visegrad countries (V4), yet remains significant in Ukraine, the Republic of Moldova, and parts of Romania and Hungary. Industry continues to dominate in traditional industrial regions (e.g. Silesia), while advanced business services are

concentrated in urban areas. Industrial modernisation is progressing primarily towards medium-level technologies, including motor vehicle manufacturing. Labour market conditions are also uneven: low unemployment rates in the V4 countries contrast with high structural unemployment in Ukraine, the Republic of Moldova, and parts of Romania. The overall level of innovation in the region remains low—only Budapest and Brno are classified as strong innovation hubs. Research and development potential is concentrated in metropolitan areas, with the highest levels of R&D expenditure recorded in regions of the Czech Republic and Poland.

Transport infrastructure plays a key role in regional integration and external connectivity of the macroregion. Air transport is concentrated around capital cities and regional airports, whose accessibility has improved significantly since 2000. However, deficits remain in the central part of the macroregion, where Cluj-Napoca Airport plays a leading role. The rail network tends to bypass mountainous areas and remains underdeveloped in the central Carpathians, whereas road transport is expanding dynamically, gradually forming a motorway ring around the main mountain range. However, travel times between major urban centres across the macroregion—particularly where crossing the Carpathian range is required—remain long due to low average speeds. Gaps in trans-Carpathian connections and the uneven quality of infrastructure continue to limit development opportunities in many areas. Infrastructure deficits are particularly visible in the eastern and southern parts of the macroregion, especially in Ukraine and the Republic of Moldova, further exacerbated by the presence of the EU's external border.

Human Capital and the Information Society in the Carpathian macroregion: state and trends

The Carpathian macroregion is home to approximately 57 million people, the majority of whom are concentrated in the foothill zones, particularly in large metropolitan areas such as Budapest, Bucharest, and Bratislava. Population density varies greatly – high mountain areas are the most sparsely populated (fewer than 20 people per km^2), whereas the valleys and the outer arc of the Carpathians – stretching from Moravia through Poland and Ukraine to Romanian Moldova – are much more densely inhabited. Over the past two decades, depopulation has been the dominant demographic trend, particularly affecting mountainous areas in Serbia, Romania, and Ukraine, as well as peripheral rural regions. Population growth is mainly recorded around large urban areas, driven by – often uncontrolled – suburbanisation processes.

Population ageing is the prevailing demographic process. Although some countries (e.g., the Republic of Moldova, Ukraine, Slovakia) recently had populations that were relatively younger than the EU average, the median age is now rising almost everywhere. The oldest populations are found in the southern Carpathians of Serbia and Romania, as well as in southern Moldova. Regions with a high proportion of children (over 20%) include the Polish-Slovak borderland and eastern Romania, while areas with a predominance of older people (over 25%) are mainly located in Serbia, southern Romania, and parts of Hungary. High demographic dependency ratios pose a significant challenge for local education, healthcare, and social security systems.

Fertility rates in the macroregion remain below the population replacement level, although significant regional disparities persist. Prior to the pandemic, some improvement was observed in the Czech Republic, Slovakia, Hungary, and Romania, while Poland, Ukraine, and Serbia recorded declines. The pandemic and its aftermath have further deepened the demographic crisis. Migration—both internal and international—has become a key driver of population change, primarily targeting the metropolitan areas of major cities. The influx of refugees from Ukraine since 2022 has significantly increased the population in certain areas, particularly in western Ukraine, as well as in the Republic of Moldova, and to a substantial extent in Poland and the Czech Republic. The long-term impact of this migration will depend on the outcome of the war initiated by Russia.

Human capital, understood as the level of education and skills, is generally below the EU average in the Carpathian macroregion. The proportion of people with higher education is highest in metropolitan areas (Budapest, Bratislava, Belgrade, Kraków), where it exceeds 40%, and lowest in Romania (below 25%). The quality of primary education also varies: students in Poland and the Czech Republic achieve the best PISA (Programme for International Student Assessment) results, while those in the Republic of Moldova, Romania, and Serbia score the lowest. Access to higher education is improving, particularly in Poland, Slovakia, and in the capital regions of Hungary and Serbia; however, a decline in student performance is observed, partly due to the effects of the COVID-19 pandemic.

Internet access is generally high in urban areas, where over 90% of households have adequate connectivity. In less urbanised regions – particularly in western Ukraine and the Republic of Moldova – access is more limited, though it is increasing rapidly. Mountainous, rural, and dispersed settlement areas continue to pose challenges for the development of digital infrastructure. The digital economy has untapped potential – the share of companies engaged in e-commerce is low and decreases towards the east. The most developed e-commerce sectors are found in the Belgrade and Budapest regions, as well as in Małopolska and parts of the Czech Republic. Romania and Slovakia remain at a relatively early stage of digital adaptation.

Social Capital and Public Service Accessibility in the Carpathian macroregion: state and trends

Social capital in the Carpathian macroregion is marked by significant spatial disparities. Considering household income as an important determinant, the highest levels of disposable income per capita are observed in the Czech regions, western Slovakia, and in the metropolitan areas of Budapest and Bucharest, as well as in the Silesian and Małopolska voivodeships in Poland. In contrast, the lowest income levels are recorded in Romanian Moldova, eastern Hungary, and across regions of Ukraine (with the exception of Lviv Oblast). Over the past decade, incomes have risen throughout the region, although not always proportionally to GDP growth. In some areas (e.g. Poland,

northern Hungary), the labour share in GDP has declined in favour of capital, whereas in others (e.g. Romania), population incomes have grown faster than GDP, potentially indicating an improvement in workers' conditions.

Social trust in the Carpathian macroregion also exhibits considerable variation. Trust in local authorities is noticeably higher than in central governments. The highest levels of trust in local and regional governments are observed in the Polish part of the macroregion, in the Moravian regions, and in selected areas of Slovakia and Romania (Nord-Vest, Centru), while the lowest levels are recorded in Bucharest and in some parts of Hungary.

Poverty and social exclusion remain serious issues. On average, 25% of the macroregion's population is at risk of poverty or social exclusion, compared with around 20% in the EU. The highest rates are observed in the Republic of Moldova (~40%) and Romania (~35%), while the best conditions prevail in the Czech Republic, western Slovakia, and the Silesian Voivodeship. The situation improved between 2015 and 2021, particularly in some regions of Hungary, Romania, and Poland (e.g. Podkarpackie).

Housing conditions in the region are generally poorer than in Western Europe. The number of dwellings per 1,000 inhabitants is below the EU average, with the lowest figures recorded in Ukraine and Poland. Housing density exceeds 500 dwellings per 1,000 inhabitants only in the largest cities, while mountain and rural regions remain significantly under-housed. Overcrowding is a serious problem, especially in Serbia, Ukraine, and Romania. Disparities are also evident in access to sanitation infrastructure, which is better in urban areas than in rural ones.

The healthcare system features a relatively high number of hospital beds (e.g. in Romania), but a lower availability of doctors—particularly in Serbia and some EU countries. The highest number of doctors per capita is found in capital cities and urban centres with specialist facilities. Despite a rise in the number of doctors in recent years, there remains a shortage of medical personnel, particularly nurses.

An analysis of public service accessibility (schools, hospitals, railway stations) reveals that the poorest access is found in peripheral, and especially mountainous, regions of Romania (e.g. Caraș-Severin, Harghita, Maramureș) and Serbia (e.g. Borski and Zaječar districts), as well as parts of the Eastern and Southern Carpathians. The best access is ensured in metropolitan areas (Bucharest, Belgrade, Budapest, Bratislava, Kraków) and in the Czech regions and Upper Silesia, where service density is very high. These areas also have the best developed public transport systems (metros, trams, trolleybuses), while smaller cities typically rely on outdated bus networks. Financial constraints and a lack of fare integration continue to undermine the competitiveness of public transport compared to private vehicles.

What territorial profiles can be identified? Which regions have what opportunities?

The further development of territorial capitals in the Carpathian macroregion require appropriate actions, which should be tailored to the specific characteristics of individual regions.

Natural capital is a strong asset of the macroregion, offering opportunities for the development of green economic sectors, environmentally friendly tourism, and renewable energy. However, its effective use requires parallel environmental protection and planned development activities that take into account local spatial and social conditions. The developed regional typology indicates how these actions should be targeted depending on the state of natural capital resources and the scale of environmental pressure, including pollution levels across different areas of the Carpathian macroregion.

The economy of the Carpathian macroregion is developing dynamically but unevenly. Key challenges include the integration of peripheral areas, energy and technological transition (including through the use of external investments), improving innovation (including smart specialisation), and making fuller use of the potential of medium-sized cities. The developed regional typology suggests how these actions should be targeted based on the state of economic capital and the degree to which regional economies are oriented towards productive versus endogenous functions in various parts of the Carpathian macroregion.

Human capital in the Carpathian macroregion requires strengthening through improved access to and quality of education, support for digital development, counteracting depopulation, and enhancing labour market participation – especially in less developed regions. Demographic and educational development is a prerequisite for the socio-economic cohesion of the macroregion. At the same time, it must address the challenges arising from uncontrolled suburbanisation in the surroundings of larger cities. The developed regional typology provides guidance on how to target these actions based on the quality of human capital and existing demographic issues in different areas of the Carpathian macroregion.

Social capital and access to services in the Carpathians require support – both through social initiatives (strengthening trust and civic engagement, particularly in micro-areas of social deprivation) and through investment (housing, healthcare, and educational infrastructure), as well as organisational improvements (in service delivery models). Reducing exclusion and improving access to services are essential for the region's social cohesion. Equally important is creating conditions for the development of entrepreneurship, including social entrepreneurship. The developed regional typology points to how these actions should be directed, depending on the scale of social challenges and the context defining the potential for developing particular types of social ties across different areas of the Carpathian macroregion.

How can these opportunities and potentials be more efficiently exploited for economic and social development in a sustainable way?

The Four Capitals Model highlights the interconnections between different forms of capital as a key to achieving sustainable development. The study emphasises the development potential of regions based on their economic, human-social, and natural capital endowments, as well as the linkages between them.

In particular, the relationship between human-social and economic assets allowed the identification of leading regions with the greatest potential for innovation, as well as those requiring intervention due to social challenges. Regions with a weaker economic base should focus on activating endogenous potentials, including entrepreneurship. Peripheral areas, in turn, require comprehensive interventions encompassing the development of technical infrastructure, human capital, and improved access to high-quality public services.

In the relationship between economic and natural assets, the analysis identified regions with high potential for innovation in green technologies, as well as the development of sustainable tourism, circular economy models, and renewable energy. It also pointed to areas in need of infrastructural improvements, including environmental protection measures and the transformation of the energy sector.

In the relationship between social and natural assets, regions were identified that offer the greatest potential for implementing sustainable, place-based development strategies grounded in local identity and responsible management of natural resources. This also includes areas suitable for the development of sustainable agriculture and renewable energy (e.g. energy cooperatives), as well as those requiring efforts to increase local community engagement and better utilise ecosystem services, along with landscape planning.

These insights formed the basis for a general typology of regions. When combined with an analysis of the interactions between different territorial capitals, this typology contributed to the design of spatial visions for sustainable socio-economic development across the Carpathian macroregion. These visions first identified warning signals related to potential conflicts—such as uncontrolled suburbanisation, timber overlogging in mountain areas, mineral extraction, and overtourism, both in cities and ecologically valuable areas. At the same time, the analysis highlighted underutilised synergies, including the dispersed settlement network, opportunities for sustainable tourism in nature-rich regions, and renewable energy in favourable locations, as well as risks related to progressing depopulation in some areas. Subsequently, spatial visions for the sustainable development of the Carpathian macroregion were formulated, based on the interrelations between natural capital—which was assigned a dedicated vision due to the need to preserve the unique Carpathian ecosystem, including biodiversity and ecological corridors—and: economy, technology, society.

The first vision – "natural environment – economy" – on the one hand, pointed to traditional development pathways, including the role of existing and planned transport infrastructure, opportunities for the development of regional (potentially cross-border) production systems, and transport corridors that maintain environmental quality. On the other hand, it also encompassed modern development models such as the circular economy, sustainable tourism, and renewable energy.

The second vision – "natural environment – technology" – addressed, in spatial terms, the presence of innovation, academic, and technology implementation hubs, as well as the development of regional innovation systems through the application of advanced technologies, including green innovation and digital connectivity zones. It also emphasised the strengthening of interregional scientific and technological linkages, both within and beyond the macroregion.

The third vision – "natural environment – society" – identified spatial opportunities to enhance social cohesion through increased civic participation in cities, the development of ethno- and ecotourism, and just transition zones supporting the shift from traditional to modern economic sectors, alongside cross-border cooperation. It also highlighted the importance of links between local communities and the natural environment through initiatives such as local energy and agricultural cooperatives, as well as extensive agricultural buffer zones surrounding protected areas.

These three visions were subsequently refined and applied to various functional areas, identified on the basis of two dimensions: their role within the settlement system (metropolitan areas, small and medium-sized towns, rural areas) and specific characteristics resulting from location (e.g. border zones), resources (e.g. mountain areas), or legal status (e.g. protected areas). For each of these areas, their specific implications were identified, and desirable development directions were proposed, taking into account economic, technological, and social factors. The aim was to mitigate risks and harness the underutilised potential highlighted in the warning spatial development vision.

What are the institutional frameworks and governance structures in the Carpathian macroregion?

Domestic governance structures in the Carpathian macroregion reflect a high degree of administrative heterogeneity, which directly influences the scope and nature of subnational engagement in cross-border and interregional cooperation frameworks. Poland stands out with one of the most decentralised models in the region, where regional and local authorities (voivodeships and municipalities) enjoy considerable autonomy and capacity in shaping territorial development and fostering international cooperation. Slovakia and Czechia feature moderately centralised systems: although they have elected regional governments, key strategic decisions and

resources are largely controlled by national authorities, which can limit the initiative of subnational actors. Romania retains a predominantly centralised structure, with counties (județe) and regional development agencies engaged in territorial governance but under close supervision from the central state. Hungary demonstrates one of the most centralised approaches in the macroregion, with local and regional authorities operating within a framework of limited institutional autonomy. Nevertheless, Hungarian actors remain visibly active in cross-border groupings such as EGTCs, often supported by national-level strategies. Ukraine, Serbia, and the Republic of Moldova maintain centralised or hybrid governance systems, where subnational governments frequently face legal, institutional, and financial constraints, reducing their consistent participation in formal cross-border structures. These differences in domestic administrative models continue to shape the depth and form of subnational engagement in cross-border cooperation.

The Carpathian macroregion is governed through a diverse mix of legal, semi-formal, and informal cooperation frameworks, reflecting historical legacies and uneven institutional capacities. Three main types of structures shape cooperation: institutionalised legal entities like the Carpathian Convention and EGTCs; flexible, politically anchored platforms such as Euroregions and the Visegrad Fund; and project-based cooperation mechanisms under EU programmes like Interreg. Each model reflects distinct logics: legal structures enable strategic continuity, flexible networks provide adaptability, and project frameworks mobilise broad participation, albeit sometimes with limited strategic depth.

This institutional diversity is geographically uneven. Western Carpathian countries (Czechia, Slovakia, Poland, Hungary) demonstrate higher institutional density, enabled by EU membership, better infrastructure, and stronger administrative traditions. Hungary and Slovakia are regional leaders, leveraging EGTCs and Euroregions through supportive national policies. Romania, although marked by a centralised governance model, maintains a stable presence in cross-border cooperation mechanisms, particularly in its western and northern borderlands. By contrast, Eastern neighbourhood countries (Ukraine, Serbia, the Republic of Moldova) face greater structural limitations, relying more heavily on bilateral or project-based cooperation. Legal and linguistic fragmentation, coupled with infrastructural and financial asymmetries, continues to hinder the emergence of coherent macroregional governance.

How can multi-level governance in the Carpathian macroregion be characterised?

Multi-level governance in the Carpathian macroregion is highly fragmented yet functionally dynamic, with strong engagement at local and regional levels, but limited strategic coordination at the macroregional scale. Local actors frequently play a leading role in initiating cooperation, not only through city twinning arrangements but also via cross-border networks and project-driven collaborations. However, transnational coherence is weak, as most initiatives operate in isolated silos without overarching alignment, hindered by the lack of an operational and unifying macroregional strategy and the fragmentation of EU funding instruments.

The governance system exhibits pronounced institutional asymmetry, where EU member states benefit from legal instruments and stable access to EU funding, while non-EU countries face significant legal-administrative mismatches, capacity constraints, and funding barriers. This unevenness restricts multilateral cooperation and reinforces bilateral patterns over integrated macroregional governance. Despite these challenges, there is a strong need for more strategic, multi-scalar coordination, with stakeholders consistently calling for legal harmonisation, simplified access to funding, and stronger national involvement. The proposed Carpathian Contact Point exemplifies a concrete response to these governance gaps, offering a model for improved coordination and support.

What are good practices in different thematic fields involving coordinated policies and actions in mountain regions in the Carpathian macroregion?

Several thematic areas show successful coordination of policies and actions across Carpathian mountain regions, despite broader governance limitations. Sustainable tourism stands out as a flagship area, with over 30% of surveyed stakeholders already engaged or interested. Cross-border eco-tourism initiatives, especially in the Slovak-Polish borderland, combine environmental goals with cultural heritage promotion and regional branding (e.g. Route of the Wallachian Culture 2017–2018 and ongoing). These projects often arise from local partnerships supported by Euroregions, Interreg, or bilateral frameworks, and are notable for their high visibility, bottom-up ownership, and thematic alignment with EU priorities.

Environmental protection offers another strong example, especially under the Carpathian Convention, the only legally binding treaty focused on mountain regions within the EU and its neighbourhood. Its protocols and working groups support transnational collaboration on biodiversity, climate, and forestry, although implementation is uneven. A notable case is the Central Parks project (2019–2022), which developed strategies for sustainable protected area management across eight countries. Coordinated under Interreg Central Europe, it led to the adoption of ecosystem service tools and biodiversity protocols now integrated into the Carpathian Convention's working structures showcasing policy-science integration, cross-sectoral collaboration, and the transfer of outputs into formal governance mechanisms.

Transborder linkages are often sustained through soft cooperation mechanisms and recurring local initiatives, which help preserve everyday connectivity and a sense of shared identity in border regions. The Route of the

Wallachian Culture (2017–2018 and ongoing) exemplifies a cross-border initiative that draws on intangible heritage to promote regional tourism and cohesion. A particularly notable case is the Vojak Švejk/Wojak Szwejk holiday train (2020–2024), which was primarily developed as a tourism-driven transport project. It has since evolved into a regular cross-border rail connection, linking Slovak and Polish destinations.

Emerging sectors such as digital innovation and green energy show high interest despite limited uptake, suggesting potential for pilot initiatives targeting smart and sustainable mountain development. The Science for the Carpathians (S4C) platform exemplifies support by mobilising academic institutions across 12+ countries, advancing interdisciplinary research for environmental governance and positioning science as a cornerstone of resilience building and sustainable development.

Lastly, EGTCs along the Hungarian-Slovak border demonstrate how legal cooperation tools can institutionalise service delivery, offering replicable governance models where legal capacity and national support align. Here governance innovation is demonstrated by the #ACCESS project (2023–2029, Interreg HU–SK), which focuses on removing legal-administrative obstacles across borders. It creates a citizen-administration platform for reporting and resolving legal barriers, offering a scalable governance model for other regions.

How to improve governance structures of the Carpathian area through joint cooperation actions at different levels?

To improve governance structures in the Carpathian area, a multi-level, coordinated, and flexible approach is essential. This implies activating cooperation at all levels of governance—from European institutions down to local authorities. A critical strategic recommendation is the development and formal adoption of a Macroregional Strategy, designed through close collaboration with all Carpathian countries and regional stakeholders. This strategy should embody a shared vision and common objectives, ensuring compatibility with broader European priorities, such as the European Green Deal, resilience goals, and digital transformation agendas.

Beyond strategic alignment, effective governance requires the institutionalisation of cooperation mechanisms that are independent of short-term, project-based funding cycles. This includes the establishment of permanent platforms such as a Carpathian Contact Point, thematic working groups, and coordination bodies with clearly defined mandates. These institutions should integrate diverse actors—from public administration and business to civil society and academia—enabling inclusive, knowledge-based governance. Additionally, legal and administrative barriers that hinder collaboration must be addressed through intergovernmental negotiations and harmonised policies, creating a conducive legal environment for long-term cooperation.

Which areas of cooperation should be prioritised?

In terms of thematic orientation, the most promising and impactful areas of cooperation span across environmental sustainability, economic development, and social cohesion, all of which respond directly to regional needs and stakeholder expectations.

Environmental cooperation should prioritize the implementation of joint nature conservation standards, maintenance of ecological corridors for biodiversity protection, and monitoring systems for environmental risks. Reducing pollution and supporting the energy transition through renewable and low-emission energy solutions are also vital, especially in light of the region's ecological sensitivity.

Economic cooperation is expected to flourish particularly in sustainable tourism, grounded in local natural and cultural heritage, and in the development of circular economy models. Supporting innovation clusters, especially in areas like green technologies and agri-environmental solutions, can unlock the economic potential of rural and mountainous areas. Additionally, enhancing transport connectivity, including clean cross-border transportation and integrated ticketing systems, alongside improvements in digital accessibility, will address existing infrastructural gaps.

Social cohesion should be strengthened through cross-border educational programmes, youth and staff mobility, and joint training initiatives in key sectors like healthcare and environmental protection. Efforts to attract and retain skilled professionals in the macroregion, particularly in peripheral or underserved areas, will help counter demographic decline and labour shortages, while also fostering a shared Carpathian identity.

What recommendations can be given for policymakers at different levels to enhance territorial cooperation and good governance practices between authorities in the Carpathian area and also with the EU?

To enable the realisation of the above priorities, coordinated action by policymakers at all governance levels is crucial. At the European level, it is recommended that institutions support the Carpathian macroregion by formally endorsing and co-financing a dedicated Macroregional Strategy or establishing a transnational Interreg Programme. These instruments would provide a legal and financial framework for sustainable, long-term cooperation. Moreover, aligning existing EU funding streams with the specific needs of the Carpathian area would enhance access to resources and increase project effectiveness.

At the national level, governments are called upon to remove legal-administrative barriers, coordinate cross-border policies, and support pilot projects that test integrated solutions. National actors also play a vital role in engaging regional and local stakeholders, thereby anchoring macroregional goals in national development agendas.

At the regional and local levels, authorities should actively participate in thematic networks, foster people-to-people cooperation, and promote bottom-up initiatives aligned with strategic objectives. Promoting a shared narrative of the Carpathian macroregion, rooted in its unique identity and assets, will help cultivate ownership, visibility, and long-term commitment to transboundary cooperation.

By embedding these recommendations in policy and practice, and by aligning them with the ambitions of the EU Cohesion Policy and territorial agenda, the Carpathian macroregion can become a model of resilient, inclusive, and innovative cooperation, demonstrating how peripheral and ecologically sensitive regions can contribute dynamically to Europe's sustainable future.

Introduction

Mountain areas boast unique characteristics, mainly due to their geography, climate, nature, and human influence **(Drexler et al., 2016; Nordregio, 2004)**. These often encompass areas of great importance in terms of environmental protection, biodiversity and access to natural resources. What also plays an important role is the cultural aspect, as mountain regions are often home to unique cultures and traditions developed throughout generations. However, the geographical barrier that mountain ranges often represent poses a challenge for the forging of efficient 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 essential 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)**. Not rarely does this require territorial cooperation, including cross-border collaboration, construed as one of the forms of international cooperation, with particular respect to actions and measures geared at reducing development barriers created by the presence of state borders **(Medeiros, 2018)**.

Territorial cooperation in mountain areas occurs at various levels; from local, through regional, to international cooperation between countries that share a 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 the key actors promoting cooperation in these areas. In order to tap into the cross-border potentials and tackle issues affecting 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 the sole one pertaining to a mountain area – the Alpine region (2015) **(Sielker and Rauhut, 2018)**. To date, efforts have been made to create a similar strategy for the Carpathian Mountains, the second-largest mountain system in Europe (after the Alps), which covers – with adjoining territories – regions in five European Union (EU) member states, i.e. Poland, the Czech Republic, Slovakia, Hungary, and Romania, and three non-EU countries, i.e. Serbia, Ukraine, and 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 aforementioned 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, for instance, 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 cross-border cooperation groups in the Carpathians. Alongside these, 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 Carpathian Strategy draft. 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 have been carried out in a bid to select 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 existing knowledge on the socio-economic processes germane to the macroregion, all the while taking into account their spatial context. On the other hand, the review indicates the need to propose appropriate measures to sort out the existing problems and seize available development opportunities. This allows for the formulation of two general objectives for this research and a number of research questions (Fig. 1.1):

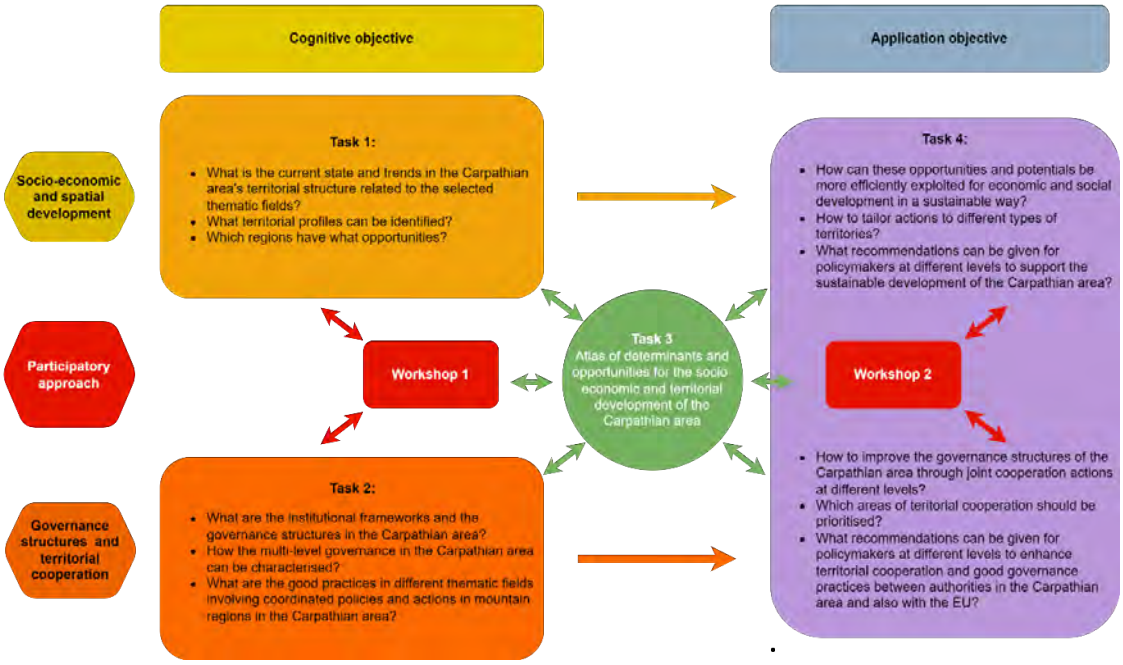
1) Cognitive objective – create new evidence for the Carpathian area by identifying territorial development challenges and opportunities for different types of regions based on multi-dimensional analysis of selected themes.

2) Application objective – provide recommendations for policymakers, 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 this research took stock of the existing body of knowledge related to the Carpathian macroregion **(e.g. Diagnosis, 2017; Strategy, 2018)**. This enabled the identification of research gaps, as well as helped expand the analyses in particular thematic scopes by way of exploring the dynamics of development phenomena and trends in more extensive fashion than before. Efforts were made to map them at the lowest available level of territorial aggregation, including 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 mountainous areas and border areas, as well as comprehensive ones based on indicators attributed to particular development determinants. This laid the groundwork for assessing the challenges and opportunities pertinent to the distinct types of regions in the context of sustainable socio-economic development.

Against the backdrop of the second objective, the present study 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 the implementation of joint actions in the thematic areas of cooperation in the Carpathian Convention as well as other initiatives and activities. Stakeholder participation aided by a set of visual aids and heuristic facilitation contributed to territorial foresight and development scenarios, thus providing 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.



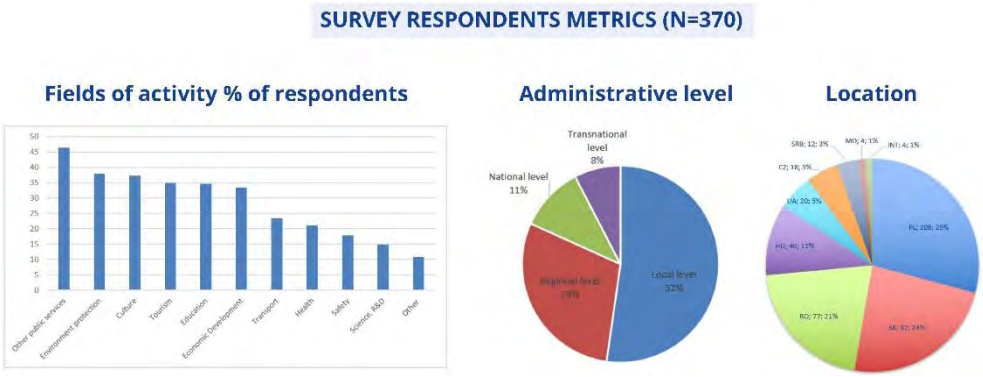
Source: Own elaboration.

Data collection for the Carpathian macroregion relied on a comprehensive approach that integrates 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 utilised 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, including the 9th Cohesion Report. To illustrate patterns of transnational cooperation in the Carpathian macroregion, the keep.eu data on European Territorial Cooperation (Interreg) were used as well.

The data were gathered also by means of the tools dedicated and developed for the KARPAT project included (1) on-line 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 for contact purposes: a) local, regional and national authorities from the Carpathian area, b) a database gathered as part of previous project on the actions under Macroregional Carpathian Strategy **(Smętkowski et al., 2022)**, c) project partners from the Carpathian macroregion in keep.eu database, d) key networking players in the Carpathian macroregion (e.g. Carpathian Convention, Euroregion, EGTCs), who were asked to distribute the survey among their partners and beneficiaries. As a result, a total of 370 responses were collected (Fig. 1.2). In-depth interviews were conducted with 11 respondents including CoR – the 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 - regional stakeholders at different level - in total 100 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 capitals; secondly, it explores the interactions between these capitals, 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. The fourth chapter outlines spatial development visions for the Carpathian macroregion,

based on the findings of Chapters 2 and 3, as well as their implications for selected functional areas, for which appropriate territorial guidance is proposed. Chapter five discusses the governance structure in the context of territorial cooperation, while Chapter six 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. These insights form the basis for the recommendations on governance and territorial cooperation presented in Chapter eight, which also take into account the good practices of territorial cooperation summarised in Chapter seven.

1 Carpathian macroregion – study area delineation

The Carpathians make up 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 form one of the longest mountain chains in Europe, second only to the Alps, with the highest peak being Gerlach (2,655m above sea level), located in the Slovak Tatras. The Carpathians are marked by diverse landscapes, ranging from high mountains with alpine climates to forested ranges and valleys. This region holds high 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.

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

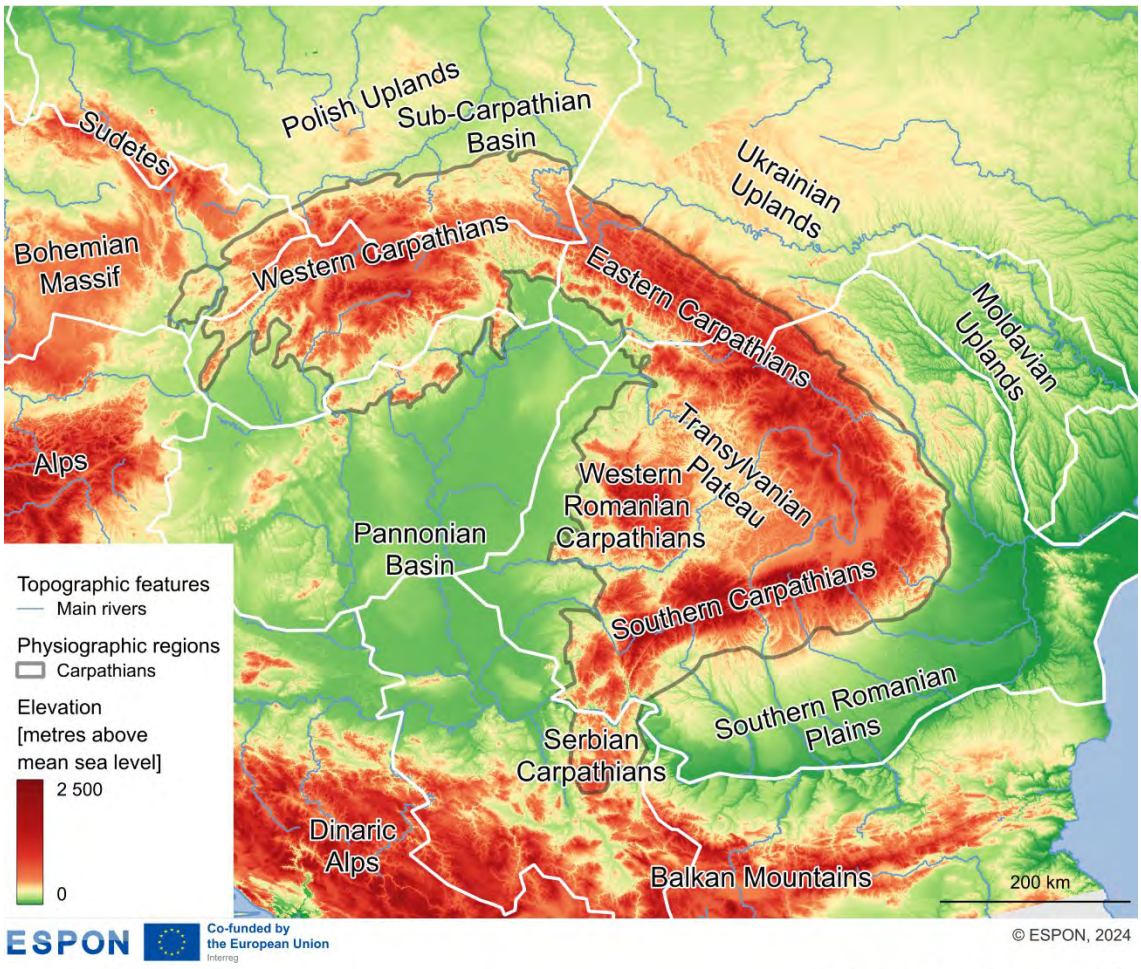
- Western Carpathians, located in the Czech Republic, Poland, Slovakia, and Hungary, consisting of the Outer Western Carpathians, Central Western Carpathians, and Inner Western Carpathians, surrounded to the northwest by the Western Outer Subcarpathia and to the north by the Northern Outer Subcarpathia;
- 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 abounds in an extensive river network, with the most significant ones either originating in the Carpathians or fed by tributaries flowing from the Carpathians, including the Morava (CZ, SK, AT), Vistula River (PL), San (UA, PL), Dniester (UA, MD), Prut (UA, MD, RO), Siret (UA, RO), Mureș (RO, HU), Tisza (UA, HU, RS), Olt (RO) Timiș (RO, RS); Váh (SK), Great Morava and South Morava (RS), and 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. 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 *macroregiunea* in Romania and *tervezési régió* in Hungary, or purely statistical units in the Czech Republic, Slovakia, and Serbia (except for the Autonomous Province of Vojvodina). Meanwhile, the Republic of Moldova can be treated as a single NUTS2 region, akin to the Baltic states. In most other Carpathian countries, the primary administrative regional structure is organised at the NUTS3 level. This includes *kraje* in the Czech Republic, *kraje* in Slovakia, *megyék* in Hungary, *județe* in Romania, and *okruzi* in Serbia. In Poland, however, the NUTS3 level serves exclusively a statistical function, much like in the Republic of Moldova. In the latter country's case, though, 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 paucity of available statistics at this level, in particular for the period preceding the reform, Ukrainian oblasts are often treated interchangeably as NUTS2 or NUTS3 units in analyses, including in this study, as it is prevalent in many other studies.

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

The delimitation of the Carpathian macroregion is not entirely unambiguous. This is due to the fact that different potential approaches to the region may be a 'cognition' region – defined by its characteristics and interactions, an 'action' region – 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:

- 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) that in general follow Carpathian Convention area,
- Adjacent regions: areas adjacent to the Carpathian Mountains: a) ones that are part of NUTS2 regions (in the case of EU countries) that comprise some NUTS3 from the first category, b) other surrounding NUTS3 regions (or equivalent in non-EU countries) which rivers originating in the Carpathian Mountains flow through.

Map 1.2
Territorial coverage of Carpathian macroregion – study area

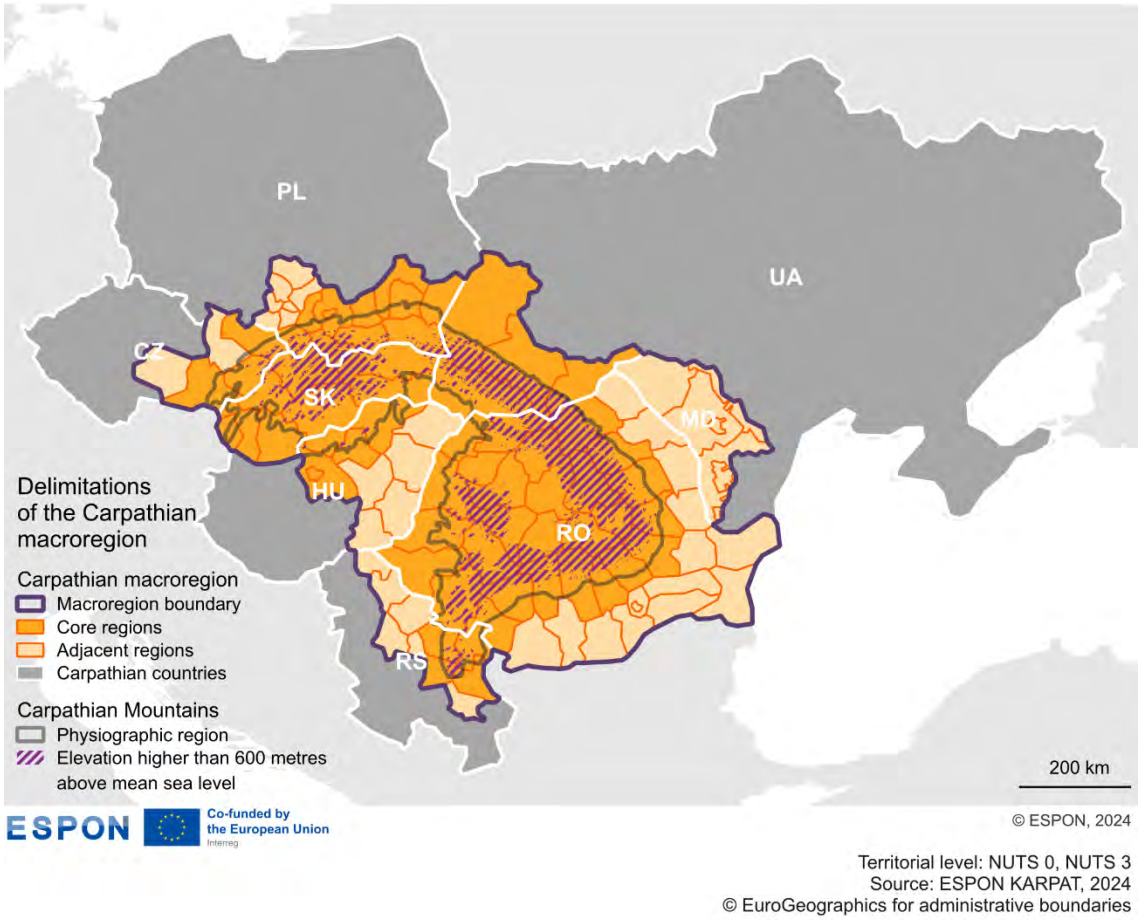


Table 1.1
Population in Carpathian macroregion, 2023

Country	Total	Carpathian macroregion		Core regions		Share %	
	population in million	in million	% country	in million	%	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.

Thus delimited macroregion [1] comprises eight countries, including seven signatories of the Carpathian Convention alongside the Republic of Moldova **(Map 1.2)**. The region under study 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.

The Carpathian macroregion based on the above-mentioned criteria boasts a population of 57 million people, with about two-thirds living in NUTS3 regions classified as core **(Table 1.1)**. The large populace of the macroregion, accounting for about 40% of the total population of the Carpathian countries, is largely driven by 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, with 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 house around 15% of Ukrainian populace. In terms of the percentage share in the macroregion, Romania's population stands particularly high – about one-third, followed by Poland (17%), whereas Hungary, Ukraine, and Slovakia have a share of around 10%, and the Czech Republic's represents a mere 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%.

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

2 Determinants of Carpathian macroregion development

2.1 Natural and human geographies

This subchapter offers an overview of the key environmental, infrastructural and cultural features of the Carpathian macroregion. It explores the natural environment, with a focus on biodiversity, protected areas, and selected pollution issues. It also examines the primary economic sectors, energy production—including renewables—settlement patterns, transport infrastructure, and the region's cultural heritage and tourism assets. Collectively, these dimensions provide a broad insight into the region's core development potential and spatial diversity. The full analysis is available in the Scientific Report.

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.

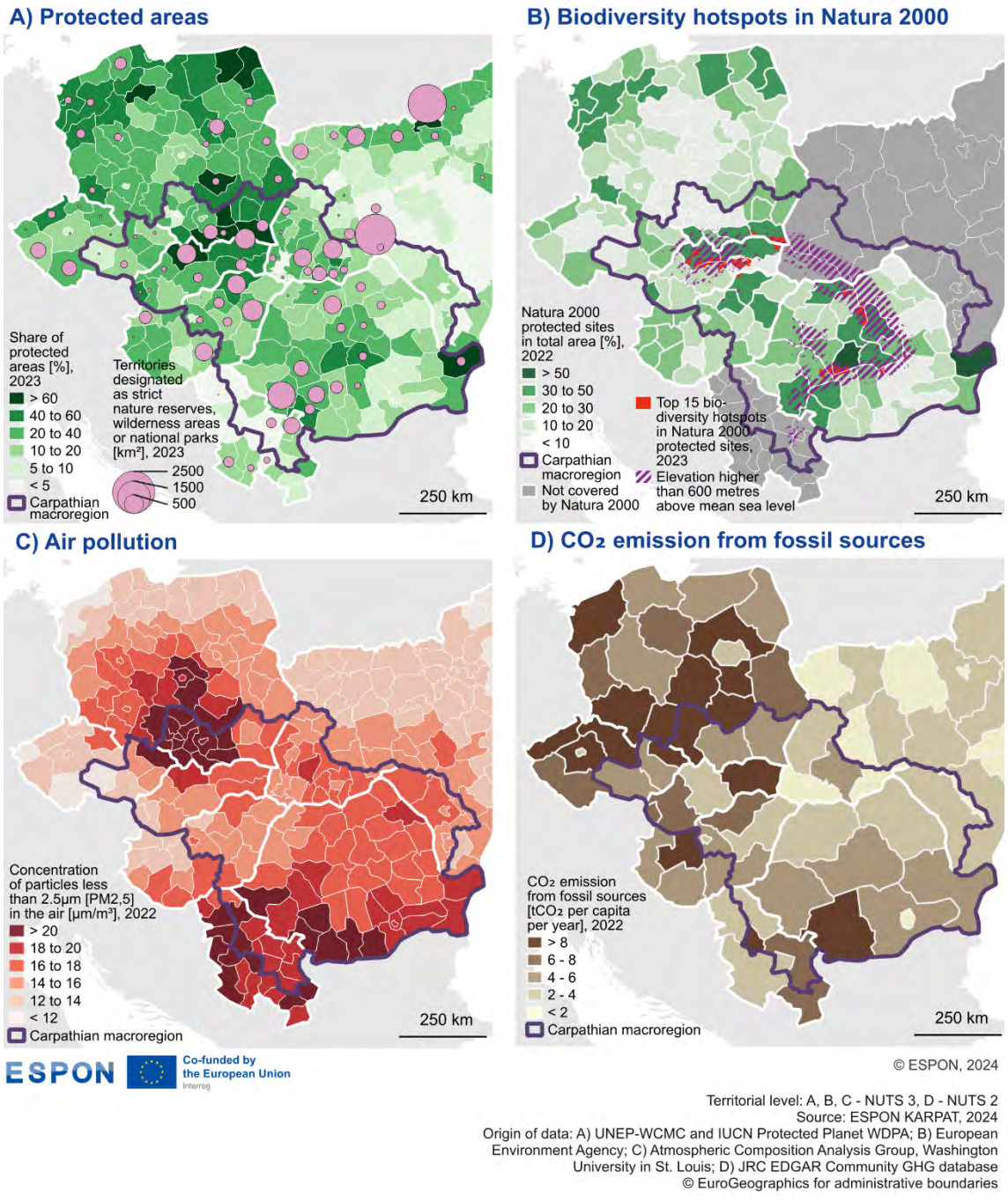
The Carpathian region's exceptional biodiversity calls for strong and effective protection. Each country applies its own system of protected areas, combining national categories (e.g. national or landscape parks) with internationally recognised networks such as Natura 2000 and UNESCO World Heritage sites. Protection regimes differ in scope and effectiveness, depending on designation type. As shown in **Map 2.1a**, the total share of protected areas can reach up to 75% in certain regions—such as Tulcea in Romania (Danube Delta), and Krośnieński and Nowotarski in Poland. However, **areas that meet strict IUCN protection standards are far less common, covering only around 9,000 km², mainly in Ukraine and Slovakia**. This highlights a potential gap in the actual effectiveness of biodiversity conservation.

Within EU countries, high protection rates are largely due to the Natura 2000 network (Map 2.1b), which on average covers 20% of Carpathian NUTS3 regions, so slightly above the EU average. The figure has remained stable since 2011 and is higher in core Carpathian areas, reaching 23.9% on average, but some regions have between 50% and 70% of their territory covered (e.g. Sibiu, Košický, Krośnieński, and Tulcea). The value of ecosystems protected within Natura 2000 sites is assessed by the presence of five high-importance indicator species and the site's conservation value for the concerned species. **The resulting biodiversity index highlights 15 major hotspots—six each in Slovakia and Romania, two in Poland, and one in Hungary—all located within the Carpathian core area**, though not always at high altitudes. Similar levels of biodiversity are likely present in parts of the Ukrainian Carpathians, though these areas are not covered in the current analysis as they lie outside the Natura 2000 network.

The quality of the environment is also shaped by pollution. Air pollution, particularly PM2.5, is the main environmental health risk in Europe, leading to over 100,000 premature deaths each year in countries such as Czechia, Hungary, Poland, Romania, Slovakia, and Serbia. **The WHO recommends annual PM2.5 levels below 5 µg/m³, but in the Carpathians, levels average 17.6 µg/m³, ranging from 10 to 30 µg/m³. The highest concentrations occur in coal-dependent regions like southern Poland, northern Czechia, Serbia, and southwestern Romania (map 2.1c)**.

CO_2 emissions from fossil fuels drive climate change and inform mitigation efforts. By 2050, the Carpathian region is projected to warm by 2.6–3.1°C, posing significant challenges for ecosystems and societies. Emissions in the area average 5.1 tonnes per capita—around two-thirds of the EU average. Coal is the most carbon-intensive fuel, and 14 of the 15 regions with emissions over 8 tonnes per capita have large coal power plants **(map 2.1d)**. In 13 regions within the Carpathians, industry is the main emission source, followed by transport (4 regions) and energy generation (3 regions).

Map 2.1
Natural environment, protected areas and pollutions

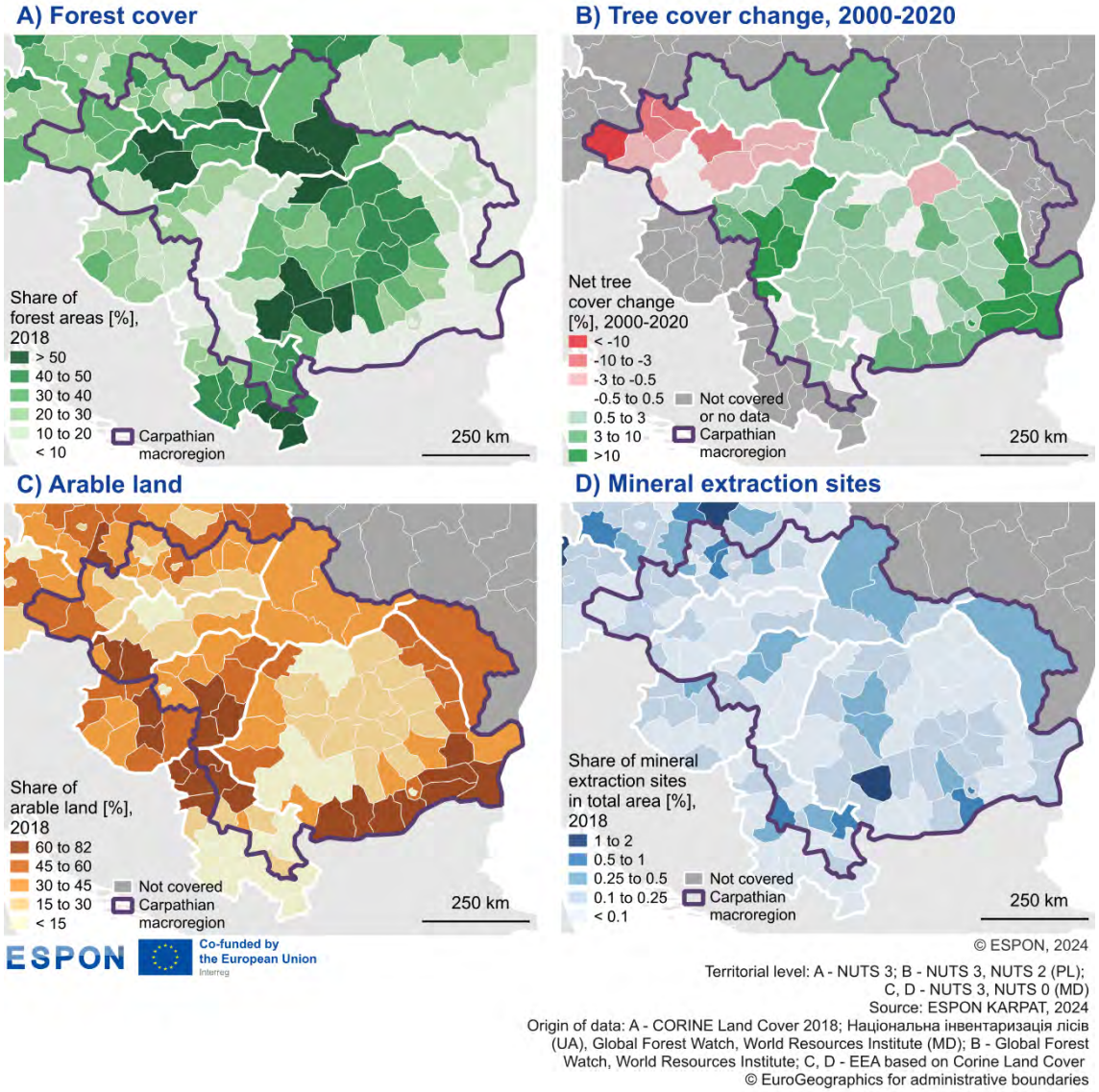


Primary sectors

The Carpathian macroregion's natural resources have traditionally been used for forestry, agriculture, and mineral extraction—still key sectors in less urbanised areas where primary sector jobs connect natural and human resources. Forestry remains economically important, affecting both carbon storage and ecosystem services. **Forest cover varies widely, exceeding 50% in some areas (Map 2.2a), while the least forested regions lie mostly outside the Carpathians, in the Pannonian Basin (Hungary, Romania, Serbia) and lowland areas in Romania and the Republic of Moldova.** Over the past two decades **(Map 2.2b)**, forest areas have grown fastest in low-cover regions like Hungary and southeastern Romania. Moderate growth is also seen in Romanian and Polish Carpathians (3–5% increase), while Slovakia and

Czechia face forest loss, mainly due to climate-driven die-off of spruce plantations. Beyond quantity, forest quality is also declining, especially in unprotected natural areas.

Map 2.2
Primary sectors: forestry and farming



A high proportion of arable land 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 (Map 2.2b). A similar situation is observed along the Prut River in Moldova and the Romanian part of Moldova, as well as in southern Moravia. 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 and Przemyśl. **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 Maramureș and Bistrița, 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

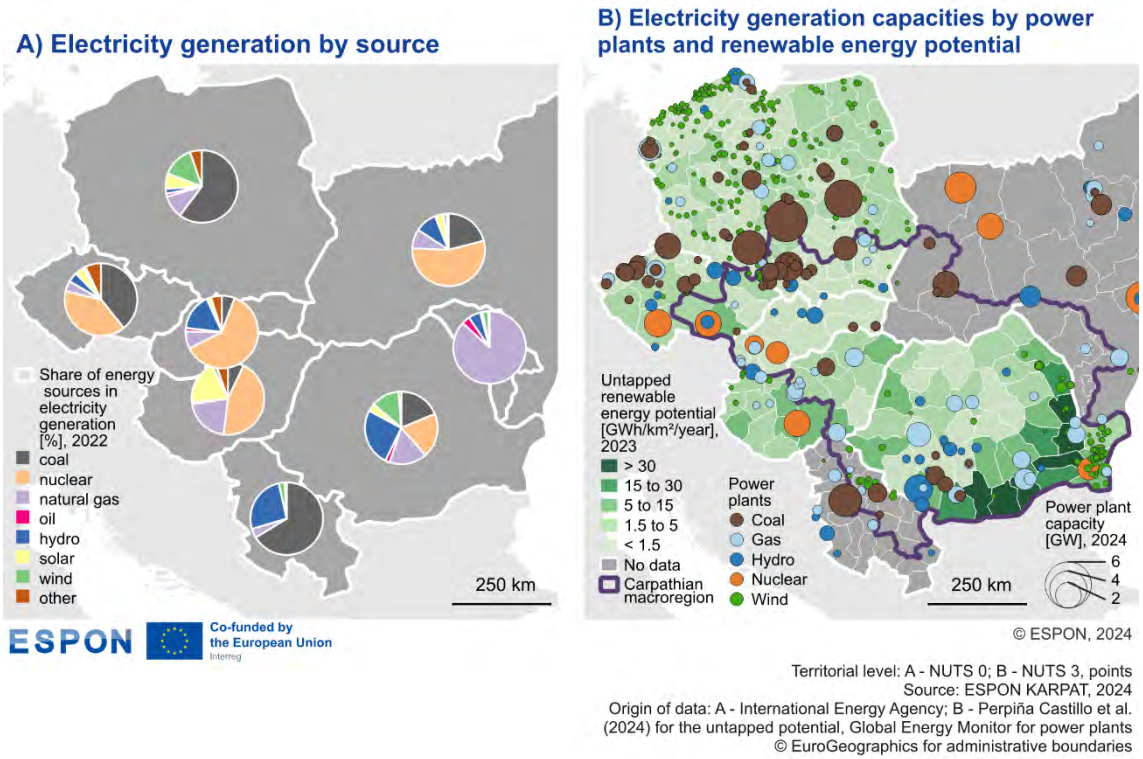
proportions of grasslands are also notable in the eastern parts of the country, particularly in the Moldovan regions along the Prut River.

Mining, particularly open-pit mining, imposes a significant burden on the natural environment. **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 (Map 2.2d).** 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. 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.**

Energy production and renewables

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 (Map 2.3a).**

Map 2.3
Energy production and renewables



Territorial level: A - NUTS 0; B - NUTS 3, points
Source: ESPON KARPAT, 2024
Origin of data: A - International Energy Agency; B - Perpiña Castillo et al. (2024) for the untapped potential, Global Energy Monitor for power plants
© EuroGeographics for administrative boundaries

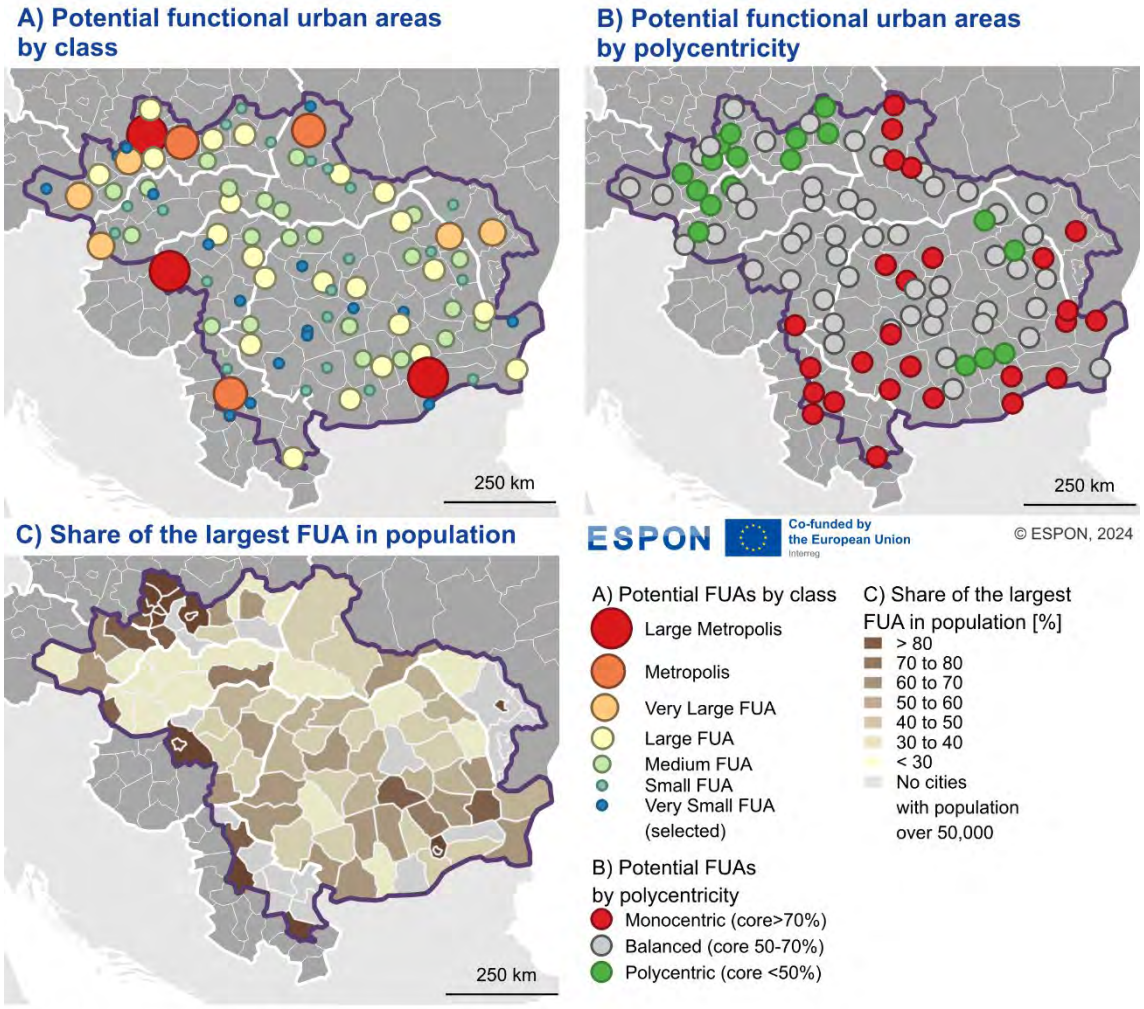
High share of coal translates to high carbon intensity of economy, which is the case of Poland, Serbia, but also natural gas-reliant the Republic of Moldova. **The transition to renewable sources is the most advanced in Romania (42% of electricity production derived from renewables) and Serbia, i.e. 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.

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 (Map 2.3b). 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 highlights opportunities for the region, most notably in south-eastern Romania.** Additional electricity production could mainly come from rural solar **photovoltaic** (PV) installations. The onshore wind, rooftop solar PV, and hydropower has much less potential in the region.

Settlement structure

Map 2.4
Settlement structure



Territorial level: A, B - LAU, C - NUTS 3
Source: ESPON KARPAT, 2024
Origin of data: Eurostat, census data in MD, UA
© EuroGeographics for administrative boundaries

The Carpathian macroregion exhibits a relatively polycentric settlement structure, marked by numerous functional urban areas (FUAs) with populations exceeding 250,000 (Map 2.4a). Although these

are geographically dispersed, they are unevenly distributed, with the largest cities mainly located on the macroregion's periphery. The densest urban network lies in the north-western part of the region, forming a pentagon between Katowice, Kraków, Budapest, Bratislava, and Brno.

A linear pattern of major urban centres also extends along the outer arc of the Carpathians, from Kraków to Bucharest via Lviv and Iași. By contrast, the inner arc contains fewer large cities, with notable centres including Cluj-Napoca, Brașov, Debrecen, and Košice. The classification of FUAs by size identifies six metropolitan areas with over 1 million inhabitants and five more exceeding 500,000, all playing key settlement and administrative roles **(Map. 2.4b)**. **In total, 23 FUAs have over 250,000 residents, suggesting that metropolisation processes—driven by population concentration and the growth of higher-order services—could involve at least 34 cities across the region.** Subregional urban centres with populations over 100,000 support these metropolitan areas by providing advanced public services. **Smaller cities (50,000+ inhabitants) may risk losing some functions to larger centres, yet remain vital for servicing their local hinterlands and offering employment, including in higher value-added sectors.**

Differences in suburban settlement patterns are visible between the northern and southern part of the macroregion (Map 2.4c). In the north (Poland, Czechia, Slovakia), urban centres are usually surrounded by dense peri-urban areas and small towns, while in the south and east (e.g. Romania, Serbia), population is more concentrated within central cities—often due to administrative boundaries that include rural zones. The economic structure of NUTS3 regions largely reflects the scale of their urban centres, with larger cities generating stronger agglomeration effects and higher productivity **(Map 2.4d)**. In cities like Budapest, Belgrade, Bucharest, Kraków, and Bratislava, the majority of the population resides in the core urban area or its immediate surroundings. Other cities with high urban population shares include Rzeszów, Brno, Debrecen, and Chernivtsi. In contrast, **some regions—especially in Slovakia (excluding Bratislava and Košice), eastern Poland, parts of Serbia, and parts of Romania—lack large urban centres or have a low urban population share**.

Transport infrastructure

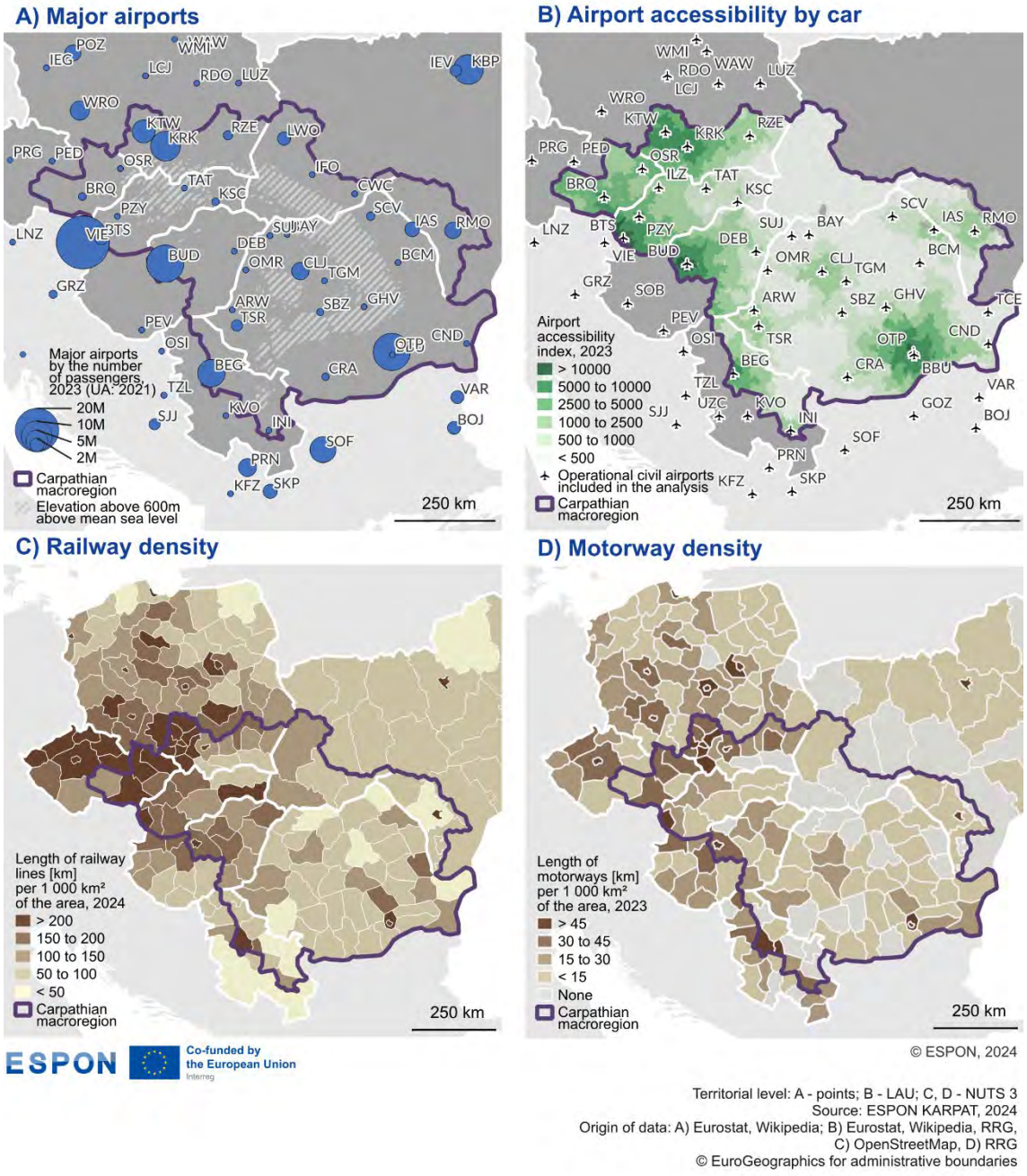
Transport infrastructure has been deemed a critical backbone for the economic and social integration within the Carpathian macroregion. Airports, railways, and roads connect urban centres with rural areas, facilitating the movement of people, goods, and services. These networks not only enhance the accessibility but also foster regional competitiveness and connectivity.

The Carpathian macroregion is served by central national airports such as Bucharest-Otopeni (OTP), Belgrade (BEG), and Budapest (BUD), alongside a network of regional airports (Map. 2.5a). **The role of regional airports is particularly significant in Poland, where Katowice-Pyrzowice (KTW) and Kraków-Balice (KRK) handle substantial passenger volumes—5.6 and 9.4 million respectively—serving not only southern Poland but also parts of Slovakia and the Czech Republic**. Some areas in these countries also fall within the catchment zones of Vienna (VIE) and Prague (PRG) airports. As a result, nearby regional airports in Bratislava (BTS) and Brno (BRQ) serve fewer passengers (1.8 million and 671,000 respectively). In Hungary, Serbia, and Moldova, air traffic remains highly centralised, with Budapest (BUD), Belgrade (BEG), and Chișinău (RMO) acting as dominant hubs. In contrast, several regional airports in Romania and Ukraine—such as Lviv (LWO), Cluj-Napoca (CLJ), Timișoara (TSR), and Iași (IAS)—have grown in both importance and passenger numbers since the early 2000s. **Air traffic across the macroregion has expanded rapidly since the early 2000s. The most significant improvements in accessibility between 2004 and 2023 were recorded in areas adjacent to the region's main airports, particularly on the macroregion's periphery (Map 2.5b)**. The development of Cluj-Napoca airport has also notably enhanced air connectivity in the central part of the region. Improved spatial, temporal, and financial accessibility has generally facilitated international tourism, business travel, and labour migration. However, the Russian invasion of Ukraine in 2022 led to the suspension of commercial air traffic within Ukraine, significantly disrupting connectivity in that part of the region.

The railway network in the Carpathian macroregion and its surroundings was historically shaped, largely in response to the region's poor transport infrastructure in the 19th century. In the Austro-Hungarian Empire, railway construction began in the mid-1800s to integrate various regions. One key project in the Carpathians was the Galician Iron Railway, connecting Vienna with Lviv, Kraków, and Przemyśl—

strategically and economically vital locations. Due to the mountainous terrain, railway construction in the Carpathians required significant engineering effort, involving tunnels, bridges, viaducts, and steep gradients.

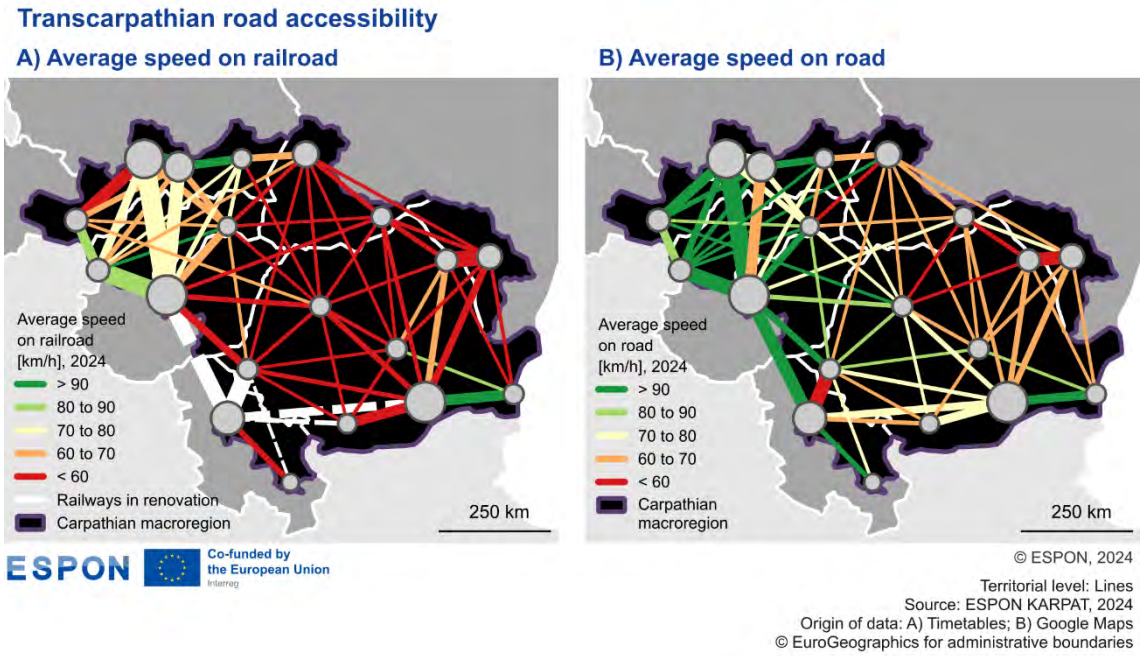
Map 2.5
Transport infrastructure: airports, railways, roads



Today, the railway network is structured around major latitudinal corridors. To the north, the upgraded E30 line—part of the North Sea–Baltic Sea corridor—connects Silesia with the Ukrainian border and extends via broad-gauge tracks to Lviv. To the south, the Rhine–Danube Corridor links Vienna, Bratislava, and Budapest with Oradea, Cluj, Brașov, Bucharest, and Constanța. An additional Rhine–Danube corridor runs via Ostrava, Žilina, and Košice. **Railway density within the Carpathians remains low, and existing infrastructure often fails to meet the transport needs of residents, businesses, and tourists—particularly in remote mountain areas (Map 2.5c).** Exceptions exist in selected zones, mainly along both sides of the mountain range and in the western part of the macroregion, where rail plays a more prominent role.

The road network in and around the Carpathian macroregion shows stronger development potential in areas adjacent to the mountain range that form natural transport corridors —particularly in the north (e.g. the A4 motorway from Silesia to the Ukrainian border) and the west (routes linking Silesia, Brno, Bratislava, Budapest, Belgrade, and on to Niš and the Bulgarian border). Additional corridors extend to the south (Craiova–Bucharest–Constanța) and the east (the under-construction A7 motorway from Bucharest to Suceava), forming a ring around the Carpathians. These developments reflect the expanding network of motorways and expressways. Breaking from this pattern are emerging routes within the Carpathians, notably in eastern Hungary and Romania's Transylvania region. Key projects include the D1 motorway in Slovakia (Bratislava–Košice) and A1 motorway in Romania (Timișoara–Alba Iulia–Bucharest), though both remain incomplete and lack direct cross-border connections. Nonetheless, Slovakia's D1 has cross-border potential through links to Poland, Ukraine, and Hungary, while Romania's A1 connects Bucharest with the Hungarian border. Other important cross-border sections—such as Bielsko-Biała–Žilina and Rzeszów–Prešov (part of the Via Carpathia initiative) and are in various stages of development. **Overall motorway and expressway density is highest in the northern and western peripheries (in geographical terms) of the macroregion, while eastern and parts of southern regions remain under connected, limiting their transport accessibility and development potential (Map 2.5d)**.

Map 2.6
Intermetropolitan connectivity in the Carpathian macroregion

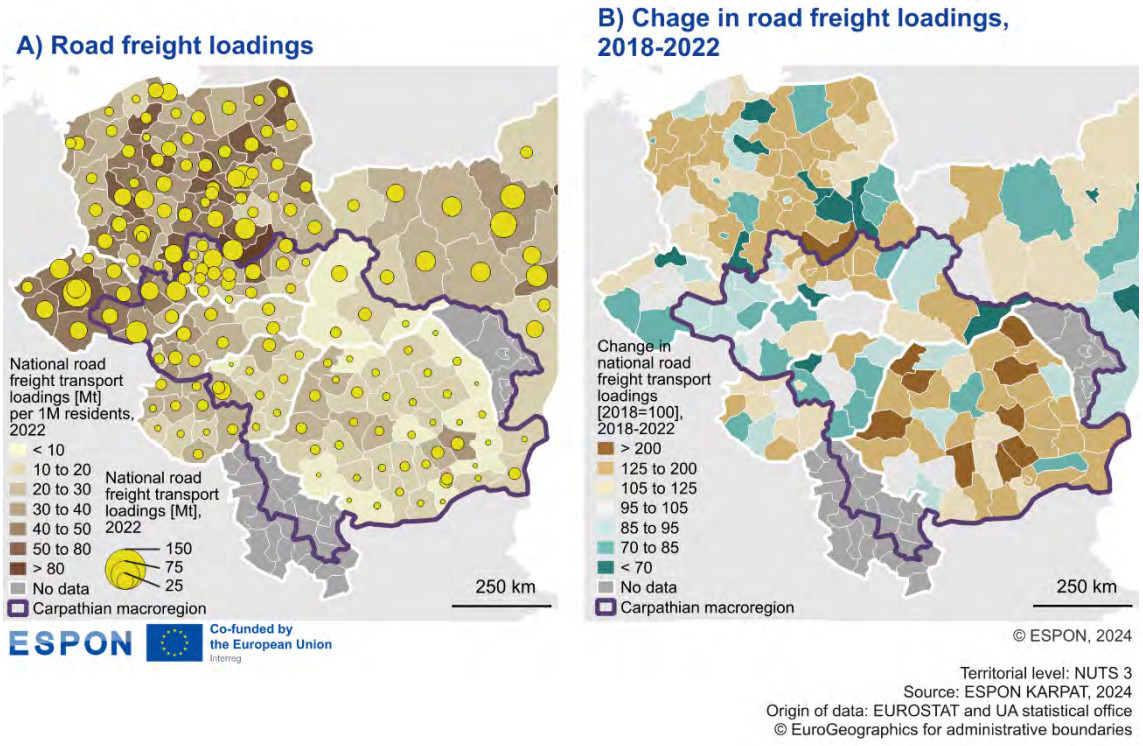


The structure of the railway network is clearly reflected in travel times between the main urban centres of the Carpathian macroregion **(Map 2.6a). Rail infrastructure is notably better developed in the western part of the region—particularly within the area bounded by the Upper Silesian Metropolis (Katowice), Ostrava, Bratislava, and Budapest. However, efficient travel generally requires routing around the Carpathians, as direct cross-mountain connections remain limited**. In central and eastern parts of the region, rail travel between major cities is slower, both in terms of speed and journey time. Modernisation is also underway on certain international routes, including connections between Serbia, Hungary, and Romania. The road transport network similarly influences travel times between urban centres **(Map 2.6b). The western macroregion—particularly the polygon formed by Katowice, Brno, Bratislava, and Budapest—has the most developed road infrastructure.** Still, travel often involves significant detours to access high-speed roads, as seen in the route from Katowice to Budapest. **In the eastern part of macroregion, travel times are significantly longer due to infrastructure gaps and the natural barrier of the Carpathian Mountains. This is especially evident in Ukraine, the Republic of Moldova, and eastern Romania.** Similar issues

exist in the southern part of the macroregion, affecting links between Serbian and Romanian cities, as well as in the north, between Polish and Slovak urban areas. In lowland regions, such as the Republic of Moldova and adjacent parts of Romania, shorter distances help mitigate travel times.

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 grown rapidly, fuelled by the expansion of warehouse logistics and evolving trade models. However, per capita freight volumes vary considerably across NUTS3 regions in the macroregion **(Map 2.7a)**. Western regions—especially in Romania, Slovakia, the Czech Republic, and Hungary—generally see higher volumes than eastern areas, due to stronger trade links and foreign investment. In Poland, the pattern is more mixed, but Carpathian regions remain relatively peripheral. In Ukraine, western regions play a small-er role in freight activity compared to the centre and east of the country. Between 2018 and 2022, freight volumes increased notably in Polish and Romanian regions **(Map 2.7b)**, though growth was uneven. Mountainous areas in Lesser Poland and eastern Hungary saw stagnation or decline, as did parts of the Czech Republic and Slovakia—except for Banská Bystrica. In Ukraine, trends varied: Zakarpattia and Ivano-Frankivsk recorded growth, while Lviv and Chernivtsi experienced declines.

Map 2.7
Freight road transport



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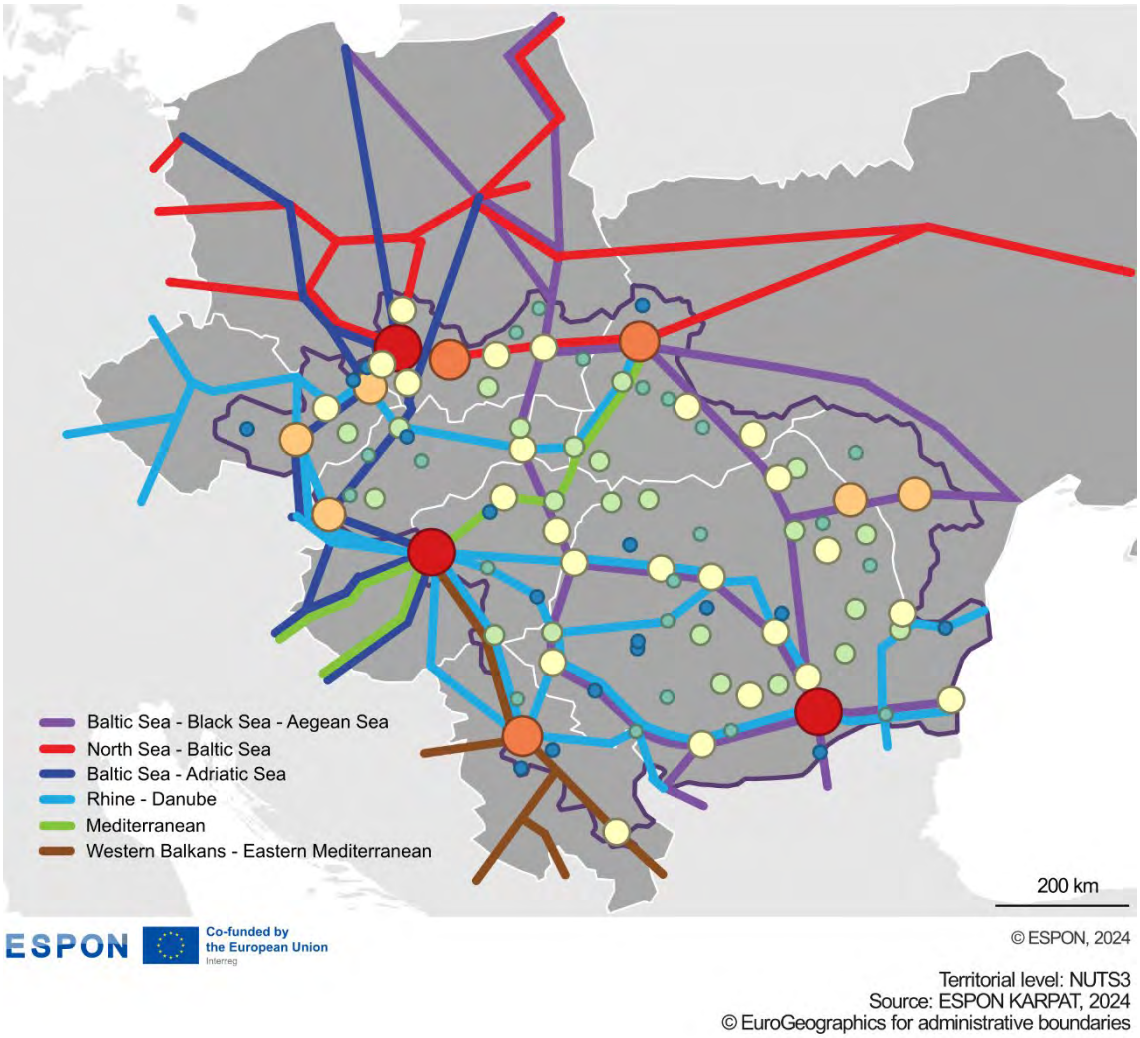
Improved transport accessibility in the Carpathian macroregion is closely linked to the development of the Trans-European Transport Network (TEN-T)—a strategic EU initiative aimed at creating an integrated, efficient, and sustainable transport infrastructure across Europe both within the EU and with neighbouring countries. **The 2024 revision of the TEN-T framework reflects changing economic and geopolitical conditions, including EU enlargement as it adds key transport corridors connecting the EU with Ukraine, Moldova, and the Western Balkans, significantly impacting the Carpathian macroregion. (Map 2.8)**. These corridors now reshape the transport structure within the region and can be broadly divided into two categories: longitudinal corridors crossing the Carpathians, such as the Scandinavian–

Mediterranean Corridor (Via Adriatica) and the Baltic Sea–Black Sea–Aegean Sea Corridor (Via Carpathia); latitudinal corridors, including the Mediterranean Corridor (with a branch from Budapest to Lviv) and the Rhine–Danube Corridor. In addition, two corridors run along the outer edge of the Carpathians: the North Sea–Baltic Sea Corridor (with extensions toward Ukraine: Lviv, Kyiv, Mariupol) and the Western Balkans–Eastern Mediterranean Corridor. **The integration of these corridors positions the Carpathian macroregion as a strategic interface between the EU and its eastern and south-eastern neighbourhoods, with the potential to significantly enhance regional accessibility and connectivity.**

Map 2.8
Schematic TEN-T network in Carpathian macroregion

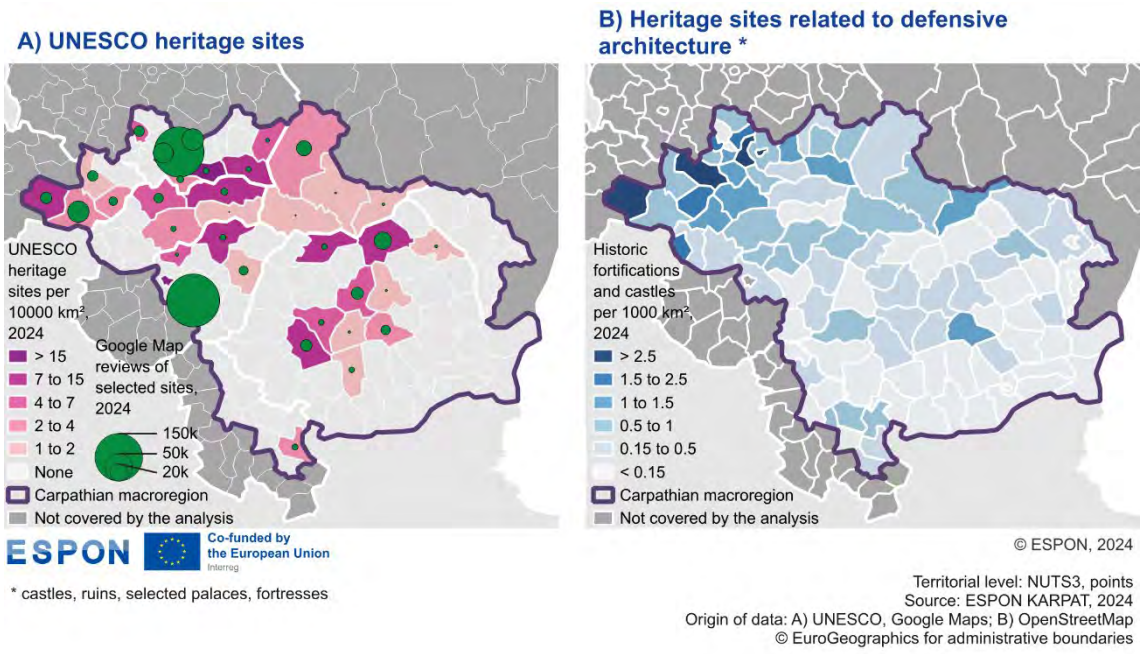


Cultural heritage and tourism

Tourism offers strong potential for the Carpathian macroregion, thanks to its rich natural and cultural heritage. **By 2024, 42 UNESCO sites had been designated, including three major area-based sites: Hortobágy National Park, the Tokaj Wine Region (HU), and the Ancient and Primeval Beech Forests (PL, SK, RO, UA).** Many sites form part of networks, including transnational totalling 90 locations **(Map 2.9a).** Wooden sacred architecture—such as churches in Poland, Slovakia, Romania, and Ukraine—accounts for 38 sites and may supports the idea of a trans-Carpathian UNESCO trail. **Google Maps review data show highest visibility/recognisability in Budapest, Kraków, and parts of Małopolska, Brno, Suceava, Lviv, and**

Transylvania. However, eastern and south-eastern Carpathian areas face challenges due to lower site density, weaker infrastructure, and limited visibility.

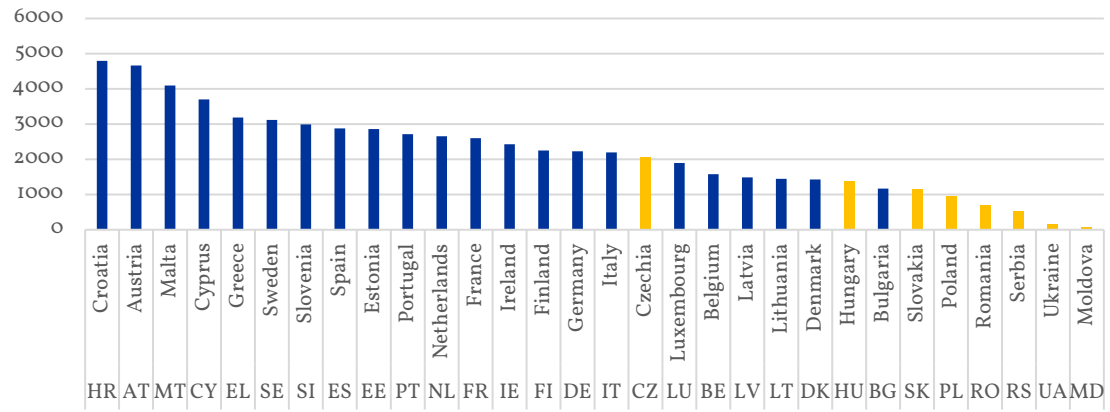
Map 2.9
Cultural heritage and tourism



Historic castles and fortifications form another important category of heritage assets, with the highest densities (over 2.5 per 1,000 km²) found in the Czech regions, as well as mountainous parts of Slovakia, Poland, Hungary, and Romania (particularly Brașov) (Map 2.9b). In contrast, the southern and eastern Carpathians exhibit lower site densities and less public recognition. Among the most recognisable landmarks are Wawel Castle (Kraków, PL), Bran, Peleș, and Corvin Castles (RO), Buda Castle (Budapest, HU), and Bratislava Castle. Accessibility and urban location are key factors contributing to their visibility. Most flagship landmarks are situated in highly urbanised areas, while sites located in mountainous regions remain less known and are often categorised as "supporting heritage sites." Despite the relatively high number of heritage sites in Ukraine, their recognisability remains low, whereas Romanian sites—particularly those in Brașov—enjoy comparatively greater visibility.

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 aarrivals (measured by the number of overnight stays per 1,000 residents) (Chart 2.1). This was particularly true for countries neighbouring the EU, especially Ukraine and 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 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. This indicates that these countries were catching up after a notable delay, driven largely by increasing wealth and the development of domestic tourism.

Chart 2.1
The number of tourists per 1,000 inhabitants, 2022



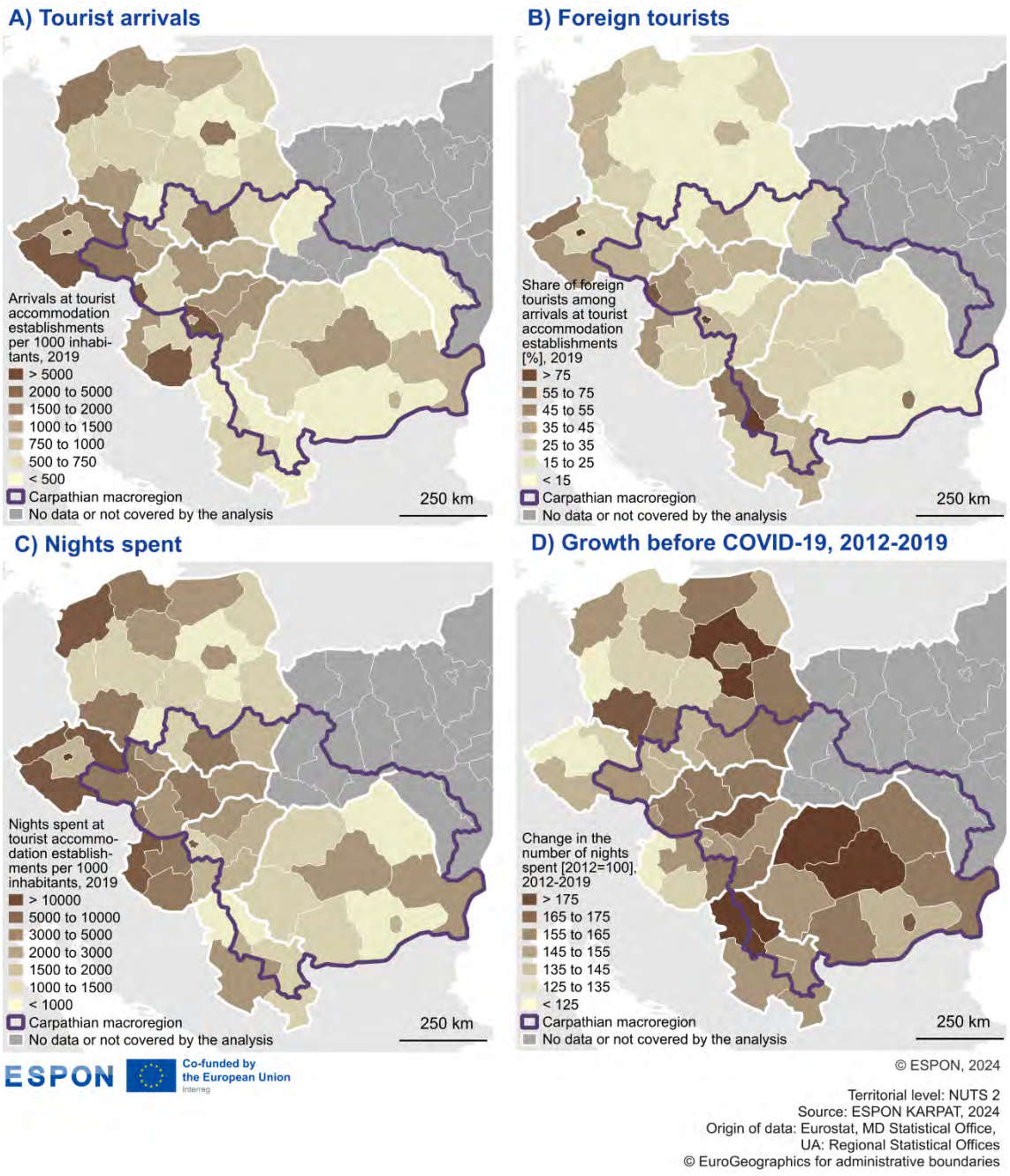
Source: own elaboration based on Eurostat
* for Ukraine data from 2021

Tourist activity in the Carpathian macroregion displays significant spatial variation, though it often matches or surpasses national averages **(Map 2.10a)**. **High tourism intensity—measured by overnight stays per 1,000 residents—is concentrated in major urban centres and their metropolitan regions, such as Bratislava, Budapest, Kraków, and Brno, where the annual average approaches two tourists per resident.** This trend is driven by the popularity of year-round city breaks and business tourism, alongside the natural and cultural assets of surrounding areas. **Outside urban centres, regions such as Central Slovakia, north-eastern Hungary, and Transylvania also report notable tourism levels, highlighting the enduring appeal of mountainous and foothill areas for spa, skiing, and hiking tourism.** In contrast, the lowland areas of Romania and the Republic of Moldova appear less attractive, especially when compared with Romania's coastal zones. In non-EU neighbouring countries, cross-border tourism may also be constrained by border formalities.

The level of tourism internationalisation varies considerably across the macroregion. **In some areas, the share of foreign tourists exceeds 50% (Map 2.10b), notably in metropolitan regions such as Budapest, Bratislava, and Bucharest, as well as in western Slovakia and Vojvodina in Serbia**. In the latter two cases, this may reflect low overall tourist numbers, with transit tourism inflating the share. Elsewhere in Slovakia, about one in three tourists comes from abroad, likely due to strong cross-border tourism with Poland and Hungary. A similar pattern is seen in Poland's Małopolskie region, supported by low-cost air travel and the region's tourist appeal. In contrast, foreign tourists account for less than 15% of visitors in other Carpathian areas of Poland, and in Moldova and Wallachia in Romania, and northern Hungary.

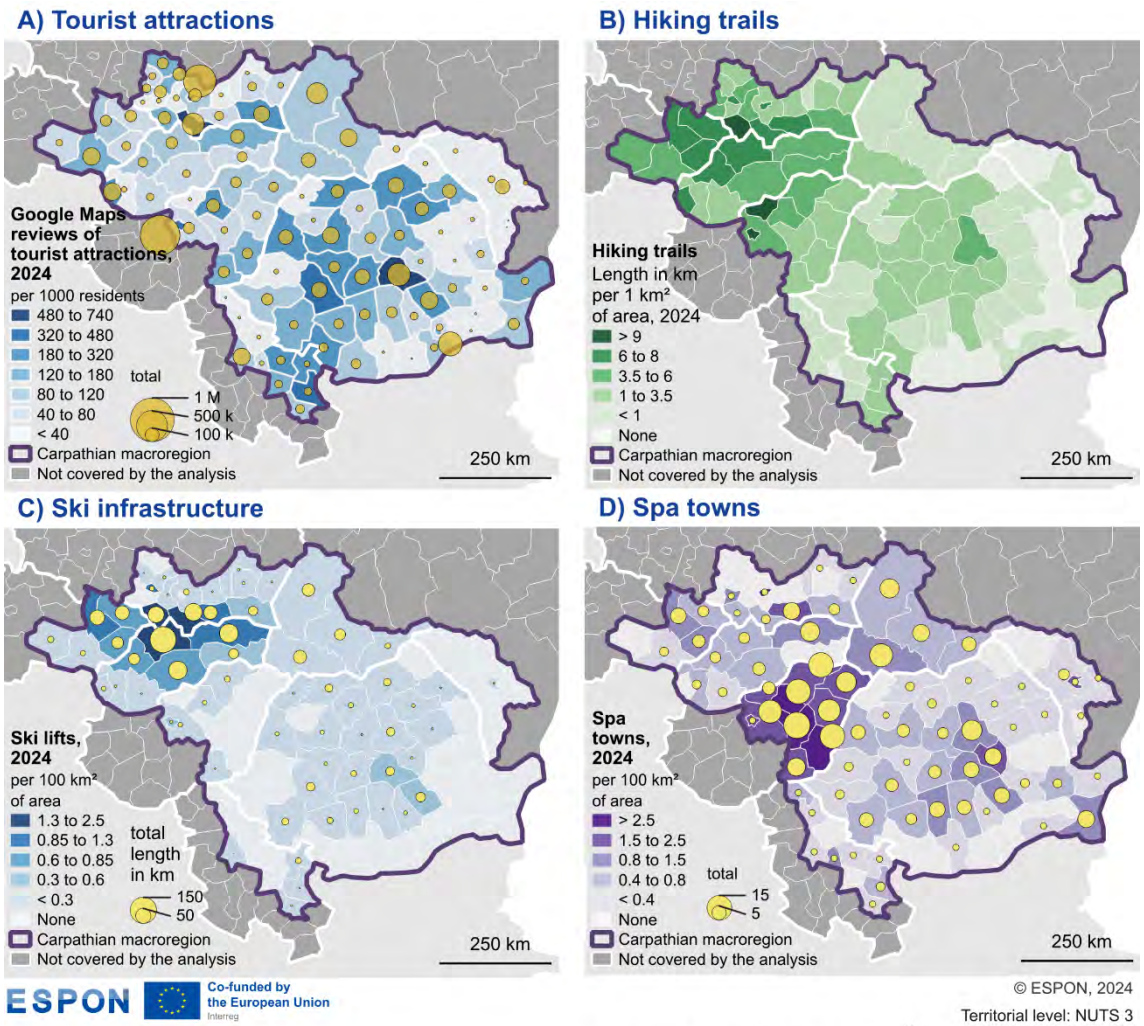
Tourism intensity, measured by the number of nights per capita, further highlights these interregional differences **(Map 2.10c)**, indicating that a higher number of tourists generally correlates with longer stays. **Tourism in the Carpathian macroregion grew rapidly between 2012 and 2019, the pre-pandemic period (Map 2.10d).** On average, **the number of nights increased by around 50%, with particularly high growth (over 65%) in central and north-western 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 2.10
Tourism – general statistics



Using Google Maps "tourist attraction" reviews to assess the attractiveness of NUTS3 regions in the Carpathian macroregion provides valuable insights (see methodology annex in the Scientific Report). **The total number of reviews highlights major cities—Budapest (over 800,000), Kraków (over 500,000), and Bucharest (almost 300,000)—as key tourist hubs, along with other large urban regions like Lvivska and Belgrade region (Map 2.11a).** However, when review density (per 1,000 inhabitants) is considered, **several mountainous areas also stand out, including Nowotarski and Krośnieński in Poland, Prešov in Slovakia, Heves in Hungary, and regions within the Carpathians, Transylvanian Plateau (notably Brasov and Hunedoara), and the Serbian Carpathians.** This suggests tourism in the macroregion extends beyond metropolitan centres, reflecting the appeal of natural and cultural heritage sites.

Map 2.11
Tourist attractions and selected infrastructure



Territorial level: NUTS 3
Source: ESPON KARPAT, 2024
Origin of data: A - Google Maps, B, C - OpenStreetMap, D - National Tourist Boards (CZ, PL, RS, SK, HU), Government Pages (UA), Wikipedia (MD), Silisteanu et.al, 2020 (RO)

This is also reflected in the diversity of tourist infrastructure across the Carpathian macroregion, including hiking trails, ski facilities, and spa resorts. **The region exhibits clear spatial patterns in the distribution of hiking infrastructure, with a marked concentration of trail networks in the Western Carpathians (Map 2.11b).** Ski tourism in the Carpathians is similarly concentrated in the western part of the macroregion. **A dense and varied network of ski resorts is found primarily in Slovakia, Poland, and Czechia, with additional clusters in selected regions of Ukraine and Romania (Map 2.11c).** These areas benefit from favourable terrain and established tourism facilities, supporting both domestic and international winter tourism. In contrast, the distribution of spa infrastructure is more varied **(Map 2.11d). Hungary clearly dominates in this area, owing to the accessibility of geothermal waters across the Pannonian Basin, which has historically underpinned the country's spa tourism. Nevertheless, several mountainous areas in Czechia, Poland, Slovakia, Ukraine, and Romania have also developed a strong specialisation in health and wellness tourism, supported by local mineral springs, therapeutic traditions, and an increasing demand for year-round relaxation-focused travel.**

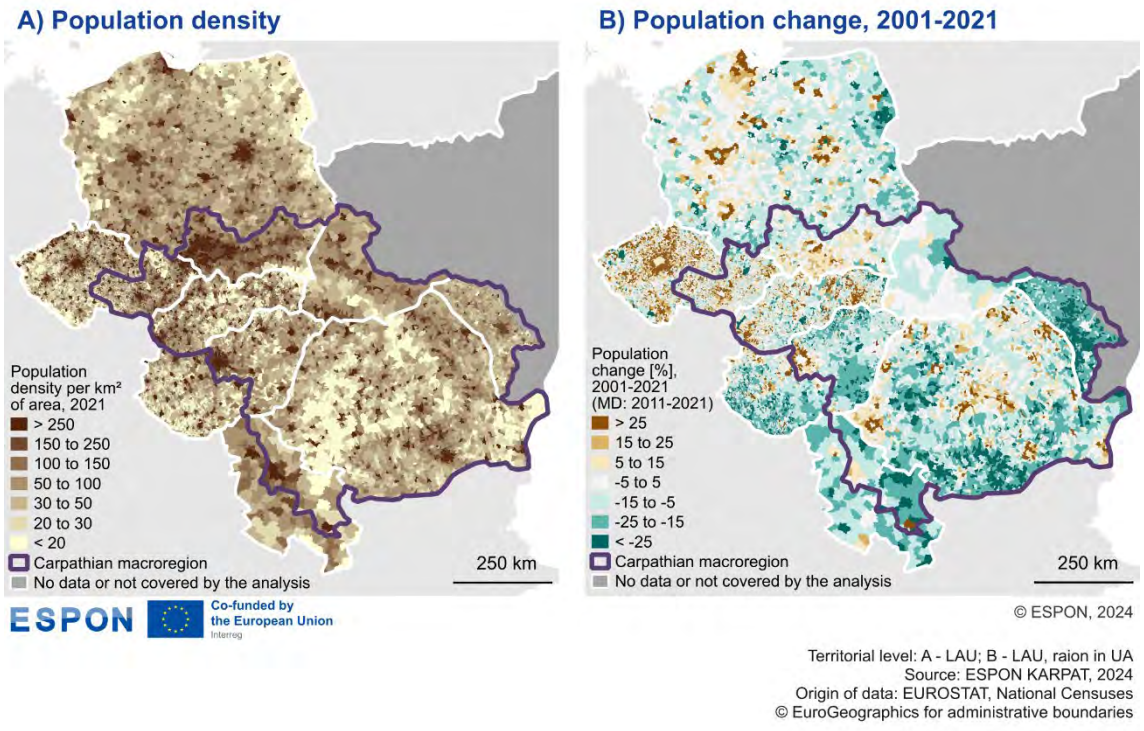
2.2 Demography and society

Demographic factors, including population density and migration patterns, are essential for understanding the diversity of areas within the Carpathian macroregion. Therefore, this analysis incorporates a range of indicators—such as population density, population change over time, migration and natural increase rates, and demographic structure—to offer a more comprehensive view of these dynamics. In addition to demographic aspects, social issues also play a key role. These include disparities in education levels, the quality and accessibility of public services such as housing, education, and healthcare—often influenced by transport mobility. Equally important are governance quality and levels of trust, which form a fundamental part of social capital. Below is a summary of the analysis results, along with a selected map. The full analysis is available in the Scientific Report.

Population density and demographic structure

The Carpathian macroregion has a population of 57 million, largely due to **major urban centres located in the mountain foothills, including capitals such as Budapest, Bucharest, and Bratislava**. However, population density varies greatly within the region, especially at more detailed levels of analysis **(Map 2.12a)**. The outline of the Carpathian mountain chain is clearly visible, as many **mountainous municipalities—particularly in Romania's Apuseni Mountains—have very low population densities, often below 20 persons per sq km**. In Slovakia, although many mountain municipalities also have low densities, there are notable exceptions—especially in the east—where densely populated valleys exist. These include former mining towns and Roma settlements. Generally, **the highest population densities are found in foothill areas along the outer arc of the Carpathians, stretching from Moravia through Silesia, Lesser Poland, and Podkarpacie in Poland and Ukraine, to Romanian Moldavia and Wallachia**. On the inner side of the arc, the Pannonian Basin shows the highest densities, covering parts of Hungary, Slovakia, Ukraine, Romania, Serbia, and sections of the Transylvanian Highlands.

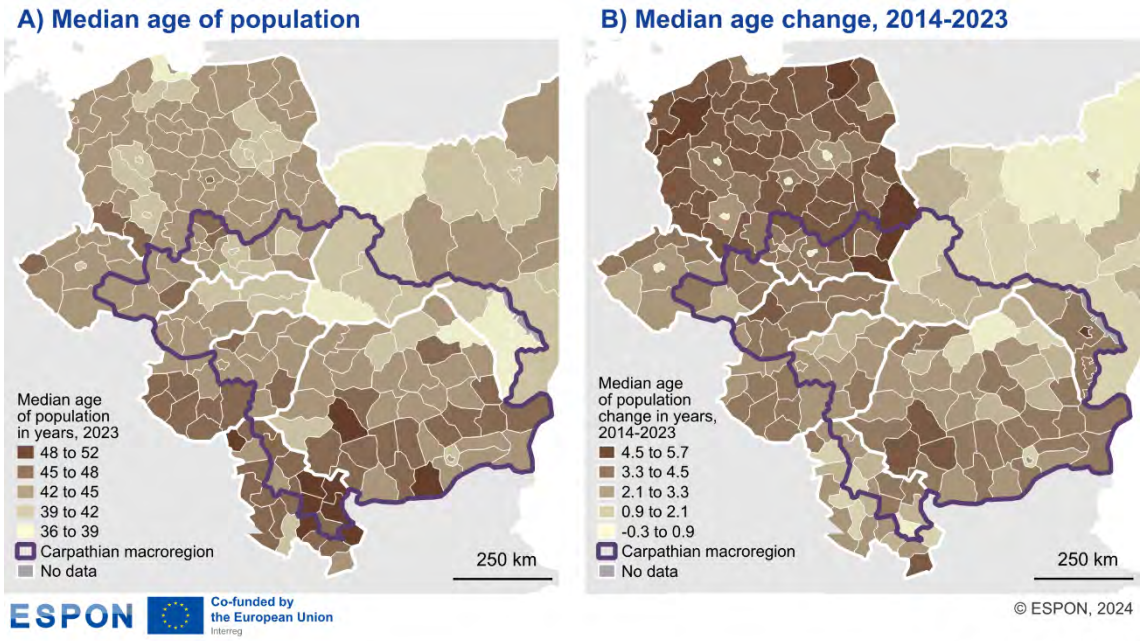
Map 2.12
Population density and population change



Although population density tends to change slowly, municipal-level data over the past two decades **(Map 2.12b)** reveal both areas of demographic decline and those of growth or stability. **Depopulation has been especially visible in mountain areas, notably in Serbia and the Western Romanian Mountains.** However, it has also affected almost all mountain regions to some extent—including northern Hungary—with the exception of certain parts of Poland and Slovakia. At the same time, **significant population decline also occurred in some rural areas**, particularly in southwestern Romania (outside major cities), southern Hungary (excluding Szeged and its surroundings), and in the Republic of Moldova. In contrast, the Romanian border region with Hungary has seen substantial growth, especially around major cities such as Timisoara, Oradea, and Satu Mare. This has been largely driven by **suburbanisation processes, which are most visible around major cities like Bratislava, Budapest, and Belgrade, but are also evident around other large urban centres in Poland, Slovakia, Romania, and the Czech Republic**.

Changes in population size may result from both the ageing 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, so the age that divides a 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 2.13a).** 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 in Romania (excluding Bucharest and Constanta), as well as the southern part of Romanian Moldova.

Map 2.13
Ageing process



Territorial level: NUTS 3
Source: ESPON KARPAT, 2024
Origin of data: EUROSTAT, MD & UA Statistical Offices; estimations for MD
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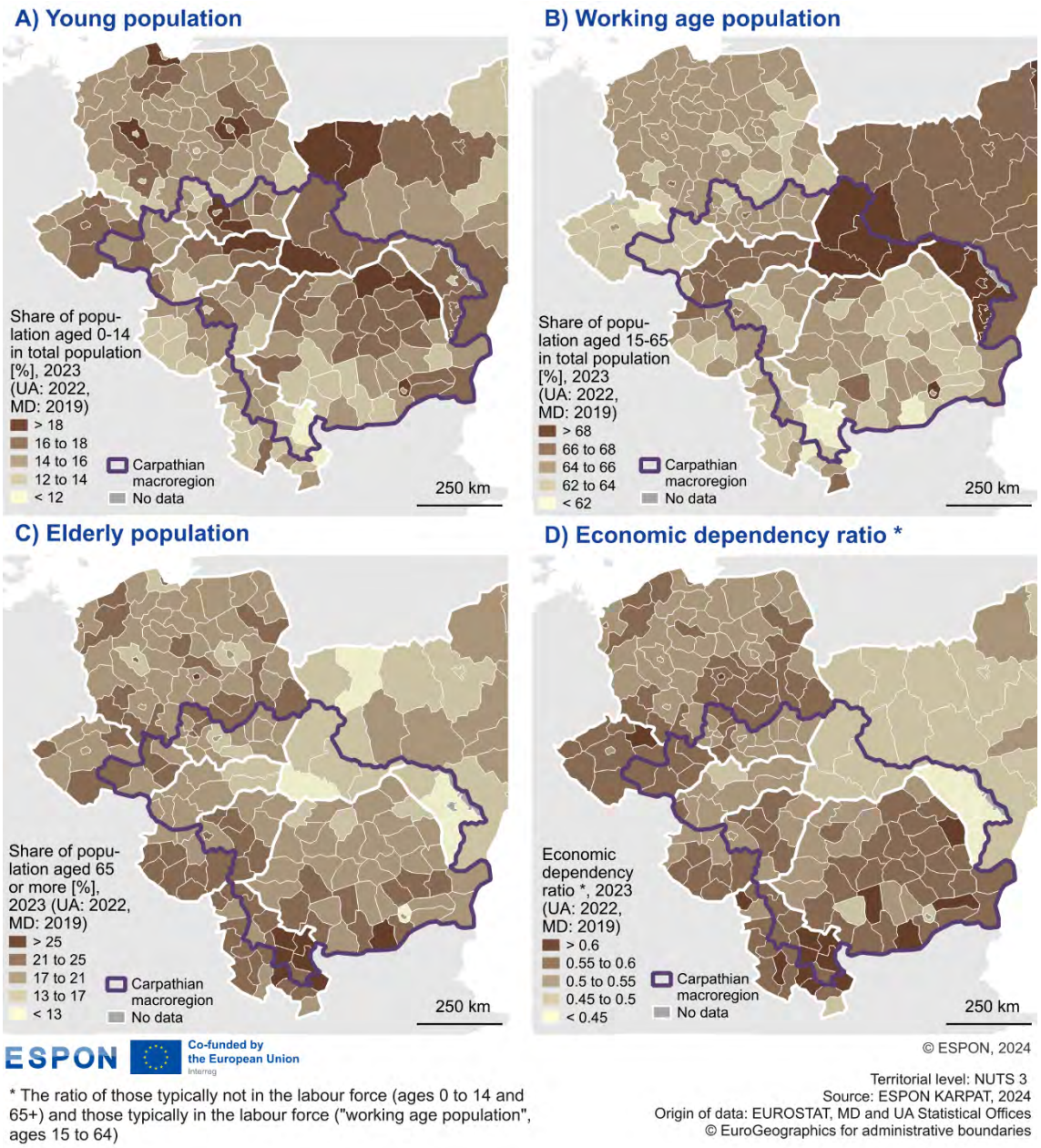
In the last decade, the median age of the population increased significantly in almost all regions, due in part to a decline in birth rates and an increase in average life expectancy. Population ageing was especially visible in two subregions of Poland's Podkarpackie Voivodeship, where the median age rose by over 5 years between 2014 and 2023 **(Map 2.13b).** 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 as well as Maramureș region in northern Romania. Meanwhile, in the mountainous regions of northern Hungary, Ukraine, and the northern part of Romanian Moldova, there the growth in residents' median age was lower.

Map 2.14
Population age structure



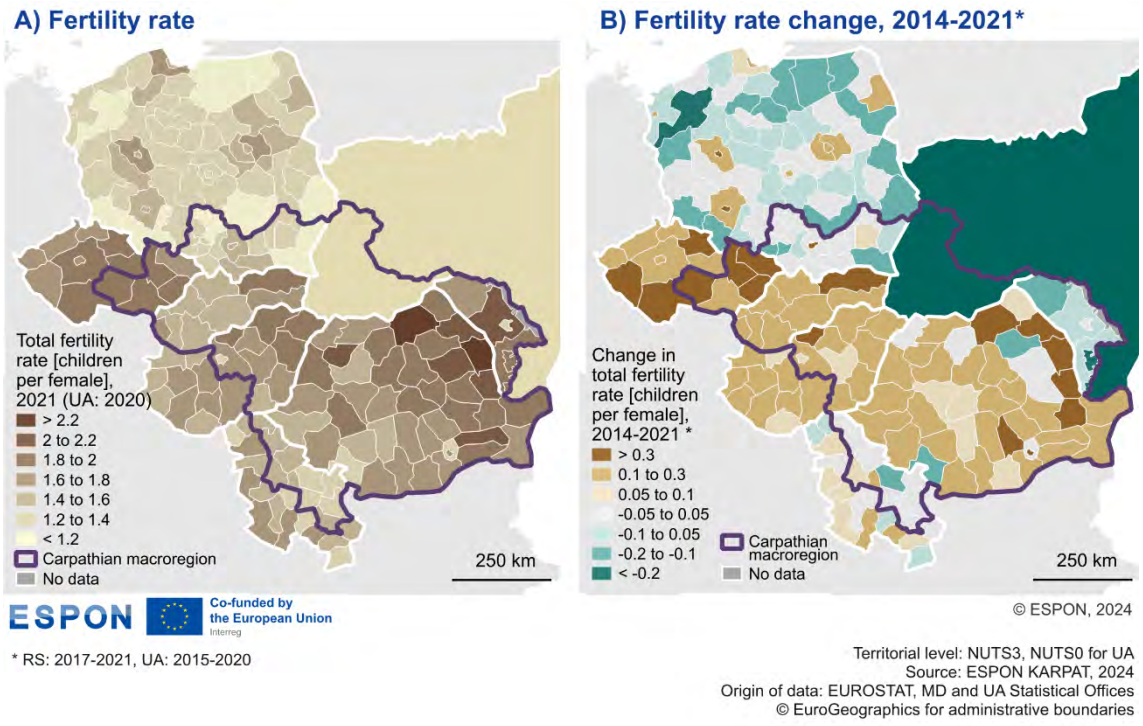
This ageing process is reflected in the population's age structure. The highest shares of people under the age of 15 (in some areas exceeding 20%) are found in the mountainous regions of the Western Carpathians along the Polish-Slovak border, as well as in the Eastern Carpathians in Ukraine and northern Romania **(Map 2.14a)**. Conversely, the highest proportions of people of working age (up to 65 years) are recorded in Ukraine and the Republic of Moldova, as well as in regions of Slovakia **(Map 2.14b)**. The largest shares of the retirement-age population (in some regions over 25%) are observed in Serbian regions, southern Romania, and

parts of eastern Hungary **(Map 2.14c)**. This is clearly reflected in the economic dependency ratio **(Map 2.14.d). In summary, the demographic situation across the Carpathian macroregion shows strong regional variation, which leads to diverse challenges for the education sector, labour market, housing, healthcare, and social security systems—depending on the specific area in question.**

Fertility rate, natural increase and migrations

Future demographic trends—aside from international migration, which plays a significant role—depend primarily on fertility rates. To ensure natural generational replacement, the fertility rate needs to exceed approximately 2.1 children per woman of reproductive age. However, **in the Carpathian countries, fertility rates remain well below this threshold, though with significant regional variation**. Indicator value suggesting the potential for generational replacement are found only in eastern Romania, and to a lesser extent in parts of the Republic of Moldova, the Czech Republic, and eastern Hungary **(Map. 2.15a)**. This has generally resulted from a marked improvement in recent years, particularly in the Czech Republic, Slovakia, Hungary, and Romania **(Map 2.15b)**. In contrast, fertility rates in Polish, Ukrainian, and Serbian regions have mostly declined, with only a few exceptions. In the Republic of Moldova, a slight decline has also been observed, although fertility rates have remained relatively high overall. Broadly speaking, both the pandemic and post-pandemic periods have tended to coincide with a worsening of the fertility situation across the region.

Map 2.15
Total fertility rate

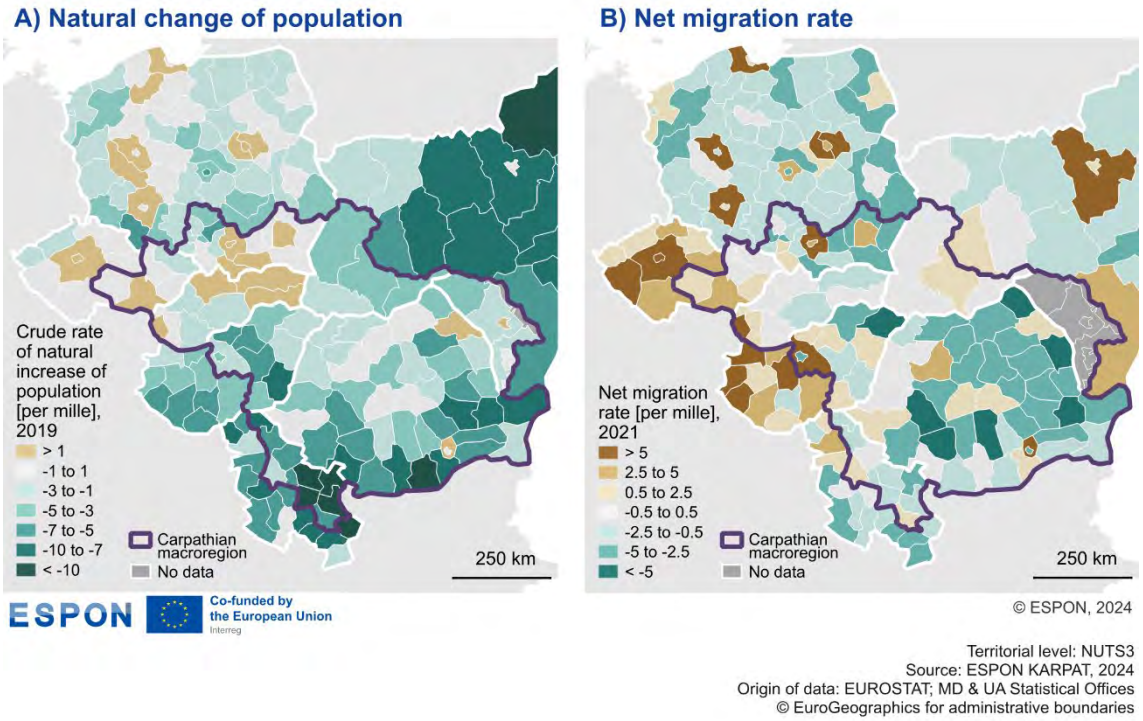


Natural population change in most Carpathian countries and regions shows a clear excess of deaths over births (Map 2.16a). In 2019, exceptions included eastern and northern regions of Slovakia, the Bratislava metropolitan area, the Małopolskie and Podkarpackie Voivodeships in Poland, selected areas of Romanian Moldova (e.g. Iași), parts of Transylvania, and the Bucharest metropolitan area. At the opposite end, Serbian regions and non-Transylvanian parts of Romania—particularly in the south—experienced a pronounced natural population decline. This trend did not worsen significantly compared to 2010, except in the Ukrainian regions, southern Romania, and the Krosno subregion in Poland. In some areas, such as north-eastern Hungary and parts of Transylvania, a slight improvement was observed. However, the post-pandemic

period brought a renewed natural decrease, particularly visible in Ukraine, Poland, western Slovakia, and selected regions of Romania and Serbia.

Given the limited natural population growth, migration flows play a crucial role in shaping population change (Map 2.16b). Migration includes both internal movements and net international migration. Internally, **two main processes dominate: suburbanisation around large cities, and outmigration from peripheral areas to major urban centres.** Internationally, there is an inflow of migrants from both developing and developed countries, mostly settling in large cities, helping to offset suburban population losses. At the same time, outward international migration—primarily to labour markets within the EU—continues to depopulate economically weaker, peripheral regions.

Map 2.16
Natural increase and migrations

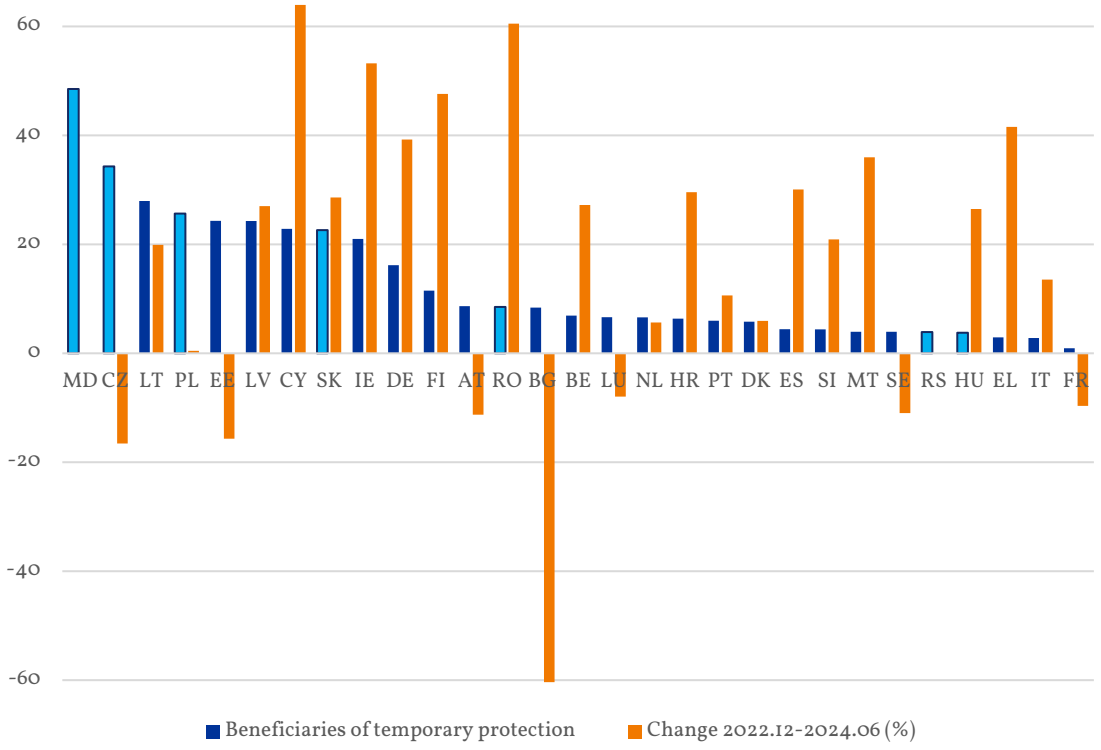


The most significant event affecting migrations in the macroregion was Russia's unprovoked invasion of Ukraine on 24 February 2022. By June 2024, around 4.3 million Ukrainians in the EU were under temporary protection, mostly in Germany (1.35 million), Poland (950,000), and the Czech Republic (350,000). **Per capita, the Republic of Moldova hosted the most refugees—about 50 per 1,000 residents - followed by the Czech Republic, Lithuania, and Poland (Chart 2.2). The Carpathian countries (excluding Ukraine) hosted in total 1.65 million Ukrainian refugees.** Apart from the countries mentioned above Slovakia also had a high per capita share (over 20 per 1,000), while Hungary and Serbia had fewer (approx. 4 per 1,000), and Romania hosted about 8.5 per 1,000. The war also triggered major internal displacement within Ukraine. By mid-2023, western **Ukraine's Carpathian regions had taken in around 530,000 internally displaced persons—about 10% of their 2021 population**—most notably the Lviv region, which received roughly over 250,000 people.

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.

Chart 2.2
Ukrainian refugees as beneficiaries of temporary protection per capita in European Countries, 2022-2024



Source: Own elaboration based on Eurostat

Education and human capital

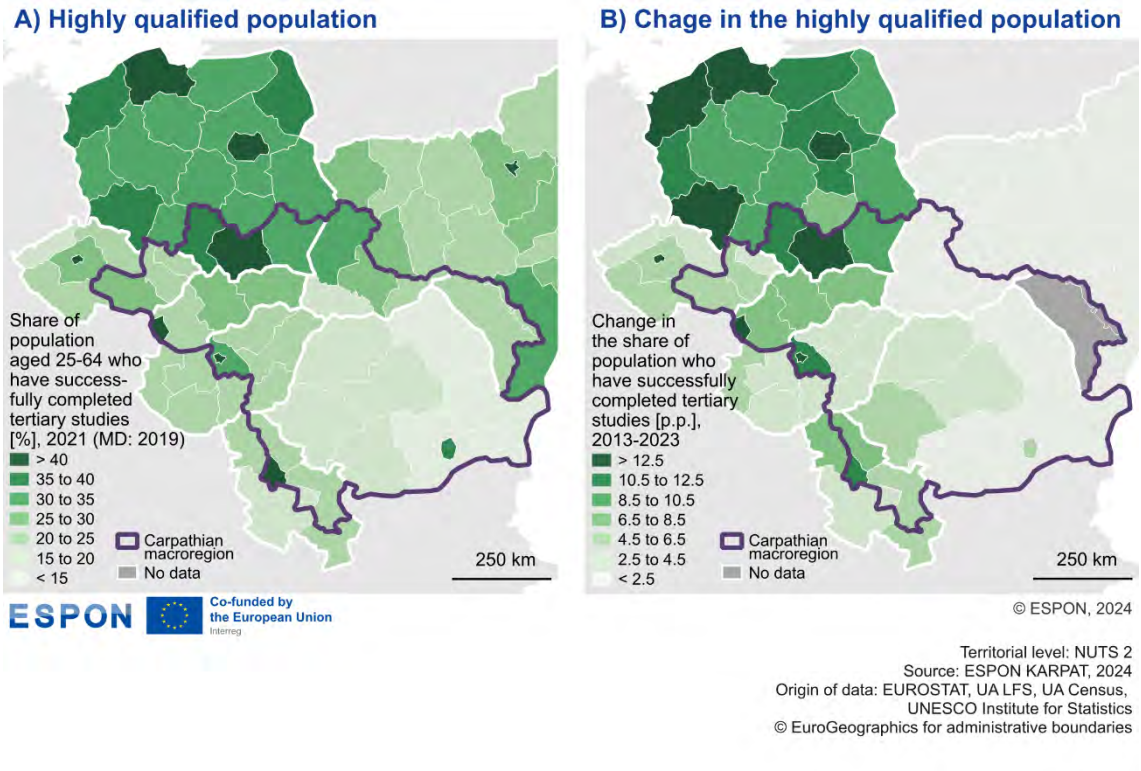
Compared to the average figures in European Union countries, the Carpathian countries display relatively low human capital potential, although this is highly diverse both between and within individual countries and regions. With the exception of Poland, all countries in this macroregion report a lower proportion of the population with higher education qualifications than the EU average. The lowest share of higher education graduates is recorded in Romania, where the rate for the 25–64 age group does not exceed 25%. **Metropolitan areas centred around the largest cities in the macroregion play a particularly important role in the concentration of human capital**—this is especially evident in cities such as Budapest, Bratislava, Belgrade, and Kraków, where more than 40% of the population holds a higher education degree. In contrast, in most regions of Romania, the proportion of university-educated residents does not exceed 20% **(Map 2.17a)**.

The educational structure of the population reflects past education policies, while current students' academic performance indicates the future quality of human capital. The OECD's Programme for International Student Assessment (PISA) survey provides internationally comparable data on the skills of 15-year-olds. **Map 2.17b** illustrates the wide variation in the proportion of students performing below the basic proficiency level in mathematics across the Carpathian countries. **The best outcomes are observed in Poland, the Czech Republic, and Hungary, where low-performing students account for less than 25% and 30% of the total**

student population, respectively. The situation is particularly concerning in the Republic of Moldova, where 55% of students fail to meet the basic proficiency level in mathematics. Romania and Serbia also report unsatisfactory results in this respect.

In the context of macroregional disparities, it should be assumed that conditions in less developed and peripheral regions are even worse than national averages, clearly highlighting the need to take action to improve the quality of primary education. This need becomes all the more urgent in light of the modest improvements in human capital in terms of higher education attainment, observed especially in the Polish part of the macroregion, and to a lesser extent in Slovakia and the capital regions of Budapest and Belgrade **(Map 2.17c)**. These gains are often accompanied by a simultaneous decline in students' academic performance, partly as a result of the COVID-19 pandemic. This trend affects all Carpathian countries but is particularly pronounced in Poland and Romania **(Map 2.17d)**.

Map 2.17
Human capital and education



Information society

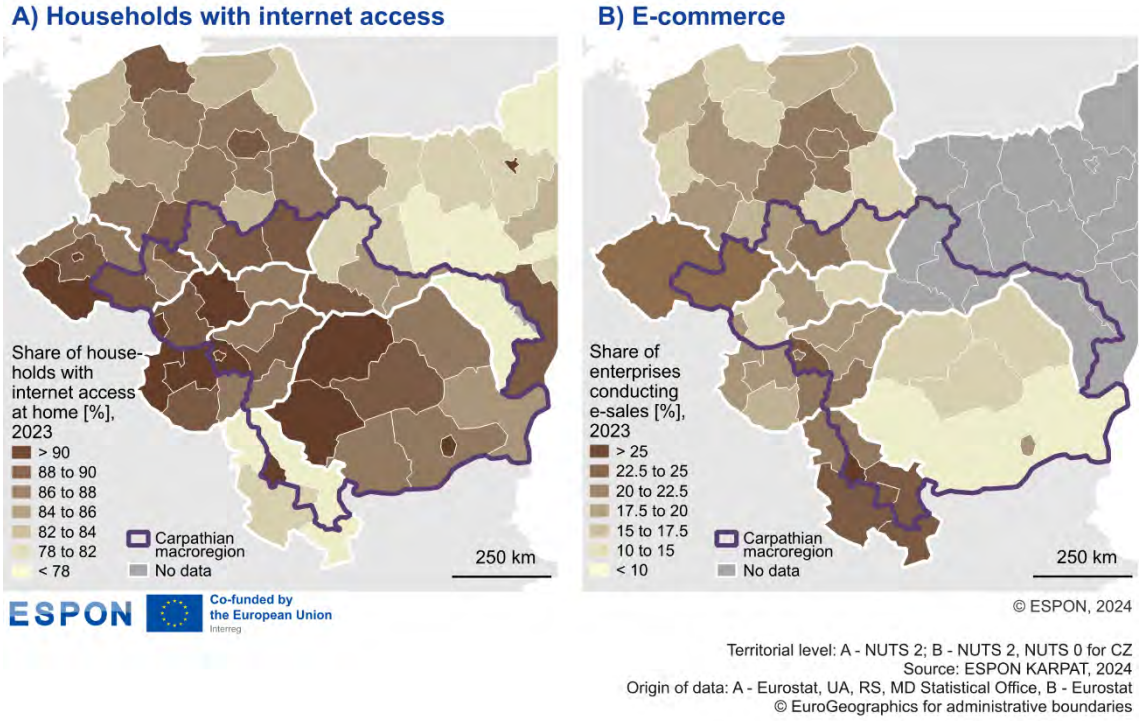
The transition to an information society—characterised by the widespread use of digital technologies and seamless access to information—is closely linked to socio-economic development. In the Carpathian macroregion, we observe generally high rates of household internet access. **Regions with very high access levels (exceeding 90%) are primarily concentrated in highly urbanised areas with well-developed digital infrastructure, such as the capital cities of Carpathian countries—Budapest, Bratislava, Bucharest, and Belgrade—as well as selected regions in Romania and Transcarpathia in Ukraine (Map 2.18a). In some less developed areas, internet access rates are noticeably lower, though still relatively high, particularly in light of the substantial increases recorded in recent years.**

The absence of modern telecommunications infrastructure is most evident in Western Ukraine and the Republic of Moldova. In these areas, internet development is hampered by lower investment levels, which, in EU countries, are partially offset by EU-funded programmes. This is particularly visible in Romanian regions, which have recorded some of the most significant improvements in internet access—exceeding 30 percentage points in recent years. Nevertheless, challenges remain in promoting digitalisation in

mountainous, agricultural, and peripheral areas of the Carpathian macroregion, where dispersed settlement patterns and low population density substantially increase the cost of infrastructure development.

At the same time, the proportion of enterprises engaging in online sales remains relatively low across the Carpathian macroregion, with a clear west-to-east gradient suggesting untapped potential. The Belgrade region leads in this regard, with Serbia overall standing out as the top performer—more than 35% of companies there conduct sales via websites, apps, or online marketplaces. The metropolitan area of Budapest also reports high levels of e-commerce engagement, alongside regions in the Czech Republic and Poland's Małopolskie region, where the share of businesses selling online reaches around 20%. In contrast, most regions in Romania and Slovakia display underdeveloped e-commerce sectors, reflecting an early stage of digital business adoption **(Map 2.18b)**.

Map 2.18
Information society



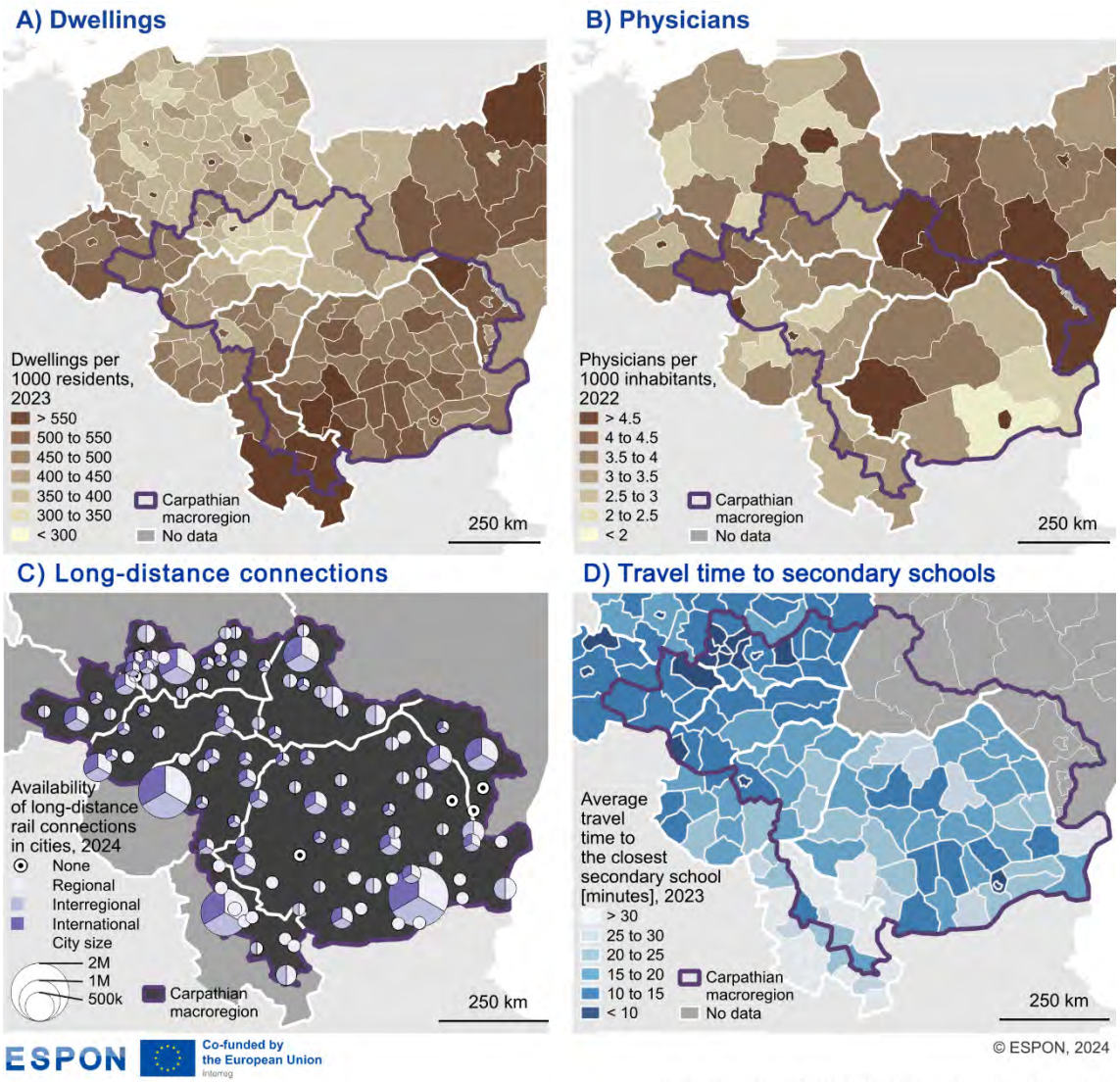
Housing, health and public service accessibility

Public services are essential to the quality of life, particularly in regions like the Carpathian macroregion. Housing, as a key factor of socio-economic development, has a strong influence on health, education, and overall well-being. This analysis assessed housing conditions and healthcare accessibility, with special attention given to mobility challenges.

Housing trends in the Carpathian macroregion reflect broader patterns in Central and Eastern Europe, notably a relatively low number of dwellings per 1,000 inhabitants. With the exception of Moldova and Serbia, most countries fall below the EU average of 514 dwellings per 1,000 people—Ukraine (373) and Poland (402) ranking lowest. Urban centres such as Kraków, Budapest, and Bratislava report higher densities (over 500), while rural and mountainous regions show much lower rates, e.g. Nowosądecki in Poland and Prešovský in Slovakia (slightly over 300) **(Map 2.19a)**. Overcrowding remains a critical issue, with the highest rates (almost 50%) in Serbia and Ukraine, while in Romania over 40%. Urban areas generally enjoy better access to amenities and sanitation, while rural areas often lag in these aspects. Broader inequalities within the region also include disparities between EU and non-EU countries.

In terms of healthcare, the Carpathian macroregion generally reports a higher number of hospital beds per 1,000 inhabitants compared to the European Union average. Romania leads with 7.3 beds per 1,000 people, well above the EU average of 5.2. **However, availability varies significantly across regions, with capital areas typically being better equipped (except for Poland).** Since 2010, the number of hospital beds has decreased in most countries, with the exception of Romania and Serbia. **When it comes to the availability of doctors, the situation is somewhat reversed in comparison to hospital bed availability. With the exception of the Czech Republic and the Republic of Moldova, the Carpathian countries report lower figures than the EU average, with the lowest value recorded in Serbia.**

Map 2.19
Housing, health and public service accessibility



Territorial level: A - NUTS 3, B - NUTS 2, C - points, D - NUTS 3
Source: ESPON KARPAT, 2024
Origin of data: A) National statistical offices and censuses, ECB Data Portal; B) EUROSTAT, MD Statistical Office, UA Ministry of Health; C) Timetables, D) ESPON DESIRE, 2024
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At the regional level, capital areas with specialised centres of supra-regional importance tend to have the highest number of doctors per 1,000 inhabitants **(Map 2.19b)**. Across the Carpathian regions, the availability of medical professionals is generally comparable to the rest of the respective national territories (better in case of Ukrainian regions). With some exception (Belgrade and Bratislava regions), most regions in the macroregion have recorded an increase in the number of doctors over the past decade, indicating some improvement.

Nonetheless, healthcare personnel shortages remain, also in nursing staff. The number of nurses per 1,000 inhabitants in most Carpathian countries remains lower than the European Union average.

Public transport systems in cities depend primarily on the size of the individual centre (Map 2.19c). 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 study area, 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.**

Spatiotemporal accessibility—measured by distance to the nearest hospital, secondary school, or train station—was analysed across the Carpathian macroregion using grid-level data from the ESPON DESIRE project. **The lowest accessibility levels, especially to secondary schools, were found in parts of Romania** (e.g. Caraş-Severin, Harghita, Bistriţa-Năsăud, Maramureş, and Tulcea) **and eastern Serbia** (Borska, Zaječarska, Braničevska) **(Map 2.19d). Other remote areas in the Southern and Eastern Carpathians also show limited access despite regional averages.** In Poland and Slovakia, the Carpathians have a lesser impact, though some mountainous zones still face long travel times. The highest accessibility is seen in major urban centres such as Bucharest, Belgrade, Budapest, Bratislava, Kraków, Upper Silesia, and regions of Czechia including Olomouc and Moravia-Silesia. The Czech Republic and Upper Silesia stand out for their particularly strong access to train stations.

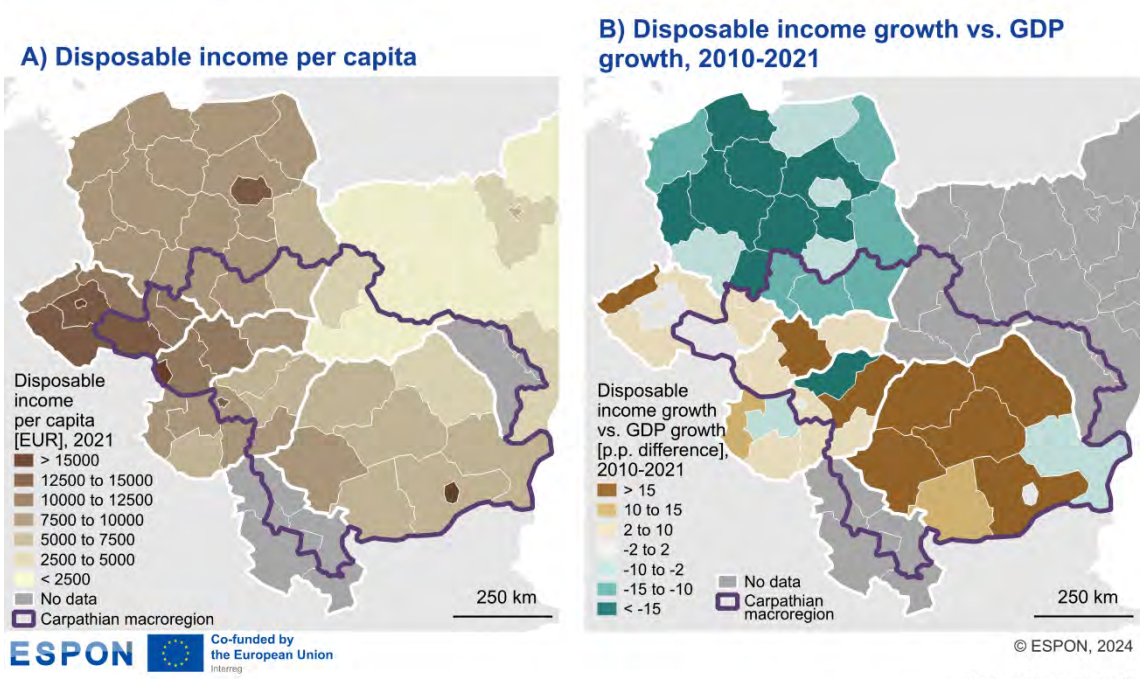
Wealth and social capital

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 city regions **(Map 2.20a)**. 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 Moldova. The poorest regions, however, were in EU candidate countries, particularly Ukrainian regions excluding the Lviv Oblast.

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 2.20b).** 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.

While disposable income reflects overall wealth, it doesn't capture income distribution. Indicators like poverty risk (below 60% of median income) and social exclusion provide a more complete picture. **In the EU, one in five people is affected, rising to one in four in the Carpathian macroregion and up to 40% in Moldova and 35% in Romania. Though notable improvements have occurred—especially in pre-war Ukraine, Hungary, Serbia, and Romania—socio-economic deprivation remains widespread, particularly in southern and eastern Romania and in EU candidate countries (Map 21a) .** Over 25% of residents are also affected in eastern Hungary, eastern Slovakia, and other Romanian regions.

Map 2.20
Disposable income per capita



Territorial level: NUTS 2
Source: ESPON KARPAT, 2024
Origin of data: EUROSTAT, UA, MD Statistical Offices
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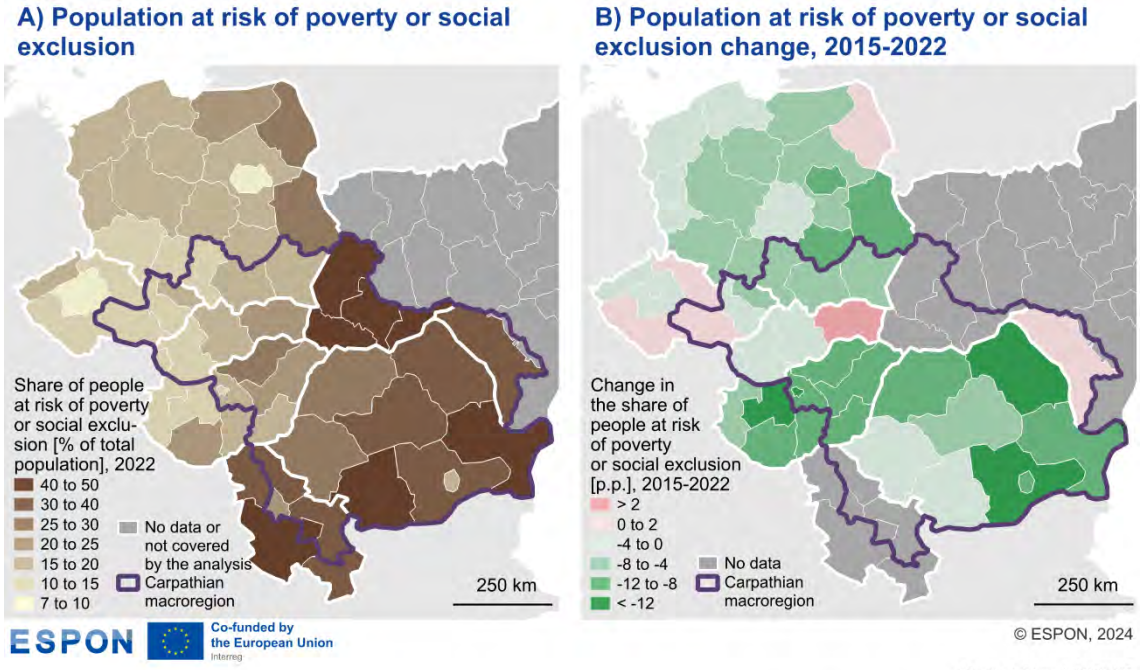
Map 2.21
Population of risk of poverty or social exclusion



Territorial level: NUTS 2
Source: ESPON KARPAT, 2024
Origin of data: A) EUROSTAT, UA and RS - estimations;
B) EUROSTAT, no data for UA and RS
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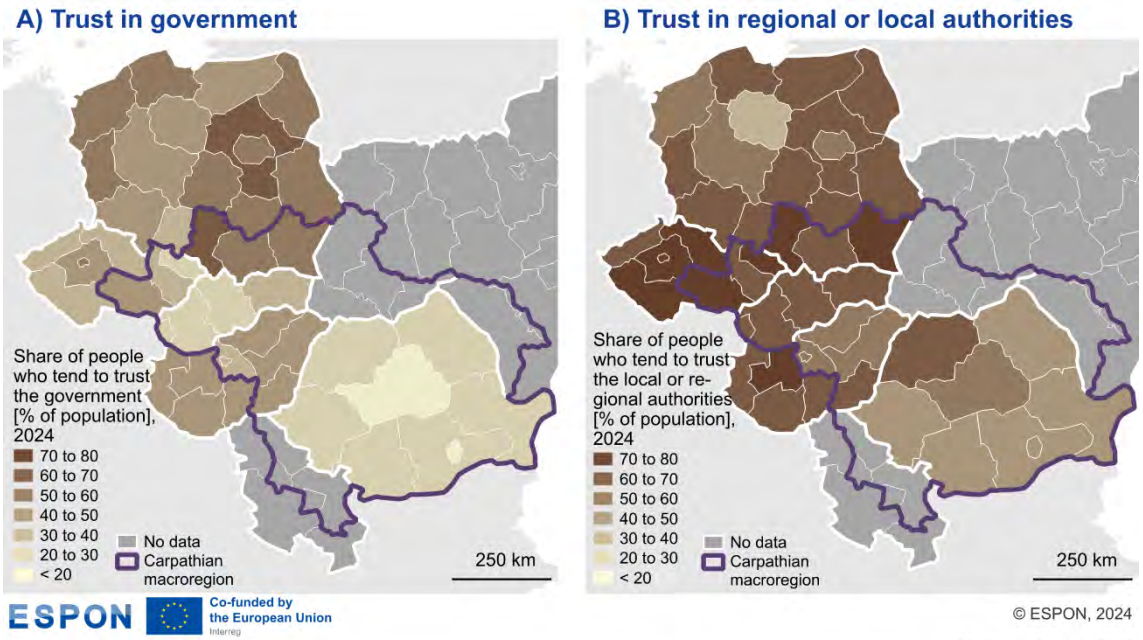
By contrast, Czech regions, western Slovakia, and Poland's Śląskie voivodeship are less exposed (around 15%). **Significant progress has been made in parts of Hungary, Romania, and Poland's Podkarpackie, with over 10 percentage point drops since 2015 (Map 21b).** However, improvements have been slower in regions with initially better conditions, while eastern Slovakia continues to face persistent challenges.

Map 2.22
Trust in government and local or regional authorities



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. **The trust towards local and regional authorities in the macroregion is dominantly higher in comparison to trust towards national governments (Map 2.22). It is especially the case in Moravia, Czechia, some Slovakian regions 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 some Hungarian regions. **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**

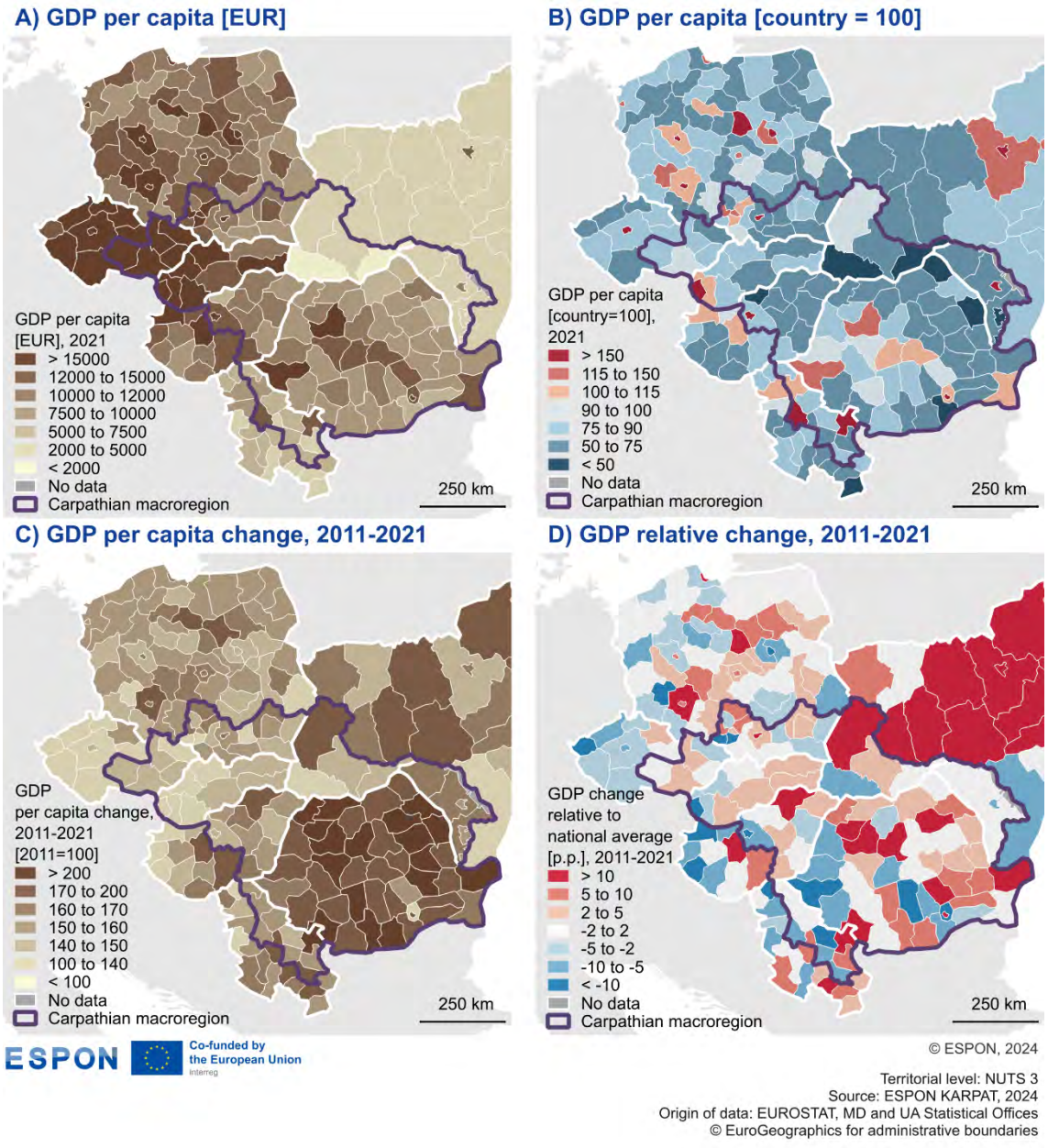
2.3 Economy, science and investments

Economic development in the Carpathian macroregion has been analysed from multiple perspectives, going beyond the standard GDP per capita indicator. This includes the structure of the economy, sectoral specialisation, labour market conditions, innovation potential, as well as entrepreneurship, investment expenditures, and business climate. Below is a summary of the analysis results along with selected maps. The full analysis is included in the Scientific Report.

Economic growth and structure

The Carpathian macroregion is characterised by significant disparities in economic development. With regard to the GDP per capita, the Czech Republic is the wealthiest country in the region, reaching 70% of the EU's average, while Ukraine and Moldova reach 10-15% **(map 2.23a).** The development gap is particularly evident **along the west-east axis and between metropolitan and peripheral areas.** In the former case, in addition to the Czech regions, the western parts of the macro-region in Slovakia, Poland and Hungary stand out positively, while at the other end, in addition to the Ukrainian and Moldovan regions, some regions of Serbia and Romania—especially in the eastern and southern parts of the country—lag behind. In each country, the most developed areas are those of **large cities, which is particularly noticeable in Romania and Poland**, countries with the most polycentric settlement networks **(map 2.23b).**

Map 2.23
Economic development



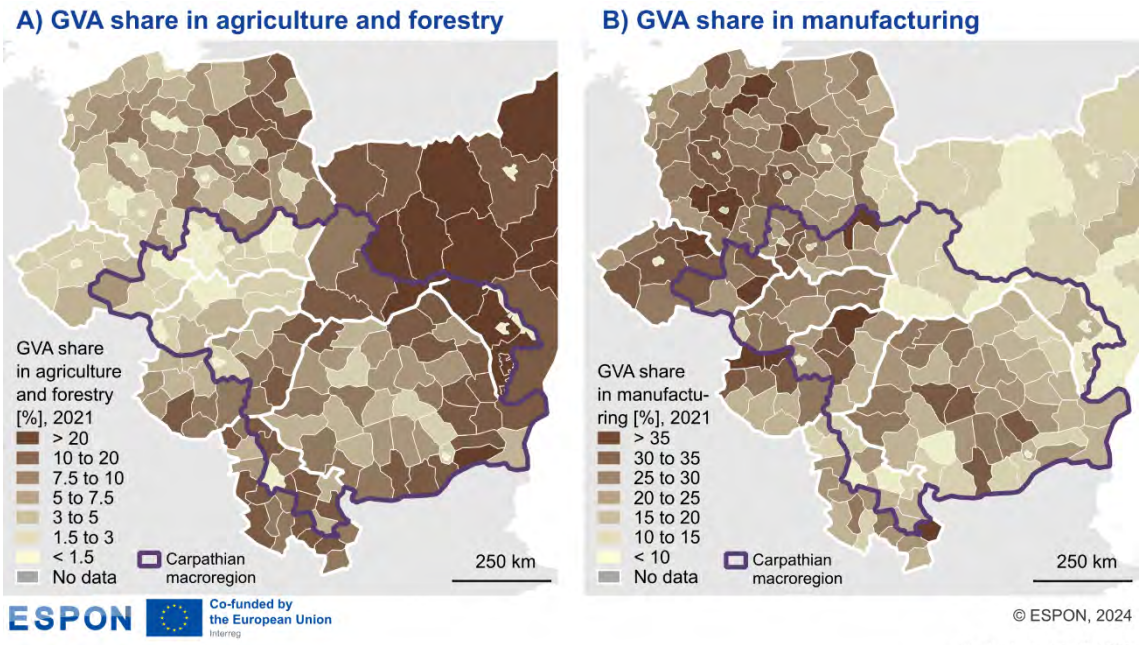
ESPON Co-funded by the European Union

Territorial level: NUTS 3
Source: ESPON KARPAT, 2024
Origin of data: EUROSTAT, MD and UA Statistical Offices

Mountainous regions, including the Polish-Slovak borderland, selected areas in Romania, **as well as rural areas**—especially in Ukraine and the Republic of Moldova—were significantly less developed, resulting in **substantial regional disparities in development levels visible within individual countries**.

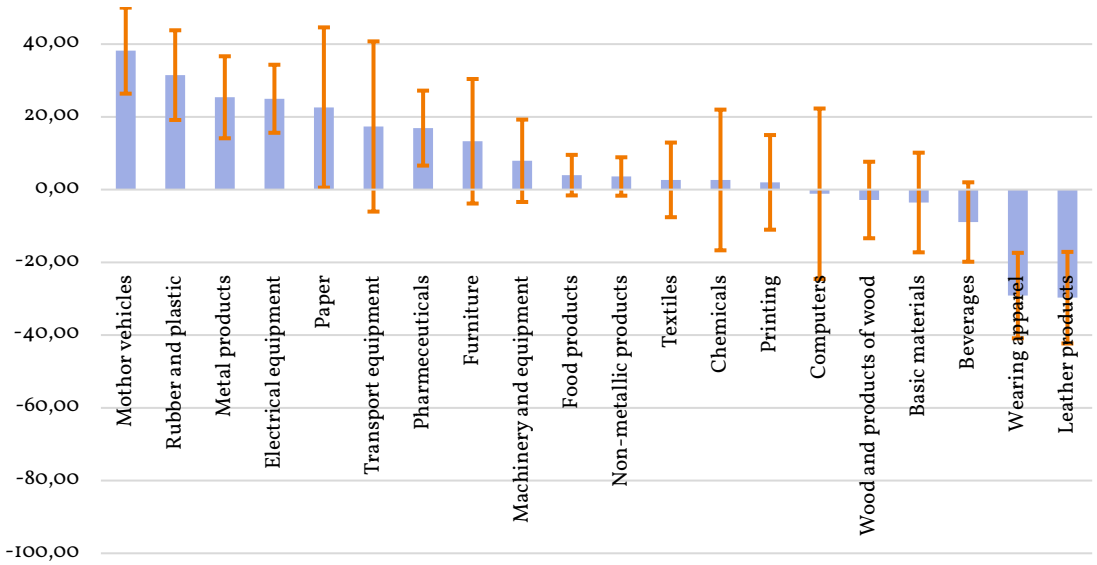
In recent decades, a convergence trend in development levels relative to the EU average has been observed, particularly in the Carpathian countries that are part of the European Union. Over the past 20 years, **Romania and the Czech Republic have recorded particularly rapid economic growth**, while especially **Ukraine and the Republic ofMoldova have noticeably trailed behind (map 2.23c)**. This has influenced the situation of regions in terms of growth dynamics in the last decade, with Romanian regions standing out, as well as some selected ones in Serbia. Furthermore, when analysing the development dynamics of regions relative to the national average, it was evident that, in general, **regions of large cities performed better**, as well as certain other areas that successfully managed economic restructuring and whose economic base aligned with the global economic cycle during the analysed period. **This contributed to the reinforcement of significant regional disparities in terms of development levels within the macroregion, as a large part of the peripheral regions developed at a slower pace.**

Map 2.24
Economic structure



One of the key factors behind the varying levels of development was the significant divergence in the economic structures of regions within the macroregion (map 2.24). For example, Carpathian regions in Poland and Slovakia had a notably low share of agriculture in their gross value added, whereas Ukrainian and Moldovan regions, along with southern Hungary and the submontane areas of Wallachia and Moldavia in Romania, remained highly dependent on this sector. The role of industrial processing in Carpathian economies also varied considerably across regions. These discrepancies were evident even within individual countries, influenced in part by the presence of major industrial centres located in submontane areas (e.g. Silesia in Poland and Czech Republic). Meanwhile, **advanced business services (e.g. financial, accounting, engineering) played a significant role in the main urban centres of the macroregion** as well as in the economies of central and eastern Slovakia. This attests to the existence of a broader trend, whereby major urban centres function as hubs, providing essential services to the surrounding agricultural and industrial regions.

Chart 2.3
Change of employment in manufacturing branches in Carpathian macroregion (%), 2010-2020

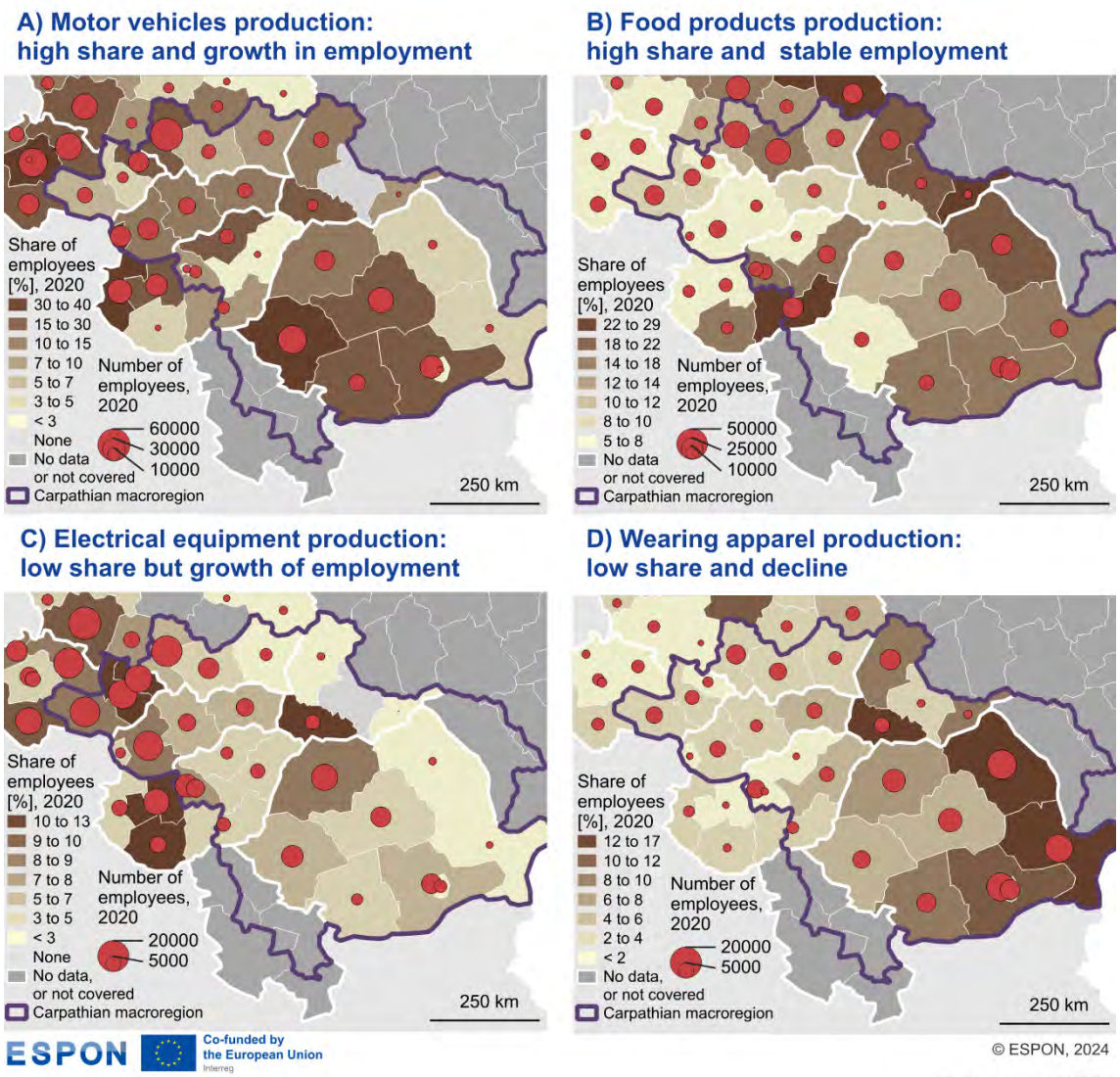


* standard deviation of change in macroregion at country level in red. Source: own elaboration based on Eurostat.

Industrial sectors also varied in their situation and importance. In recent years, the highest employment growth in the macroregion was recorded in selected medium-high technology industries, such as the production of motor vehicles and electrical equipment, as well as in medium-low technology industries, such as the production of rubber and plastic products as well as metal products **(Chart 2.3)**.

This may indicate the modernisation of the macroregion's industrial structure. Next in line were paper and cardboard products (low technology) and the production of other transport equipment, partially related to high-tech industries, such as the aerospace sector. Among the industries that maintained their market shares were the agri-food and wood industries, which rely on local resources. In contrast, the wearing apparel and leather goods industries experienced a decline. In the former case, this was due to the relocation of production to Asian countries, while in the latter, it resulted from the replacement of natural materials with synthetic products. These transformations have a varied impact on the competitive position of individual regions, as illustrated by the maps showing the distribution of workers in selected manufacturing industries **(Map 2.25)**.

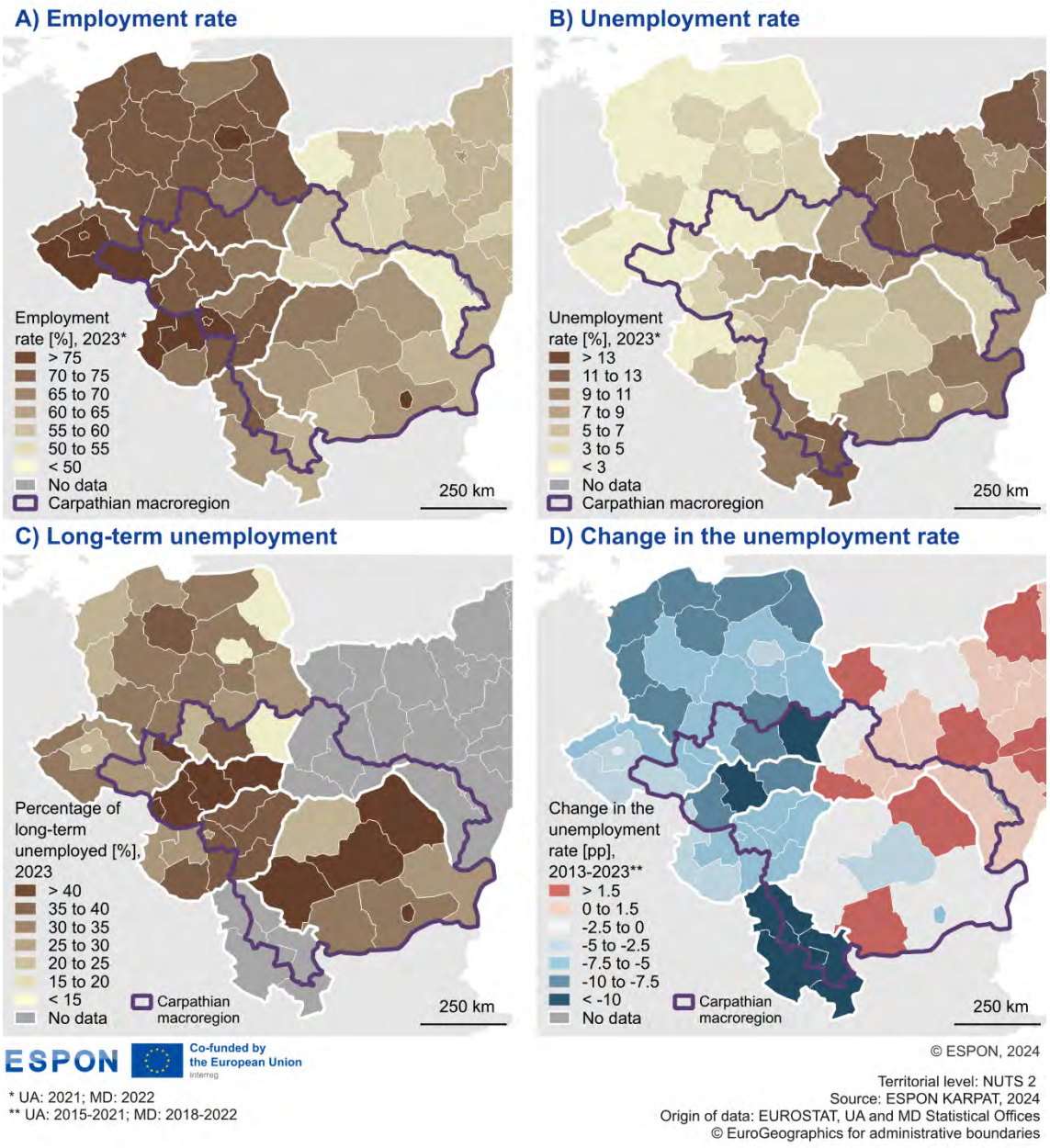
Map 2.25
Employment in selected industry branches in Carpathian macroregion



Labour market

The labour market situation demonstrated significant differences across the macroregion **(Map 2.26)**. In the Visegrad Group countries and most of their regions located in the Carpathian macroregion, the unemployment figures were low and the employment rate was high (except for Eastern Slovakia). In contrast, in Moldova, Ukraine, Serbia, and their regions, the situation was far worse, with low employment rates and high structural unemployment,. This, to some extent, applied to Romania, and in terms of high long-term unemployment, also to Slovakia, which may indicate a concentration of social issues in some of its regions. **The economic crisis after 2008 led to a surge in unemployment figures across the entire macroregion. However, since 2013, an improvement has been observed in all countries, apart from Ukraine.** The most significant improvement was seen in the Serbian regions, as well as in selected regions of the Polish and Slovak parts of the macroregion. In Romania, by contrast, regional-level changes in this regard were more disparate.

Map 2.26
Labour market

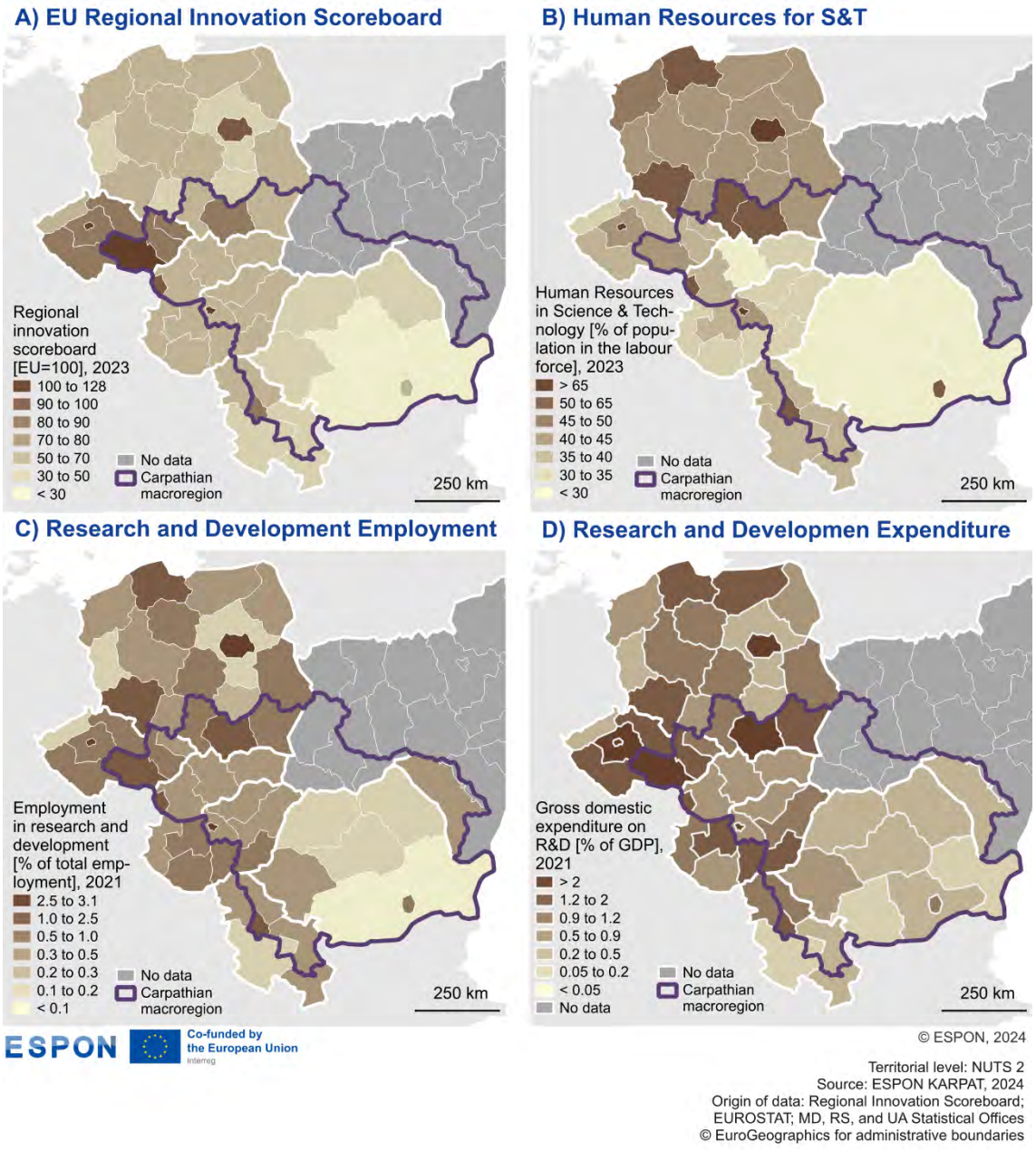


Science and innovativeness

The level of innovation in the Carpathian macroregion is low compared to the European average, and no region was classified as an innovation leader, according to the EU Regional Innovation Scoreboard **(Map 2.27a)**. Only the regions of Budapest and Brno were classified as "strong innovators," while most regions belonged to the lowest category of "emerging innovators," with the worst index levels observed in some regions of Romania. It can be assumed that such a situation in this regard is similar or even more pronounced in the regions of EU candidate countries.

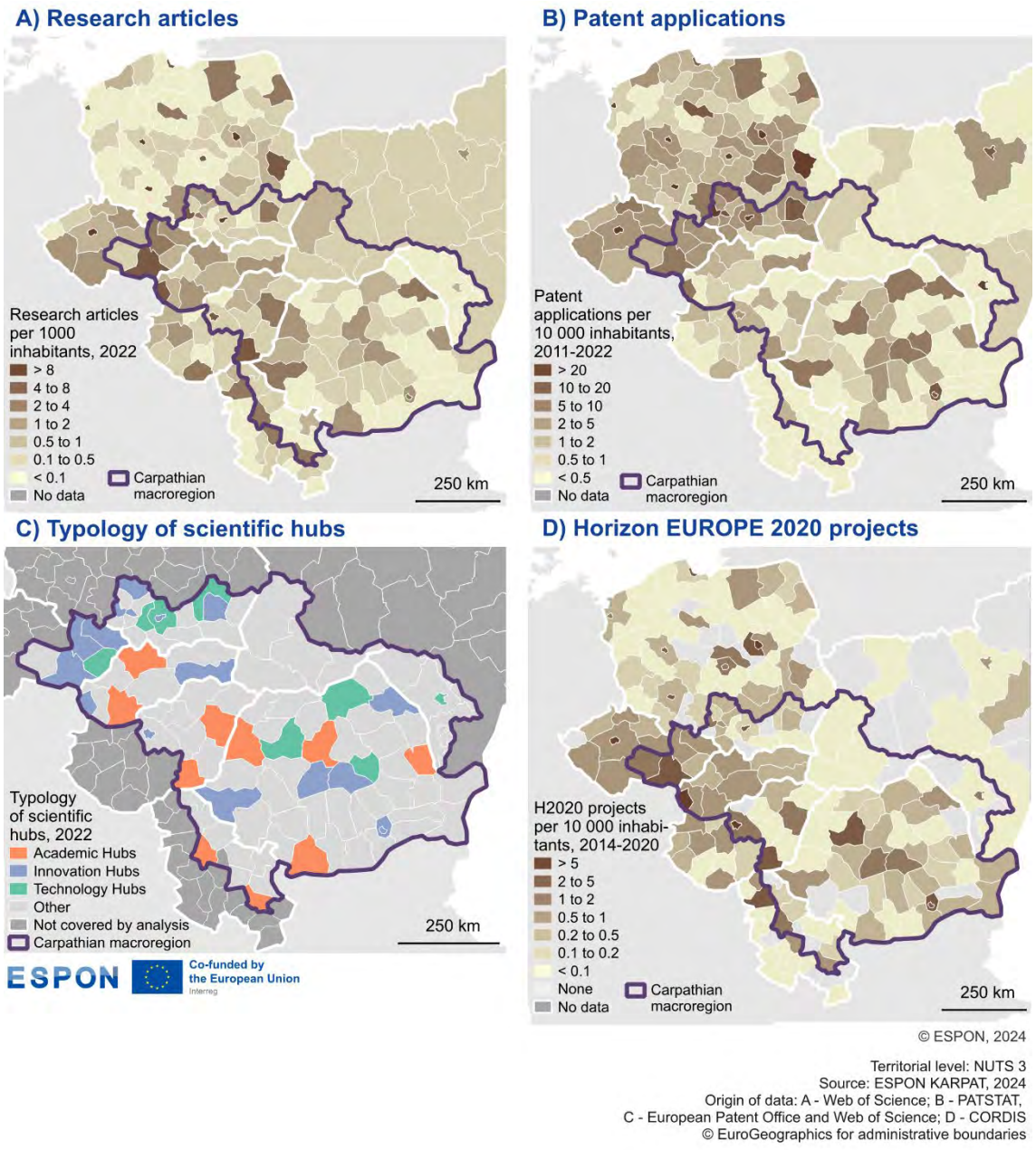
The greatest innovation potential, linked to existing human resources in science and technology, is found in the largest cities of the macroregion, such as Budapest and Bratislava **(Map 2.27b)**. Research and development (R&D) expenditures as a share of GDP are the highest in Czech and Polish regions, as well as in some Hungarian regions **(Map 2.27d)**. In recent years, these expenditures have generally increased, following a similar trend observed across Slovakia and certain Romanian regions. In contrast, the percentage of people employed in R&D is the lowest in Ukrainian regions **(Map 2.27c)**.

Map 2.27
Science and innovation – rankings, employment and expenditures



The number of registered patent applications and scientific papers in relation to the population helps identify the main technology and science hubs in the Carpathian macroregion. These are primarily concentrated in large urban regions, some of which function as innovation hubs in both these domains (Map 2.28). As for the patent activity, certain regions with smaller industrial centres exhibit notable patent activity, indicating latent potential for development into technology hubs. On the other hand, a number of academic centres located in medium-sized cities distinguish themselves in terms of scientific publications. These centres are relatively evenly distributed across the Carpathian macroregion.

Map 2.28
Science and innovation – patents, articles and cooperation



Territorial level: NUTS 3
Source: ESPON KARPAT, 2024
Origin of data: A - Web of Science; B - PATSTAT,
C - European Patent Office and Web of Science; D - CORDIS

Entrepreneurship

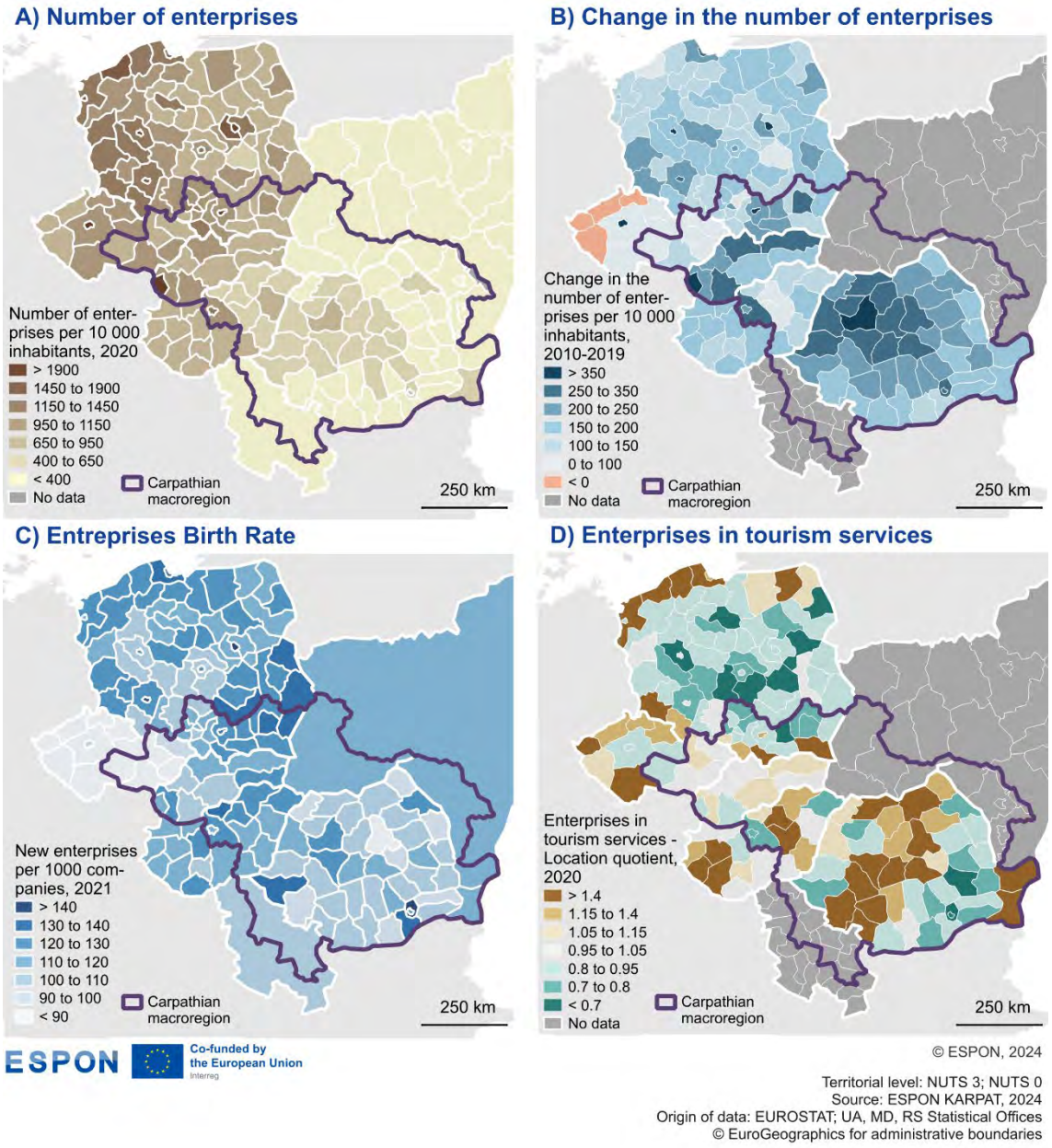
The scale of local entrepreneurship in the Carpathian macroregion was influenced, on the one hand, by the business climate and national regulations, and on the other, by the development opportunities offered by individual regions. As a result, the regions of the Visegrad Group [2] countries had a higher number of businesses per 10,000 inhabitants, particularly in the largest urban areas, such as Bratislava and Kraków **(Map. 2.29a)**. Less favourable conditions for entrepreneurship were observed in EU candidate countries, thus leading to a significantly smaller scale of business activity. However, in Romania, recent years have seen a noticeable growth of the SME sector, especially in the northwestern and central parts of the country **(Map**

[2] The Visegrad countries are: Poland, the Czech Republic, Slovakia, and Hungary.

2.29b). Meanwhile, in Polish regions, both business creation and closure processes were the most dynamic, which reflects an intense cycle of entrepreneurial activity **(Map 2.29c)**.

The structure of the business sector was clearly diverse. In Czechia, Serbia, and their regions, industrial companies comprised a larger share of the total, while in Romanian and Hungarian regions, firms operating in the advanced business services sector were more prevalent. This specialisation was particularly visible in regions with large urban centres**. Tourism, in terms of the number of businesses, proved to be an important sector, especially in the mountainous regions along the Carpathian range and in the coastal regions of Romania (Map 2.29d).**

Map 2.29
Entrepreneurship



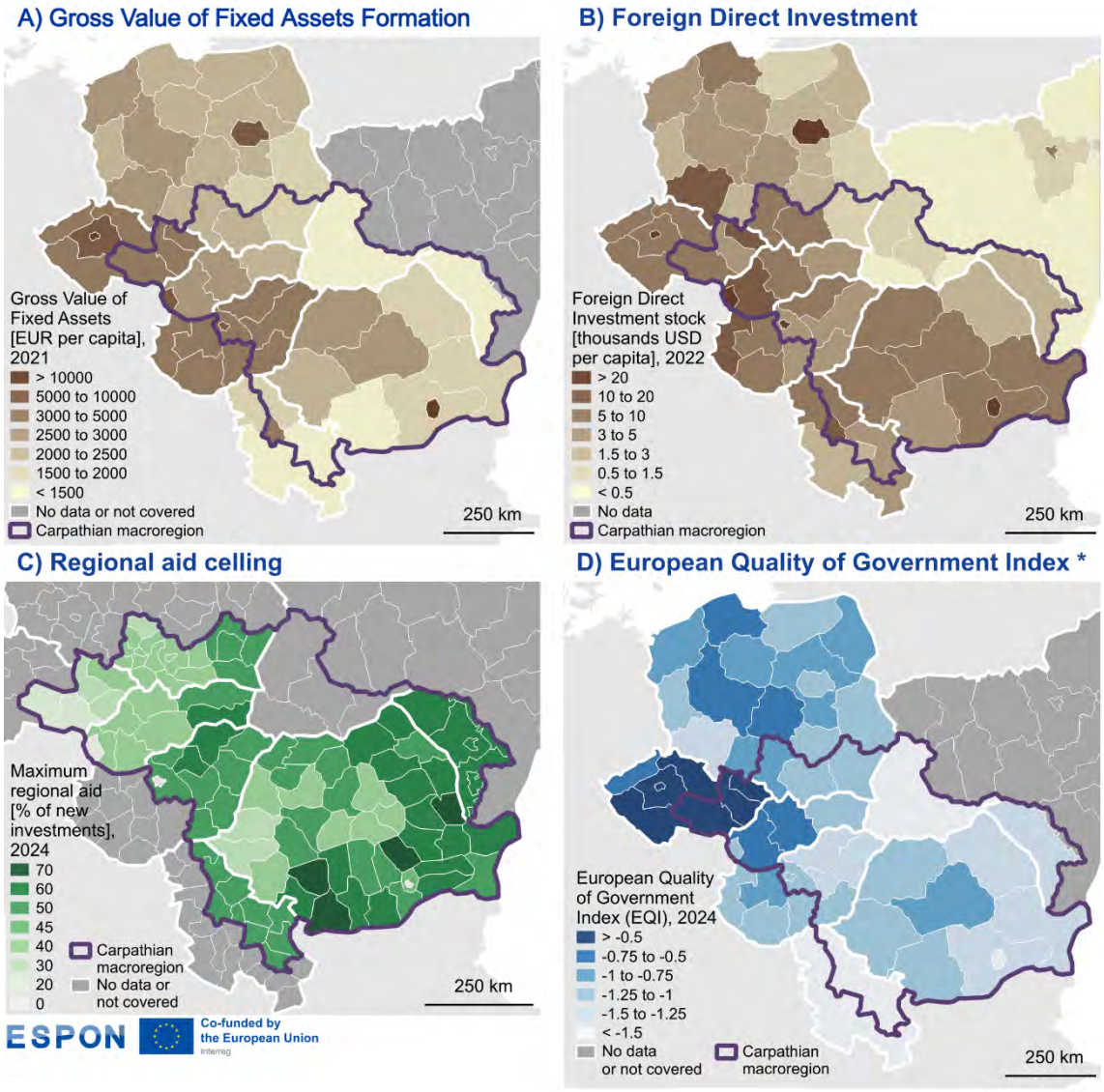
Territorial level: NUTS 3; NUTS 0
Source: ESPON KARPAT, 2024
Origin of data: EUROSTAT; UA, MD, RS Statistical Offices

Investments and business environment

The level of fixed asset formation in a region is closely linked to its overall economic development. In this respect, Czech and Hungarian regions stand out positively within the macroregion, while

Ukraine and the Republic of Moldova lag behind (map 2.30a). This disparity also influences **foreign investors' interest, as they tend to prefer investing in more developed and easily accessible regions, especially ones located in the northwestern part of the macroregion (map 2.30b).** Latterly, however, there has been a significant increase in interest in Romanian regions.

Map 2.30
Investments and business environment



Territorial level: A, B, D - NUTS 2; C - NUTS 3
Source: ESPON KARPAT, 2024
Origin of data: A - EUROSTAT; UA, MD Statistical Offices; B - UNCTAD, ESPON; C - European Commission, D - EUROSTAT
* Estimations for RS, UA & MD based on Corruption Index at country level

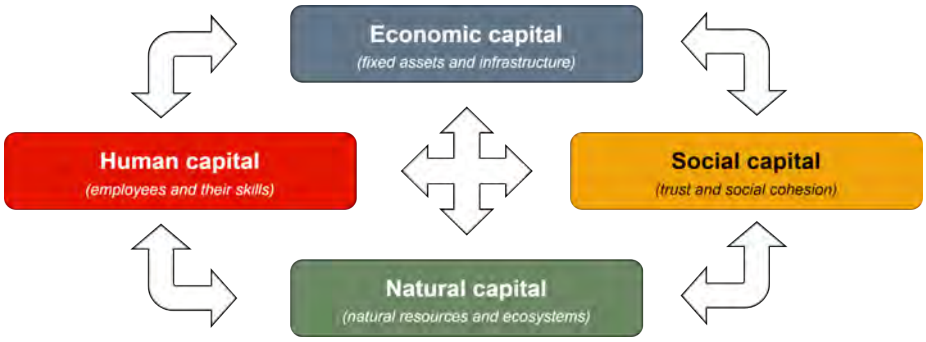
Higher public aid limits in less developed regions may potentially encourage investment in these areas, while in some more developed regions, the level of such aid has been gradually on the wane in recent years (map. 2.30c). Despite these variations, the investment attractiveness of the macroregion remains relatively high, owing to the presence of numerous investment areas and industrial parks, which are widely available across all parts of the macroregion. **Another factor shaping the investment climate is the quality of governance; although its value in the analysed area generally trails behind the European average, it is estimated to be highest in Czech and Slovak regions and lowest in Serbian and Ukrainian regions (map 2.30d).** In recent years, however, a notable improvement in governance quality has been particularly evident in the regions of Romania.

3 Typology of regions and interactions between territorial capitals

The development conditions of the Carpathian macroregion require a comprehensive synthesis that allow to identify various types of regions. For each of these types, policy recommendations aimed at minimising risks and utilising opportunities and synergies 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.

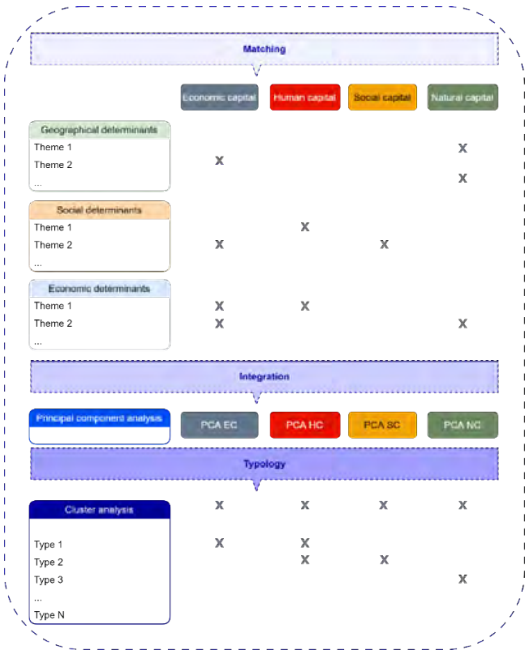
To represent each type of territorial capital, a set of indicators (see Scientific Report) was applied and synthesised using the principal component analysis (PCA)[3] and cluster analysis[4] methods **(Fig. 3.2)**. This methodology enabled: 1) The identification of key dimensions of regional differentiation for **each type of capital**. Based on these dimensions, distinct regional types were identified, and **thematic recommendations** were developed for each; 2) The synthesis of such thematic dimensions to derive a **cross-sectoral regional profile**, highlighting the strengths and weaknesses of individual regions and pointing to **potential development**

[3] PCA (Principal Component Analysis) has the advantage of enabling data synthesis while minimising information loss, in order to reveal the most important dimensions of variation within a given dataset

[4] Cluster analysis (CA) is a method used to group similar objects or data points into clusters based on their characteristics, allowing patterns and structures within the data to be identified.

opportunities. 3) Finally, a **general typology of regions** within the Carpathian macroregion was developed using cluster analysis. This typology illustrates both the similarities and differences among regions and supports the **creation of synthetic regional profiles**.

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 and their general dimensions. In addition to the quantitative analyses described below, this assessment incorporated also the opinions of Carpathian stakeholders gathered through on-line survey and expressed during participatory workshop.

3.1 Main dimensions of territorial capitals differentiations

Each of the four capitals of the Carpathian macroregion was operationalised 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.

Economic capital

The main dimensions of the spatial diversity of economic capital in the Carpathian macroregion based on PCA method (list of used indicators is presented in **Scientific Report)** relate, on the one hand, to the degree of capital accumulation mainly in the form of fixed assets formation (i.e. long-term tangible assets) used in business activities or transport infrastructure that facilitates the production and exchange of goods and services, referred to as **"capital accumulation"**. On the other hand, they involve specific relationships between the production and consumption sectors within economic processes (that is, whether a region is more oriented toward production activities or consumption functions, such as for instance a developed housing market), , referred to as "**production vs. consumption**". These two components explained approximately 70% of total regional differentiation in terms of economic capital variables in the Carpathian macroregion.

The "**capital accumulation**" aspect of economic capital in the Carpathian macroregion as a synthetic indicator (principal component) is associated relatively equally with such variables as a high level of economic development (GDP per capita) and the high level of investments including foreign capital inflow and well-developed public transport infrastructure (road and rail). This dimension or regional differentiation also

reflects, to a lesser extent, the effects of agglomeration (variable 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 (Map 3.1a).** The importance of the latter for higher levels of accumulated capital was evident in Romania, as seen in regions located along major transport corridors along the existing or planned motorways connecting Bucharest to the Romanian-Hungarian border. **Conversely, values of "capital accumulation" is significantly lower in the non-EU countries (Ukraine, Serbia, Republic of Moldova),, as well as in some peripheral regions of Poland, Slovakia, Romania, and, to a lesser extent, Hungary.**

The second weaker (in a sense of variance explained) dimension of economic capital spatial diversity in the Carpathian macroregion has been defined as the "**primacy of production over consumption"**. The production sector in this case is illustrated by freight transport loadings of manufactured goods using road transport per capita, indicating the "export potential" of a given region 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 production) 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 flat availability. Overall, high values for this principal component characterised the **north-western part of the Carpathian macroregion, which is more accessible to the main markets for manufactured goods in Western Europe (Map 3.1b). In contrast, lower values were found in the southern and south-eastern 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 differentiation into a typology highlights regions for which targeted recommendations can be formulated in line with their specific characteristics **(Map. 3.1c, Table 3.1)**:

- (Red) **Regions characterised by a high level of economic development and substantial fixed assets, with a production sector that is more developed than the consumption sector.** In such areas, public authorities may benefit from placing greater emphasis on the consumer dimension — for instance, through social programmes, including municipal housing initiatives, particularly in urban areas with rising housing demand. Investments in social infrastructure (such as education, healthcare, and public services) are also recommended to enhance quality of life and retain a highly skilled workforce. This recommendation is especially relevant for the industrialised, north-western part of the Carpathian macroregion, including Carpathian regions in the Czech Republic and western parts of Poland, Slovakia, and Hungary as well as Belgrade region in Serbia.
- (Purple) **Regions with lower levels of economic development, where the consumption sector is relatively more developed than production activities.** In such areas, development efforts should prioritise investment in technical and transport infrastructure, as well as the creation of a favourable business environment aimed at attracting new investments (e.g. business parks, tax incentives) and supporting the growth of local enterprises (e.g. business incubators, vocational training, local clusters). This recommendation is particularly relevant for regions in the Republic of Moldova and Serbia, as well as the majority of Romanian regions.
- (Green) **Regions with higher levels of economic development, where the consumer sector dominates over production.** These areas have strong economic growth potential, and it is crucial to create conditions that enable the optimal use of existing fixed assets (e.g. technology transfer, development of regional transport systems), supported by well-designed incentive schemes for investors (e.g. assistance in brownfield redevelopment). This approach would capitalise on their favourable transport accessibility and high agglomeration potential. It applies to selected metropolitan regions, particularly in Romania — such as Bucharest, Cluj-Napoca, Brașov, and Timisoara — as well as certain Hungarian regions, including Szeged and Heves.

Map 3.1
Economic capital – dimensions of diversity and types of regions

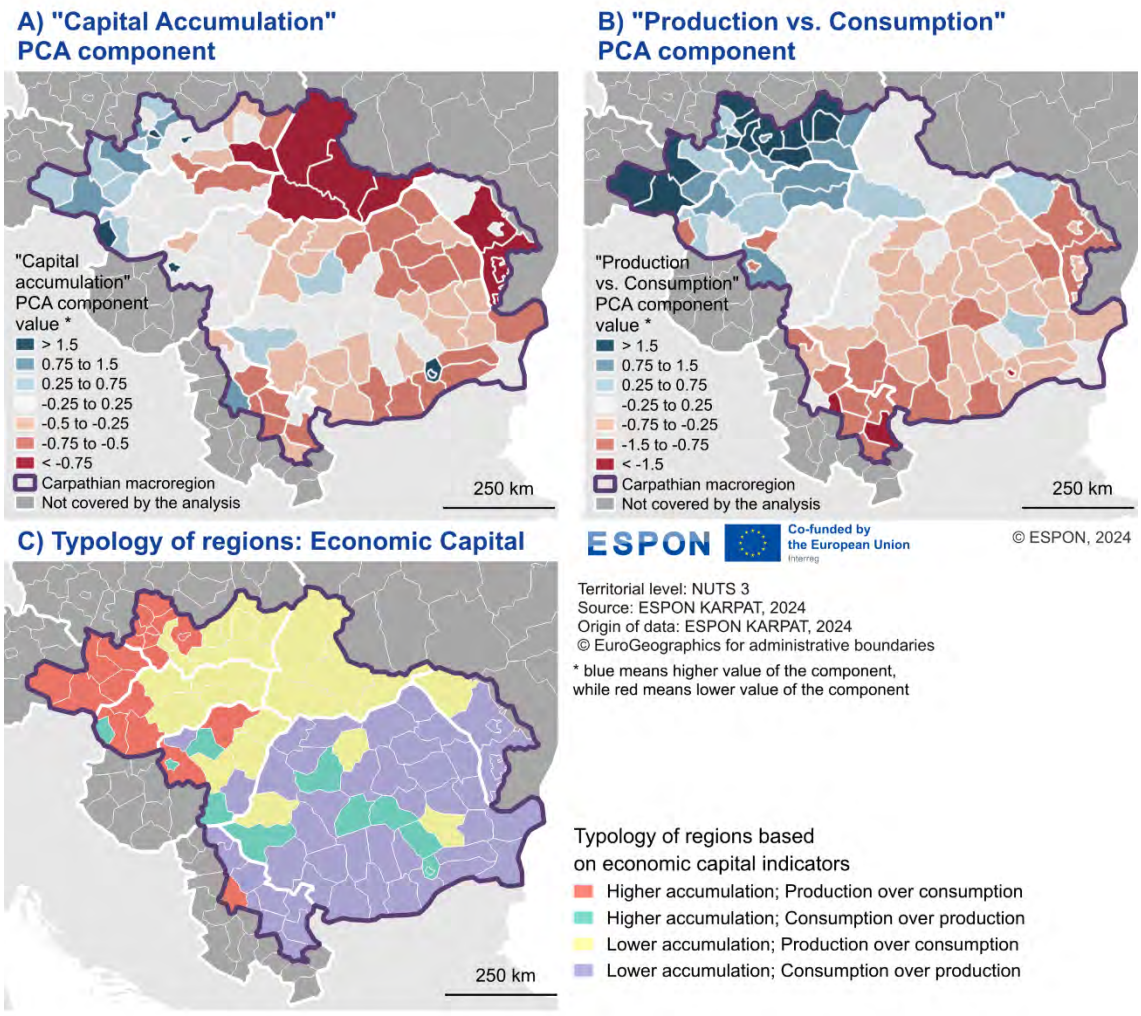


Table 3.1
Recommendations for the regions - economic capital

	"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)

- (Yellow) **Regions with low levels of economic development but a relatively well-developed production sector compared to the consumption sector.** In these areas, efforts should focus on developing higher-value-added economic activities (e.g. advanced manufacturing or knowledge-intensive services), supported by strategically chosen smart specialisations. Strengthening these specialisations will be particularly feasible under conditions that support the development of regional production systems and create an environment conducive to external investment. This, in turn, should enable the creation of high-quality jobs, which would stimulate the development of local consumer-oriented services. This recommendation is particularly relevant for eastern regions of Poland and Slovakia, as well as certain areas in Hungary, Ukraine, and Romania.

It is important to note that these recommendations are not limited to specific types of regions and may also be implemented elsewhere, provided they are appropriately adapted to the local context.

Human capital

The main dimensions of human capital spatial differentiation based on PCA method (list of used indicators is presented in **Scientific Report)** 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 (list of used indicators is presented in **Table 3.2**). These two components explained approximately 77% of total regional differentiation in terms of human capital in the Carpathian macroregion.

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 high share of workers capable of participating in the development and implementation of innovations, as well as a high 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 **(Map. 3.2a)**. 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 Chișinău.

The second regional dimension of human capital variation is its **"viability"**. High viability is associated with a lower median age of the population, often accompanied by a relatively high natural increase and population growth in the region, sometimes supported also by positive migration balance. 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 **(Map. 3.2b)**. 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 regions for which targeted recommendations can be formulated in line with their specific characteristics **(Map. 3.2c, Table 3.2)**:

- (Red) **Regions with relatively high-quality human capital is paired with a high viability of the regional population.** Population growth in these areas could generate pressure to develop new land. This require appropriate spatial planning to prevent uncontrolled urban sprawl including, 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) **Regions with relatively low-quality human capital paired with high regional population viability.** This situation indicates a need to improve the accessibility and quality of education systems – from early childhood education to higher and vocational education. Enhancing the quality of human capital could unlock endogenous development potential and mitigate the negative effects

Map 3.2
Human capital – dimensions of diversity and types of regions

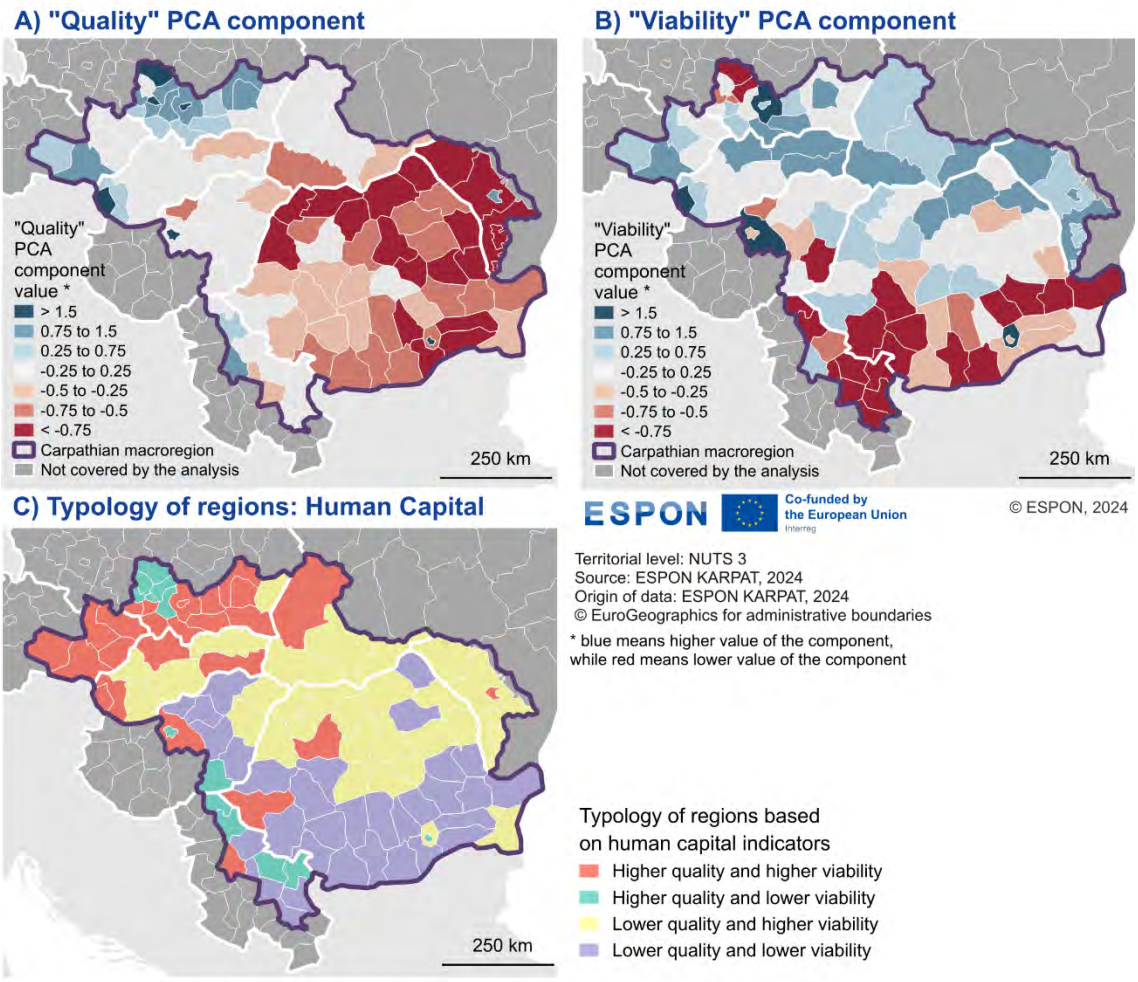


Table 3.2
Recommendations for the regions - human capital

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

Source: Own elaboration (EUROREG)

of outmigration. This applies mainly to northern Romania, Ukraine, the Republic of Moldova, and selected regions in Slovakia.

- (Green) **Regions with relatively high-quality human capital paired with low regional population viability.** This may suggest a need to enhance quality of life – for example, through housing programmes – in order to increase the migration attractiveness of these areas. This situation primarily affects certain subregions of the Silesian Voivodeship in Poland, some Serbian regions, and the Szeged area in Hungary.
- (Purple) **Regions with both low-quality human capital and relatively low regional population viability.** In these areas, efforts should focus on halting the loss of human capital and encouraging the return of emigrants. Strengthening regional education systems tailored 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 elsewhere, provided they are appropriately adapted to the local context.

Social capital

The main dimensions of social capital variation in the Carpathian macroregion relate, on the one hand, to **"social cohesion"**, and on the other, to the **"potential for social interaction"**, which reflects population density as well as existing settlement and administrative structures (list of used indicators is presented in **Scientific Report**). These two components explained approximately 75% of total regional differentiation in terms of social capital in the Carpathian macroregion.

The first dimension of social capital regional 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 government. Favourable conditions in this respect are especially evident in the north-western part of the macroregion, parts of metropolitan areas, and some regions in southern Hungary and Transylvania in Romania **(Map 3.3a)**. Conversely, regions located in EU candidate countries, parts of southern and eastern Romania, northern Hungary, and the Košice region in Slovakia are characterised by significantly lower levels of social cohesion.

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. Urban and other densely populated areas, due to their social and cultural diversity, tend to foster bridging social capital, while rural areas are more likely to rely on bonding social capital, rooted in close-knit, homogeneous communities. This factor is partly influenced by differences in administrative structures across countries, favouring regions with relatively large municipalities resulting from administrative reforms. Greater opportunities for bridging social interactions are more evident in Poland, but also in Ukraine, Serbia, selected regions of Hungary, and, to a lesser extent, Romania. **(Map 3.3b)**.

Combining these two dimensions yields the following typology of regions and respective thematic recommendations **(Map. 3.3c, Table 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. Recommended actions include support for anti-segregation measures – such as housing policies that promote social mixing and investment in deprived neighbourhoods – as well as programmes aimed at strengthening local social capital, including community centres, participatory budgeting and other grassroots initiatives.

Map 3.3
Social capital – dimensions of diversity and types of regions

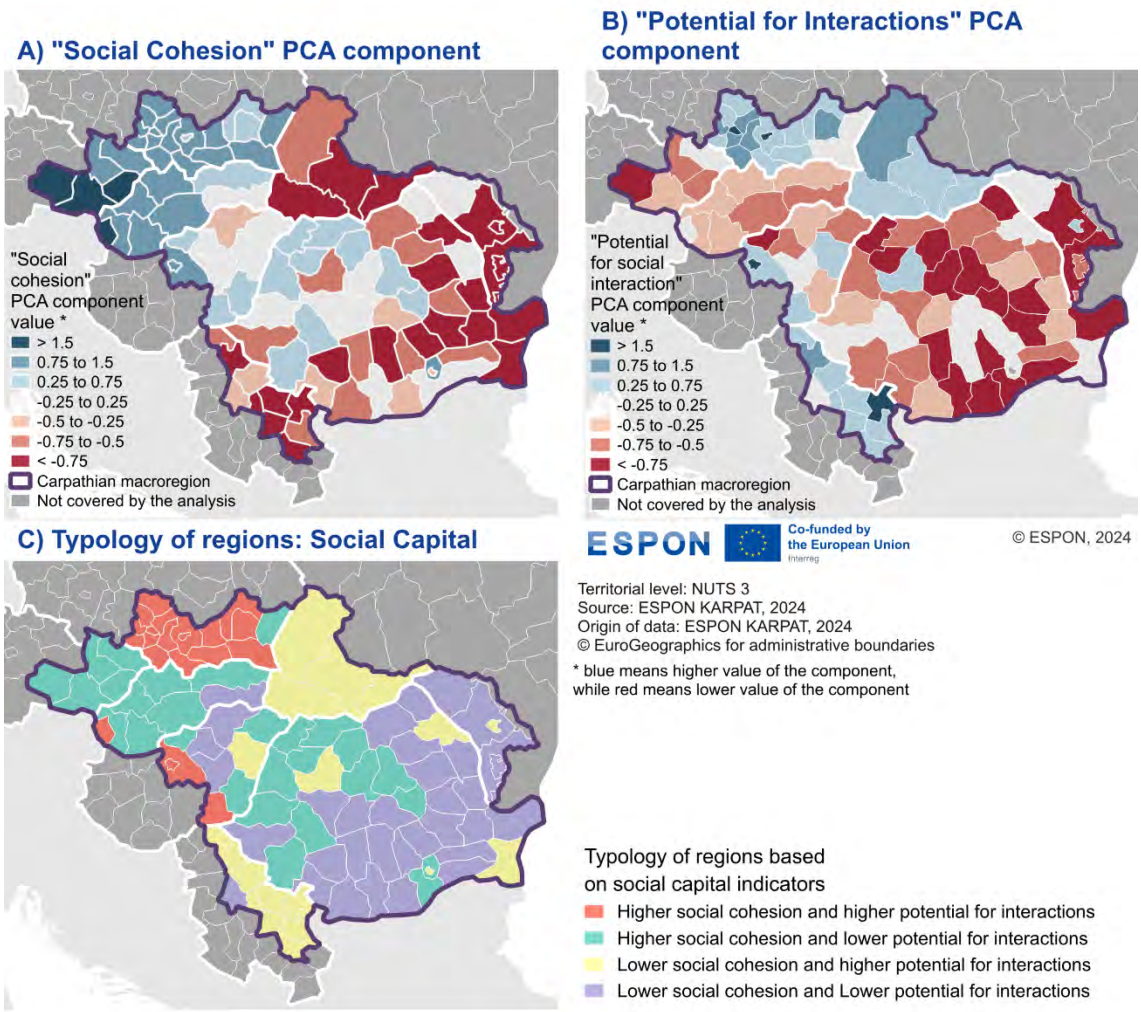


Table 3.3
Recommendations for the regions - social capital

	"Social cohesion" – higher	"Social cohesion" – lower
"Potential for social interactions" – higher	Addressing issues of localised 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 programmes

Source: Own elaboration (EUROREG)

- (Yellow) **Regions with lower social cohesion but a higher potential for social interactions.** In these areas, efforts should focus on strengthening and improving the effectiveness of local institutions to build social trust and support the development of civil society – for example, through the creation of networks of local leaders and community facilitators. This could enhance the capacity for social initiatives aimed at marginalised groups (e.g. dedicated community spaces) and foster conditions for local entrepreneurship (e.g. social cooperatives). This category primarily includes regions in the candidate countries of Ukraine and Serbia, as well as Chișinău in the Republic of Moldova, and certain regions of Romania (e.g. Cluj-Napoka) and Hungary (e.g. Debrecen).
- (Green) **Regions with high social cohesion but low potential for social interactions.** For these regions, it may be beneficial to consider administrative reforms aimed at improving the delivery of public services, including measures to prevent transport exclusion or the establishment of inter-municipal public service centres (e.g. in education and healthcare). Such reforms are particularly important in territorially fragmented areas, where dispersed settlement patterns limit the efficiency and accessibility of public services. These recommendations are particularly relevant for regions in the Czech Republic, Slovakia, and northern Romania.
- (Purple) **Regions with a concentration of social challenges and relatively low potential for social interactions.** In these areas, efforts should focus on improving access to public services and implementing targeted social programmes to mitigate the risk of long-term social disadvantage. Recommended measures include grant schemes supporting grassroots initiatives, community-building activities, and the development of local leadership and resident networks. This applies most notably to regions in the Republic of Moldova, southern and eastern Romania, and eastern Hungary.

It is important to note that these recommendations are not limited to specific types of regions and may also be implemented elsewhere, provided they are appropriately adapted to the local context.

Natural capital

The main dimensions of natural capital variation pertain, on the one hand, to **"natural environment assets"** and, on the other, to selected aspects of **"environmental pollution"** related to particulate emissions and natural resource exploitation (list of used indicators is presented in **Scientific Report**). These two components explained approximately 51% of total regional differentiation in terms of natural capital in the Carpathian macroregion. However, CO_2 emissions linked to climate targets, as well as high livestock density, were not found to correlate with these dimension – indicating that these issues represent a distinct challenges requiring separate consideration.

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, e.g. the Natura 2000 network. This is also typically associated with a relatively low share of arable land. The spatial distribution of this factor of differentiation aligns clearly with the Carpathian mountain range, while outside this range, high values are characteristic of the Danube Delta **(Map 3.4a)**. In contrast, intensively cultivated lowland areas in river valleys, especially those of the Danube (in Hungary, Serbia, and Romania), the Pannonian Basin, Moldova, and the highlands in Poland's Silesian and Lesser Poland Voivodeships tend to fare lower in this respect due to significant land alteration and agricultural intensification.

In terms of selected elements of **"environmental pollution"** (pollutant emissions and mineral extraction), south-eastern Hungary, north-western Romania, northern Serbia, and parts of western Slovakia, the Czech Republic, and the Podkarpackie Voivodeship in Poland stand out positively **(Map 3.4b)**. These areas experience low PM2.5 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 3.4c, Table 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 and organic farming. They include significant portions of the Western (Poland, Slovakia, Hungary) and Eastern

Map 3.4
Natural capital – dimensions of diversity and types of regions

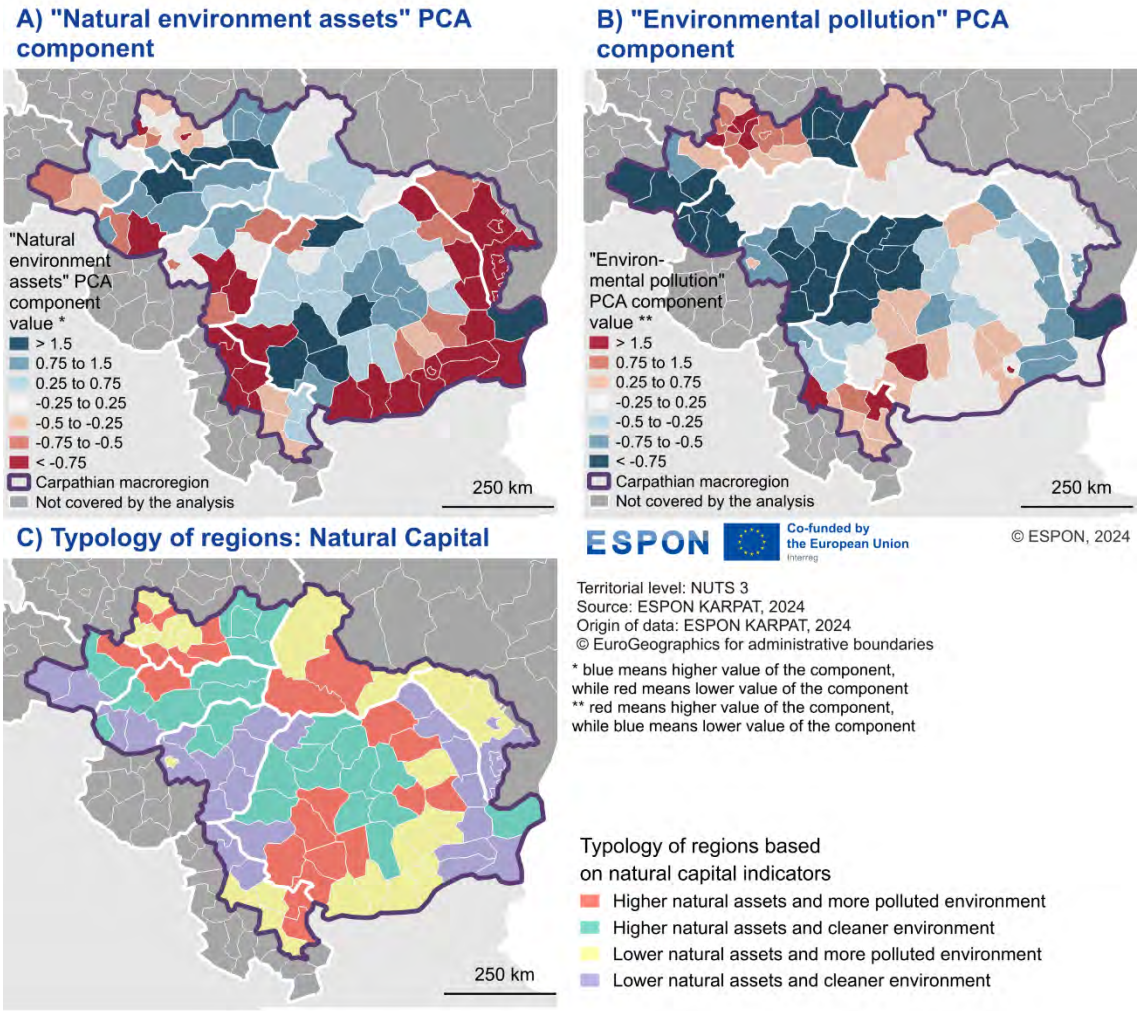


Table 3.4
Recommendations for the regions - natural capital

	„Natural environment assets" – higher	"Natural environment assets" – lower
"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)

Carpathians and Transylvania (Romania) and the Danube Delta in Romania. Recommended actions include supporting eco-certification schemes, enhancing local value chains, and promoting community-based tourism and agritourism initiatives that preserve the natural and cultural heritage of the area.

- (Yellow) **Areas with relatively low natural assets and at risk of environmental pollution.** In these regions, a comprehensive energy transition is essential, alongside efforts to identify and strengthen the protection of ecologically valuable areas. This applies to parts of Poland (highland areas in the Śląskie and Małopolskie voivodeships), Ukraine (Lviv and Chernivtsi oblasts), northern and central regions of the Republic of Moldova, Wallachia in Romania, and the southern section of the Carpathian Mountains in Serbia as well as Belgrade region.
- (Red) **Areas with high environmental value but facing specific environmental challenges.** In these regions, particular attention should be given to mitigating the negative effects of low-stack emissions, especially during the colder months, as this can significantly hinder the development of tourism. In addition, efforts should focus on reducing the environmental impacts of natural resource extraction and promoting a transition to renewable energy sources. This category includes various regions in the Western Carpathians (Polish-Czech and Slovak borderlands, and the central part of the Śląskie Voivodeship in Poland), the Eastern Carpathians (Transcarpathia and Ivano-Frankivsk in Ukraine, and Suceava and Neamț in Romania), and the Southern Carpathians (e.g. Gorj in Romania and the Borska Oblast in Serbia).
- (Purple) **Areas with low pollution but relatively limited natural environment assets.** These regions are especially well-suited for the development of sustainable agriculture and renewable energy production. Given their lower ecological sensitivity, they offer favourable conditions for the deployment of renewable energy infrastructure – such as wind and solar farms – which, while potentially altering the landscape and requiring land use, can be more easily integrated here than in ecologically valuable areas. In addition, these areas are suitable for biogas-based intensive agriculture and afforestation measures, which can enhance both environmental sustainability and rural resilience. This category primarily includes the Pannonian Basin in Hungary, the Danube Valley in Serbia, and the Prut Valley in the Romanian part of Moldova.

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. The general recommendation for all types of regions regarding natural capital 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

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

The most significant dimensions of regional diversity in the Carpathian macroregion, derived from the combination of the four territorial capitals (economic, human, social, and natural), can be grouped into three overarching components also based on PCA: economic, social, and environmental (list of indicator is presented in **Scientific Report**). These components form the basis for three complementary typologies that highlight both the strengths and weaknesses of individual regions, and in turn, may suggest differentiated development opportunities.

The "**economic" dimension** reflects the accumulation of capital, which enhances productivity and the potential for economic growth. It is reinforced by the high quality of human capital and strong potential for social interaction, especially in urbanised and densely populated areas. Spatially, this component exposes clear disparities between metropolitan and peripheral (including mountainous) areas, and more broadly, between the north-western and south-eastern parts of the macroregion. The "**social" dimension** is associated with social cohesion, demographic viability, and elements of consumption-oriented development. It reflects both the strength of local communities and the capacity of regions to sustain their populations. This component

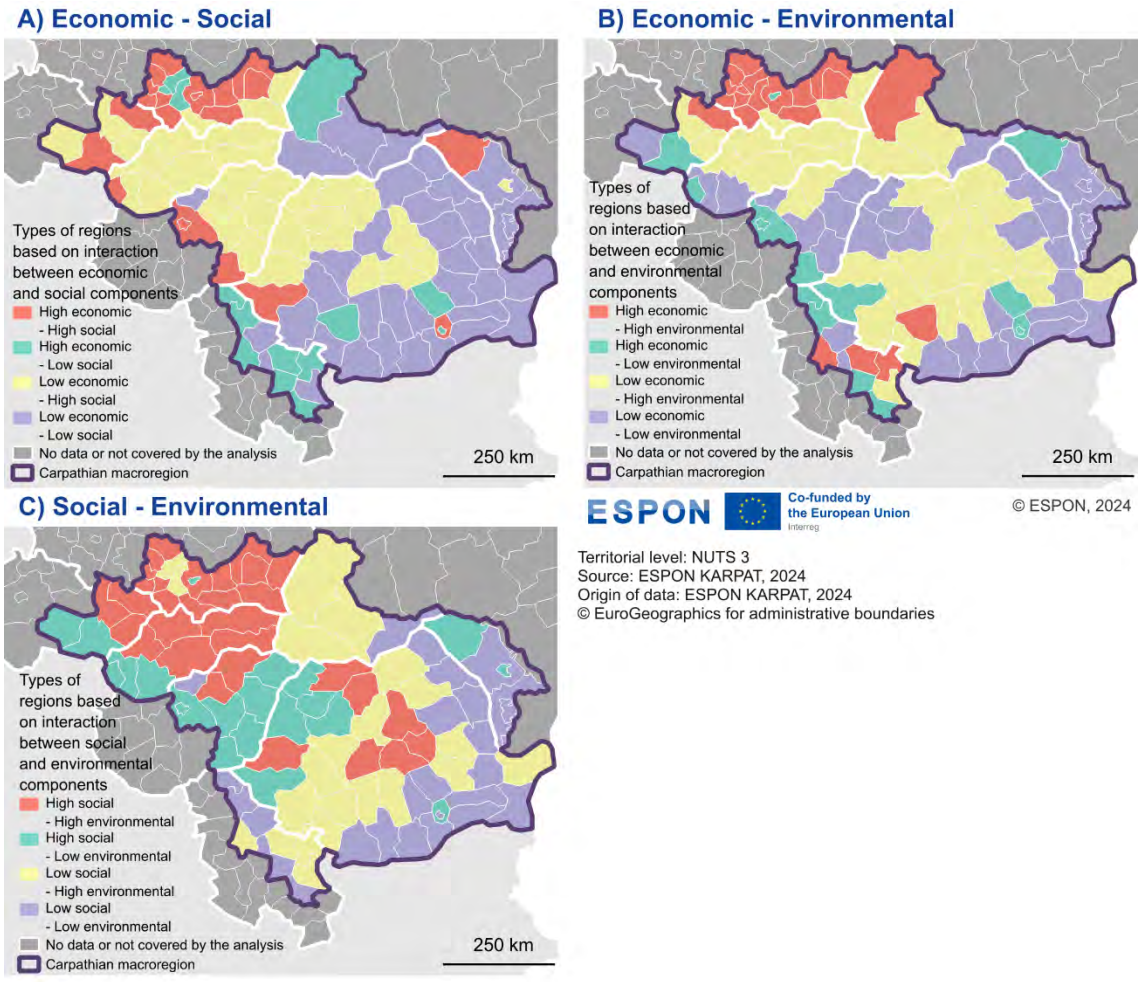
broadly follows a similar spatial pattern to the economic one but shows an even stronger alignment along the north-west to south-east gradient. The "**environmental" dimension** primarily captures the value of natural environment assets and, to a lesser extent, aspects of environmental pollution. This dimension is strongly associated with mountainous areas – particularly the Carpathian arc – and the Danube Delta. These components explained approximately 73% of total regional differentiation in terms of four capitals in the Carpathian macroregion.

By combining these three cross-thematic components in pairs, an another set of **regional typologies** was developed to capture the complex interplay between territorial capital dimensions and to identify context-specific development opportunities.

1. **Economic–Social** typology that classifies regions based on the interaction between economic potential and social conditions **(Map 3.5a)**:
    - **Strong performers (red)**: Regions with both high economic capacity and strong social dimension. These areas (e.g. urban regions in western Carpathians) may offer the most favourable environment for integrated, innovation-led development.
    - **Double disadvantage (purple)**: Regions with weak economic performance and social challenges. These areas require comprehensive, multi-sectoral support, including infrastructure development, human capital investment, social inclusion programmes, and improved access to basic services.
    - **Economically strong, socially vulnerable (green)**: Regions with sound economic indicators but facing social challenges. In these areas, redistributive policies, quality-of-life improvements, and inclusive governance can help convert economic success into broader well-being.
    - **Socially strong, economically weaker (yellow)**: Regions with cohesive communities but limited economic opportunities. Here, development strategies should build on local resilience and social capital, while stimulating entrepreneurship and attracting investment.
2. **Economic–Environmental** typology that contrasts economic development levels with natural capital endowment **(Map 3.5b)**:
    - **High potential regions (red)**: Regions with both high economic performance and high natural assets. These areas (e.g. some Polish and Slovak urban areas adjacent to mountains) can lead in eco-innovation, sustainable tourism, and green technologies.
    - **Low potential regions (purple)**: Regions lacking both economic and environmental assets. Development efforts should prioritise just transition mechanisms (policies that support communities during the move toward greener and more sustainable industries), infrastructure investment, and support for sustainable agriculture or energy.
    - **Economically strong, environmentally limited (green)**: Urbanised regions with economic advantages but limited natural resources. These areas are suitable for the expansion of renewable energy infrastructure or circular economy models.
    - **Environmentally rich, economically weak (yellow)**: Mountainous and peripheral areas with high ecological value but limited economic activity. These regions should be supported through conservation-linked development, such as eco-tourism, organic farming, and green entrepreneurship.
3. **Social–Environmental** typology that explores the link between social cohesion and environmental quality **(Map 3.5c)**:
    - **Balanced potential (red)**: Regions with both strong social and environmental capital. These areas are ideal for place-based, sustainable development strategies rooted in local identity and stewardship of natural resources.
    - **Double disadvantage (purple)**: Regions with social vulnerabilities and low environmental value. These areas may benefit from targeted support for community development, public service provision, and landscape restoration.

- **Socially strong, environmentally limited (green)**: Regions with resilient populations but low ecological value. These are suitable for renewable energy investment, sustainable agriculture, and urban–rural connectivity improvements.
- **Environmentally rich, socially weaker (yellow)**: Regions with significant natural assets but weaker social structures. Development policies should focus on strengthening local governance, engaging residents, and building inclusive economic opportunities.

Map 3.5
Typology of regions based on interactions between main components of diversity



Based on the combined analysis of the economic, social, and environmental components, a general typology of regions was developed using cluster analysis. This classification provides a synthetic perspective on territorial diversity across the Carpathian macroregion, identifying coherent spatial patterns shaped by overlapping strengths and weaknesses across the three dimensions. The map illustrating this typology **(Map 3.6)** highlights relatively spatially cohesive areas, largely shaped by environmental factors. For instance one of the most prominent distinctions is between the mountainous regions of the Carpathian range (marked in red and green) and the surrounding lowland areas, which form separate regional types due to differences in environmental, economic, and social conditions (marked in blue). For this reason, their labels were primarily based on their geographical location. The typology identifies the following types of regions and their features based on component values **(Tab. 3.5)**:

- (Red) **"Western Carpathians"**: Located in the northern part of the macroregion (excluding northern Hungary), these regions are characterised by significant natural assets, including forested

landscapes and protected areas. They also exhibit relatively strong performance in the social dimension, which clearly differentiates them from the Eastern and Southern Carpathians. However, the level of economic capital in these regions tends to be moderate.

- (Yellow) **"Metropolitan Centres"**: This is the most distinct category, comprising major cities that were delimited as standalone NUTS3 units. These areas display very high values in the economic dimension but limited environmental qualities, largely due to intense urbanisation and the limited territorial extent of these units. On the other hand, the social dimension reached medium values, suggesting the potential existence of localized issues that require targeted solutions.

- (Orange) **"Industrial Surroundings"**: This group includes highly urbanised and economically developed regions such as the Silesian Voivodeship in Poland and the Belgrade region in Serbia. These areas combine strong economic capital, well-developed infrastructure, and high population density with environmentally diverse landscapes. Some zones within these regions serve as protective buffers against industrial pollution. Nevertheless, these areas also experience considerable environmental pressure and, in some cases, social fragmentation.

- (Dark Green) **"Eastern Carpathians"**: Including the Transylvanian Plateau (excluding the Cluj region) and northern Hungary, these regions are somewhat less distinctive than other mountain areas. They are characterised by relatively weaker economic performance but generally above-average environmental conditions. The values in the social dimension are also moderate (especially in comparison with the "Western Carpathians"), which may indicate the presence of certain issues in this regard.

- (Green and Light Green) **"Southern Carpathians"** and the Danube Delta and **"Southern/Serbian"** Carpathians, share quite similar overall profiles in terms of the analysed dimensions. The main distinction lies in the economic sphere: while the "Southern Carpathians" face economic underdevelopment, the "Southern/Serbian Carpathians"—due in part to mineral resource extraction—display a higher level of economic and infrastructural development. However, both subtypes are marked by substantial social and demographic challenges. In all these mountainous regions, the environmental dimension remains above average.

- (Blue, including light and dark colours) **"Carpathian Surroundings"** these regions, located on the peripheries of the mountain areas, are commonly defined by their comparatively lower environmental assets relative to the Carpathian core. The **"Western Surroundings"** (dark blue), stretching from the Brno region in the Czech Republic through the Pest region in Hungary to Satu Mare in Romania, demonstrate stronger economic and especially social performance compared to the **"Eastern/Western"** and **"Southern Surroundings"**. Furthermore and "Southern Surroundings" (light blue) face more acute social challenges and more limited development prospects than "Eastern/Western" surroundings.

This general typology has been instrumental in shaping the spatial development visions building for the Carpathian macroregion, providing a structured understanding of territorial diversity and potential.

Map 3.6
Typology of Carpathian regions based on economic, social and environmental dimensions

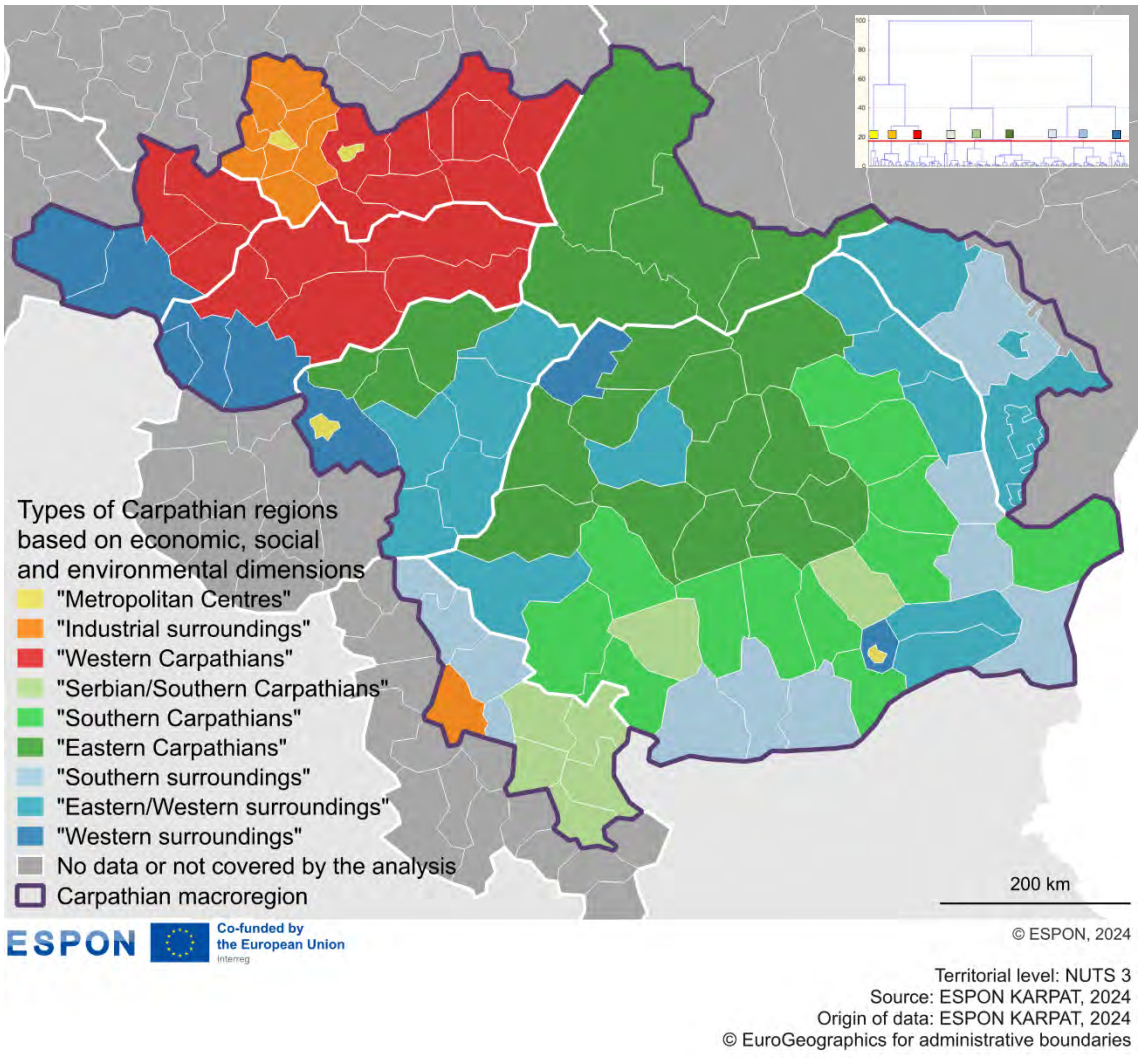


Table 3.5
Characteristic of different types of regions in Carpathian macroregion

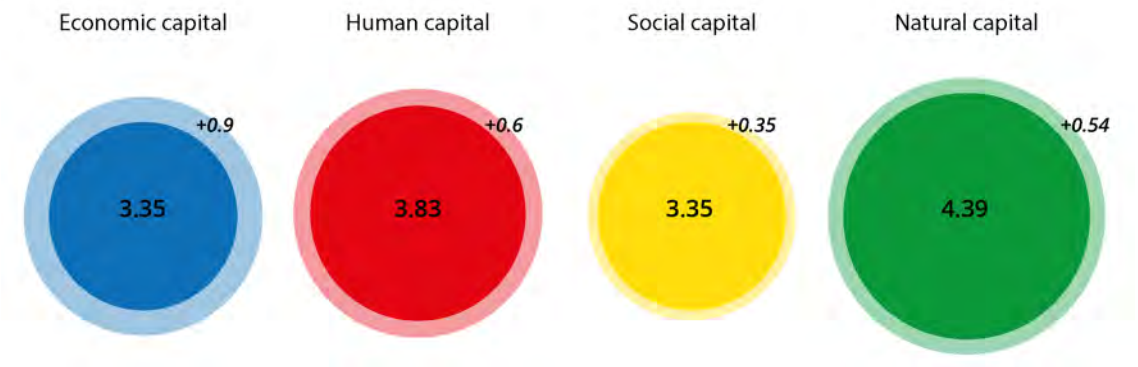
Tye of regions	"Economic-strength"	"Social-cohesion"	"Environmental-value"
„Metropolitan Centres"	3.78	-0.08	-0.94
„Industrial surroundings"	1.13	0.12	1.06
„Western Carpathians"	-0.05	0.99	1.03
„Serbian/Southern Carpathians"	0.32	-2.17	0.51
„Southern Carpathians"	-0.58	-0.79	0.38
„Eastern Carpathians"	-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)

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. 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 from Carpathian countries, representing various levels of public authorities, thematic fields, and both public and non-public sectors.

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



Source: own elaboration based on survey results.

According to the respondents, the regions comprising the Carpathian macroregion possess the greatest resources in terms of natural capital, followed by human capital **(Fig. 3.3)**. 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 (e.g. low share of people with higher education), these were not perceived as critical by the survey respondents. Conversely, the respondents gave lower ratings to the resources of economic and social capital, in contrast to natural and human 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 past decade, at least in certain regions.

The assessment of the state and changes in various types of capital varied across countries **(details are presented in Scientific Report)**. 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.

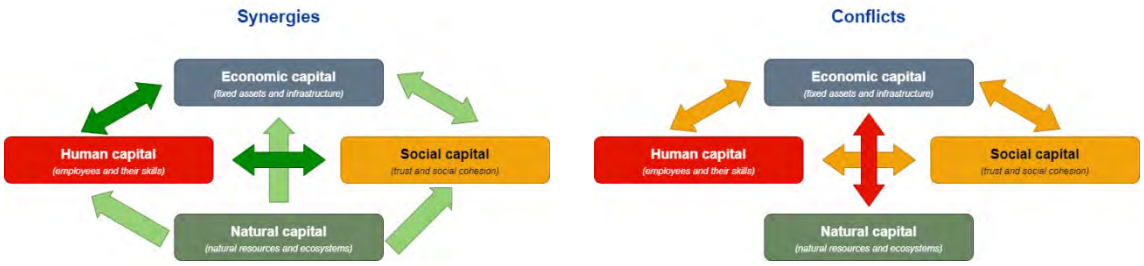
The state of natural capital was generally well-regarded, with positive changes noted in all countries except Hungary. Romania stood out with particularly favourable assessments in this category. In summary, while there are positive trends in economic and human capital in some countries (notably Romania 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[5], reveal both signs of synergy and areas of conflict (**Fig. 3.4**) Notable synergies were identified, particularly between economic and human capital. However, workshop discussions[6] 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 economies —particularly the mismatch between graduates' skills and the demands of local labour markets or key industries. 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 synergy between natural capital on other types of capitals was assessed by survey respondents as weaker.

Figure 3.4
Assessment of Relationships Between Territorial Capitals in the Carpathian macroregion

SYNERGIES	EC	HC	SC	NC
EC		59	30	25
HC	44		52	18
SC	33	54		19
NC	41	35	31	

CONFLICTS	EC	HC	SC	NC
EC		23	25	37
HC	22		27	15
SC	31	26		10
NC	48	17	13	



* percentage of respondents that indicated specific synergy/conflict
Source: own elaboration based on survey results.

[5] ESPON KARPAT survey espondents were actors involved or potentially engaged in territorial cooperation in the Carpathian area, including representatives of local, regional, and national authorities, previous project participants, Carpathian macroregion partners (keep.eu), and networks such as the Carpathian Convention and Euroregions. Total: 370 responses.

[6] Participants of two ESPON KARPAT workshops (approx. 100) were regional stakeholders at various levels, actively engaged in assessing development factors, shaping future visions, and drafting governance and cooperation recommendations for the Carpathian macroregion.

It was largely characterised 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 Carpathian region's potential to balance environmental preservation with economic and social benefits.

Figure 3.5
Synergies and Conflicts Between Territorial Capitals in Functional Areas by Country

SYNERGIES	Metropolitan areas	Small and medium cities	Rural areas	Border areas	Mountain areas	Protected areas
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)	2.0	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)	2.0	1.6	1.3	1.4	1.4	1.5

CONFLICTS	Metropolitan areas	Small and medium cities	Rural areas	Border areas	Mountain areas	Protected areas
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.

The primary manifestation of conflicts pertains to the relationship between economic and natural capital, highlighted by approximately half of the survey respondents. This primarily concerned issues related to uncontrolled suburbanisation —including unplanned residential sprawl and land-use change near urban areas—, 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.

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 between territorial capitals were most evident in the metropolitan areas of large cities, followed by the functional areas of small and medium-sized cities. Synergies in metropolitan areas were particularly noticeable in Poland, Serbia, and Hungary, while they were weakest in Ukraine (**Fig. 3.5**). In Ukraine, greater synergies were observed rather 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.

4 Spatial development visions and territorial guidance for functional areas

4.1 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).

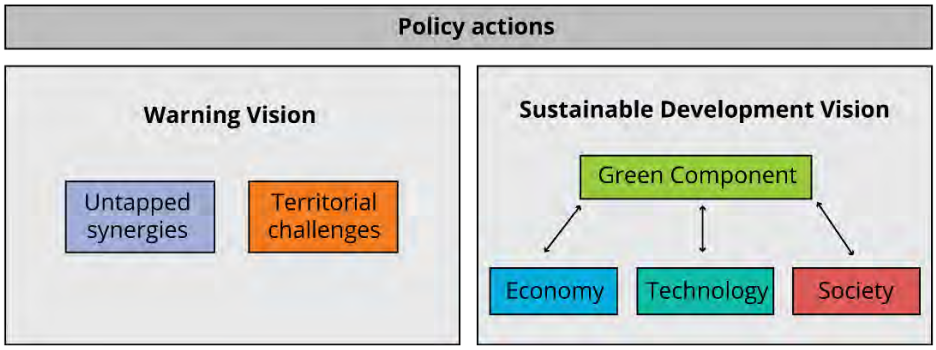
As a first step, it was decided that the development visions would be grounded in the activities of public authorities, whose actions largely determine the outcomes of current spatial trends and the region's ability to respond to external challenges. Based on this premise, two distinct visions were formulated: 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 4.1)**.

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 (details available in the Scientific Report). 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 4.1
Spatial development visions for Carpathian macroregion



Source: Own elaboration (EUROREG).

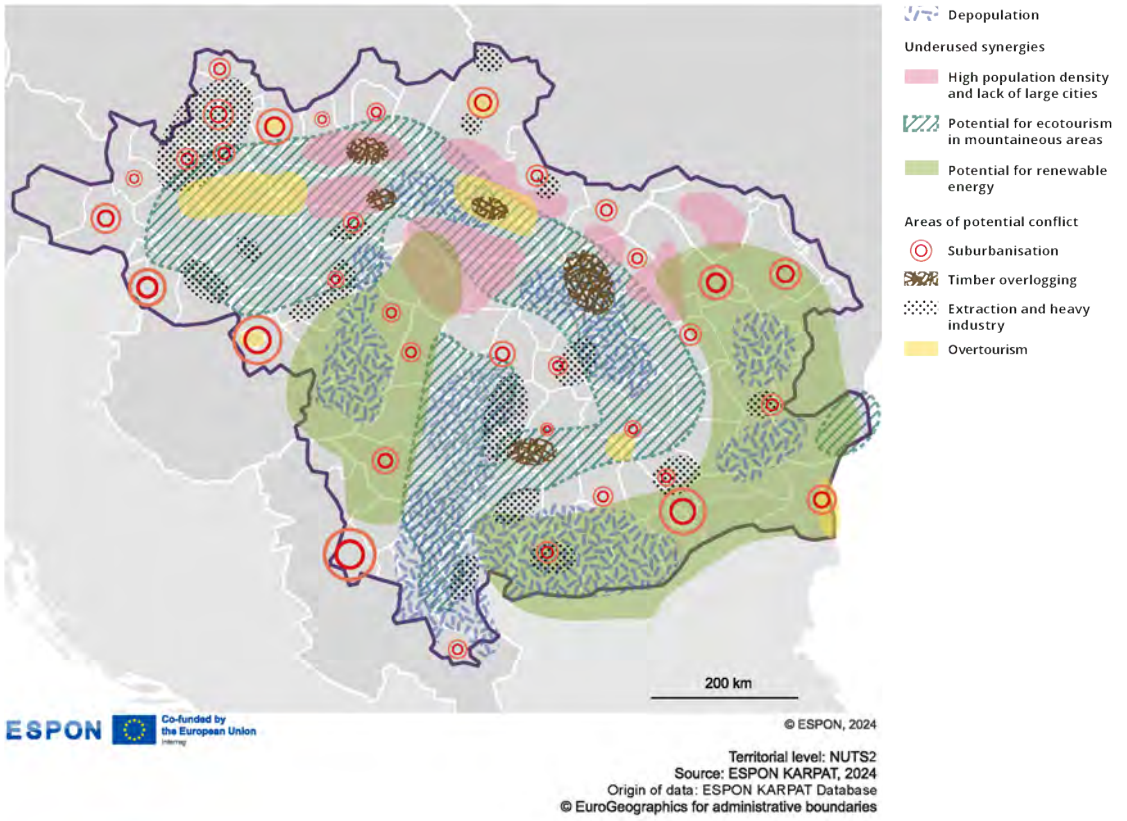
"Warning" spatial development vision

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.

Map 4.1
Warning spatial development vision



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.
- 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).

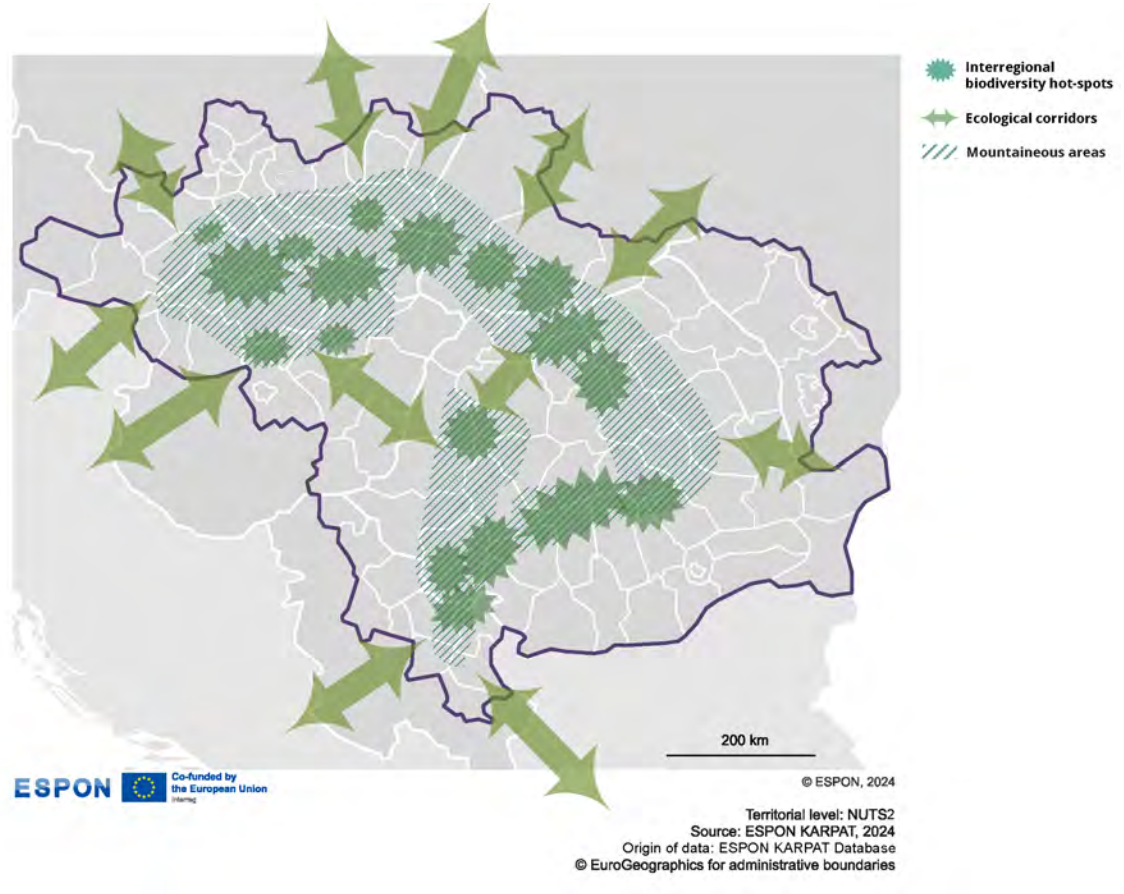
Spatially, the following elements can be highlighted **(Map 4.1)**:

- 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.

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.

Map 4.2
"Natural environment" component of sustainable development sub-vision



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.

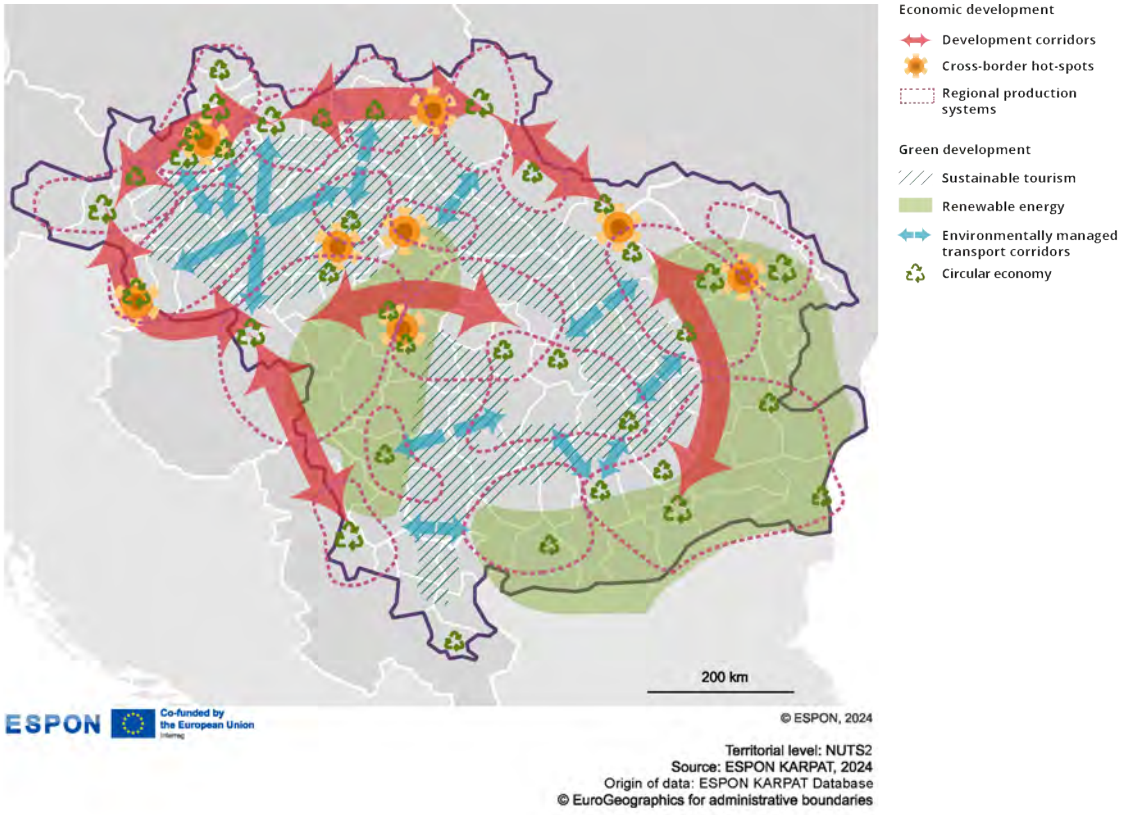
"Natural environment – Economy" sustainable development vision

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 CO_2 emissions: Reducing carbon-intensive industries, promoting renewable energy sources (especially solar energy) and implementing modern low-carbon technologies in production.

Map 4.3
"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.

"Natural environment – Technology" sustainable development sub-vision

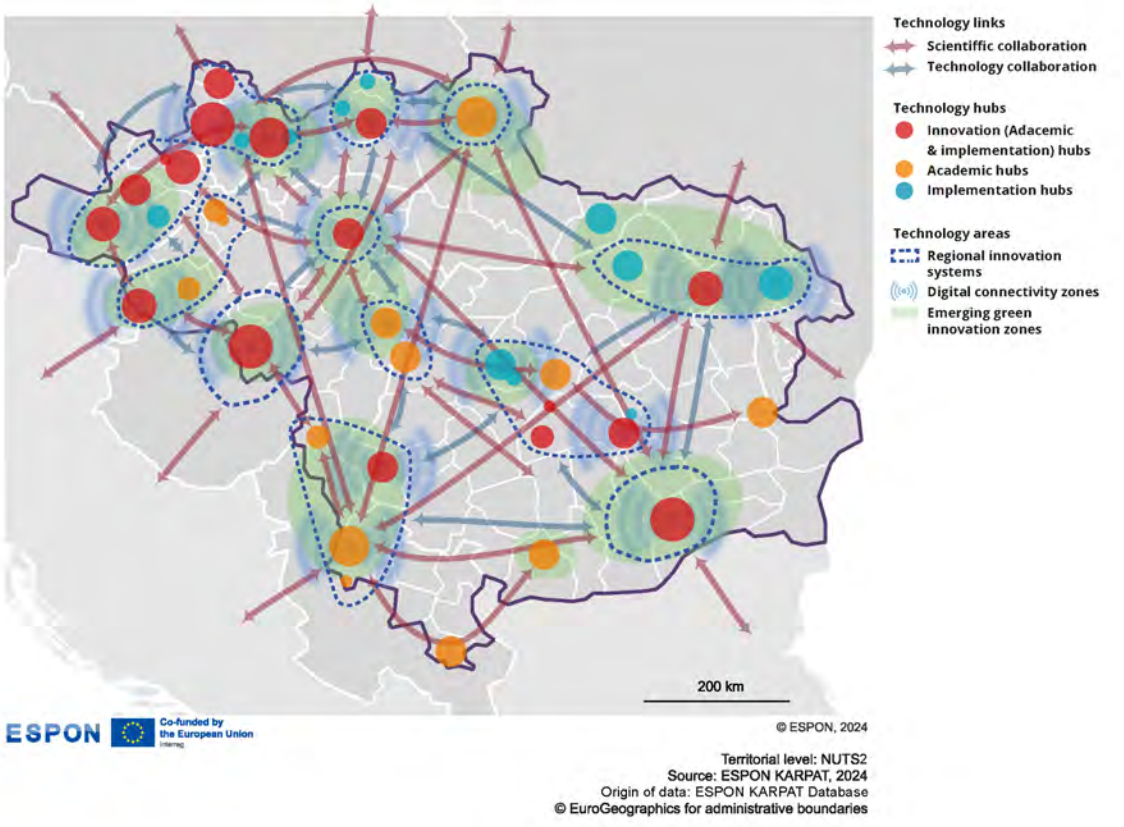
The "Natural environment-Technology" sub-vision envisions a transformation towards sustainable economic growth driven by technology, implemented in line with the Quadruple Helix model, engaging companies, scientific institutions, local authorities, society, and ecological stakeholders. The vision emphasises 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 as 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.

Map 4.4
"Natural environment-Technology" spatial development sun-vision



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.

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.

"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.

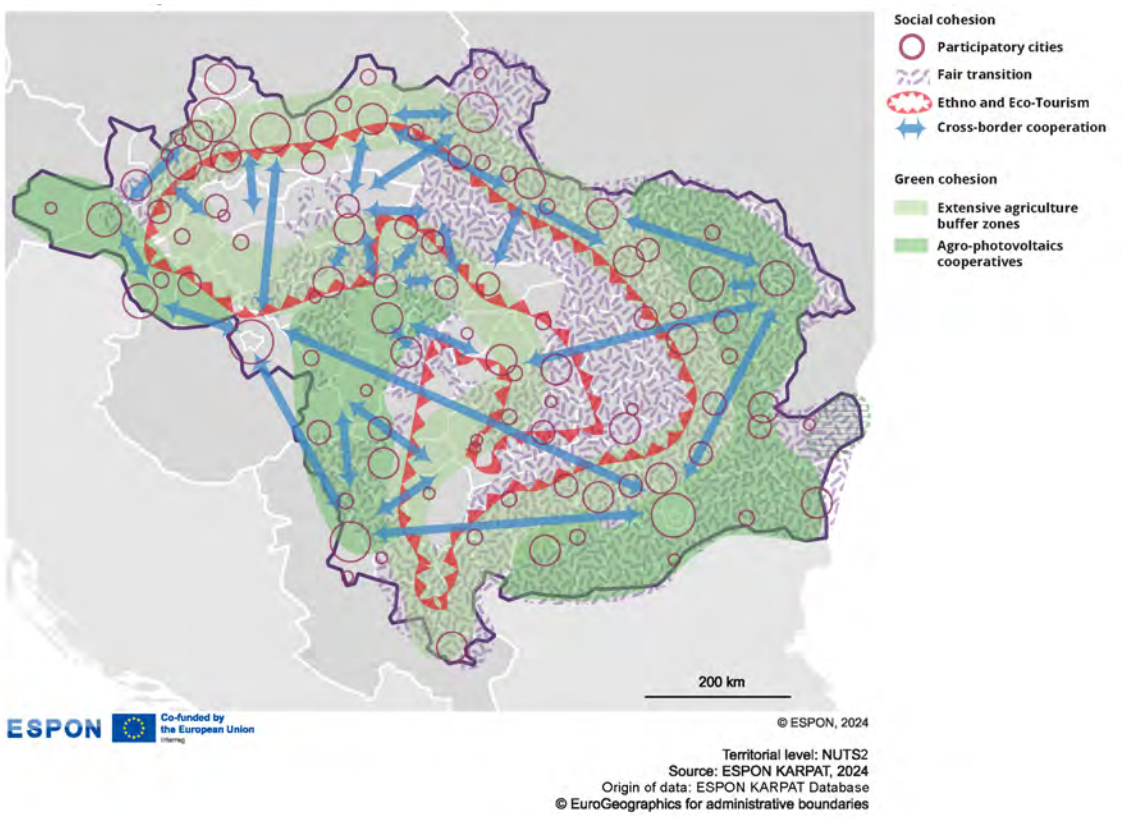
The sub-vision emphasizes the importance of strengthening urban-rural links to ensure balanced development and equitable sharing of the benefits of sustainable growth. Rural areas contribute high-quality, sustainably produced food and ecosystem services, while urban areas act as hubs for education, innovation, 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 4.5
"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.

4.2 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 4.1
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.
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.

Functional areas	Sustainable Spatial Development Vision		
	"Natural environment – Economy"	**"Natural environment – Technology"**	**"Natural environment – Society"**
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.
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.

Functional areas	Sustainable Spatial Development Vision		
	"Natural environment – Economy"	**"Natural environment – Technology"**	**"Natural environment – Society"**
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).

5 Administrative structure and multi-level governance

5.1 Domestic level

The administrative structure of the Carpathian countries differs significantly. The main feature of the multi-level governance framework defines all of the analysed countries as a unitary parliamentary democracy with a three-tier or a two-tier system of subnational government. A three-tier system consisting of regions, counties, and municipalities exists in Poland and Ukraine, whereas a two-tier system composed of regions (or districts) and municipalities as the main governing bodies can be found in Czechia, Slovakia, Hungary, Romania, Serbia and the Republic of Moldova.

The position of subnational governments (SNG) in the Carpathian countries vary considerably mainly due to the history and political shifts which resulted in transition from the communist centralised states towards 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, poviat in Poland), an upper intermediate level refers to regions. As shown in **Table 5.1**, 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.

Table 5.1
Competencies at different levels of governance in the Carpathian countries

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

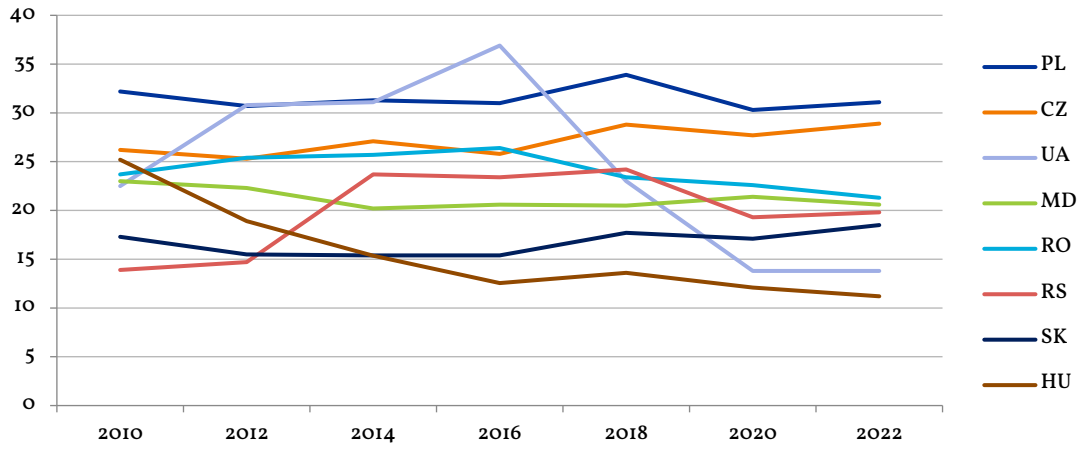
Source: Elaborated based on OECD/UCLG data (2022).

The distribution of governance competencies across Carpathian countries reveals distinct patterns that group states according to the structure and depth of their decentralisation. The Czech Republic,

Slovakia, and Poland demonstrate a balanced, multi-level governance model, with consistent involvement across local, intermediate, and regional levels. In contrast, Hungary and Romania exhibit a more centralised, vertically integrated approach, where the intermediate level is often absent or marginal. Serbia, the Republic of Moldova, and Ukraine show fragmented or transitional governance structures. Sectors such as education, housing, community amenities, and culture and recreation are primarily managed at the local level, suggesting a strong emphasis on subsidiarity and local responsiveness. In contrast, transport and economic affairs, health, spatial planning and social welfare tend to involve local and regional levels and in some cases all levels, requiring coordinated multi-level governance. Environmental protection stands out for its shared governance between local and regional levels, with the intermediate layer playing a limited role. These findings are in line with ESPON COMPAS project results and show crystalising typology of multi-levels governance models of Carpathian countries.

The power attributed to different levels of governance is reflected in the degree of decentralisation, which can be measured as a share of local government expenditure in the total public expenditure. Chart 5.1 illustrates share of sub-national level expenditure in general government expenditure between 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 5.1
Dynamics of sub-national government expenditure as % of general government expenditure in the Carpathian countries, 2010-2022



Source: Elaborated based on OECD/UCLG and IMF data (2022).
*subnational level (regional, intermediate or local)

Looking at the dynamics of expenditures further reveals divergent trajectories in financial decentralisation. In early 2010s Ukraine, Czechia and Poland consistently recorded the highest levels, with Ukraine peaking at approximately 37% in 2016 before gradually declining later, while Czechia and Poland maintained a stable range between 25%-30% and 30% - 34% respectively throughout the period. In contrast, Hungary registered a steady decline from the third most decentralised to the most centralised of all Carpathian countries scoring showing a steady decline from 24% to just above 11%. Ukraine experienced the most drastic shift towards centralisation—rising sharply to peak near 37% of in 2016, then falling dramatically to 14%. There recentralisation tendencies were driven by political turmoil initiated by the Russian annexation of Crimea in 2014 and then escalation of the conflict in 2022. By 2022 it is possible to identify 3 models: centralised (under 15%) - comprising of Ukraine and Hungary; moderate - displaying stable levels, remaining in the 18%-22% range represented by Romania, the Republic of Moldova, Serbia and Slovakia and decentralised – represented by Czechia and Poland with around one third of public spending done by sub-national entities. **These patterns underscore a clear disparity in the degree and direction of fiscal decentralisation, with some countries consolidating local spending authority and others**

reversing earlier reforms, posing challenges for macro-regional alignment in public finance governance.

All in all, the average of subnational government (SNG) expenditures in the Carpathian countries amounted to 20.6% of public spending in 2022, and it 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 among the analysed states these two countries have the most impactful and competence-rich SNG authorities in terms of public spending.

In Poland and Czechia, the primary spending area of subnational 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 been also a primary spending area of SNG in Slovakia (40.2%) and the Republic of Moldova (55.3%). Other important areas of SNG activity in Poland, Czechia, Slovakia, and the Republic of Moldova include health care and transport. In turn, health care measured by expenditure has become a primary subnational competence in Romania (22.8%), which is followed by transport and economic affairs (19.6%).

The share of municipalities expenditure has also increased in Serbia, reflecting an extension of their competences. However, staff salaries remain the key item in the budgets, accounting for 38.7% of the total SNG spending in 2020. The opposite trend of governing was seen in Hungary, where upper local authorities (counties) have been deprived of competencies in education, health care, environmental protection, culture, social welfare, and transport. As a result, the shares of SNG expenditure in the given sectors precipitously fell. In Hungary, only municipalities 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 full-scale invasion against Ukraine in 2022, the transfer of responsibilities has become extremely complicated and rife with 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 predominantly responsible for issuing payments to education employees, social protection and the health care sector. Over 43% of the SNG spending is allocated to payroll in these areas. Though in general some 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 fluid.

5.2 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 programmes. They altogether create a diverse network of partners, complemented with a series of bilateral and multilateral cooperation formats.

Euroregions

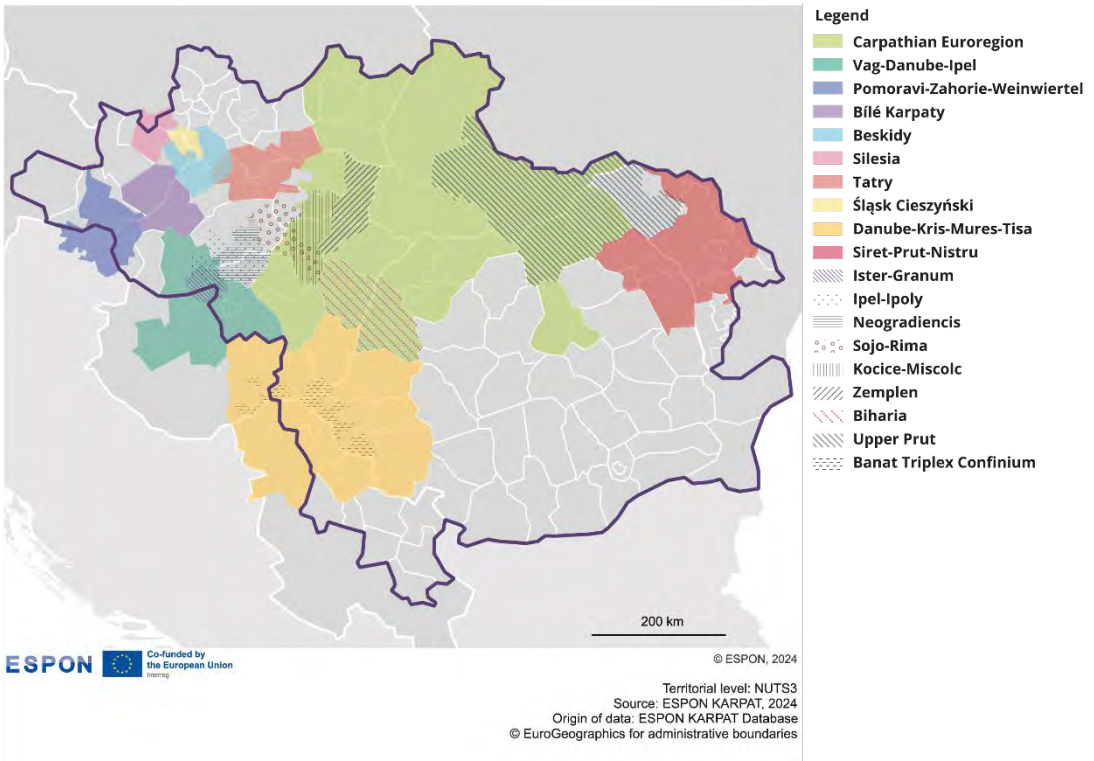
Euroregions are a form of cross-border cooperation between local governments of neighbouring countries at different administrative levels. The governance structure of Euroregions is based on political agreement among bordering entities and usually consists of the council, secretariat, and working committees 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 countries demonstrates a high extent of diversity. By 2023, a total number of 19 Euroregions had been established in the Carpathian area (**Map 5.1**).

The largest concentrations of Euroregions can be found in Slovakia (12), where they cover the country's entire border area, as well as in Hungary (11). Poland is a member of 6 such cooperation arrangements, while Czechia and Romania participate in five 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. The majority of Euroregions located in the Carpathian area are involved in some bilateral cross-border forms of cooperation. 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 across 19 regional units in 5 countries and reaching over 500-kilometre distances entails many challenges in multilateral contacts, e.g. language barriers, divergent legal systems, political and economic disparities **(Lytvyn and Tyushka, 2020)**. Nonetheless, the Euroregion serves as a platform for a few active arrangements, such as SMEK – the 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 5.1)** 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 5.1
Map of Euroregions in the Carpathian macroregion



EGTC

The European Grouping of Territorial Cooperation (EGTC), enabled in 2006 by a regulation of the European Parliament, is the main instrument for those types of cooperation that require legal personality (that Euroregions lack), providing a new legally-grounded tool and an autonomous structure to an established cross-border organisation.

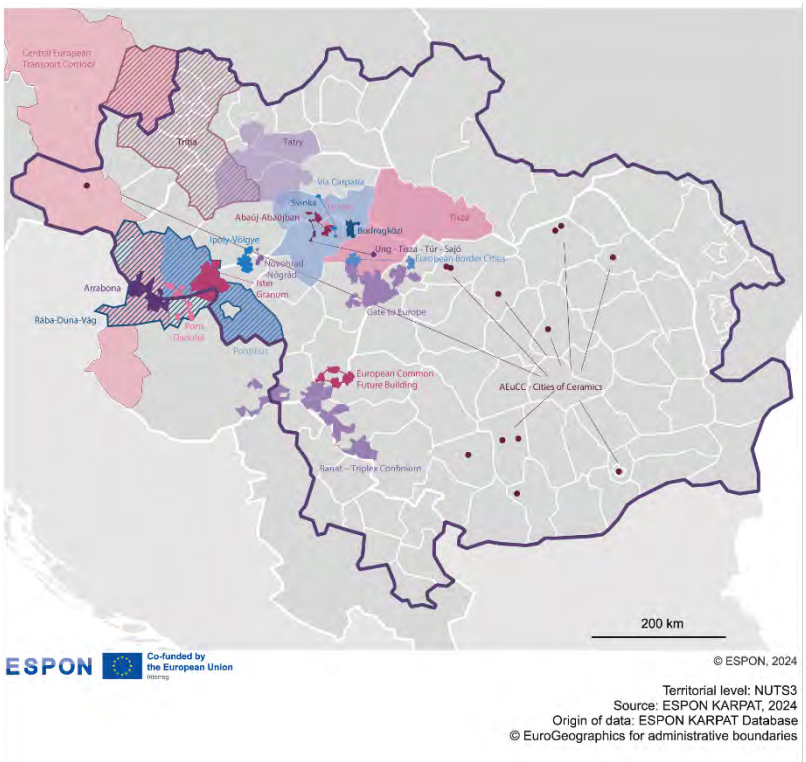
The territorial spread of EGTC in the Carpathian macroregion is largely associated with cultural and historical background of cooperating municipalities **(Map 5.2)**. However, the financial support provided by the European institutions is deemed an important trigger of EGTC proliferation**. By 2023, 22 EGTCs in the**

Carpathian macroregion have been created. The dynamic of EGTC formation shows that this process was initiated in 2008, when the first EGTC (Ister-Granum) was established by converting an Euroregion into an EGTC formula. **The largest increase of EGTC occurred in 2013 when another 5 of them were formed. This growth was mainly stimulated by the then-upcoming 2014-2020 programming period, which provided new funding opportunities through the EU instruments. The majority of EGTCs (75%) is located in Hungary, where most of them are situated on the border with Slovakia. The Hungarian border also concentrates one of the largest and the smallest EGTC**. While the largest EGTC Rába-Duna-Vág covers 25,407 km², the smallest one Torysa is operating on the area of a mere 60 km². Overall, out of 22 EGTC located in the Carpathian macroregion, 6 have an area surpassing 10,000 km², 7 EGTC between 1000-10,000 km², 7 EGTC in the range of 1000-100 km², and two of the smallest EGTC operate on the area below 100 km².

Notably, Hungarian-Slovak EGTCs are among the most active organisations. 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 EGTCs experience challenges, including financial woes, deepened by language barriers.

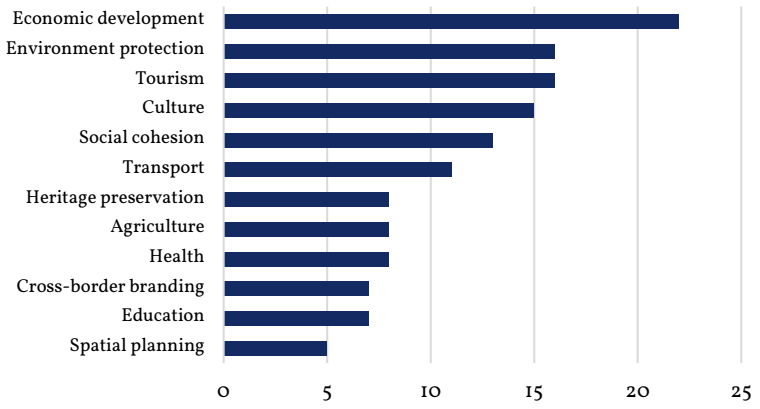
The governing structure of EGTCs in most cases includes statutory bodies (general assembly and director) and supervisory boards. The primary advantage of the EGTC is the ability to sign legal contracts and apply for EU and external funding. Given such possibilities, one of the main goals of EGTCs in the Carpathian area is to reduce economic and geographic marginalisation by developing infrastructural, cultural, economic, and environment initiatives in cross-border areas. This scope of goals largely correlates with the main areas of cooperation declared by the majority of EGTCs located in the Carpathian macroregion (**Chart 5.2**).

Map 5.2
Map of European Groupings of Territorial Cooperations (EGTC) in Carpathian macroregion



Source: Own elaboration based on https://egtcmonitor.cesci-net.eu/en/

Chart 5.2
Main areas of EGTC cooperation in the Carpathian macroregion, 2024



Source: Own elaboration based on desk research.

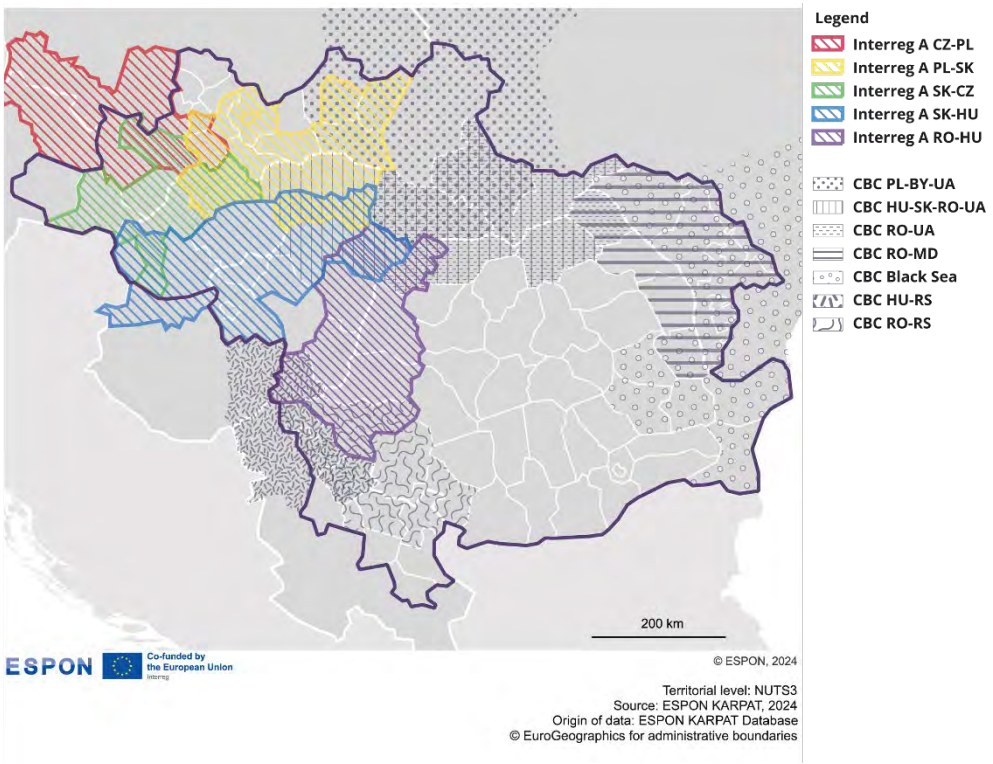
Interreg CBC programmes

Important triggers of cross-border consolidation in the Carpathian macroregion are Interreg programmes. They offer a range of frameworks in multi-level governance bringing together actors from the public, private and NGO sectors. In the period 2014-2020, the programme that connected the largest number of stakeholders from the Carpathian area was Interreg V-A (**Chart 5.3**).

Multiple Interreg programs cover the same geographical areas, leading to overlapping zones where stakeholders can benefit from various funding opportunities for cross-border initiatives. 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 programs 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 funded form Interreg A programme.

Map 5.3
Map of Interreg cooperation structures in Carpathian macroregion, 2014-2020



Source: own elaboration based on European Commission

5.3 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 **(Map 5.4)**.

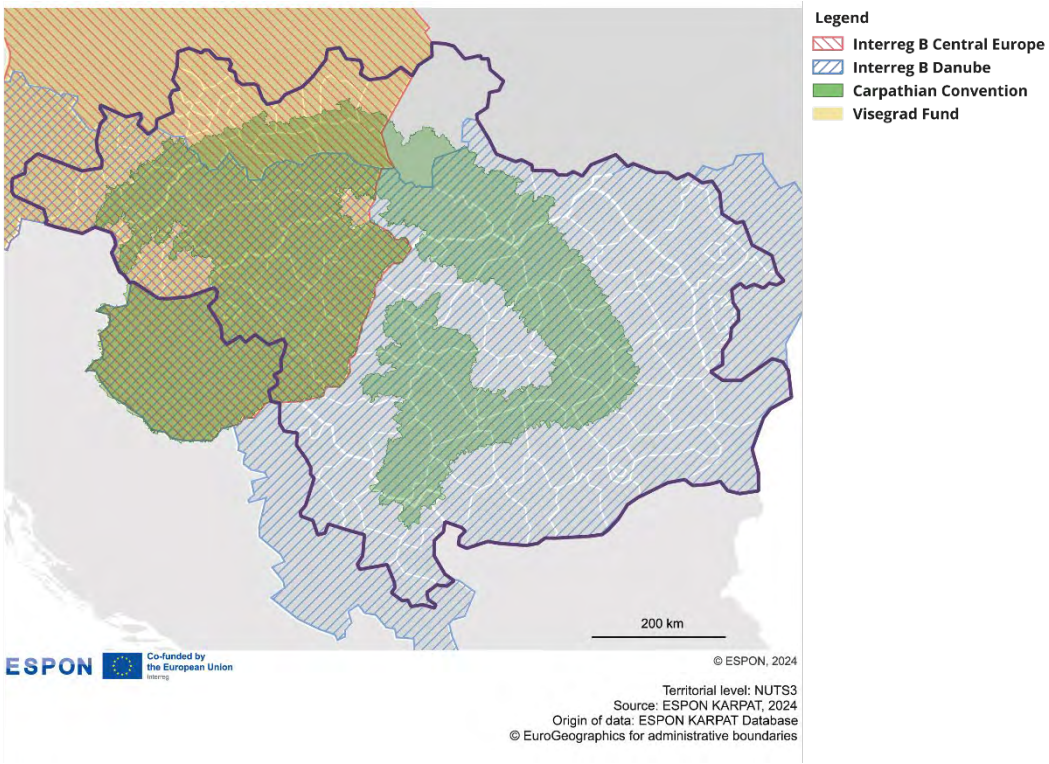
A primary example of such transnational cooperation is the International Visegrad Fund established in 2000 by Czechia, Slovakia, Hungary, and Poland (V4 countries). The supreme body of the Fund is the Conference of Ministers of Foreign Affairs of the V4 countries, which approves the Fund's budget and determines the rules of cooperation. **Since 2000, the Fund has supported over 6,000 projects with a total budget of 120 million euros distributed among various public and non-governmental actors**. The main spectrum of their activities extends from small cross-border ventures to multilateral and international projects in the areas of culture, education, environment, tourism, innovation, and social development.

Other crucial instruments for transnational cooperation in the Carpathian macroregion are Interreg programmes transnational strand B, which allow entities in countries that do not share the borders to work together and develop networks of cooperation. In the macroregion, there is no programme 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 region of Lviv. As a result, this weakens the potential for cooperation, especially in relation to the specificity of mountain areas.

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, and 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.

Map 5.4
Transnational programmes and initiatives in the Carpathian macroregion, 2014-2020



Source: Own elaboration base on European Commission.

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 working together in different projects in the Carpathian area. So far, the parties (COP) have adopted five 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), the Carpathian Network of NGOs (CERI), and Science for the Carpathians (S4C) **(Vetier, 2016).**

Furthermore, 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 Macroregional 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 Wladyslaw Ortyl (PL/ECR) and involves both EU and non-EU states, specifically Serbia and Ukraine, emphasising inclusivity in its strategic framework. 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. The group prioritises sustainable development, cultural preservation, and environmental protection, all the while creating platforms for dialogue, best shared practices, and informal yet targeted collaboration among stakeholders.

6 Territorial cooperation

This chapter presents two key aspects of cross-border cooperation in the Carpathian macroregion; on the one hand, the grassroots collaboration between partner cities, and on the other, international initiatives, including the Interreg programme, which leverage external funding and primarily take the shape 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 programmes 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.

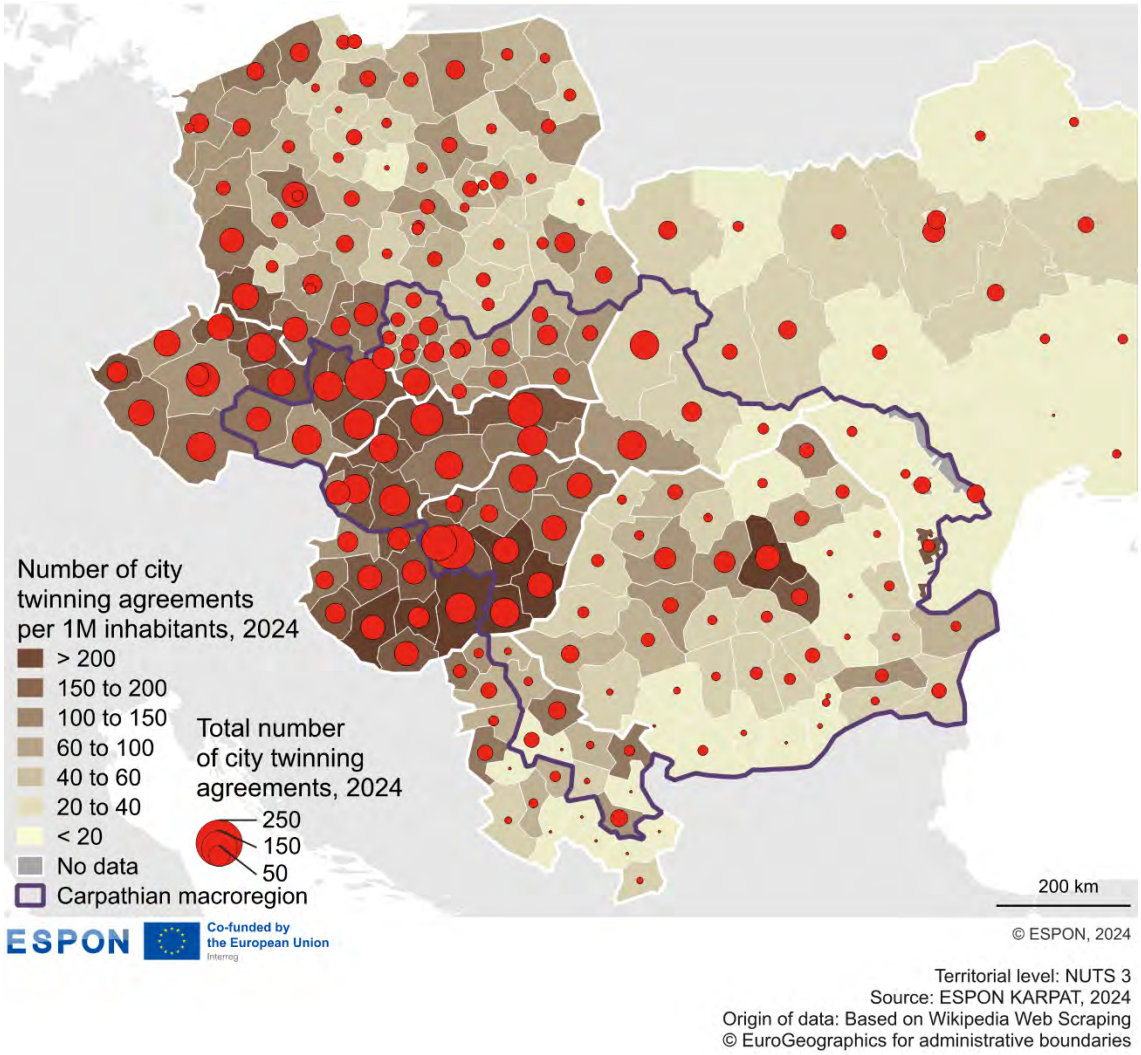
6.1 City twinning agreements

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. The origins of this cooperation in Europe date back, according to some sources, to the 19th century and, according to others, to the 1920s. 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 are typically bottom-up initiatives, often stemming from personal contacts between local leaders (**Furmankiewicz, 2005**). Their growth is also supported by international organisations, including EU institutions and bodies such as the Council of European Municipalities and Regions. Although thousands of such agreements exist in Europe (**Płoszaj, 2013; CERM, 2007**), only about a third result in active or lasting cooperation (**Smętkowski et al., 2022**).

Twinning between towns is strongly developed in the Carpathian macroregion, especially in its western part (Map 6.1). In quantitative terms, local governments located in the Czech Republic, Slovakia and Hungary boast the highest number of twinning agreements. To a certain extent, this is due to the fragmented administrative structure of these countries, which are characterised by an extremely high number of 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 these 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 is least popular in the Republic of Moldova and a significant number of Romanian regions, especially those located in Moldova and Wallachia, as well as in some Serbian regions**.

Map 6.1
City twinning agreements by NUTS3 regions

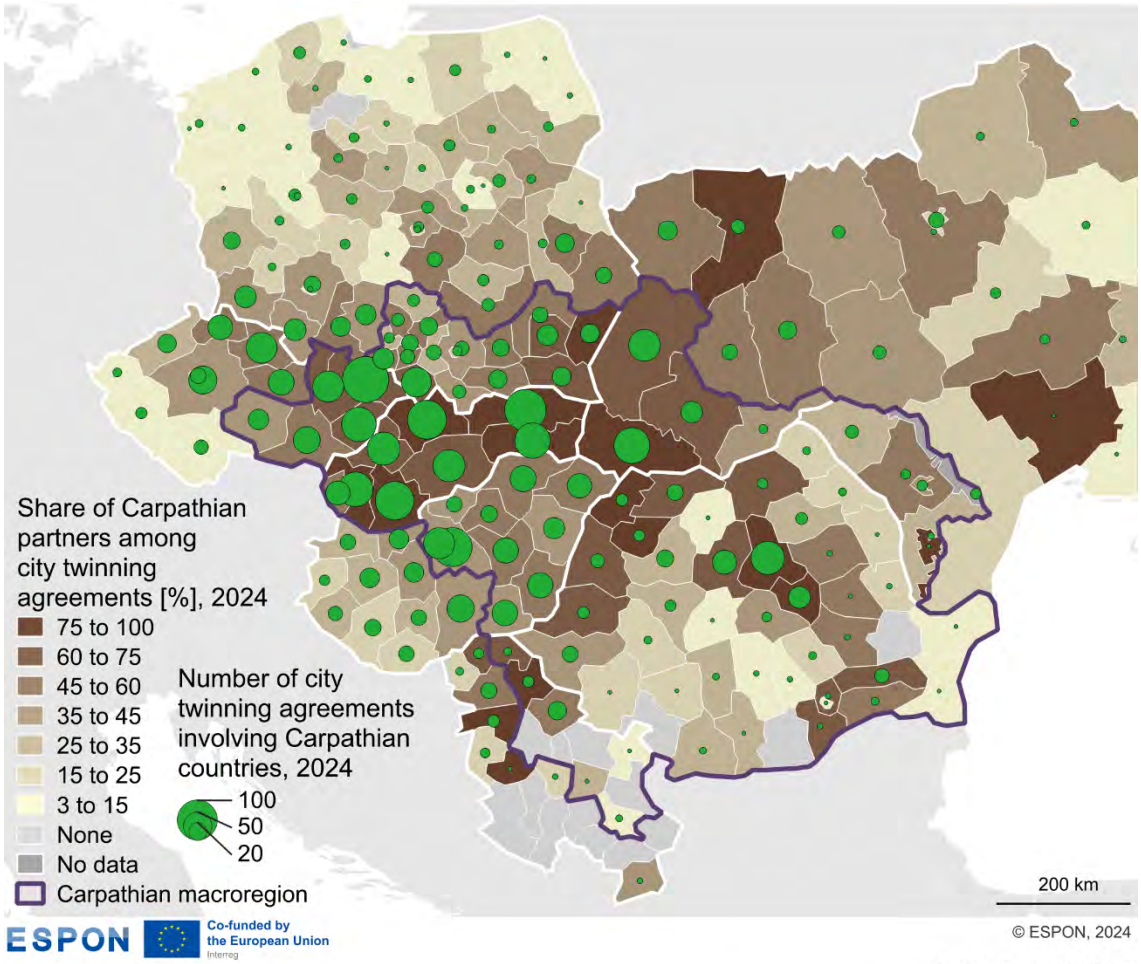


An analysis of the direction of bilateral agreements shows that this form of cooperation is particularly intensive between partners located in neighbouring countries (Map. 6.2). As a result, a large number of agreements, and in the case of some regions of the Carpathian macroregion even all the agreements 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 75% of all city twinning agreements involve partners from the Carpathian countries.**

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.

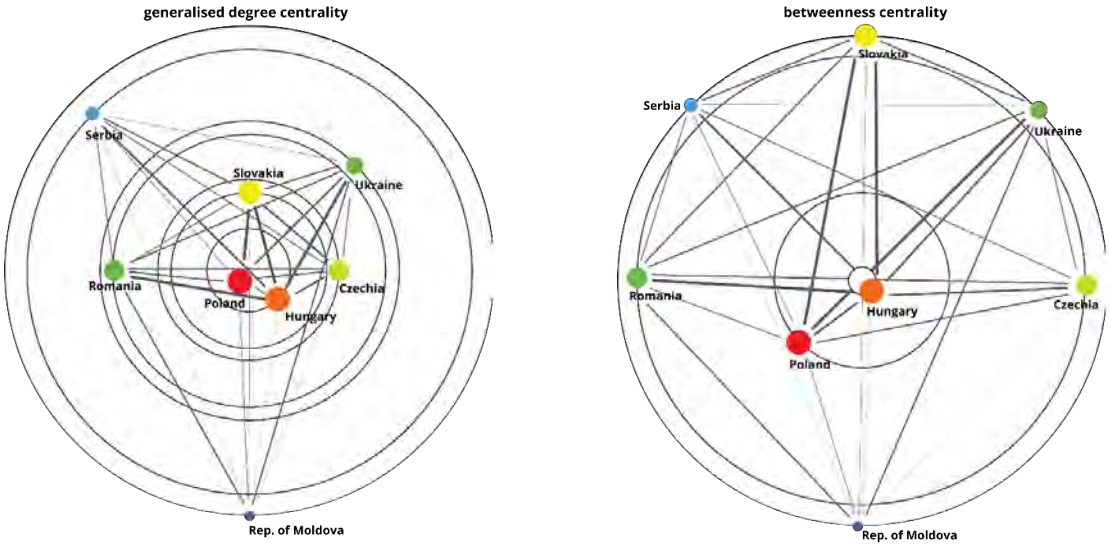
Aggregating, at the national level, the number of twinning agreements concluded allows for an assessment of each country's overall importance within transnational cooperation networks in the Carpathian macroregion **(Chart 6.1). In terms of the degree of development of twinning within the Carpathian macroregion (generalised degree centrality index), Poland played the greatest role, followed by Hungary. The role of the Czech Republic and Slovakia as city twinning nodes was also significant.** Romania and Ukraine, on the other hand, played a less prominent 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

Map 6.2
City twinning agreements involving partners from the Carpathian countries



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

Chart 6.1
City twinning networks in the Carpathian countries - network centralities



the 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.

6.2 Transnational initiatives and projects

Transnational initiatives and projects play a crucial role in fostering regional development and integration within the Carpathian macroregion. This in particular is implemented under the framework of Interreg programmes, which provide financial and organisational support for cross-border and transnational cooperation. Alongside 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, a network analysis of cooperation within the macroregion has been performed, examining the relationships and linkages between various stakeholders, including local authorities, non-governmental organisations, and international institutions.

Interreg programs

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. 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 period 2021-2027, implemented under the name of Interreg NEXT (Ukraine and the Republic of Moldova). The transnational cooperation, encompassing wider geographic areas, e.g. ones linked to macroregional strategies, is carried out within the Interreg strand B. For the purposes of interregional cooperation, the Interreg strand C was established, promoting the exchange of experiences and capacity building between regions.

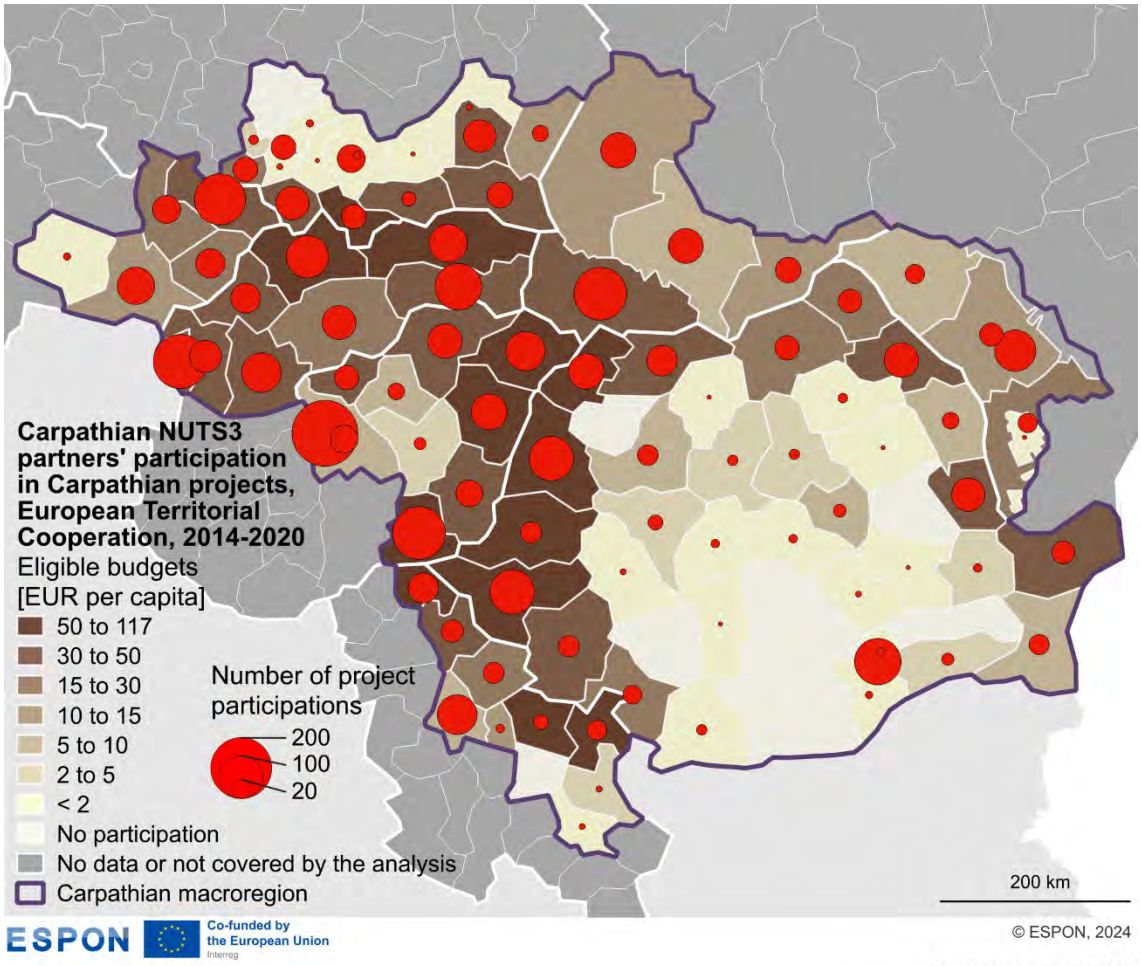
A set of 1,388 "Carpathian projects"[7] from the 2014-2020 programming period, was selected from the keep.eu database for the study analysis. There were 6,163 partners (project participations) in the Carpathian projects, including 3,649 partners located in the Carpathian macroregion. **CBC projects (Interreg A) were the most common type of projects, making up around 79% of Carpathian projects (1,069 projects for the amount of EUR 1.02 billion, 69% of total EU funding), followed by transnational projects (Interreg B) (15% of projects – 209 projects, accounting for 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. 6.3)**, which shows a higher intensity of collaboration along all national borders (e.g. well visible in Romania). This is related to eligibility criteria that favours 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, which is especially visible in the cases of Budapest and Bratislava.**

The share of the project budget, illustrated on the **map 6.3**, is based on the value of the partner's eligible budget. **The total expenditure of the Carpathian projects amounted to about 1.76 billion EUR (with about EUR 1.47 billion of the EU funding). The share of the Carpathian partners in the eligible budget**

[7] The term "Carpathian projects" is used in the report to refer to Interreg projects selected according to the following methodology: 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.

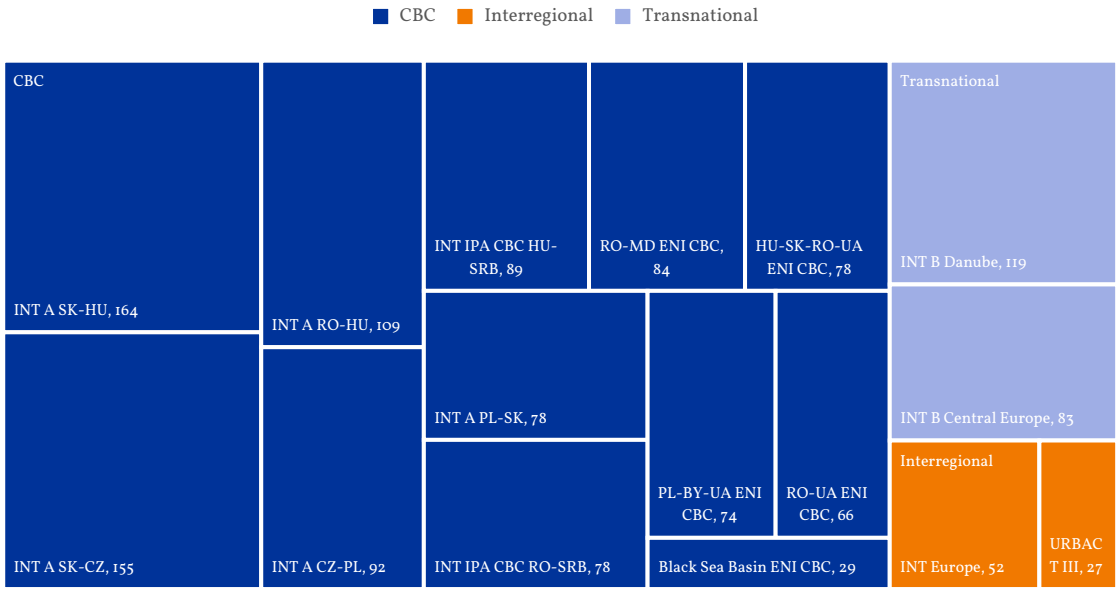
accounted for around EUR 1.27 billion (87% of this sum coming from CBC projects, 11% from transnational ones and around 1,6% from interregional ones, as those involved more partners from outside the Carpathian macroregion). Throughout the programming period, some regions received support exceeding EUR 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.

Map 6.3
Project participations and budgets shares of Carpathian projects, 2014-2020



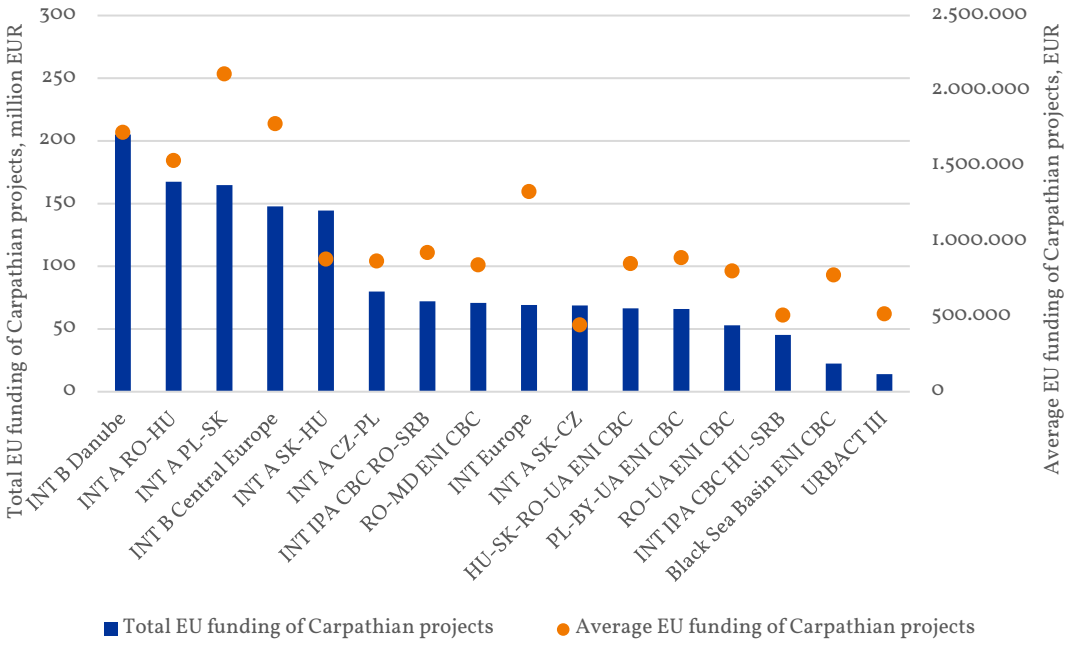
The numbers of Carpathian projects within specific programmes are presented in **Chart 6.2**. The biggest share of projects was implemented in the Interreg A bilateral programmes between Slovakia and Hungary, and Slovakia and the Czech Republic. **Transnational cooperation was mainly supported by the Interreg B Danube and Central Europe Programmes, each supporting only 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 in which, however, the non-EU members Carpathian countries were not included in the 2014-2020 programming period.

Chart 6.2
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.

Chart 6.3
Budgets Carpathian projects – EU funding, 2014-2020

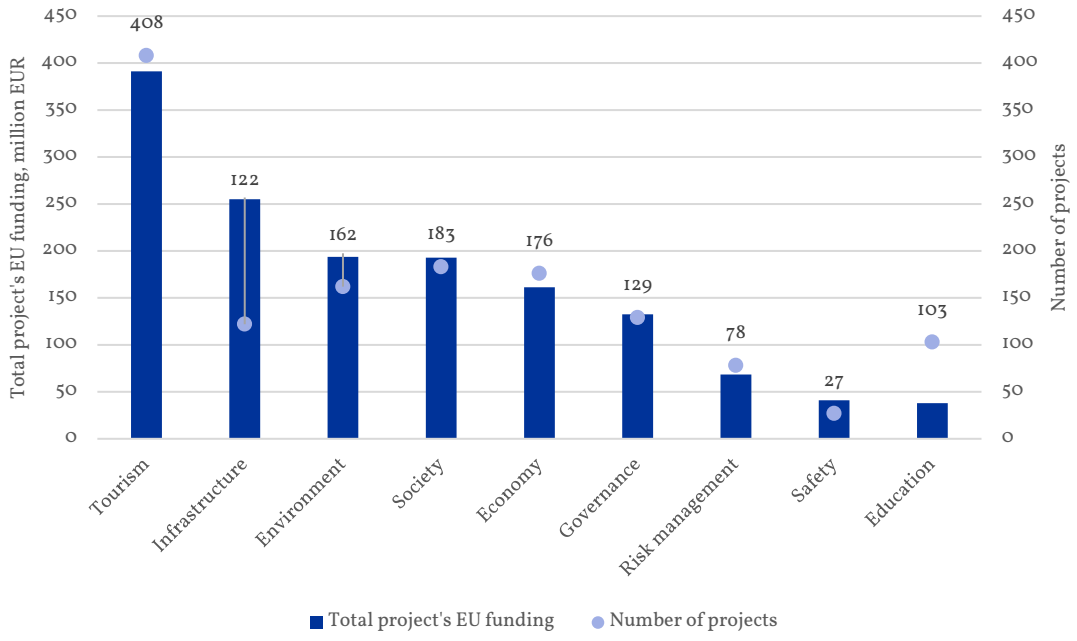


* programmes with less than 5 projects were excluded from the chart.
Source: Own elaboration based on keep.eu.

Regarding budgets, the largest amount of EU funding was distributed to Carpathian projects in the Interreg B Danube Programme, followed by the INTRREG A Romania – Hungary, Interreg A Poland – Slovakia, and Interreg B Central Europe (Chart 6.3). The different order than the one observed in the case of the project 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, larger. 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 organisations are at the forefront, followed by Slovakian and Romanian ones.

Romanian, Hungarian, and Slovakian partners participated in the largest share of projects (Map. 6.4) – it was related to the largest number of programmes which the Carpathian entities from these countries were eligible for. The three countries prevailed in the nominal numbers of Carpathian projects and project participations (partners). Poland, the Czech Republic, and Ukraine participated in twice as few Carpathian projects vis-a-vis the leading countries. Serbia and the Republic of Moldova found themselves on the rear end 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. The engagement of the 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.

Chart 6.4
Thematic areas and budgets of Carpathian projects (EU funding), 2014-2020



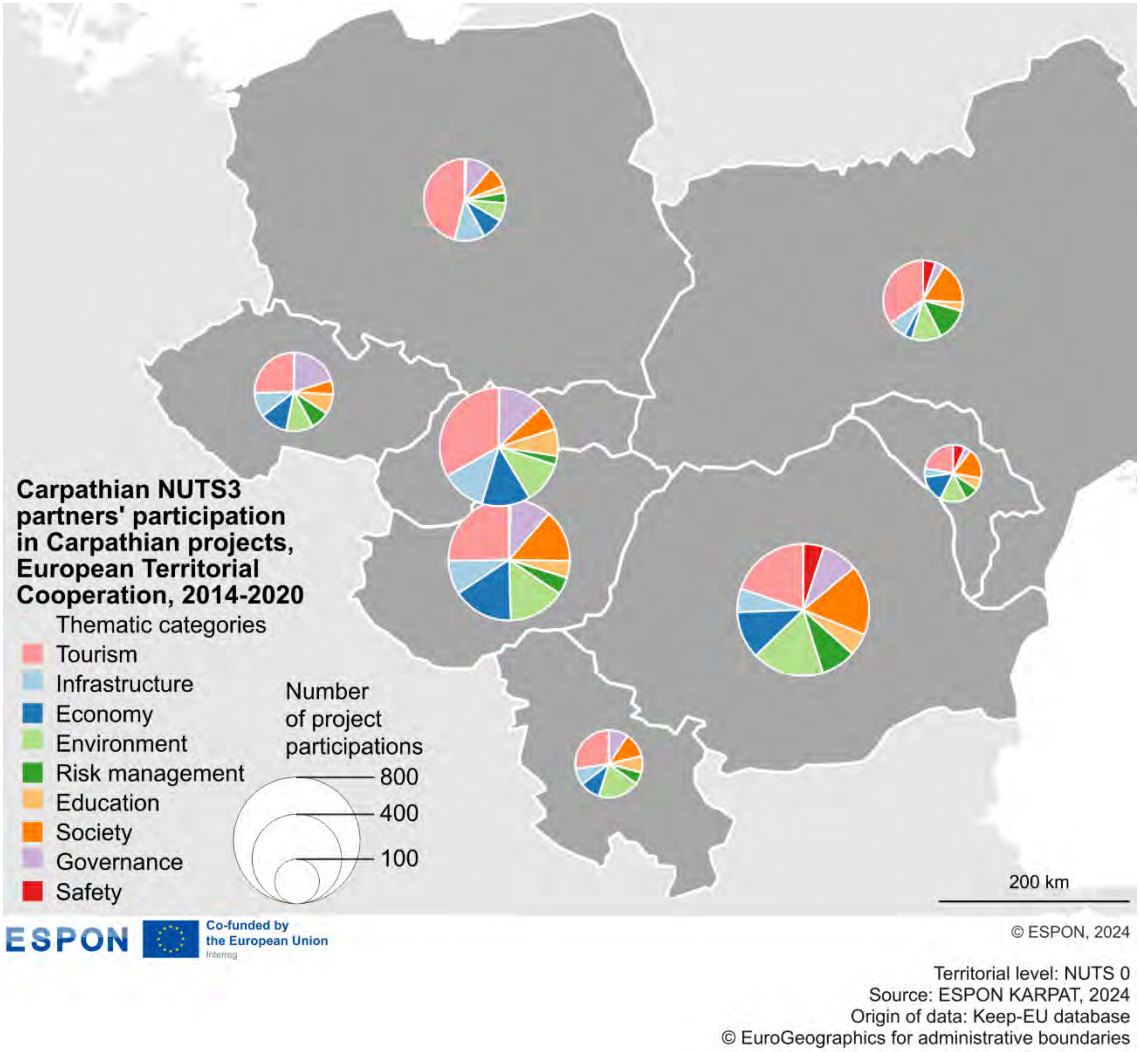
Source: Own elaboration based on keep.eu.

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 (265), Germany (243), Austria (240), Croatia (214) and Bulgaria (161), but also

from Italy (222), which is very active in the ETC programmes. For the remaining countries, the number of partners generally does not exceed 50, barring Spain (70) and Bosnia and Herzegovina (52).

The most significant number of Carpathian projects and the largest part of the budget were dedicated to the theme of tourism (Chart 6.4). Projects in the thematic areas of society and economy were the next most numerous. Projects in the thematic areas of infrastructure, safety, and environment 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. 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 highest proportions of Carpathian NUTS3 partners who engaged in the touristic field of cooperation were noted in the case of Poland, Ukraine, and Slovakia. 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 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. A larger proportion of Hungarian Carpathian NUTS3 entities engaged in economic projects rather than in the other countries.**

Map 6.4
Thematic categories of Carpathian projects, 2014-2020



Territorial level: NUTS 0
Source: ESPON KARPAT, 2024
Origin of data: Keep-EU database
© EuroGeographics for administrative boundaries

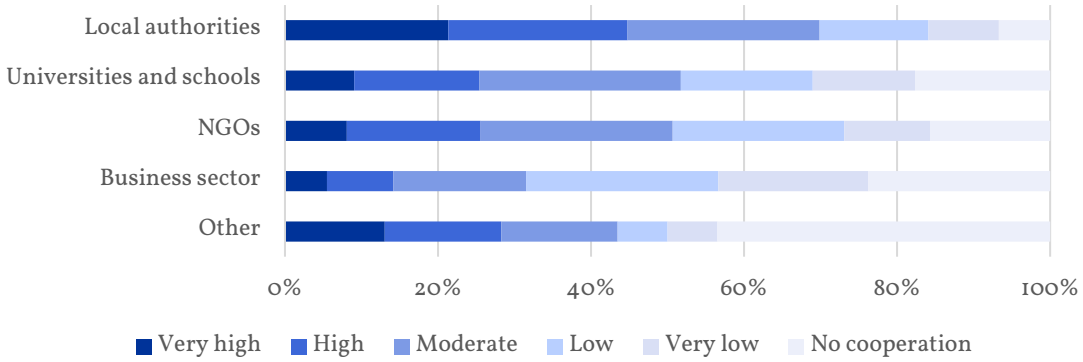
In the 2021–2027 programming period, the Interreg programmes have largely continued in their previous form. The most important changes constituted (1) the exclusion of Belarus from Poland –

Ukraine CBC Programme that became bilateral, (2) the transfer of the Black Sea Basin Programme from Interreg strand A to B, and (3) the 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 hold 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, at the end of 2023 Ukraine, Serbia, and the Republic of Moldova were included in the Interreg Europe Programme. It created a new cooperation opportunity in the field of the exchange of experience and sharing of practices among the regions. It has also been possible for all the countries to take part in the 2021-2027 URBACT activities.

Cooperation practices and networks

Chart 6.5 offers 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 predominantly seen as "low" or "very low" in terms of cooperation intensity, thus pointing to limited interactions with respondents.** 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.

Chart 6.5
Intensity of cross-border cooperation by type of institutional partner

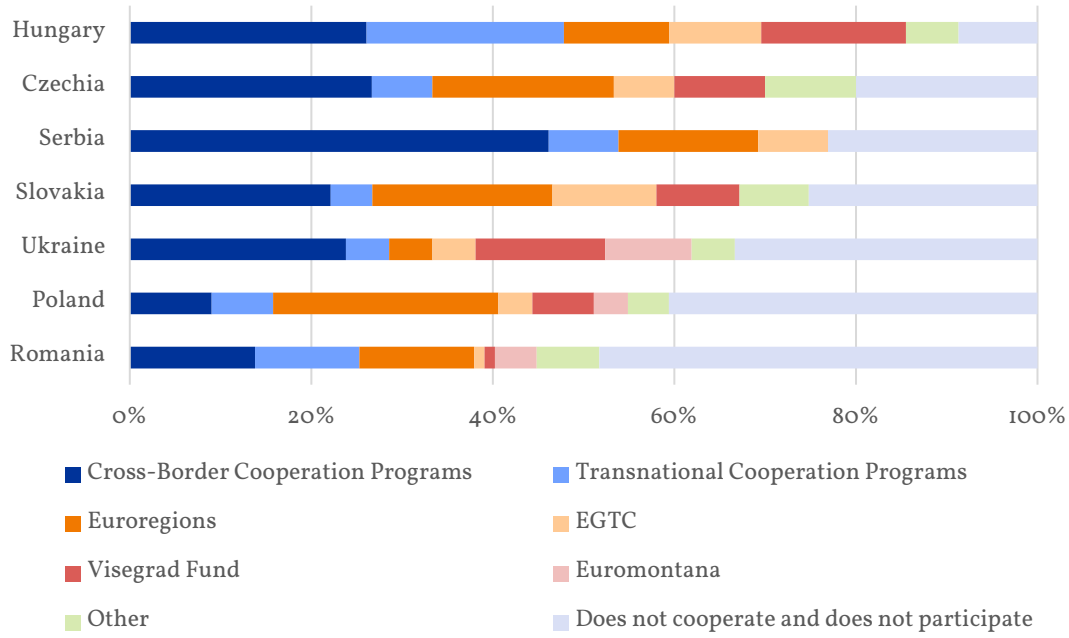


Source: Own elaboration based on KARPAT survey [N=337] (EUROREG).

The involvement of respondents with various cooperation frameworks lays bare the 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 6.6, centrally located Hungary shows the most diverse and robust involvement in territorial cooperation, especially Cross-Border Cooperation and Transnational Cooperation Programs with notable participation in Euroregions, EGTCs and Visegrad Fund. Only 10% of Hungarian respondents did not declare any experience in transnational collaboration. Slovakia demonstrates diverse engagement across all categories, particularly in CBC and Euroregions, with moderate involvement in transnational programmes, EGTC and Visegrad Fund. Poland and Czechia share similar cooperation patterns with significant activity within Euroregions and CBC programmes, a strong presence in transnational programmes and Visegrad Fund; however, almost 40% of Polish respondents declared dearth of cooperation experience. Romania stands out with only 50% of cooperation engagement, which is equally divided between CBC, transnational programmes and Euroregions, though its engagement in EGTCs or Euromontana appears more limited. Ukraine and Serbia participate

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

Chart 6.6
Survey respondents' experience in transnational cooperation frameworks by country



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

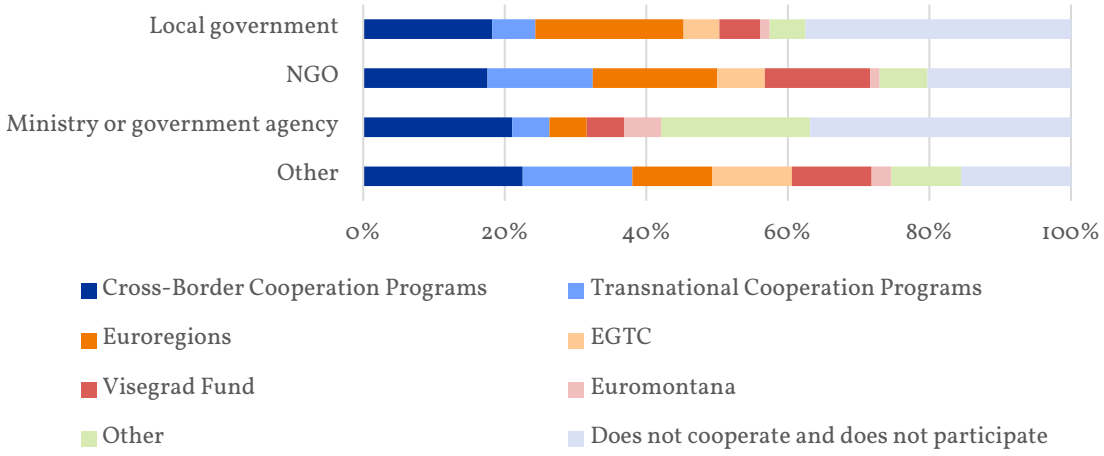
Survey results reveal major differences in types of Euroregions that survey respondents are involved in. Out of all respondents that indicated their experience in Euroregions the most frequently mentioned is Euroregion Karpacki, with 25 references. Euroregion Tatry follows with 12 mentions, also reflecting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

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 macroregion. It is therefore conspicuous 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 organisations 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.

From the institutional point of view, the experience of survey respondents in various transnational cooperation frameworks has some distinctive patterns. **Chart 6.7 indicates that 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 transnational**

programmes 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.

Chart 6.7
Experience of respondents in transnational cooperation frameworks by organisation type



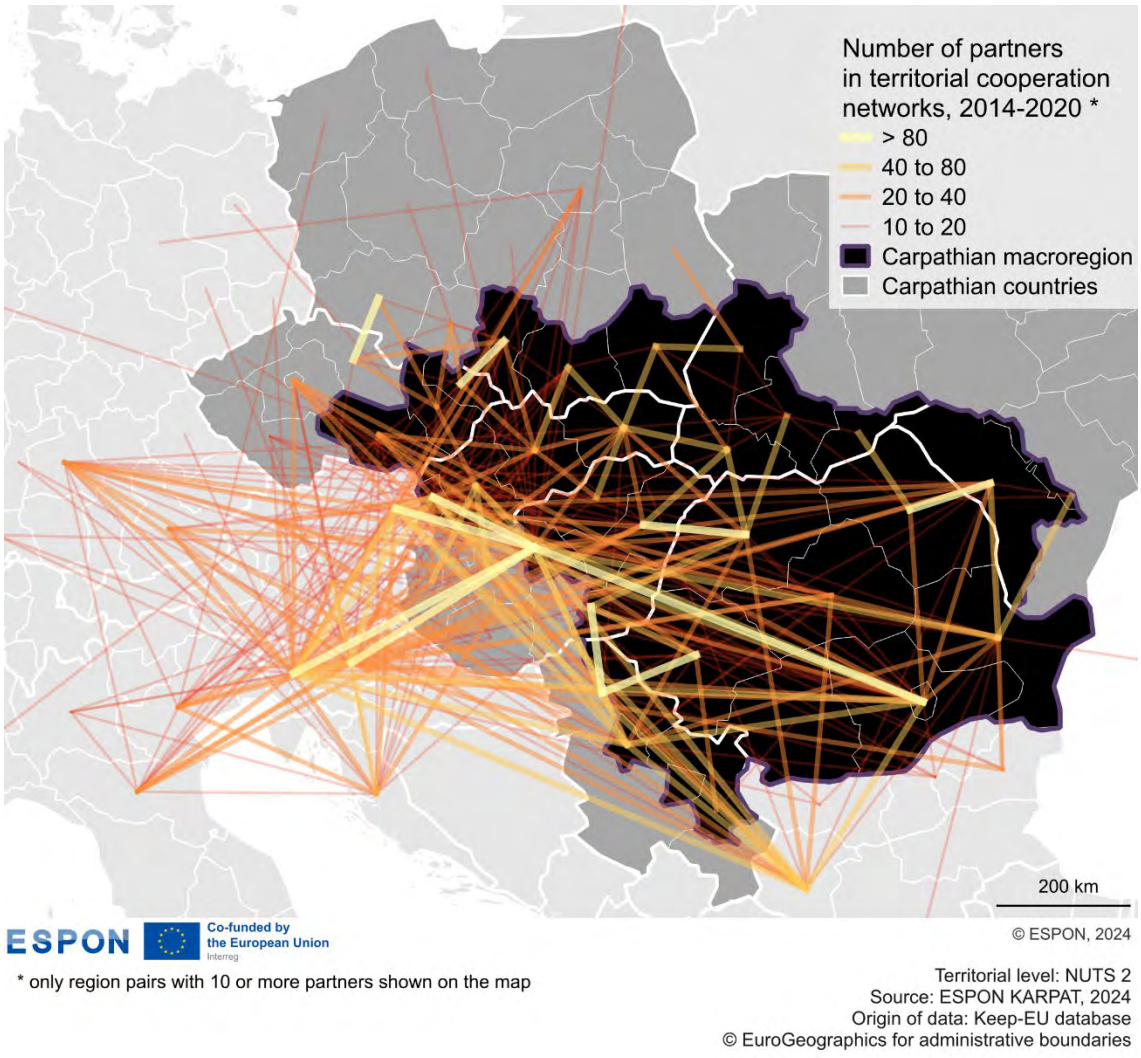
Source: Own elaboration based on KARPAT survey [N=337] (EUROREG).

NGOs, on the other hand, are comparatively engaged in CBC, transnational programmes 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 programmes and other (bilateral) cooperation frameworks with similarly limited engagement in other types of cooperation.

The survey results reveal distinctive typologies of collaboration across the Carpathian macroregion 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 on Czechia and Poland, followed by Hungary and Ukraine. Serbian stakeholders, hold strong ties with Hungary and Romania while showing limited interaction with its more distant Carpathian partners. Romania's collaboration is dominated by the Republic of Moldova and Serbia, while relationships with Hungary, Poland, and Ukraine remain moderate.

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 nurturing a mix of localised and macroregional collaboration.

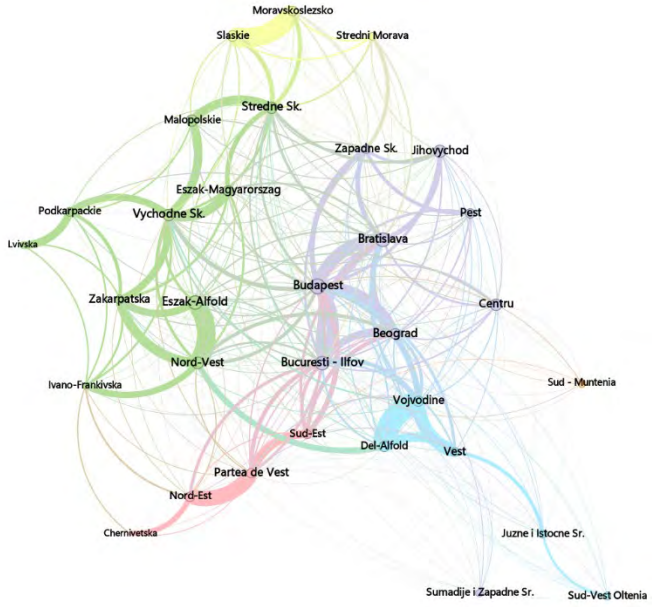
Map 6.5
Territorial cooperation networks in Carpathian macroregion and beyond, 2014-2020



Stakeholders from Ukraine rely heavily on a few key partners, showcasing selective collaboration 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.

Network analysis based on the keep.eu data defines Budapest, Bratislava, Bucharest-Ilfov as dominant collaboration hubs in the Carpathian macroregion with strong connections to the nearby nexus of Vienna (**Map 6.5**). 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.**

Figure 6.1
Network structure and clustering in Carpathian macroregion, 2014-2020



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

Network analysis of the same database performed in Gephi reveals further information regarding collaboration network structures illustrated in **Figure 6.1**. **The network of territorial cooperation is densely connected in the core (Budapest and Bratislava), indicating a strong level of collaboration among central regions, while peripheral regions have fewer and weaker connections. The absence of directionality in the outer parts 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. Based on the network analysis, regions tend to group together into distinct clusters that still maintain links with other groups, which supports an overall sense of integration across the network. **In addition, the pattern of connections shows that most regions are not only linked to many others, but their immediate neighbours also exhibit a high degree of mutual collaboration. This indicates that while there are clear and separate clusters of regional partnerships, strong local relationships further strengthen these networks**.

The central Carpathian cluster indicated in the purple cluster is dominated by Budapest, Bratislava, and surrounding regions like Pest and Zapadne Slovensko. It exhibits the densest and most interconnected structure, pointing to its key role in the macroregion. As the hub of the network, not only does it facilitate collaboration within its own cluster but also serves as a bridge linking the other clusters, thus showing its central importance in regional integration. The north-eastern (green) cluster, consisting of regions such as Podkarpackie, Zakarpatska, Východné Slovensko, and Lvivska, is characterised 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, emphasising the central node's role in connecting these peripheral regions to the larger collaboration network. The north-western (yellow) cluster, with regions like Moravskoslezsko, Śląskie, Střední Morava, and Małopolskie, is also cohesive, having many internal connections that reflect robust collaboration. However, unlike the north-wester cluster, it exhibits a greater focus on intra-national and Western-oriented partnerships. While it maintains strong connections with Budapest and Bratislava, it remains distinctive 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

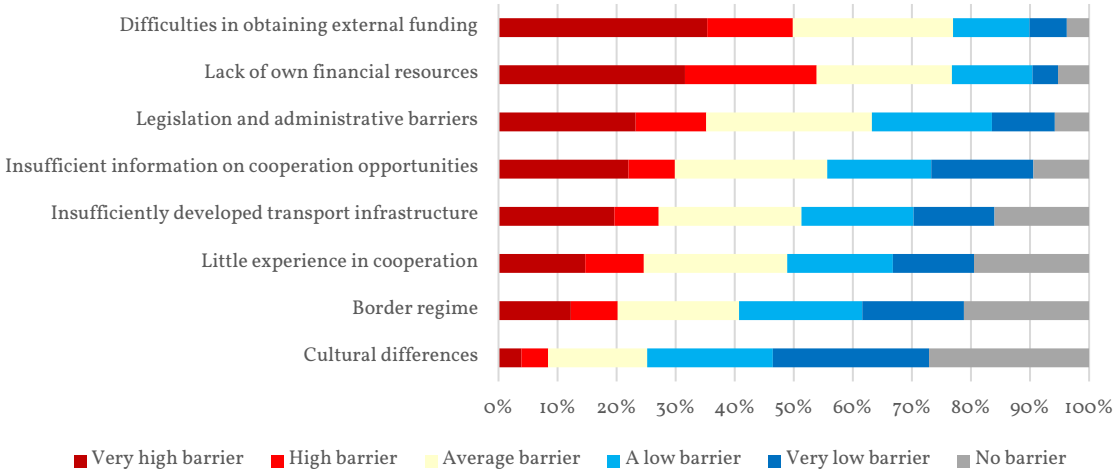
Istočne Srbije, is the least cohesive. Its connections are more distributed and sparser compared to other clusters, indicating a weaker network of collaboration. Positioned on the periphery, this cluster shows signs of emerging participation in EU projects but remains less integrated into the broader network.

6.3 Barriers and opportunities for transnational cooperation

In this chapter, the barriers and the opportunities to develop the cooperation potential will be described,based on the collected data, while the recommendations towards different levels of Carpathian stakeholders – the European Union, national states, regional and local entities are presented in the last chapter of the report.

The study's data empirically confirms that the cultural barriers are not believed to be of importance in Carpathian cooperation. The survey respondents placed them at the end of the list **(Chart 6.8)**, with less than 10% 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.

Chart 6.8
Barriers in transnational cooperation in the Carpathian macroregion according to the KARPAT survey



Source: Own elaboration based on KARPAT survey [N=355] (EUROREG).

Having already passed the initial phase when the cultural obstacles might have played a more important role, the Carpathian cooperation 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 hampering cross-border projects and initiatives **(Chart 6.8)**. 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 the lack of own resources.

While securing the EU funding for Carpathian cooperation could present a significant opportunity, it is necessary to take into consideration the different formal statuses of Carpathian countries. These 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 analysis of ETC shows, the Interreg strand A or B do not allow projects involving all Carpathian countries at once. For that reason, the stakeholders formulate the recommendations for establishing the Carpathian transnational cooperation programme or existing financing sources better aligning to the needs of the macroregion**. As explained by one of the interviewees, at the beginning of the 1990s, there was a local cooperation initiative in the Carpathian macroregion that was not followed by the national

and EU level and was not reflected in the structure of the current Interreg, which separated Poland from the other four countries cooperating together in the one of the strand A programmes HU-RO-SK-UA ("*EU funding "destroyed" these natural structures that initiated (…) bottom-up activities*"). **The Interreg B Carpathian programme would enable such cooperation, though.**

On the other hand, the need to establish stable cooperation structures, independent from time-bound EU project funding, is seen. 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 macroregion. Some respondents point out that the Interreg part of the EU budget is very tight, 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 macroregion. 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, one interviewee proposed considering some financial and organisational support for EGTCs from the central governments. Regardless of the legal regulatory framework institutionalising the EGTCs, they still grapple with differences in national laws and complex procedures and rely on external financing to an extent **(Evrard and Engl, 2018)**.

According to the survey results, legal and administrative barriers also constitute a serious obstacle to cooperation, 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 border. **T. Lundén (2018)** 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. According to the interview 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 in 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 tandem with budgetary capacities and the level of decentralisation sometimes follows political changes at the national level.

Particularly in the case of non-EU members, the legal barriers 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 EU, there are special instruments in place that aim at easing legal obstacles caused by, e.g. inadequate EU legislation and shortcomings in the transposition of EU legislation into national law, incoherent national laws, or administrative barriers and incompatible competences **(cf. Metis GmbH. et al., 2017)**. 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 obstacles **(Association of European Border Regions, 2024)**. The KARPAT interviewees agreed that some legal problems have to be tackled at the national level; without the state government involvement they will continue to inhibit regional cooperation.

According to this study's research findings, apart from the necessary efforts to alleviate legal and administrative barriers, it is also crucial to gather and share information about them, for instance, concerning various regulatory regimes effective in a specific policy field on both sides of the border or differences in competences of regional and local authorities. The interview respondents brought up difficulties in gathering such information and shortages in knowledge of how to deal with them as factors that 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. However, it could hinder some cooperation opportunities, as 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 the COVID-19 pandemic.

The lack of adequate information on cooperation initiatives and capacity shortages were mentioned by the respondents to the survey 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 sometimes there is a need for a more experienced and leading in excellence "*driver behind the collaboration*" and that is not always possible to find it in the macroregion. 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.

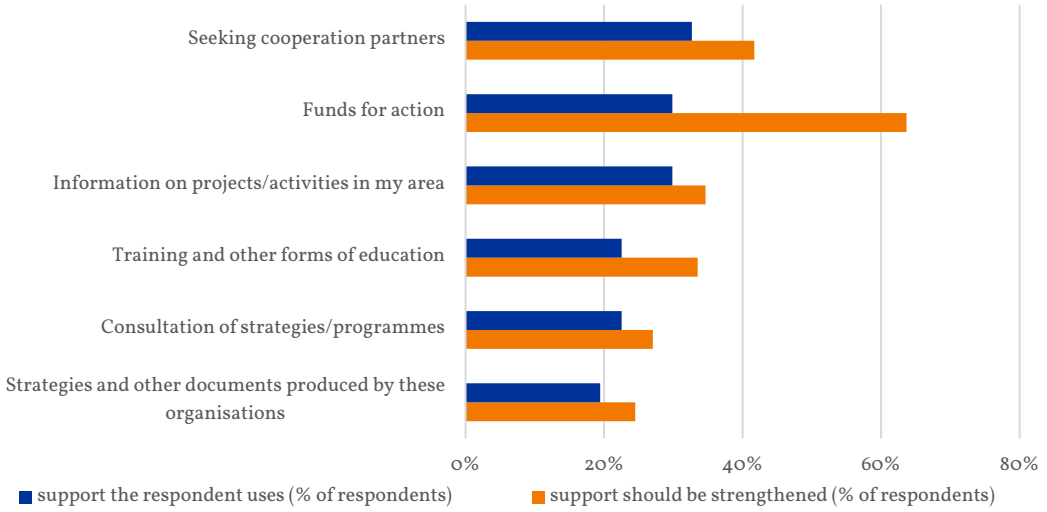
The existence of institutional coordination and support for cooperation activities is important in this context. The online survey respondents indicated the available to them and preferred forms of support expected from the transnational organisations (**Chart 6.9**). **The most frequent forms of support 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 or activities. The highest expectations of the respondents are pinned on the increase of funds for actions, which is in consonance with their perception of financial barriers as the most significant 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 address the relational, informational and educational needs of Carpathian entities. The second policy workshop participants assessed their importance and highlighted the networking platform, followed by funding and projects inventories as the most valuable. 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 still exists a necessity to invest in building up local capacities as the human resources, their stability and skills are seen by researchers as the factor impeding the cross-border cooperation potential **(Knippschild, 2011; Lytvyn and Tyushka, 2020)**.

Another aspect of the Carpathian institutional environment that may be seen as a political barrier is the insufficient political commitment or engagement of various stakeholders, giving territorial cooperation little priority **(Sienkiewicz, 2021; Shuliak and Shuliak, 2021)**.

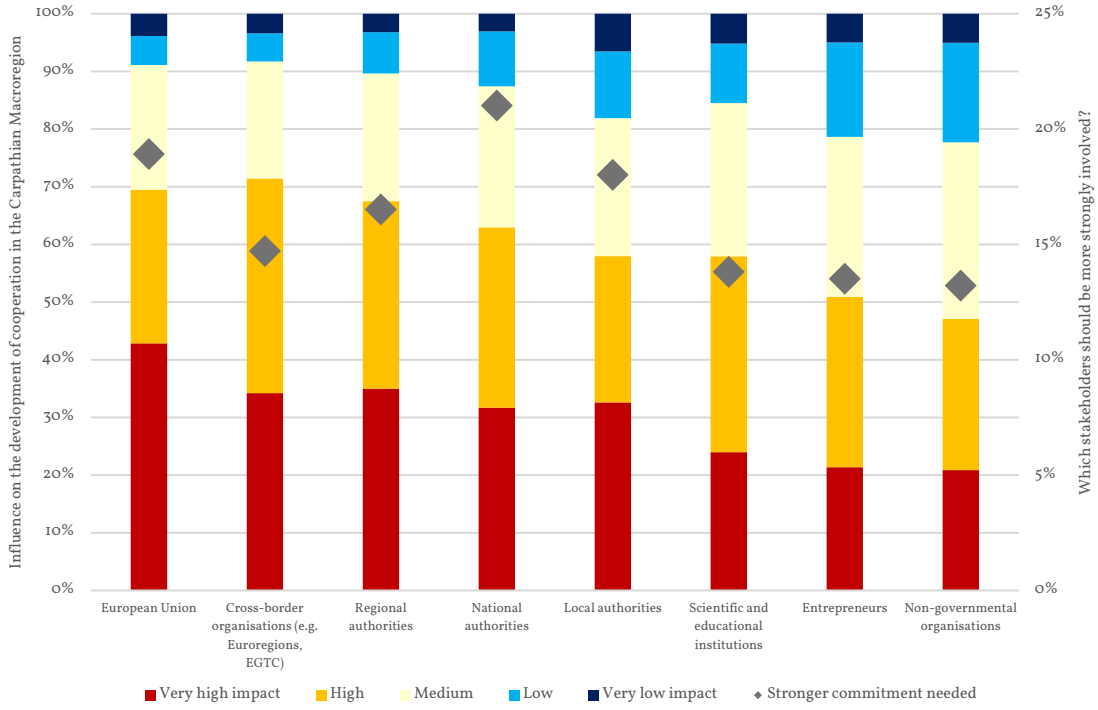
Respondents to the online survey consider the European Union to be the most influential actor in the development of cooperation in the Carpathian macroregion (Chart 6.10). However, it is closely followed by cross-border organisations, such as Euroregions or EGTCs and regional authorities. National authorities come fourth in terms of their influence on cooperation but are regarded as the actors whose involvement should be strengthened the most. In the next places, the European Union as well as 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 presented in the last chapter as the process requires coordinated action at multiple levels**.

Chart 6.9
Support used from transnational/cross-border organisations and views on strengthening them



* multiple answers were allowed
Source: Own elaboration based on KARPAT survey [N=355] (EUROREG).

Chart 6.10
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 respondents drew 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 and shorn of 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 leanings and irrespective of the 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 may unlock the cooperation potential, but it needs to reach beyond the ETC projects, combine other financing sources, and involve coordinating other actors' activities.

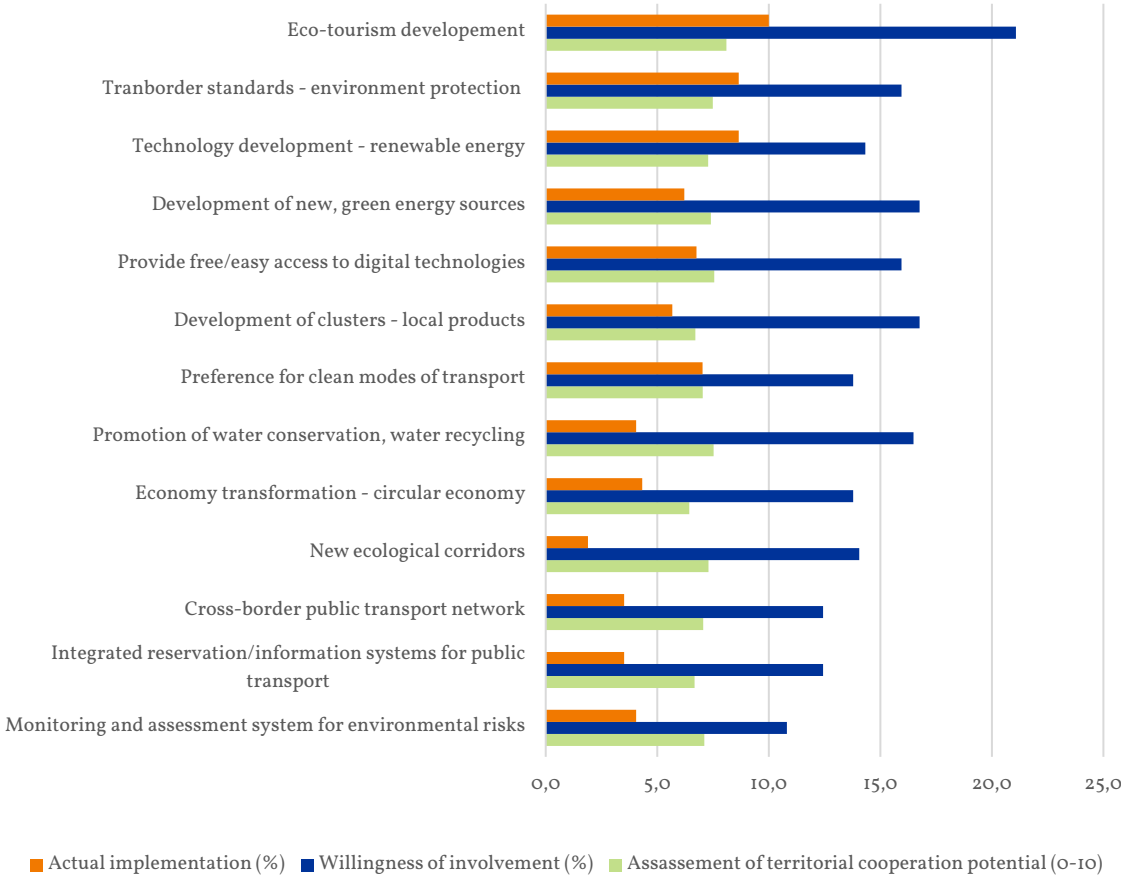
The interview respondents raised the question of missing vision and strategy for the Carpathian macroregion that should be endorsed by all the national states and the need for a systematic approach, and a common, coherent plan to replace the ad-hoc projects. Within the EU regulatory framework, the corresponding instrument would be a macroregional strategy. To that point, the significant involvement of relevant stakeholders is crucial – as it propounds **F. Sielker (2018)**, macroregions are stakeholder-based. **KARPAT interview respondents underline that the engagement of regions is fundamental for strategy drafting**. Despite the existing efforts to develop one for the Carpathian macroregion, its establishment is not certain. **For that reason, it is appropriate to consider, when issuing the recommendations, a vision stripped of a formal EU common strategy. In that case, it would be crucial to elaborate at least a coherent definition or story of the macroregion (resuming its particular character and common development aims), shared by all countries involved, which 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 pilot project (Smętkowski et al., 2021), a selection of actions 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.

Based on the survey results, there was significant interest in all proposed topics (**Fig. 6.11**). At least a dozen respondents indicated participation in these activities (except for creating ecological corridors, championed 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 survey sample.

The most represented area of engagement was sustainable tourism, with 10% of respondents (N=37) currently engaged and some further 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 (yet still more than 10%) declared plans to engage in cross-border transport initiatives, such as improving passenger facilities and monitoring environmental risks**.

Chart 6.11
Implementation of key activities and their potential for development of transnational cooperation in Carpathian macroregion



* assessment was rescaled for the purpose of better visualisation from 1-5 to 2-10
Source: Own elaboration based on KARPAT survey [N=355] (EUROREG).

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 a 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.

7 Good practices of territorial cooperation

Topics identified as particularly promising for the development of transborder cooperation in the Carpathian macroregion served as the basis for case study analysis and identification of good practices corresponding to the key topics. The compilation of 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 7.1**.

The analysis of identified best practices revealed that they encompassed various forms of the four territorial 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 utilise 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 examined initiatives underlined the importance of cross-border cooperation and territorial governance as key to the success of implemented projects. This included engagement across various levels of administration, from central to local, as well as collaboration involving a variety of actors, ranging from government agencies to non-governmental organisations. This was directly seen in case of an umbrella project, #ACCESS, but was also 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 utilisation of resources proved crucial in the S4C initiative, while the cross-border railway connection development project accentuated the effective mobilisation of local social potential for regional-level transport development through cross-border cooperation.

In terms of innovation, the projects demonstrated robust potential. 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. Elements of sustainability were well-illustrated in the case of the Wallachian Culture Trail, which building upon the original idea continued through various initiatives. 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 unearthed the potential for knowledge transfer, serving as a foundation for further research initiatives under the Horizon Europe programme. The transferability of best practices was particularly promising in the #ACCESS project and in the S4C initiative, which was replicated in other mountainous areas. Moreover, the Wallachian Culture Trail's expansion to additional countries has been facilitated by ongoing efforts to promote the initiative.

Table 7.1
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 Vojak 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 cooperation/ 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 flexile 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 branched s 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 transferrable 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)

8 Recommendations for governance structure and territorial cooperation

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 Subchapter 6.3 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 8.1)**. 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 Scientific Report)**. 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.

Table 8.1
Recommendations for enhancing Carpathian governance structure for transnational cooperation

Organisational level	Recommendations	European	National	Regional	Local
Strategic level– endorsed by the ESPON KARPAT stakeholders : ***- to share a common vision of the Carpathian macroregion and objectives for its development,*** ***- to diagnose and pursue the joint implementation of specific pilot initiatives within the adopted strategic framework***	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: ***- to invest in stable Carpathian governance structures and platforms that are not dependent on external project funding,*** ***-to stimulate thinking and acting in the framework of common Carpathian initiatives at local and regional level*** ***-to strengthen institutions engaged in Carpathian cooperation***	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	European	National	Regional	Local
Operational level – endorsed by the ESPON KARPAT stakeholders : ***-to ensure legal, financial, and organisational framework supporting the implementation of Carpathian projects, according to the needs, and involving actors from all relevant territories***	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).

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.

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 EUE (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 6.10) 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/communitarian 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 ARPAF (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). Cooperation 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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The ESPON EGTC is the Single Beneficiary of the ESPON 2030 Cooperation Programme. The Single Operation within the programme is implemented by the ESPON EGTC and co-financed by the European Regional Development Fund, the EU Member States and the Partner States, Iceland, Liechtenstein, Norway, and Switzerland.